

Mathematics 1 - ADE - English - 2026/2027

01-Functions for serial number: 1

Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a periodic compound interest rate of 8% in 6 periods (compounding frequency) and in the bank B we are paid a periodic compound interest rate of 3% in 7 periods (compounding frequency). We initially deposit 1000 euros in the bank A and 7000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **8.***** years.
- 2) In **2.***** years.
- 3) In **6.***** years.
- 4) In **0.***** years.
- 5) In **9.***** years.

Exercise 2

Certain parcel of land is devalued from an initial value of 391000 euros until a final value of 241000 euros along 6 years. Determine the rate of compound interest for that devaluation.

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) The interest rate is **1.***** %.
- 2) The interest rate is **6.***** %.
- 3) The interest rate is **5.***** %.
- 4) The interest rate is **3.***** %.
- 5) The interest rate is **7.***** %.

Exercise 3

We have a bank account that initially offers a periodic compound interest rate of 5% in 11 periods (compounding frequency), and after 1 year the conditions are modified and then we obtain a continuous compound rate of 10%. The initial deposit is 7000 euros. Compute the amount of money in the account after 10 years from the moment of the first deposit.

- 1) We will have ****8.***** euros.
- 2) We will have ****6.***** euros.
- 3) We will have ****4.***** euros.
- 4) We will have ****1.***** euros.
- 5) We will have ****7.***** euros.

Exercise 4

A firm sells Q tons of certain product. The price received per ton is given by the formula $P=70000-20Q$. On the other hand, the production cost per ton is $C=20000+8Q$. In addition, the transportation cost is 47872 per ton. Compute the maximum profit that can be obtained selling this product.

- 1) Profit = 49176 .
- 2) Profit = 29701 .
- 3) Profit = 20593 .
- 4) Profit = 40432 .
- 5) Profit = 31420 .

Exercise 5

Deposits in certain investment account vary from year to year alternating gains and losses periods. We have the following data about the deposits for different years:

year	deposits
0	197
2	125
4	69

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t . Employ that function to determine the minimum funds available in the investment account .

- 1) The minimum for the depositis in the account was 10 .
- 2) The minimum for the depositis in the account was 29 .
- 3) The minimum for the depositis in the account was -3 .
- 4) The minimum for the depositis in the account was 16 .
- 5) The minimum for the depositis in the account was -2 .

Exercise 6

The funds of a public institution alternate periods of deficit and surplus.

We have the following information for several years (in millions of euros):

year	funds
0	30
4	6
7	51

Employ an interpolation polynomial to build a function that

yields the funds for each year t . We know that due to the legislation the funds of such an institution have to be kept between 6 and 15

. Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from $t=0$ to $t=7$).

- 1) The funds are inside the limits for the interval: $[4, 7]$.
- 2) The funds are inside the limits for the interval: $[0, 1]$.
- 3) The funds are inside the limits for the interval: $[1, 4]$.
- 4) The funds are inside the limits for the intervals: $[0, 2]$ y $[4, 5]$.
- 5) The funds are inside the limits for the interval: $[1, 2]$.
- 6) The funds are inside the limits for the interval: $[1, 7]$.
- 7) The funds are inside the limits for the intervals: $[1, 2]$ y $[4, 5]$.
- 8) The funds are inside the limits for the interval: $[0, 4]$.

Exercise 7

The population of a city is studied between years $t=2$ and $t=8$. In that

period the population is given by the function $P(t) = 1 + 240t - 54t^2 + 4t^3$

. Determine the intervals of years when the population is between 191 and 361.

- 1) Along the intervals of years: $[4., 6.03635]$ and $[7.03725, 8.28508]$.
- 2) Along the interval of years: $[2.33506, 7.]$.
- 3) Along the interval of years: $[4.69822, 7.]$.
- 4) Along the intervals of years: $[3., 5.7629]$ and $[6., 7.]$.
- 5) Along the interval of years: $[2, 6]$.
- 6) Along the interval of years: $[3.60801, 5.]$.
- 7) Along the interval of years: $[3., 6.]$.
- 8) Along the intervals of years: $[2, 2]$ and $[6, 8]$.

Exercise 8

Compute the limit: $\lim_{x \rightarrow \infty} \left(\frac{3 + 9x - 7x^2}{-6 + 6x - 7x^2} \right)^{-4+7x}$

1) $-\infty$

2) $\frac{1}{e^3}$

3) $\frac{1}{e^5}$

4) 1

5) ∞

6) 0

7) $\frac{1}{e^4}$

Exercise 9

A factory produces certain type of devices. The marginal cost (cost of producing one unit) decreases when we produce a large amount of units and it is given by the function $C(x) = \frac{2 + 3x + 8x^2 + 9x^3}{6 + 6x + 7x^2 + 6x^3}$

. Determine the expected cost per unit when a large amount of units is produced.

1) ∞

2) 0

3) $\frac{3}{2}$

4) 10000

5) -2

6) $-\infty$

7) $\frac{38}{25}$

Exercise 10

The population in certain turistic area

increases exponentially and is given by the function $P(t) = 86\,000 e^{t/50}$ that indicates the number of resident citizens for every year t . At the same time, depending on the season, the city receives a variable number of

tourists given by the trigonometric function $I(t) = 2000 + 1000 \sin\left[\frac{t}{2\pi}\right]$

that yields the amount of visitors in the area for every moment t (t in years).

Determine how many years are necessary until the total number of habitants is 120000. (the solution can be found for t between 11 and 16).

- 1) $t = **.*$
- 2) $t = **.*$
- 3) $t = **.*$
- 4) $t = **.*$
- 5) $t = **.*$

Exercise 11

Study the continuity of the function $f(x) = \begin{cases} 2e^{x-1} - \sin(1-x) & x \leq 1 \\ 2e^{x-1} - 2e^3 & 1 < x < 4 \\ \sin(4-x) & 4 \leq x \end{cases}$

- 1) The functions is continuous for all points.
- 2) The functions is not continuous at any point.
- 3) The function is continuous for all the points except for $x=1$.
- 4) The function is continuous for all the points except for $x=4$.
- 5) The function is continuous for all the points except for $x=1$ and $x=4$.

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01-Functions for serial number: 2

Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a compound interest rate of 3% and in the bank B we are paid a compound interest rate of 10%. We initially deposit 10000 euros in the bank A and 5000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **5.***** years.
- 2) In **1.***** years.
- 3) In **8.***** years.
- 4) In **3.***** years.
- 5) In **0.***** years.

Exercise 2

We have one bank account that offers a compound interest rate of 3% where we initially deposit 14000 euros. How long time is it necessary until the amount of money in the account reaches 18000 euros?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **8.***** years.
- 2) In **4.***** years.
- 3) In **3.***** years.
- 4) In **5.***** years.
- 5) In **0.***** years.

Exercise 3

We have a bank account that initially offers a compound interest rate of 5%, and after 1 year the conditions are modified and then we obtain a periodic compound interest rate of 7% in 7 periods (compounding frequency). The initial deposit is 10000 euros. Compute the amount of money in the account after 8 years from the moment of the first deposit.

- 1) We will have ****7.***** euros.
- 2) We will have ****4.***** euros.
- 3) We will have ****3.***** euros.
- 4) We will have ****5.***** euros.
- 5) We will have ****1.***** euros.

Exercise 4

A firm sells Q tons of certain product. The price received per ton is given by the formula $P=20000-13Q$. On the other hand, the production cost per ton is $C=10000+2Q$. In addition, the transportation cost is 8890 per ton. Compute the maximum profit that can be obtained selling this product.

- 1) Profit = 19131 .
- 2) Profit = 14022 .
- 3) Profit = 14765 .
- 4) Profit = 20535 .
- 5) Profit = 27306 .

Exercise 5

Deposits in certain investment account vary from year to year alternating gains and losses periods. We have the following data about the deposits for different years:

year	deposits
1	6
2	17
3	34

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t . Employ that function to forecast the exact amount for year 5.

- 1) The depositis in the account for year 5 are 7 .
- 2) The depositis in the account for year 5 are 86 .
- 3) The depositis in the account for year 5 are 121 .
- 4) The depositis in the account for year 5 are -7 .
- 5) The depositis in the account for year 5 are 2 .

Exercise 6

The funds of a public institution alternate periods of deficit and surplus.

We have the following information for several years (in millions of euros):

year	funds
1	21
4	30
6	46

Employ an interpolation polynomial to build a function that

yields the funds for each year t . We know that due to the legislation the funds of such an institution have to be kept between 25 and 37

- . Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from $t=1$ to $t=6$).

- 1) The funds are inside the limits for the interval: $[-3, 0]$.
- 2) The funds are inside the limits for the interval: $[-3, 6]$.
- 3) The funds are inside the limits for the interval: $[-3, 3]$.
- 4) The funds are inside the limits for the interval: $[3, 6]$.
- 5) The funds are inside the limits for the intervals: $[-3, -1]$ y $[5, 6]$.
- 6) The funds are inside the limits for the interval: $[0, 3]$.
- 7) The funds are inside the limits for the interval: $[-3, -1]$.
- 8) The funds are inside the limits for the interval: $[3, 5]$.

Exercise 7

The population of certain type of rodents is analyzed in a region between years $t=2$

and $t=10$. Along that period the population is given by the function $P(t) =$

$9 + 384t - 72t^2 + 4t^3$ (thousands of rodents). Determine the intervals of years during which the number of rodents is between 541 and 585.

- 1) Along the intervals of years: $[4.45404, 7.]$ and $[8., 10.4246]$.
- 2) Along the interval of years: $[3.08578, 7.]$.
- 3) Along the interval of years: $[4., 6.]$.
- 4) Along the intervals of years: $[2., 5.76449]$ and $[6., 8.68143]$.
- 5) Along the intervals of years: $[2., 7.]$ and $[8.13845, 9.]$.
- 6) Along the intervals of years: $[2.1459, 2.5359]$, $[6, 7]$ and $[8.8541, 9.4641]$.
- 7) Along the intervals of years: $[2, 2.1459]$, $[2.5359, 6]$, $[7, 8.8541]$ and $[9.4641, 10]$.
- 8) Along the interval of years: $[7., 9.]$.

Exercise 8

Compute the limit: $\lim_{x \rightarrow -\infty} \left(\frac{-6 + 6x + 7x^2}{7 + 8x + 7x^2} \right)^{-3+8x+7x^2}$

- 1) $\frac{1}{e^4}$
- 2) $\frac{1}{e^2}$
- 3) ∞
- 4) $\frac{1}{e^3}$
- 5) 1
- 6) 0
- 7) $-\infty$

Exercise 9

A factory produces certain type of devices. The marginal cost (cost of producing one unit) decreases when we produce a large amount of units and it is given by the function $C(x) = \frac{7 + x + 6x^2}{6 + 7x + 7x^2 + 6x^3}$. Determine the expected cost per unit when a large amount of units is produced.

- 1) ∞
- 2) -1
- 3) $-\infty$
- 4) -3
- 5) 17000
- 6) $-\frac{2}{3}$
- 7) 0

Exercise 10

We deposit 6000 euros in a bank account with a compound interest rate of 3%. At the same time every year we also add in a safe-deposit box (therefore with no interest rate) 1000 euros. How long time is it necessary until the total amount of money (jointly in the bank account and safe-deposit box) is 30000 euros? (the solution can be found for t between 17 and 22).

- 1) $t = **.*1****$
- 2) $t = **.*3****$
- 3) $t = **.*5****$
- 4) $t = **.*7****$
- 5) $t = **.*9****$

Exercise 11

Study the continuity of the function $f(x) = \begin{cases} -\sin(2-x) & x \leq 2 \\ x-2 & 2 < x < 3 \\ 1-3 \log(x-2) & 3 \leq x \end{cases}$

- 1) The functions is continuous for all points.
- 2) The functions is not continuous at any point.
- 3) The function is continuous for all the points except for $x=2$.
- 4) The function is continuous for all the points except for $x=3$.
- 5) The function is continuous for all the points except for $x=2$ and $x=3$.

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01-Functions for serial number: 3

Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a compound interest rate of 3% and in the bank B we are paid a periodic compound interest rate of 7% in 11 periods (compounding frequency). We initially deposit 11000 euros in the bank A and 7000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **7.***** years.
- 2) In **9.***** years.
- 3) In **8.***** years.
- 4) In **0.***** years.
- 5) In **1.***** years.

Exercise 2

We have one bank account that offers a continuous compound rate of 4% where we initially deposit 14000 euros. How long time is it necessary until the amount of money in the account reaches 19000 euros?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **9.***** years.
- 2) In **5.***** years.
- 3) In **8.***** years.
- 4) In **0.***** years.
- 5) In **7.***** years.

Exercise 3

We have a bank account that initially offers a compound interest rate of 8%, and after 3 years the conditions are modified and then we obtain a periodic compound interest rate of 8% in 12 periods (compounding frequency). The initial deposit is 11000 euros. Compute the amount of money in the account after 4 years from the moment of the first deposit.

- 1) We will have ****5.***** euros.
- 2) We will have ****0.***** euros.
- 3) We will have ****2.***** euros.
- 4) We will have ****9.***** euros.
- 5) We will have ****6.***** euros.

Exercise 4

A firm sells Q tons of certain product. The price received per ton is given by the formula $P=8000-15Q$. On the other hand, the production cost per ton is $C=7000+3Q$. In addition, the transportation cost is 532 per ton. Compute the maximum profit that can be obtained selling this product.

- 1) Profit = 1934 .
- 2) Profit = 1086 .
- 3) Profit = 2176 .
- 4) Profit = 3182 .
- 5) Profit = 3042 .

Exercise 5

Deposits in certain investment account vary from year to year alternating gains and losses periods. We have the following data about the deposits for different years:

year	deposits
1	7
3	37
4	61

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t . Employ that function to forecast the exact amount for year 6 .

- 1) The depositis in the account for year 6 are 3 .
- 2) The depositis in the account for year 6 are 14 .
- 3) The depositis in the account for year 6 are 1 .
- 4) The depositis in the account for year 6 are 127 .
- 5) The depositis in the account for year 6 are 169 .

Exercise 6

The funds of a public institution alternate periods of deficit and surplus.

We have the following information for several years (in millions of euros):

year	funds
1	23
5	39
7	71

Employ an interpolation polynomial to build a function that

yields the funds for each year t . We know that due to the legislation the funds of such an institution have to be kept between 39 and 53

- . Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from $t=1$ to $t=7$).

- 1) The funds are inside the limits for the interval: $[-2, 0]$.
- 2) The funds are inside the limits for the interval: $[-2, 5]$.
- 3) The funds are inside the limits for the interval: $[5, 6]$.
- 4) The funds are inside the limits for the interval: $[5, 7]$.
- 5) The funds are inside the limits for the interval: $[-2, 7]$.
- 6) The funds are inside the limits for the interval: $[-2, -1]$.
- 7) The funds are inside the limits for the interval: $[0, 5]$.
- 8) The funds are inside the limits for the intervals: $[-2, -1]$ y $[6, 7]$.

Exercise 7

The population of a city is studied between years $t=3$ and $t=8$. In that

period the population is given by the function $P(t) = 9 + 504t - 78t^2 + 4t^3$

- . Determine the intervals of years when the population is between 1087 and 1143.

- 1) Along the interval of years: $[3., 5.20848]$.
- 2) Along the interval of years: $[5.5, 8]$.
- 3) Along the intervals of years: $[3.54652, 6.]$ and $[7., 8.33869]$.
- 4) Along the interval of years: $[3., 5.37891]$.
- 5) Along the intervals of years: $[3., 5.]$ and $[7.01563, 8.6483]$.
- 6) Along the intervals of years: $[5., 6.42759]$ and $[7.36076, 8.76958]$.
- 7) Along the intervals of years: $[3, 5.5]$, $[7, 7]$ and $[8, 8]$.
- 8) Along the interval of years: $[3., 7.]$.

Exercise 8

Compute the limit: $\lim_{x \rightarrow \infty} \left(\frac{6 + 7x + 8x^2}{-6 + 5x + 8x^2} \right)^{-5-4x+2x^2}$

- 1) 1
- 2) $\frac{1}{e^3}$
- 3) 0
- 4) $-\infty$
- 5) $\frac{1}{e^4}$
- 6) $\frac{1}{e^5}$
- 7) ∞

Exercise 9

From an initial deposit 19000, the interest rate varies every year in such a way that the total amount of money in the account is given by the function $C(t) =$

$$19000 \left(\frac{6 + 7t + 8t^2}{-6 + 5t + 8t^2} \right)^{-5-4t+2t^2}. \text{ Determine the future tendency for the}$$

deposits that we will have after a large number of years.

- 1) 19000
- 2) $\frac{19000}{e^3}$
- 3) 0
- 4) $-\infty$
- 5) $\frac{19000}{e^4}$
- 6) $\frac{19000}{e^5}$
- 7) ∞

Exercise 10

We deposit 6000 euros in a bank account with a compound interest rate of 10%. At the same time every year we also add in a safe-deposit box (therefore with no interest rate) 1000 euros. How long time is it necessary until the total amount of money (jointly in the bank account and safe-deposit box) is 46000 euros? (the solution can be found for t between 15 and 20).

- 1) $t = \dots 0 \dots$
- 2) $t = \dots 2 \dots$
- 3) $t = \dots 4 \dots$
- 4) $t = \dots 6 \dots$
- 5) $t = \dots 8 \dots$

Exercise 11

Study the continuity of the function $f(x) = \begin{cases} -3 \sin(3-x) & x \leq 3 \\ 0 & 3 < x < 5 \\ 2 - 3 \log(x-4) & 5 \leq x \end{cases}$

- 1) The function is continuous for all points.
- 2) The function is not continuous at any point.
- 3) The function is continuous for all the points except for $x=3$.
- 4) The function is continuous for all the points except for $x=5$.
- 5) The function is continuous for all the points except for $x=3$ and $x=5$.

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01-Functions for serial number: 4

Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a continuous compound rate of 5% and in the bank B we are paid a continuous compound rate of 10%. We initially deposit 10000 euros in the bank A and 1000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **8.***** years.
- 2) In **0.***** years.
- 3) In **6.***** years.
- 4) In **4.***** years.
- 5) In **7.***** years.

Exercise 2

We have one bank account that offers a compound interest rate of 3% where we initially deposit 5000 euros. How long time is it necessary until the amount of money in the account reaches 12000 euros?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **4.***** years.
- 2) In **7.***** years.
- 3) In **9.***** years.
- 4) In **0.***** years.
- 5) In **6.***** years.

Exercise 3

We have a bank account that initially offers a compound interest rate of 9%, and after 3 years the conditions are modified and then we obtain a compound interest rate of 6%. The initial deposit is 10000 euros. Compute the amount of money in the account after 7 years from the moment of the first deposit.

- 1) We will have ****0.***** euros.
- 2) We will have ****4.***** euros.
- 3) We will have ****2.***** euros.
- 4) We will have ****9.***** euros.
- 5) We will have ****5.***** euros.

Exercise 4

A firm sells Q tons of certain product. The price received per ton is given by the formula $P=70000-13Q$. On the other hand, the production cost per ton is $C=20000+20Q$. In addition, the transportation cost is 47162 per ton. Compute the maximum profit that can be obtained selling this product.

- 1) Profit = 55336 .
- 2) Profit = 86389 .
- 3) Profit = 51907 .
- 4) Profit = 32719 .
- 5) Profit = 61017 .

Exercise 5

Deposits in certain investment account vary from year to year alternating gains and losses periods. We have the following data about the deposits for different years:

year	deposits
1	3
2	8
4	24

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t . Employ that function to forecast the exact amount for year 5 .

- 1) The depositis in the account for year 5 are -2 .
- 2) The depositis in the account for year 5 are -1 .
- 3) The depositis in the account for year 5 are 19 .
- 4) The depositis in the account for year 5 are 35 .
- 5) The depositis in the account for year 5 are 48 .

Exercise 6

The funds of a public institution alternate periods of deficit and surplus.

We have the following information for several years (in millions of euros):

year	funds
1	25
4	31
8	-17

Employ an interpolation polynomial to build a function that

yields the funds for each year t . We know that due to the legislation the funds of such an institution have to be kept between 25 and 31

- . Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from $t=1$ to $t=8$).

- 1) The funds are inside the limits for the interval: $[0, 5]$.
- 2) The funds are inside the limits for the interval: $[5, 8]$.
- 3) The funds are inside the limits for the interval: $[2, 8]$.
- 4) The funds are inside the limits for the intervals: $[0, 1]$ y $[4, 5]$.
- 5) The funds are inside the limits for the intervals: $[1, 2]$ y $[4, 5]$.
- 6) The funds are inside the limits for the interval: $[1, 2]$.
- 7) The funds are inside the limits for the interval: $[0, 2]$.
- 8) The funds are inside the limits for the interval: $[2, 5]$.

Exercise 7

The population of a city is studied between years $t=2$ and $t=10$. In

that period the population is given by the function $P(t) = 420t - 72t^2 + 4t^3$

- . Determine the intervals of years when the population is between 352 and 584.

- 1) Along the interval of years: $[4.00961, 8.]$.
- 2) Along the intervals of years: $[3., 4.73701]$ and $[8.73249, 10.]$.
- 3) Along the intervals of years: $[2., 3.]$ and $[5.3385, 10.]$.
- 4) Along the interval of years: $[2., 9.67351]$.
- 5) Along the interval of years: $[2, 10]$.
- 6) Along the intervals of years: $[3., 4.]$ and $[6.11901, 7.12457]$.
- 7) Along the interval of years: $[2, 2]$.
- 8) That number of mice is reach for no interval of years.

Exercise 8

Compute the limit: $\lim_{x \rightarrow \infty} \left(\frac{3 - 5x - 6x^2 - 8x^3}{8 - 9x - 8x^2 - 8x^3} \right)^{-9 - 4x + 3x^2}$

- 1) $-\infty$
- 2) 1
- 3) $\frac{1}{e^5}$
- 4) $\frac{1}{e}$
- 5) 0
- 6) ∞
- 7) $\frac{1}{e^3}$

Exercise 9

A factory produces certain type of devices. The marginal cost (cost of producing one unit) decreases when we produce a large amount of units and it is given by the function $C(x) = \frac{3 + 3x + 2x^2 + 3x^3}{6 + 8x + 3x^2 + x^3}$

. Determine the expected cost per unit when a large amount of units is produced.

- 1) 6000
- 2) ∞
- 3) $-\frac{3}{4}$
- 4) 3
- 5) 0
- 6) $\frac{61}{20}$
- 7) $-\infty$

Exercise 10

We deposit 2000 euros in a bank account with a periodic compound interest rate of 6% in 10 periods (compounding frequency). At the same time every year we also add in a safe-deposit box (therefore with no interest rate) 2000 euros. How long time is it necessary until the total amount of money (jointly in the bank account and safe-deposit box) is 33000 euros? (the solution can be found for t between 10 and 15).

- 1) $t = **.*$
- 2) $t = **.*$
- 3) $t = **.*$
- 4) $t = **.*$
- 5) $t = **.*$

Exercise 11

Study the continuity of the function $f(x) = \begin{cases} 3 \sin(2-x) + 2 \cos(2-x) & x \leq 2 \\ 3 \log(x-1) - 1 - 3 \log(4) & 2 < x < 5 \\ \log(x-4) - 1 & 5 \leq x \end{cases}$

- 1) The function is continuous for all points.
- 2) The function is not continuous at any point.
- 3) The function is continuous for all the points except for $x=2$.
- 4) The function is continuous for all the points except for $x=5$.
- 5) The function is continuous for all the points except for $x=2$ and $x=5$.

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01-Functions for serial number: 5

Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a periodic compound interest rate of 5% in 5 periods (compounding frequency) and in the bank B we are paid a compound interest rate of 8%. We initially deposit 15000 euros in the bank A and 2000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **4.***** years.
- 2) In **0.***** years.
- 3) In **5.***** years.
- 4) In **2.***** years.
- 5) In **1.***** years.

Exercise 2

Certain parcel of land is devalued from an initial value of 467000 euros until a final value of 232000 euros along 10 years. Determine the rate of continuous compound interest for that devaluation.

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) The interest rate is **0.***** %.
- 2) The interest rate is **7.***** %.
- 3) The interest rate is **2.***** %.
- 4) The interest rate is **6.***** %.
- 5) The interest rate is **9.***** %.

Exercise 3

We have a bank account that initially offers a continuous compound rate of 10%, and after 2 years the conditions are modified and then we obtain a compound interest rate of 10%. The initial deposit is 15000 euros. Compute the amount of money in the account after 8 years from the moment of the first deposit.

- 1) We will have ****1.***** euros.
- 2) We will have ****6.***** euros.
- 3) We will have ****3.***** euros.
- 4) We will have ****2.***** euros.
- 5) We will have ****5.***** euros.

Exercise 4

A firm sells Q tons of certain product. The price received per ton is given by the formula $P=300-17Q$. On the other hand, the production cost per ton is $C=200-15Q$. In addition, the transportation cost is 44 per ton. Compute the maximum profit that can be obtained selling this product.

- 1) Profit = 604 .
- 2) Profit = 434 .
- 3) Profit = 274 .
- 4) Profit = 392 .
- 5) Profit = 535 .

Exercise 5

Deposits in certain investment account vary from year to year alternating gains and losses periods. We have the following data about the deposits for different years:

year	deposits
1	179
3	131
4	110

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t . Employ that function to determine the minimum funds available in the investment account .

- 1) The minimum for the depositis in the account was 10 .
- 2) The minimum for the depositis in the account was 6 .
- 3) The minimum for the depositis in the account was 7 .
- 4) The minimum for the depositis in the account was 14 .
- 5) The minimum for the depositis in the account was 74 .

Exercise 6

The funds of a public institution alternate periods of deficit and surplus.

We have the following information for several years (in millions of euros):

year	funds
1	20
5	44
9	164

Employ an interpolation polynomial to build a function that

yields the funds for each year t . We know that due to the legislation the funds of such an institution have to be kept between 29 and 125

- . Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from $t=1$ to $t=9$).

- 1) The funds are inside the limits for the interval: $[-4, 4]$.
- 2) The funds are inside the limits for the interval: $[-4, 9]$.
- 3) The funds are inside the limits for the intervals: $[-4, 0]$ y $[8, 9]$.
- 4) The funds are inside the limits for the interval: $[-4, 0]$.
- 5) The funds are inside the limits for the interval: $[4, 8]$.
- 6) The funds are inside the limits for the interval: $[4, 9]$.
- 7) The funds are inside the limits for the interval: $[0, 4]$.
- 8) The funds are inside the limits for the intervals: $[0, 0]$ y $[4, 8]$.

Exercise 7

The population of a city is studied between years $t=3$ and $t=7$. In that

period the population is given by the function $P(t) = 10 + 360t - 66t^2 + 4t^3$

- . Determine the intervals of years when the population is between 498 and 660.

- 1) Along the interval of years: $[3.04493, 5.44902]$.
- 2) Along the intervals of years: $[3.38601, 5.]$ and $[6., 7.]$.
- 3) Along the intervals of years: $[3.36806, 4.]$ and $[6.42755, 7.35825]$.
- 4) Along the intervals of years: $[3., 5.]$ and $[6., 7.52877]$.
- 5) Along the intervals of years: $[3, 3]$, $[5, 5]$ and $[6.5, 7]$.
- 6) Along the interval of years: $[3, 6.5]$.
- 7) Along the interval of years: $[4., 7.]$.
- 8) Along the intervals of years: $[3.05023, 4.]$ and $[5., 7.]$.

Exercise 8

Compute the limit: $\lim_{x \rightarrow \infty} \left(\frac{2 - 3x + 3x^2}{3 - 7x + 3x^2} \right)^{-3-4x+9x^2}$

- 1) 0
- 2) ∞
- 3) $\frac{1}{e^3}$
- 4) $-\infty$
- 5) $\frac{1}{e^4}$
- 6) $\frac{1}{e^2}$
- 7) 1

Exercise 9

A factory produces certain type of devices. The marginal cost (cost of producing one unit) decreases when we produce a large amount

of units and it is given by the function $C(x) = \frac{5 + 9x + 5x^2 + 8x^3 + x^4}{7 + 9x + 7x^2 + 9x^3 + 8x^4}$

. Determine the expected cost per unit when a large amount of units is produced.

- 1) ∞
- 2) 20000
- 3) $\frac{1}{8}$
- 4) $-\infty$
- 5) 0
- 6) $\frac{3}{20}$
- 7) -1

Exercise 10

The population in certain turistic area

increases exponentially and is given by the function $P(t) = 95\,000 e^{t/50}$ that indicates the number of resident citizens for every year t . At the same time, depending on the season, the city receives a variable number of

tourists given by the trigonometric function $I(t) = 5000 + 3000 \sin\left[\frac{t}{2\pi}\right]$

that yields the amount of visitors in the area for every moment t (t in years).

Determine how many years are necessary until the total number of habitants is 145000.

(the solution can be found for t between 15 and 20).

- 1) $t = **.*1****$
- 2) $t = **.*3****$
- 3) $t = **.*5****$
- 4) $t = **.*7****$
- 5) $t = **.*9****$

Exercise 11

Study the continuity of the function $f(x) = \begin{cases} 2e^{x-2} - 2\sin(2-x) & x \leq 2 \\ -\sin(2-x) - 1 - \sin(3) & 2 < x < 5 \\ -\sin(5-x) - \cos(5-x) & 5 \leq x \end{cases}$

- 1) The functions is continuous for all points.
- 2) The functions is not continuous at any point.
- 3) The function is continuous for all the points except for $x=2$.
- 4) The function is continuous for all the points except for $x=5$.
- 5) The function is continuous for all the points except for $x=2$ and $x=5$.

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01-Functions for serial number: 6

Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a periodic compound interest rate of 1% in 10 periods (compounding frequency) and in the bank B we are paid a continuous compound rate of 4%. We initially deposit 7000 euros in the bank A and 1000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **3.***** years.
- 2) In **0.***** years.
- 3) In **4.***** years.
- 4) In **1.***** years.
- 5) In **9.***** years.

Exercise 2

Certain parcel of land is devalued from an initial value of 356000 euros until a final value of 182000 euros along 6 years. Determine the rate of continuous compound interest for that devaluation.

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) The interest rate is **7.***** %.
- 2) The interest rate is **3.***** %.
- 3) The interest rate is **6.***** %.
- 4) The interest rate is **2.***** %.
- 5) The interest rate is **1.***** %.

Exercise 3

We have a bank account that initially offers a compound interest rate of 1%, and after 1 year the conditions are modified and then we obtain a compound interest rate of 5%. The initial deposit is 7000 euros. Compute the amount of money in the account after 8 years from the moment of the first deposit.

- 1) We will have ****5.***** euros.
- 2) We will have ****4.***** euros.
- 3) We will have ****8.***** euros.
- 4) We will have ****1.***** euros.
- 5) We will have ****9.***** euros.

Exercise 4

A firm sells Q tons of certain product. The price received per ton is given by the formula $P=1000-18Q$. On the other hand, the production cost per ton is $C=400-13Q$. In addition, the transportation cost is 580 per ton. Compute the maximum profit that can be obtained selling this product.

- 1) Profit = 17 .
- 2) Profit = 22 .
- 3) Profit = 18 .
- 4) Profit = 15 .
- 5) Profit = 20 .

Exercise 5

Deposits in certain investment account vary from year to year alternating gains and losses periods. We have the following data about the deposits for different years:

year	deposits
0	446
1	388
2	334

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t . Employ that function to determine the minimum funds available in the investment account .

- 1) The minimum for the depositis in the account was 15 .
- 2) The minimum for the depositis in the account was -3 .
- 3) The minimum for the depositis in the account was 238 .
- 4) The minimum for the depositis in the account was -4 .
- 5) The minimum for the depositis in the account was 8 .

Exercise 6

The funds of a public institution alternate periods of deficit and surplus.

We have the following information for several years (in millions of euros):

year	funds
0	23
2	23
6	47

Employ an interpolation polynomial to build a function that

yields the funds for each year t . We know that due to the legislation the funds of such an institution have to be kept between 26 and 38

- . Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from $t=0$ to $t=6$).

- 1) The funds are inside the limits for the interval: $[0, 3]$.
- 2) The funds are inside the limits for the interval: $[-3, 6]$.
- 3) The funds are inside the limits for the intervals: $[-3, -1]$ y $[5, 6]$.
- 4) The funds are inside the limits for the interval: $[3, 6]$.
- 5) The funds are inside the limits for the interval: $[-3, 3]$.
- 6) The funds are inside the limits for the interval: $[-3, -1]$.
- 7) The funds are inside the limits for the interval: $[-3, 0]$.
- 8) The funds are inside the limits for the interval: $[3, 5]$.

Exercise 7

The population of certain type of rodents is analyzed in a region between years $t=0$ and $t=8$. Along that period the population is given by the function $P(t) = 240t - 54t^2 + 4t^3$ (thousands of rodents). Determine the intervals of years during which the number of rodents is between 350 and 512.

- 1) Along the interval of years: $[4., 8.]$.
- 2) Along the interval of years: $[3.5, 8]$.
- 3) Along the intervals of years: $[2.21316, 4.23445]$ and $[5., 8.]$.
- 4) Along the interval of years: $[2., 6.]$.
- 5) Along the interval of years: $[2.11224, 3.24996]$.
- 6) Along the intervals of years: $[0, 3.5]$, $[5, 5]$ and $[8, 8]$.
- 7) Along the interval of years: $[2.3826, 5.30023]$.
- 8) Along the interval of years: $[0.781115, 5.]$.

Exercise 8

Compute the limit: $\lim_{x \rightarrow \infty} \left(\frac{3 + 2x - 8x^2}{7 + 7x - 8x^2} \right)^{-6+8x+3x^2}$

- 1) $-\infty$
- 2) $\frac{1}{e^4}$
- 3) ∞
- 4) 1
- 5) $\frac{1}{e^3}$
- 6) 0
- 7) e

Exercise 9

A factory produces certain type of devices. The marginal cost (cost of producing one unit) decreases when we produce a large amount of units and it is given by the function $C(x) = \frac{5 + 8x + 3x^2 + 3x^3 + 2x^4}{6 + 7x + 3x^2 + 9x^3 + 6x^4}$

. Determine the expected cost per unit when a large amount of units is produced.

- 1) $\frac{17}{50}$
- 2) $-\infty$
- 3) 0
- 4) $\frac{1}{3}$
- 5) $-\frac{3}{4}$
- 6) 3000
- 7) ∞

Exercise 10

The population in certain turistic area

increases exponentially and is given by the function $P(t) = 54\,000 e^{t/100}$ that indicates the number of resident citizens for every year t . At the same time, depending on the season, the city receives a variable number of

tourists given by the trigonometric function $I(t) = 2000 + 1000 \sin\left[\frac{t}{2\pi}\right]$

that yields the amount of visitors in the area for every moment t (t in years).

Determine how many years are necessary until the total number of habitants is 76000.

(the solution can be found for t between 31 and 36).

- 1) $t = \dots 0 \dots$
- 2) $t = \dots 2 \dots$
- 3) $t = \dots 4 \dots$
- 4) $t = \dots 6 \dots$
- 5) $t = \dots 8 \dots$

Exercise 11

Study the continuity of the function $f(x) = \begin{cases} 2e^{x-3} + 3\sin(3-x) & x \leq 3 \\ 8 - 2x & 3 < x < 4 \\ -2\cos(4-x) & 4 \leq x \end{cases}$

- 1) The functions is continuous for all points.
- 2) The functions is not continuous at any point.
- 3) The function is continuous for all the points except for $x = 3$.
- 4) The function is continuous for all the points except for $x = 4$.
- 5) The function is continuous for all the points except for $x = 3$ and $x = 4$.

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01-Functions for serial number: 7

Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a periodic compound interest rate of 5% in 12 periods (compounding frequency) and in the bank B we are paid a periodic compound interest rate of 10% in 2 periods (compounding frequency). We initially deposit 14000 euros in the bank A and 3000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **7.***** years.
- 2) In **3.***** years.
- 3) In **2.***** years.
- 4) In **0.***** years.
- 5) In **9.***** years.

Exercise 2

Certain parcel of land is revalued from an initial value of 202000 euros until a final value of 357000 euros along 9 years. Determine the rate of continuous compound interest for that revaluation.

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) The interest rate is **2.***** %.
- 2) The interest rate is **5.***** %.
- 3) The interest rate is **1.***** %.
- 4) The interest rate is **3.***** %.
- 5) The interest rate is **6.***** %.

Exercise 3

We have a bank account that initially offers a continuous compound rate of 10%, and after 3 years the conditions are modified and then we obtain a compound interest rate of 4%. The initial deposit is 14000 euros. Compute the amount of money in the account after 7 years from the moment of the first deposit.

- 1) We will have ****9.***** euros.
- 2) We will have ****8.***** euros.
- 3) We will have ****2.***** euros.
- 4) We will have ****0.***** euros.
- 5) We will have ****5.***** euros.

Exercise 4

A firm sells Q tons of certain product. The price received per ton is given by the formula $P=11000-8Q$. On the other hand, the production cost per ton is $C=4000+2Q$. In addition, the transportation cost is 6220 per ton. Compute the maximum profit that can be obtained selling this product.

- 1) Profit = 15 210 .
- 2) Profit = 23 545 .
- 3) Profit = 5464 .
- 4) Profit = 24 799 .
- 5) Profit = 22 544 .

Exercise 5

Deposits in certain investment account vary from year to year alternating gains and losses periods. We have the following data about the deposits for different years:

year	deposits
0	8
2	104
3	146

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t . Employ that function to determine the maximum funds available in the investment account .

- 1) The maximum for the depositis in the account was -9 .
- 2) The maximum for the depositis in the account was 346 .
- 3) The maximum for the depositis in the account was 13 .
- 4) The maximum for the depositis in the account was 248 .
- 5) The maximum for the depositis in the account was -4 .

Exercise 6

The funds of a public institution alternate periods of deficit and surplus.

We have the following information for several years (in millions of euros):

year	funds
2	5
5	14
9	110

Employ an interpolation polynomial to build a function that

yields the funds for each year t . We know that due to the legislation the funds of such an institution have to be kept between 5 and 29

- . Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from $t=2$ to $t=9$).

- 1) The funds are inside the limits for the interval: $[0, 4]$.
- 2) The funds are inside the limits for the intervals: $[2, 2]$ y $[4, 6]$.
- 3) The funds are inside the limits for the interval: $[0, 9]$.
- 4) The funds are inside the limits for the interval: $[0, 2]$.
- 5) The funds are inside the limits for the interval: $[0, 0]$.
- 6) The funds are inside the limits for the intervals: $[0, 2]$ y $[6, 9]$.
- 7) The funds are inside the limits for the intervals: $[0, 2]$ y $[4, 6]$.
- 8) The funds are inside the limits for the interval: $[4, 9]$.

Exercise 7

The population of a city is studied between years $t=4$ and $t=10$. In that

period the population is given by the function $P(t) = 3 + 420t - 72t^2 + 4t^3$

- . Determine the intervals of years when the population is between 867 and 1003.

- 1) Along the interval of years: $[9.7366, 10.1779]$.
- 2) Along the intervals of years: $[4, 9]$ and $[10, 10]$.
- 3) Along the interval of years: $[9, 10]$.
- 4) Along the interval of years: $[4.2806, 9.]$.
- 5) Along the interval of years: $[5.49631, 6.]$.
- 6) Along the interval of years: $[8.09173, 10.5021]$.
- 7) Along the interval of years: $[4., 10.1918]$.
- 8) Along the interval of years: $[4.55538, 10.]$.

Exercise 8

Compute the limit: $\lim_{x \rightarrow -\infty} \left(\frac{4 - 3x - x^2}{2 + 8x - x^2} \right)^{-8 - 2x + 3x^2}$

- 1) 1
- 2) $\frac{1}{e^5}$
- 3) $\frac{1}{e^2}$
- 4) $\frac{1}{e^4}$
- 5) 0
- 6) ∞
- 7) $-\infty$

Exercise 9

The population of certain country (in millions of habitants) is given by the function $P(t) =$

$23 \left(\frac{1 - 4t - 3t^2 - 3t^3}{2 + 8t + 3t^2 - 3t^3} \right)^{-2 + 6t + 5t^2}$. Determine the future tendency for this population.

- 1) $\frac{23}{e^2}$
- 2) 23
- 3) 0
- 4) ∞
- 5) $-\infty$
- 6) $\frac{23}{e^5}$
- 7) $\frac{23}{e^4}$

Exercise 10

The population in certain turistic area

increases exponentially and is given by the function $P(t) = 62000 e^{t/50}$ that indicates the number of resident citizens for every year t . At the same time, depending on the season, the city receives a variable number of

tourists given by the trigonometric function $I(t) = 4000 + 3000 \sin\left[\frac{t}{2\pi}\right]$

that yields the amount of visitors in the area for every moment t (t in years).

Determine how many years are necessary until the total number of habitants is 96000.

(the solution can be found for t between 16 and 21).

- 1) $t = **.*1****$
- 2) $t = **.*3****$
- 3) $t = **.*5****$
- 4) $t = **.*7****$
- 5) $t = **.*9****$

Exercise 11

Study the continuity of the function $f(x) = \begin{cases} 2e^{x+2} + \sin(x+2) & x \leq -2 \\ \frac{2}{3} - \frac{2x}{3} & -2 < x < 1 \end{cases}$

- 1) The functions is continuous for all points.
- 2) The functions is not continuous at any point.
- 3) The function is continuous for all the points except for $x = -2$.
- 4) The function is continuous for all the points except for $x = 1$.
- 5) The function is continuous for all the points except for $x = -2$ and $x = 1$.

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01-Functions for serial number: 8

Exercise 1

We have two bank accounts, the first in the

bank A and the second in the bank B. In the bank A we obtain a continuous compound rate of 9% and in the bank B we are paid a compound interest rate of 3%. We initially deposit 1000 euros in the bank A and 5000

in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **6.***** years.
- 2) In **5.***** years.
- 3) In **3.***** years.
- 4) In **8.***** years.
- 5) In **0.***** years.

Exercise 2

We have one bank account that offers a

periodic compound interest rate of 5% in 9 periods (compounding frequency) where we initially deposit 5000

euros. How long time is it necessary until the amount of money in the account reaches 13000 euros?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **9.***** years.
- 2) In **5.***** years.
- 3) In **2.***** years.
- 4) In **8.***** years.
- 5) In **0.***** years.

Exercise 3

We have a bank account that initially offers a compound interest rate of 5%, and after 3 years the conditions are modified and then we obtain a compound interest rate of 9%. The initial deposit is 5000 euros. Compute the amount of money in the account after 4 years from the moment of the first deposit.

- 1) We will have ****9.***** euros.
- 2) We will have ****5.***** euros.
- 3) We will have ****7.***** euros.
- 4) We will have ****8.***** euros.
- 5) We will have ****0.***** euros.

Exercise 4

A firm sells Q tons of certain product. The price received per ton is given by the formula $P=1000-2Q$. On the other hand, the production cost per ton is $C=900+Q$. In addition, the transportation cost is 28 per ton. Compute the maximum profit that can be obtained selling this product.

- 1) Profit = 583 .
- 2) Profit = 472 .
- 3) Profit = 293 .
- 4) Profit = 432 .
- 5) Profit = 719 .

Exercise 5

Deposits in certain investment account vary from year to year alternating gains and losses periods. We have the following data about the deposits for different years:

year	deposits
2	-9
3	-17
5	-39

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t . Employ that function to forecast the exact amount for year 6 .

- 1) The depositis in the account for year 6 are -53 .
- 2) The depositis in the account for year 6 are 7 .
- 3) The depositis in the account for year 6 are 15 .
- 4) The depositis in the account for year 6 are 3 .
- 5) The depositis in the account for year 6 are -69 .

Exercise 6

The funds of a public institution alternate periods of deficit and surplus.

We have the following information for several years (in millions of euros):

year	funds
0	18
2	-6
5	3

Employ an interpolation polynomial to build a function that

yields the funds for each year t . We know that due to the legislation the funds of such an institution have to be kept between -6 and 3

. Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from $t=0$ to $t=5$).

- 1) The funds are inside the limits for the interval: $[1, 2]$.
- 2) The funds are inside the limits for the interval: $[0, 1]$.
- 3) The funds are inside the limits for the interval: $[1, 5]$.
- 4) The funds are inside the limits for the interval: $[4, 5]$.
- 5) The funds are inside the limits for the intervals: $[1, 2]$ y $[4, 5]$.
- 6) The funds are inside the limits for the interval: $[1, 4]$.
- 7) The funds are inside the limits for the interval: $[0, 4]$.
- 8) The funds are inside the limits for the intervals: $[0, 2]$ y $[4, 5]$.

Exercise 7

The population of a city is studied between years $t=0$ and $t=7$. In that period the population is given by the function $P(t) = 9 + 96t - 36t^2 + 4t^3$

. Determine the intervals of years when the population is between -127 and 89 .

- 1) Along the intervals of years: $[1., 4.]$ and $[5., 7.54103]$.
- 2) Along the interval of years: $[0, 5]$.
- 3) Along the interval of years: $[4., 6.]$.
- 4) Along the intervals of years: $[-4.45015 \times 10^{-308}, 1.]$ and $[6., 7.38145]$.
- 5) Along the interval of years: $[4.59448, 5.]$.
- 6) Along the interval of years: $[2.72255, 3.46627]$.
- 7) Along the intervals of years: $[0, 0]$, $[2, 2]$ and $[5, 7]$.
- 8) Along the interval of years: $[2.00741, 7.]$.

Exercise 8

Compute the limit: $\lim_{x \rightarrow \infty} \left(\frac{-7 - 4x + 9x^2}{-8 + 4x + 9x^2} \right)^{-9+8x+x^2}$

- 1) $\frac{1}{e^3}$
- 2) $\frac{1}{e^5}$
- 3) $-\infty$
- 4) 1
- 5) $\frac{1}{e^4}$
- 6) ∞
- 7) 0

Exercise 9

The population of certain country (in millions of habitants) is given by the function $P(t) =$

$$14 \left(\frac{-3 + 7t + 7t^2}{-4 - 8t + 7t^2} \right)^{-5+4t}. \text{ Determine the future tendency for this population.}$$

- 1) $-\infty$
- 2) ∞
- 3) $14 e^{60/7}$
- 4) $\frac{14}{e^4}$
- 5) 14
- 6) 0
- 7) $14 e^{857/100}$

Exercise 10

We deposit 2000 euros in a bank account with a compound interest rate of 4%. At the same time every year we also add in a safe-deposit box (therefore with no interest rate) 2000 euros. How long time is it necessary until the total amount of money (jointly in the bank account and safe-deposit box) is 38000 euros? (the solution can be found for t between 13 and 18).

- 1) $t = ** .0****$
- 2) $t = ** .2****$
- 3) $t = ** .4****$
- 4) $t = ** .6****$
- 5) $t = ** .8****$

Exercise 11

Study the continuity of the function $f(x) = \begin{cases} 0 & x \leq -3 \\ -\frac{4x}{3} - 4 & -3 < x < 0 \\ \sin(x) - 2 \cos(x) & 0 \leq x \end{cases}$

- 1) The functions is continuous for all points.
- 2) The functions is not continuous at any point.
- 3) The function is continuous for all the points except for $x = -3$.
- 4) The function is continuous for all the points except for $x = 0$.
- 5) The function is continuous for all the points except for $x = -3$ and $x = 0$.

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01-Functions for serial number: 9

Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a compound interest rate of 2% and in the bank B we are paid a periodic compound interest rate of 8% in 8 periods (compounding frequency). We initially deposit 9000 euros in the bank A and 5000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **0.***** years.
- 2) In **9.***** years.
- 3) In **3.***** years.
- 4) In **4.***** years.
- 5) In **1.***** years.

Exercise 2

Certain parcel of land is devalued from an initial value of 308000 euros until a final value of 167000 euros along 7 years. Determine the rate of compound interest for that devaluation.

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) The interest rate is **6.***** %.
- 2) The interest rate is **9.***** %.
- 3) The interest rate is **8.***** %.
- 4) The interest rate is **0.***** %.
- 5) The interest rate is **2.***** %.

Exercise 3

We have a bank account that initially offers a periodic compound interest rate of 4% in 3 periods (compounding frequency), and after 3 years the conditions are modified and then we obtain a periodic compound interest rate of 9% in 11 periods (compounding frequency). The initial deposit is 9000 euros. Compute the amount of money in the account after 4 years from the moment of the first deposit.

- 1) We will have ****1.***** euros.
- 2) We will have ****0.***** euros.
- 3) We will have ****3.***** euros.
- 4) We will have ****4.***** euros.
- 5) We will have ****6.***** euros.

Exercise 4

A firm sells Q tons of certain product. The price received per ton is given by the formula $P=70000-18Q$. On the other hand, the production cost per ton is $C=20000+3Q$. In addition, the transportation cost is 48530 per ton. Compute the maximum profit that can be obtained selling this product.

- 1) Profit = 32547 .
- 2) Profit = 25897 .
- 3) Profit = 25725 .
- 4) Profit = 22564 .
- 5) Profit = 8545 .

Exercise 5

Deposits in certain investment account vary from year to year alternating gains and losses periods. We have the following data about the deposits for different years:

year	deposits
2	36
4	68
5	81

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t . Employ that function to determine the maximum funds available in the investment account .

- 1) The maximum for the depositis in the account was 117 .
- 2) The maximum for the depositis in the account was 11 .
- 3) The maximum for the depositis in the account was 5 .
- 4) The maximum for the depositis in the account was 3 .
- 5) The maximum for the depositis in the account was 101 .

Exercise 6

The funds of a public institution alternate periods of deficit and surplus.

We have the following information for several years (in millions of euros):

year	funds
2	3
5	-6
7	-2

Employ an interpolation polynomial to build a function that

yields the funds for each year t . We know that due to the legislation the funds of such an institution have to be kept between 3 and 10

- . Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from $t=2$ to $t=7$).

- 1) The funds are inside the limits for the interval: $[0, 1]$.
- 2) The funds are inside the limits for the interval: $[2, 2]$.
- 3) The funds are inside the limits for the interval: $[1, 8]$.
- 4) The funds are inside the limits for the interval: $[1, 2]$.
- 5) The funds are inside the limits for the interval: $[0, 8]$.
- 6) The funds are inside the limits for the intervals: $[0, 2]$ y $[8, 9]$.
- 7) The funds are inside the limits for the interval: $[1, 7]$.
- 8) The funds are inside the limits for the interval: $[7, 8]$.

Exercise 7

The population of certain type of rodents is analyzed in a region between years $t=0$ and $t=8$. Along that period the population is given by the function $P(t) = 10 + 144t - 42t^2 + 4t^3$ (thousands of rodents). Determine the intervals of years during which the number of rodents is between -180 and 10.

- 1) Along the interval of years: $[0, 8]$.
- 2) Along the interval of years: $[0, 0]$.
- 3) Along the intervals of years: $[0.14935, 1.]$ and $[3., 5.]$.
- 4) Along the intervals of years: $[-4.45015 \times 10^{-308}, 2.31412]$ and $[4., 5.38604]$.
- 5) Along the interval of years: $[2.39431, 5.48342]$.
- 6) Along the intervals of years: $[1.3742, 3.21244]$ and $[5.74929, 8.]$.
- 7) Along the intervals of years: $[-4.45015 \times 10^{-308}, 2.]$ and $[4.1263, 8.]$.
- 8) That number of mice is reach for no interval of years.

Exercise 8

Compute the limit: $\lim_{x \rightarrow \infty} \left(\frac{5 - 5x - 5x^2}{-3 - 3x - 5x^2} \right)^{1+3x}$

- 1) ∞
- 2) $\frac{1}{e^2}$
- 3) 1
- 4) $\frac{1}{e^4}$
- 5) $e^{6/5}$
- 6) 0
- 7) $-\infty$

Exercise 9

From an initial deposit 8000, the interest rate varies every year in such a way that the total amount of money in the account is given by the function $C(t) =$

$$8000 \left(\frac{-6 - 5t + 2t^2}{-3 - 3t + 2t^2} \right)^{1+3t}. \text{ Determine the future tendency for the}$$

deposits that we will have after a large number of years.

- 1) 8000
- 2) $\frac{8000}{e^4}$
- 3) 0
- 4) $\frac{8000}{e^3}$
- 5) $\frac{8000}{e^{1501/500}}$
- 6) ∞
- 7) $-\infty$

Exercise 10

The population in certain turistic area

increases exponentially and is given by the function $P(t) = 76\,000 e^{t/100}$ that indicates the number of resident citizens for every year t . At the same time, depending on the season, the city receives a variable number of

tourists given by the trigonometric function $I(t) = 2000 + 1000 \sin\left[\frac{t}{2\pi}\right]$

that yields the amount of visitors in the area for every moment t (t in years).

Determine how many years are necessary until the total number of habitants is 118000. (the solution can be found for t between 38 and 43).

- 1) $t = ** .1****$
- 2) $t = ** .3****$
- 3) $t = ** .5****$
- 4) $t = ** .7****$
- 5) $t = ** .9****$

Exercise 11

Study the continuity of the function $f(x) = \begin{cases} -2e^x - \sin(x) & x \leq 0 \\ 3\sin(x) - \cos(x) - 1 & 0 < x < 1 \\ -2e^{x-1} & 1 \leq x \end{cases}$

- 1) The functions is continuous for all points.
- 2) The functions is not continuous at any point.
- 3) The function is continuous for all the points except for $x=0$.
- 4) The function is continuous for all the points except for $x=1$.
- 5) The function is continuous for all the points except for $x=0$ and $x=1$.

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01-Functions for serial number: 10

Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a compound interest rate of 10% and in the bank B we are paid a periodic compound interest rate of 5% in 3 periods (compounding frequency). We initially deposit 10000 euros in the bank A and 14000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **0.***** years.
- 2) In **7.***** years.
- 3) In **1.***** years.
- 4) In **5.***** years.
- 5) In **9.***** years.

Exercise 2

Certain parcel of land is revalued from an initial value of 339000 euros until a final value of 478000 euros along 10 years. Determine the rate of compound interest for that revaluation.

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) The interest rate is **6.***** %.
- 2) The interest rate is **2.***** %.
- 3) The interest rate is **4.***** %.
- 4) The interest rate is **8.***** %.
- 5) The interest rate is **3.***** %.

Exercise 3

We have a bank account that initially offers a compound interest rate of 10%, and after 4 years the conditions are modified and then we obtain a continuous compound rate of 10%. The initial deposit is 14000 euros. Compute the amount of money in the account after 9 years from the moment of the first deposit.

- 1) We will have ****1.***** euros.
- 2) We will have ****4.***** euros.
- 3) We will have ****7.***** euros.
- 4) We will have ****5.***** euros.
- 5) We will have ****9.***** euros.

Exercise 4

A firm sells Q tons of certain product. The price received per ton is given by the formula $P=15000-17Q$. On the other hand, the production cost per ton is $C=7000-15Q$. In addition, the transportation cost is 7884 per ton. Compute the maximum profit that can be obtained selling this product.

- 1) Profit = 1316 .
- 2) Profit = 1682 .
- 3) Profit = 698 .
- 4) Profit = 1665 .
- 5) Profit = 2101 .

Exercise 5

Deposits in certain investment account vary from year to year alternating gains and losses periods. We have the following data about the deposits for different years:

year	deposits
1	37
2	62
3	85

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t . Employ that function to determine the maximum funds available in the investment account .

- 1) The maximum for the depositis in the account was 206 .
- 2) The maximum for the depositis in the account was 14 .
- 3) The maximum for the depositis in the account was 142 .
- 4) The maximum for the depositis in the account was 11 .
- 5) The maximum for the depositis in the account was 13 .

Exercise 6

The funds of a public institution alternate periods of deficit and surplus.

We have the following information for several years (in millions of euros):

year	funds
2	14
6	90
10	230

Employ an interpolation polynomial to build a function that

yields the funds for each year t . We know that due to the legislation the funds of such an institution have to be kept between -5 and 152

. Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from $t=2$ to $t=10$).

- 1) The funds are inside the limits for the interval: $[0, 10]$.
- 2) The funds are inside the limits for the interval: $[0, 8]$.
- 3) The funds are inside the limits for the interval: $[10, 10]$.
- 4) The funds are inside the limits for the interval: $[-\frac{19}{2}, 10]$.
- 5) The funds are inside the limits for the interval: $[-2, 4]$.
- 6) The funds are inside the limits for the interval: $[-2, 6]$.
- 7) The funds are inside the limits for the interval: $[8, 10]$.
- 8) The funds are inside the limits for the interval: $[2, 8]$.

Exercise 7

The population of a city is studied between years $t=4$ and $t=10$. In that period the population is given by the function $P(t) = 2 + 420t - 72t^2 + 4t^3$

. Determine the intervals of years when the population is between 786 and 1002 .

- 1) Along the interval of years: $[6.64792, 9.]$.
- 2) Along the intervals of years: $[4., 5.17025]$ and $[8.00994, 10.2962]$.
- 3) Along the intervals of years: $[4, 4]$, $[7, 7]$ and $[10, 10]$.
- 4) Along the interval of years: $[5., 9.25913]$.
- 5) Along the intervals of years: $[4.04419, 5.]$ and $[7., 9.79684]$.
- 6) Along the interval of years: $[5., 6.4412]$.
- 7) Along the interval of years: $[4, 10]$.
- 8) Along the intervals of years: $[5.69219, 6.74622]$ and $[9.59592, 10.7072]$.

Exercise 8

Compute the limit: $\lim_{x \rightarrow \infty} \left(\frac{-8 + 3x - 4x^2 + 9x^3}{-6 + 6x - 7x^2 + 9x^3} \right)^{-4-9x+x^2}$

- 1) 0
- 2) 1
- 3) ∞
- 4) $\frac{1}{e^2}$
- 5) $-\infty$
- 6) $\frac{1}{e^4}$
- 7) $\frac{1}{e^3}$

Exercise 9

From an initial deposit 7000, the interest rate varies every year in such a way that the total amount of money in the account is given by the function $C(t) =$

$$7000 \left(\frac{8 + 3t + 8t^2}{-4 - 6t + 8t^2} \right)^{2+t+8t^2}. \text{ Determine the future tendency for the}$$

deposits that we will have after a large number of years.

- 1) 7000
- 2) 0
- 3) $\frac{7000}{e^3}$
- 4) $-\infty$
- 5) $\frac{7000}{e^2}$
- 6) $\frac{7000}{e^5}$
- 7) ∞

Exercise 10

The population in certain turistic area

increases exponentially and is given by the function $P(t) = 79\,000 e^{t/50}$ that indicates the number of resident citizens for every year t . At the same time, depending on the season, the city receives a variable number of

tourists given by the trigonometric function $I(t) = 5000 + 3000 \sin\left[\frac{t}{2\pi}\right]$

that yields the amount of visitors in the area for every moment t (t in years).

Determine how many years are necessary until the total number of habitants is 123000. (the solution can be found for t between 19 and 24).

- 1) $t = **.*$
- 2) $t = **.*$
- 3) $t = **.*$
- 4) $t = **.*$
- 5) $t = **.*$

Exercise 11

Study the continuity of the function $f(x) = \begin{cases} 2 \sin(x) - e^x & x \leq 0 \\ 2 \sin(x) - \cos(x) - 2 - 2 \sin(2) + \cos(2) & 0 < x < 2 \\ -2 \log(x-1) - 2 & 2 \leq x \end{cases}$

- 1) The functions is continuous for all points.
- 2) The functions is not continuous at any point.
- 3) The function is continuous for all the points except for $x=0$.
- 4) The function is continuous for all the points except for $x=2$.
- 5) The function is continuous for all the points except for $x=0$ and $x=2$.

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01-Functions for serial number: 11

Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a periodic compound interest rate of 1% in 6 periods (compounding frequency) and in the bank B we are paid a compound interest rate of 6% . We initially deposit 11000 euros in the bank A and 4000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **6.***** years.
- 2) In **1.***** years.
- 3) In **0.***** years.
- 4) In **3.***** years.
- 5) In **7.***** years.

Exercise 2

Certain parcel of land is devalued from an initial value of 380000 euros until a final value of 115000 euros along 6 years. Determine the rate of continuous compound interest for that devaluation .

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) The interest rate is **7.***** %.
- 2) The interest rate is **2.***** %.
- 3) The interest rate is **3.***** %.
- 4) The interest rate is **9.***** %.
- 5) The interest rate is **6.***** %.

Exercise 3

We have a bank account that initially offers a periodic compound interest rate of 1% in 4 periods (compounding frequency) , and after 3 years the conditions are modified and then we obtain a compound interest rate of 4% . The initial deposit is 11000 euros. Compute the amount of money in the account after 8 years from the moment of the first deposit.

- 1) We will have ****0.***** euros.
- 2) We will have ****4.***** euros.
- 3) We will have ****3.***** euros.
- 4) We will have ****7.***** euros.
- 5) We will have ****2.***** euros.

Exercise 4

A firm sells Q tons of certain product. The price received per ton is given by the formula $P=4000-8Q$. On the other hand, the production cost per ton is $C=3000+2Q$. In addition, the transportation cost is 220 per ton. Compute the maximum profit that can be obtained selling this product.

- 1) Profit = 15 210 .
- 2) Profit = 15 491 .
- 3) Profit = 14 166 .
- 4) Profit = 10 162 .
- 5) Profit = 8 093 .

Exercise 5

Deposits in certain investment account vary from year to year alternating gains and losses periods. We have the following data about the deposits for different years:

year	deposits
1	4
3	-4
4	-5

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t . Employ that function to determine the minimum funds available in the investment account .

- 1) The minimum for the depositis in the account was 4 .
- 2) The minimum for the depositis in the account was 6 .
- 3) The minimum for the depositis in the account was -5 .
- 4) The minimum for the depositis in the account was 9 .
- 5) The minimum for the depositis in the account was -10 .

Exercise 6

The funds of a public institution alternate periods of deficit and surplus.

We have the following information for several years (in millions of euros):

year	funds
0	20
3	-25
7	-1

Employ an interpolation polynomial to build a function that

yields the funds for each year t . We know that due to the legislation the funds of such an institution have to be kept between -25 and -16

- . Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from $t=0$ to $t=7$).

- 1) The funds are inside the limits for the intervals: $[2, 3]$ y $[5, 6]$.
- 2) The funds are inside the limits for the interval: $[2, 7]$.
- 3) The funds are inside the limits for the interval: $[0, 5]$.
- 4) The funds are inside the limits for the interval: $[2, 3]$.
- 5) The funds are inside the limits for the interval: $[0, 2]$.
- 6) The funds are inside the limits for the intervals: $[0, 3]$ y $[5, 6]$.
- 7) The funds are inside the limits for the interval: $[2, 5]$.
- 8) The funds are inside the limits for the interval: $[5, 7]$.

Exercise 7

The population of a city is studied between years $t=1$ and $t=9$. In

that period the population is given by the function $P(t) = 72t - 30t^2 + 4t^3$

- . Determine the intervals of years when the population is between 110 and 1720.

- 1) Along the interval of years: $[1.08116, 2.]$.
- 2) Along the intervals of years: $[1.20345, 3.01809]$ and $[6.69038, 8.49101]$.
- 3) Along the intervals of years: $[1, 5]$ and $[9, 9]$.
- 4) Along the intervals of years: $[1.37093, 3.]$ and $[5.48573, 9.28534]$.
- 5) Along the intervals of years: $[1., 2.41836]$ and $[4.72944, 7.17813]$.
- 6) Along the intervals of years: $[5., 6.]$ and $[7., 9.78809]$.
- 7) Along the intervals of years: $[1.57173, 5.68399]$ and $[7.72635, 9.]$.
- 8) Along the interval of years: $[5, 9]$.

Exercise 8

Compute the limit: $\lim_{x \rightarrow -\infty} \left(\frac{4 - 5x - 8x^2}{7 - 6x - 8x^2} \right)^{-4+2x}$

- 1) 1
- 2) ∞
- 3) $\frac{1}{e^5}$
- 4) $\frac{1}{e^4}$
- 5) 0
- 6) $\frac{1}{e^{1/4}}$
- 7) $-\infty$

Exercise 9

A factory produces certain type of devices. The marginal cost (cost of producing one unit) decreases when we produce a large amount of units and it is given by the function $C(x) = \frac{2 + 9x + 5x^2}{5 + 7x + 9x^2}$. Determine the expected cost per unit when a large amount of units is produced.

- 1) -1
- 2) 0
- 3) $-\infty$
- 4) ∞
- 5) $\frac{5}{9}$
- 6) 7000
- 7) $\frac{14}{25}$

Exercise 10

The population in certain turistic area

increases exponentially and is given by the function $P(t) = 85\,000 e^{t/100}$ that indicates the number of resident citizens for every year t . At the same time, depending on the season, the city receives a variable number of

tourists given by the trigonometric function $I(t) = 2000 + 1000 \sin\left[\frac{t}{2\pi}\right]$

that yields the amount of visitors in the area for every moment t (t in years).

Determine how many years are necessary until the total number of habitants is 113000. (the solution can be found for t between 23 and 28).

- 1) $t = **.*$
- 2) $t = **.*$
- 3) $t = **.*$
- 4) $t = **.*$
- 5) $t = **.*$

Exercise 11

Study the continuity of the function $f(x) = \begin{cases} -2e^{x-1} & x \leq 1 \\ \frac{3x}{2} - \frac{11}{2} & 1 < x < 3 \\ \sin(3-x) - \cos(3-x) & 3 \leq x \end{cases}$

- 1) The functions is continuous for all points.
- 2) The functions is not continuous at any point.
- 3) The function is continuous for all the points except for $x=1$.
- 4) The function is continuous for all the points except for $x=3$.
- 5) The function is continuous for all the points except for $x=1$ and $x=3$.

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01-Functions for serial number: 12

Exercise 1

We have two bank accounts, the first in the

bank A and the second in the bank B. In the bank A we obtain a compound interest rate of 3% and in the bank B we are paid a compound interest rate of 10%. We initially deposit 11000 euros in the bank A and 4000

in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **2.***** years.
- 2) In **5.***** years.
- 3) In **0.***** years.
- 4) In **1.***** years.
- 5) In **9.***** years.

Exercise 2

We have one bank account that offers a

compound interest rate of 3% where we initially deposit 14000

euros. How long time is it necessary until the amount of money in the account reaches 16000 euros?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **4.***** years.
- 2) In **6.***** years.
- 3) In **2.***** years.
- 4) In **0.***** years.
- 5) In **9.***** years.

Exercise 3

We have a bank account that initially offers a

periodic compound interest rate of 5% in 2 periods (compounding frequency), and after 1 year the conditions are modified and then we obtain a continuous compound rate of 1%. The initial deposit is 11000 euros. Compute the amount of money in the account after 6 years from the moment of the first deposit.

- 1) We will have ****2.***** euros.
- 2) We will have ****9.***** euros.
- 3) We will have ****0.***** euros.
- 4) We will have ****1.***** euros.
- 5) We will have ****3.***** euros.

Exercise 4

A firm sells Q tons of certain product. The price received per ton is given by the formula $P=20000-14Q$. On the other hand, the production cost per ton is $C=10000+18Q$. In addition, the transportation cost is 8912 per ton. Compute the maximum profit that can be obtained selling this product.

- 1) Profit = 12364 .
- 2) Profit = 4520 .
- 3) Profit = 6228 .
- 4) Profit = 9248 .
- 5) Profit = 7837 .

Exercise 5

Deposits in certain investment account vary from year to year alternating gains and losses periods. We have the following data about the deposits for different years:

year	deposits
2	3
4	-3
5	-9

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t . Employ that function to forecast the exact amount for year 6 .

- 1) The depositis in the account for year 6 are 18 .
- 2) The depositis in the account for year 6 are -10 .
- 3) The depositis in the account for year 6 are -17 .
- 4) The depositis in the account for year 6 are -27 .
- 5) The depositis in the account for year 6 are -3 .

Exercise 6

The funds of a public institution alternate periods of deficit and surplus.

We have the following information for several years (in millions of euros):

year	funds
1	7
5	7
8	28

Employ an interpolation polynomial to build a function that

yields the funds for each year t . We know that due to the legislation the funds of such an institution have to be kept between 7 and 12

- . Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from $t=1$ to $t=8$).

- 1) The funds are inside the limits for the intervals: $[0, 1]$ y $[6, 8]$.
- 2) The funds are inside the limits for the interval: $[0, 5]$.
- 3) The funds are inside the limits for the interval: $[5, 8]$.
- 4) The funds are inside the limits for the intervals: $[1, 1]$ y $[5, 6]$.
- 5) The funds are inside the limits for the interval: $[0, 8]$.
- 6) The funds are inside the limits for the intervals: $[0, 1]$ y $[5, 6]$.
- 7) The funds are inside the limits for the interval: $[0, 1]$.
- 8) The funds are inside the limits for the interval: $[0, 0]$.

Exercise 7

The population of certain type of rodents is analyzed in a region between years $t=3$ and $t=7$. Along that period the population is given by the function $P(t) = 9 + 360t - 66t^2 + 4t^3$ (thousands of rodents). Determine the intervals of years during which the number of rodents is between 659 and 819.

- 1) Along the interval of years: $[5., 6.]$.
- 2) Along the interval of years: $[3., 5.]$.
- 3) Along the interval of years: $[6.5, 7]$.
- 4) Along the interval of years: $[6., 7.]$.
- 5) Along the intervals of years: $[3, 6.5]$ and $[7, 7]$.
- 6) Along the intervals of years: $[5, 5]$ and $[6.5, 7]$.
- 7) Along the interval of years: $[3., 6.21815]$.
- 8) Along the interval of years: $[5., 7.21057]$.

Exercise 8

Compute the limit: $\lim_{x \rightarrow \infty} \left(\frac{9 + 6x - 8x^2}{2 + 7x - 8x^2} \right)^{-9 - 9x + 6x^2}$

- 1) $\frac{1}{e^3}$
- 2) e^3
- 3) 0
- 4) $-\infty$
- 5) $\frac{1}{e^2}$
- 6) 1
- 7) ∞

Exercise 9

The population of certain country (in millions of habitants) is given by the function $P(t) =$

$7 \left(\frac{-7 - 6t + 2t^2 + 3t^3}{7 + 6t - 9t^2 + 3t^3} \right)^{3+9t}$. Determine the future tendency for this population.

- 1) $\frac{7}{e^3}$
- 2) 7
- 3) $-\infty$
- 4) $\frac{7}{e^2}$
- 5) ∞
- 6) 0
- 7) $7e^{33}$

Exercise 10

We deposit 8000 euros in a bank account with a compound interest rate of 1%. At the same time every year we also add in a safe-deposit box (therefore with no interest rate) 2000 euros. How long time is it necessary until the total amount of money (jointly in the bank account and safe-deposit box) is 34000 euros? (the solution can be found for t between 12 and 17).

- 1) $t = ** .0****$
- 2) $t = ** .2****$
- 3) $t = ** .4****$
- 4) $t = ** .6****$
- 5) $t = ** .8****$

Exercise 11

Study the continuity of the function $f(x) = \begin{cases} 0 & x \leq 3 \\ 3 - x & 3 < x < 4 \\ 3 \sin(4 - x) - e^{x-4} & 4 \leq x \end{cases}$

- 1) The functions is continuous for all points.
- 2) The functions is not continuous at any point.
- 3) The function is continuous for all the points except for $x=3$.
- 4) The function is continuous for all the points except for $x=4$.
- 5) The function is continuous for all the points except for $x=3$ and $x=4$.

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01-Functions for serial number: 13

Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a continuous compound rate of 10% and in the bank B we are paid a compound interest rate of 2%. We initially deposit 3000 euros in the bank A and 9000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **4.***** years.
- 2) In **0.***** years.
- 3) In **8.***** years.
- 4) In **3.***** years.
- 5) In **5.***** years.

Exercise 2

Certain parcel of land is revalued from an initial value of 133000 euros until a final value of 287000 euros along 7 years. Determine the rate of continuous compound interest for that revaluation.

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) The interest rate is **6.***** %.
- 2) The interest rate is **9.***** %.
- 3) The interest rate is **2.***** %.
- 4) The interest rate is **8.***** %.
- 5) The interest rate is **0.***** %.

Exercise 3

We have a bank account that initially offers a continuous compound rate of 3%, and after 3 years the conditions are modified and then we obtain a periodic compound interest rate of 1% in 5 periods (compounding frequency). The initial deposit is 9000 euros. Compute the amount of money in the account after 2 years from the moment of the first deposit.

- 1) We will have ****8.***** euros.
- 2) We will have ****4.***** euros.
- 3) We will have ****5.***** euros.
- 4) We will have ****6.***** euros.
- 5) We will have ****3.***** euros.

Exercise 4

A firm sells Q tons of certain product. The price received per ton is given by the formula $P=90000-4Q$. On the other hand, the production cost per ton is $C=30000+18Q$. In addition, the transportation cost is 58108 per ton. Compute the maximum profit that can be obtained selling this product.

- 1) Profit = 51809 .
- 2) Profit = 34665 .
- 3) Profit = 40678 .
- 4) Profit = 14378 .
- 5) Profit = 24113 .

Exercise 5

Deposits in certain investment account vary from year to year alternating gains and losses periods. We have the following data about the deposits for different years:

year	deposits
0	459
2	347
3	297

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t . Employ that function to determine the minimum funds available in the investment account .

- 1) The minimum for the depositis in the account was 9 .
- 2) The minimum for the depositis in the account was 12 .
- 3) The minimum for the depositis in the account was 209 .
- 4) The minimum for the depositis in the account was 15 .
- 5) The minimum for the depositis in the account was 1 .

Exercise 6

The funds of a public institution alternate periods of deficit and surplus.

We have the following information for several years (in millions of euros):

year	funds
1	29
3	37
6	19

Employ an interpolation polynomial to build a function that

yields the funds for each year t . We know that due to the legislation the funds of such an institution have to be kept between 18 and 29

- . Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from $t=1$ to $t=6$).

- 1) The funds are inside the limits for the interval: $[6, 6]$.
- 2) The funds are inside the limits for the interval: $[0, 5]$.
- 3) The funds are inside the limits for the interval: $[1, 6]$.
- 4) The funds are inside the limits for the interval: $[-2, 5]$.
- 5) The funds are inside the limits for the interval: $[-2, 6]$.
- 6) The funds are inside the limits for the interval: $[0, 6]$.
- 7) The funds are inside the limits for the intervals: $[1, 1]$ y $[5, 6]$.
- 8) The funds are inside the limits for the interval: $[5, 6]$.

Exercise 7

The population of certain type of rodents is analyzed in a region between years $t=3$ and $t=9$. Along that period the population is given by the function $P(t) = 2 + 504t - 78t^2 + 4t^3$ (thousands of rodents). Determine the intervals of years during which the number of rodents is between 730 and 1242.

- 1) Along the intervals of years: $[6.31574, 7.]$ and $[8.64444, 9.]$.
- 2) Along the interval of years: $[3, 9]$.
- 3) Along the intervals of years: $[3, 3]$ and $[9, 9]$.
- 4) Along the interval of years: $[5.31976, 8.]$.
- 5) Along the interval of years: $[4., 6.47124]$.
- 6) Along the intervals of years: $[3., 5.69601]$ and $[7., 9.59082]$.
- 7) Along the interval of years: $[4., 6.]$.
- 8) Along the interval of years: $[3.50194, 9.]$.

Exercise 8

Compute the limit: $\lim_{x \rightarrow \infty} \left(\frac{-7 - 9x + 5x^2 + 9x^3}{8 + 7x - 6x^2 + 9x^3} \right)^{-7+2x}$

- 1) ∞
- 2) 0
- 3) $-\infty$
- 4) e
- 5) $\frac{1}{e}$
- 6) $e^{22/9}$
- 7) 1

Exercise 9

A factory produces certain type of devices. The marginal cost (cost of producing one unit) decreases when we produce a large amount of units and it is given by the function $C(x) = \frac{8 + 7x + 2x^2 + 2x^3}{9 + 6x + 4x^2 + 8x^3}$. Determine the expected cost per unit when a large amount of units is produced.

- 1) 9000
- 2) -1
- 3) $-\infty$
- 4) ∞
- 5) $\frac{1}{4}$
- 6) $\frac{31}{100}$
- 7) 0

Exercise 10

The population in certain turistic area

increases exponentially and is given by the function $P(t) = 83\,000 e^{t/100}$ that indicates the number of resident citizens for every year t . At the same time, depending on the season, the city receives a variable number of

tourists given by the trigonometric function $I(t) = 4000 + 3000 \sin\left[\frac{t}{2\pi}\right]$

that yields the amount of visitors in the area for every moment t (t in years).

Determine how many years are necessary until the total number of habitants is 126000. (the solution can be found for t between 38 and 43).

- 1) $t = **.*$
- 2) $t = **.*$
- 3) $t = **.*$
- 4) $t = **.*$
- 5) $t = **.*$

Exercise 11

Study the continuity of the function $f(x) = \begin{cases} 2e^{x-3} + 3\sin(3-x) & x \leq 3 \\ -e^{x-3} + 3\sin(3-x) + e^3 + 3\sin(3) & 3 < x < 6 \end{cases}$

- 1) The functions is continuous for all points.
- 2) The functions is not continuous at any point.
- 3) The function is continuous for all the points except for $x=3$.
- 4) The function is continuous for all the points except for $x=6$.
- 5) The function is continuous for all the points except for $x=3$ and $x=6$.

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01-Functions for serial number: 14

Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a periodic compound interest rate of 2% in 5 periods (compounding frequency) and in the bank B we are paid a compound interest rate of 9%. We initially deposit 10000 euros in the bank A and 1000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **1.***** years.
- 2) In **7.***** years.
- 3) In **8.***** years.
- 4) In **4.***** years.
- 5) In **0.***** years.

Exercise 2

We have one bank account that offers a compound interest rate of 3% where we initially deposit 15000 euros. How long time is it necessary until the amount of money in the account reaches 18000 euros?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **4.***** years.
- 2) In **7.***** years.
- 3) In **8.***** years.
- 4) In **6.***** years.
- 5) In **0.***** years.

Exercise 3

We have a bank account that initially offers a compound interest rate of 3%, and after 3 years the conditions are modified and then we obtain a continuous compound rate of 3%. The initial deposit is 10000 euros. Compute the amount of money in the account after 5 years from the moment of the first deposit.

- 1) We will have ****9.***** euros.
- 2) We will have ****7.***** euros.
- 3) We will have ****8.***** euros.
- 4) We will have ****2.***** euros.
- 5) We will have ****5.***** euros.

Exercise 4

A firm sells Q tons of certain product. The price received per ton is given by the formula $P=100000-12Q$. On the other hand, the production cost per ton is $C=70000+12Q$. In addition, the transportation cost is 28272 per ton. Compute the maximum profit that can be obtained selling this product.

- 1) Profit = 11793 .
- 2) Profit = 31823 .
- 3) Profit = 19349 .
- 4) Profit = 13731 .
- 5) Profit = 31104 .

Exercise 5

Deposits in certain investment account vary from year to year alternating gains and losses periods. We have the following data about the deposits for different years:

year	deposits
1	0
2	-4
3	-12

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t . Employ that function to forecast the exact amount for year 4 .

- 1) The depositis in the account for year 4 are -40 .
- 2) The depositis in the account for year 4 are 14 .
- 3) The depositis in the account for year 4 are 9 .
- 4) The depositis in the account for year 4 are -4 .
- 5) The depositis in the account for year 4 are -24 .

Exercise 6

The funds of a public institution alternate periods of deficit and surplus.

We have the following information for several years (in millions of euros):

year	funds
1	3
4	15
6	33

Employ an interpolation polynomial to build a function that

yields the funds for each year t . We know that due to the legislation the funds of such an institution have to be kept between 15 and 23

- . Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from $t=1$ to $t=6$).

- 1) The funds are inside the limits for the interval: $[-4, 6]$.
- 2) The funds are inside the limits for the interval: $[-4, 4]$.
- 3) The funds are inside the limits for the interval: $[0, 4]$.
- 4) The funds are inside the limits for the interval: $[-4, -3]$.
- 5) The funds are inside the limits for the interval: $[4, 6]$.
- 6) The funds are inside the limits for the intervals: $[-4, -3]$ y $[5, 6]$.
- 7) The funds are inside the limits for the interval: $[4, 5]$.
- 8) The funds are inside the limits for the interval: $[-4, 0]$.

Exercise 7

The population of a city is studied between years $t=2$ and $t=9$. In that period the population is given by the function $P(t) = 4 + 420t - 72t^2 + 4t^3$

- . Determine the intervals of years when the population is between 724 and 788.

- 1) Along the interval of years: $[3., 4.]$.
- 2) Along the intervals of years: $[2, 3]$ and $[4, 9]$.
- 3) Along the interval of years: $[5., 8.44248]$.
- 4) Along the intervals of years: $[3., 4.]$ and $[8., 9.]$.
- 5) Along the interval of years: $[3, 4]$.
- 6) Along the intervals of years: $[3.66627, 5.76459]$ and $[7., 9.]$.
- 7) Along the intervals of years: $[3, 4]$ and $[7, 7]$.
- 8) Along the intervals of years: $[4., 6.]$ and $[7., 8.02739]$.

Exercise 8

Compute the limit: $\lim_{x \rightarrow -\infty} \left(\frac{2 - 7x + 4x^2}{-5 + 8x + 4x^2} \right)^{-3+7x}$

- 1) 0
- 2) $-\infty$
- 3) ∞
- 4) 1
- 5) $\frac{1}{e^4}$
- 6) $\frac{1}{e^{105/4}}$
- 7) $\frac{1}{e^2}$

Exercise 9

A factory produces certain type of devices. The marginal cost (cost of producing one unit) decreases when we produce a large amount

of units and it is given by the function $C(x) = \frac{3 + 4x + 3x^2 + 2x^3 + 3x^4}{7 + 5x + 6x^2 + 9x^3 + 3x^4}$

. Determine the expected cost per unit when a large amount of units is produced.

- 1) $\frac{103}{100}$
- 2) 19 000
- 3) $-\frac{3}{5}$
- 4) 0
- 5) $-\infty$
- 6) 1
- 7) ∞

Exercise 10

We deposit 18000 euros in a bank account with a periodic compound interest rate of 2% in 3 periods (compounding frequency). At the same time every year we also add in a safe-deposit box (therefore with no interest rate) 1000 euros. How long time is it necessary until the total amount of money (jointly in the bank account and safe-deposit box) is 63000 euros? (the solution can be found for t between 29 and 34).

- 1) $t = **.*$
- 2) $t = **.*$
- 3) $t = **.*$
- 4) $t = **.*$
- 5) $t = **.*$

Exercise 11

Study the continuity of the function $f(x) = \begin{cases} 3 \sin(2-x) - \cos(2-x) & x \leq 2 \\ 2x - 5 & 2 < x < 3 \\ 1 - 3 \log(x-2) & 3 \leq x \end{cases}$

- 1) The function is continuous for all points.
- 2) The function is not continuous at any point.
- 3) The function is continuous for all the points except for $x=2$.
- 4) The function is continuous for all the points except for $x=3$.
- 5) The function is continuous for all the points except for $x=2$ and $x=3$.

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01-Functions for serial number: 15

Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a compound interest rate of 2% and in the bank B we are paid a continuous compound rate of 5%. We initially deposit 14000 euros in the bank A and 9000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **1.***** years.
- 2) In **6.***** years.
- 3) In **4.***** years.
- 4) In **9.***** years.
- 5) In **0.***** years.

Exercise 2

Certain parcel of land is revalued from an initial value of 227000 euros until a final value of 496000 euros along 6 years. Determine the rate of continuous compound interest for that revaluation.

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) The interest rate is **1.***** %.
- 2) The interest rate is **3.***** %.
- 3) The interest rate is **5.***** %.
- 4) The interest rate is **6.***** %.
- 5) The interest rate is **7.***** %.

Exercise 3

We have a bank account that initially offers a compound interest rate of 8%, and after 1 year the conditions are modified and then we obtain a periodic compound interest rate of 4% in 2 periods (compounding frequency). The initial deposit is 14000 euros. Compute the amount of money in the account after 4 years from the moment of the first deposit.

- 1) We will have ****6.***** euros.
- 2) We will have ****0.***** euros.
- 3) We will have ****7.***** euros.
- 4) We will have ****9.***** euros.
- 5) We will have ****5.***** euros.

Exercise 4

A firm sells Q tons of certain product. The price received per ton is given by the formula $P=40000-8Q$. On the other hand, the production cost per ton is $C=20000+13Q$. In addition, the transportation cost is 17942 per ton. Compute the maximum profit that can be obtained selling this product.

- 1) Profit = 21774 .
- 2) Profit = 50421 .
- 3) Profit = 56237 .
- 4) Profit = 85244 .
- 5) Profit = 26663 .

Exercise 5

Deposits in certain investment account vary from year to year alternating gains and losses periods. We have the following data about the deposits for different years:

year	deposits
0	1
2	113
4	209

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t . Employ that function to determine the maximum funds available in the investment account .

- 1) The maximum for the depositis in the account was 15 .
- 2) The maximum for the depositis in the account was 14 .
- 3) The maximum for the depositis in the account was 323 .
- 4) The maximum for the depositis in the account was 451 .
- 5) The maximum for the depositis in the account was -5 .

Exercise 6

The funds of a public institution alternate periods of deficit and surplus.

We have the following information for several years (in millions of euros):

year	funds
2	3
5	-6
7	-2

Employ an interpolation polynomial to build a function that

yields the funds for each year t . We know that due to the legislation the funds of such an institution have to be kept between -18 and 3

- . Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from $t=2$ to $t=7$).

- 1) The funds are inside the limits for the interval: $[0, 7]$.
- 2) The funds are inside the limits for the interval: $[7, 8]$.
- 3) The funds are inside the limits for the interval: $[-2, 6]$.
- 4) The funds are inside the limits for the interval: $[-2, 4]$.
- 5) The funds are inside the limits for the interval: $[0, 8]$.
- 6) The funds are inside the limits for the interval: $[-2, 5]$.
- 7) The funds are inside the limits for the interval: $[2, 7]$.
- 8) The funds are inside the limits for the interval: $[7, 7]$.

Exercise 7

The population of a city is studied between years $t=4$ and $t=10$. In that period the population is given by the function $P(t) = 9 + 648t - 90t^2 + 4t^3$

- . Determine the intervals of years when the population is between 1481 and 1507.

- 1) Along the interval of years: $[7., 9.]$.
- 2) Along the interval of years: $[6., 10.]$.
- 3) Along the intervals of years: $[4., 8.]$ and $[9.50766, 10.7703]$.
- 4) Along the intervals of years: $[6.49496, 7.45004]$ and $[8.63311, 9.05946]$.
- 5) Along the intervals of years: $[4.68826, 5.18826]$, $[7, 8]$ and $[9.81174, 10]$.
- 6) Along the intervals of years: $[4, 4.68826]$, $[5.18826, 7]$, $[8, 9.81174]$ and $[10, 10]$.
- 7) Along the interval of years: $[4., 7.]$.
- 8) Along the intervals of years: $[5.6909, 7.]$ and $[8.41656, 10.5863]$.

Exercise 8

Compute the limit: $\lim_{x \rightarrow -\infty} \left(\frac{7 + 2x + 9x^2}{-7 - 8x + 9x^2} \right)^{6+6x}$

- 1) $\frac{1}{e^3}$
- 2) $e^{20/3}$
- 3) 0
- 4) $\frac{1}{e^5}$
- 5) 1
- 6) $-\infty$
- 7) ∞

Exercise 9

The population of certain country (in millions of habitants) is given by the function $P(t) =$

$20 \left(\frac{-7 + 2t - 7t^2}{-7 - 8t - 7t^2} \right)^{6+6t}$. Determine the future tendency for this population.

- 1) $\frac{20}{e^{60/7}}$
- 2) 0
- 3) $-\infty$
- 4) 20
- 5) ∞
- 6) $\frac{20}{e^5}$
- 7) $\frac{20}{e^{8571/1000}}$

Exercise 10

The population in certain turistic area

increases exponentially and is given by the function $P(t) = 65\,000 e^{t/50}$ that indicates the number of resident citizens for every year t . At the same time, depending on the season, the city receives a variable number of

tourists given by the trigonometric function $I(t) = 5000 + 1000 \sin\left[\frac{t}{2\pi}\right]$

that yields the amount of visitors in the area for every moment t (t in years).

Determine how many years are necessary until the total number of habitants is 114000.

(the solution can be found for t between 26 and 31).

- 1) $t = **.\text{0}****$
- 2) $t = **.\text{2}****$
- 3) $t = **.\text{4}****$
- 4) $t = **.\text{6}****$
- 5) $t = **.\text{8}****$

Exercise 11

Study the continuity of the function $f(x) = \begin{cases} 2e^{x+2} - 2\sin(x+2) & x \leq -2 \\ 0 & -2 < x < -1 \\ -3\sin(x+1) & -1 \leq x \end{cases}$

- 1) The functions is continuous for all points.
- 2) The functions is not continuous at any point.
- 3) The function is continuous for all the points except for $x = -2$.
- 4) The function is continuous for all the points except for $x = -1$.
- 5) The function is continuous for all the points except for $x = -2$ and $x = -1$.

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01-Functions for serial number: 16

Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a periodic compound interest rate of 7% in 9 periods (compounding frequency) and in the bank B we are paid a compound interest rate of 2% . We initially deposit 6000 euros in the bank A and 10000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **2.***** years.
- 2) In **1.***** years.
- 3) In **0.***** years.
- 4) In **7.***** years.
- 5) In **5.***** years.

Exercise 2

We have one bank account that offers a continuous compound rate of 4% where we initially deposit 15000 euros. How long time is it necessary until the amount of money in the account reaches 20000 euros?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **1.***** years.
- 2) In **5.***** years.
- 3) In **7.***** years.
- 4) In **3.***** years.
- 5) In **0.***** years.

Exercise 3

We have a bank account that initially offers a periodic compound interest rate of 4% in 2 periods (compounding frequency) , and after 4 years the conditions are modified and then we obtain a periodic compound interest rate of 3% in 5 periods (compounding frequency) . The initial deposit is 10000 euros. Compute the amount of money in the account after 6 years from the moment of the first deposit.

- 1) We will have ****8.***** euros.
- 2) We will have ****9.***** euros.
- 3) We will have ****4.***** euros.
- 4) We will have ****7.***** euros.
- 5) We will have ****2.***** euros.

Exercise 4

A firm sells Q tons of certain product. The price received per ton is given by the formula $P=15000-12Q$. On the other hand, the production cost per ton is $C=4000+7Q$. In addition, the transportation cost is 10354 per ton. Compute the maximum profit that can be obtained selling this product.

- 1) Profit = 3583 .
- 2) Profit = 6717 .
- 3) Profit = 5472 .
- 4) Profit = 5491 .
- 5) Profit = 1822 .

Exercise 5

Deposits in certain investment account vary from year to year alternating gains and losses periods. We have the following data about the deposits for different years:

year	deposits
2	-2
4	-22
6	-58

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t . Employ that function to forecast the exact amount for year 8.

- 1) The depositis in the account for year 8 are -142 .
- 2) The depositis in the account for year 8 are 8 .
- 3) The depositis in the account for year 8 are -2 .
- 4) The depositis in the account for year 8 are -110 .
- 5) The depositis in the account for year 8 are 3 .

Exercise 6

The funds of a public institution alternate periods of deficit and surplus.

We have the following information for several years (in millions of euros):

year	funds
1	20
4	47
6	95

Employ an interpolation polynomial to build a function that

yields the funds for each year t . We know that due to the legislation the funds of such an institution have to be kept between 17 and 32

- . Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from $t=1$ to $t=6$).

- 1) The funds are inside the limits for the interval: $[0, 3]$.
- 2) The funds are inside the limits for the interval: $[6, 6]$.
- 3) The funds are inside the limits for the interval: $[1, 3]$.
- 4) The funds are inside the limits for the interval: $[-2, 7]$.
- 5) The funds are inside the limits for the interval: $[0, 6]$.
- 6) The funds are inside the limits for the interval: $[-1, 6]$.
- 7) The funds are inside the limits for the interval: $[3, 6]$.
- 8) The funds are inside the limits for the interval: $[-2, 5]$.

Exercise 7

The population of a city is studied between years $t=2$ and $t=9$. In that period the population is given by the function $P(t) = 6 + 504t - 78t^2 + 4t^3$

- . Determine the intervals of years when the population is between 1076 and 1436.

- 1) Along the intervals of years: $[2.39992, 3.70571]$ and $[5., 6.18203]$.
- 2) Along the intervals of years: $[2, 5]$ and $[9, 9]$.
- 3) Along the interval of years: $[5, 9]$.
- 4) Along the intervals of years: $[2., 4.77075]$ and $[5.75626, 8.39538]$.
- 5) Along the interval of years: $[6.3756, 7.]$.
- 6) Along the intervals of years: $[3.75016, 4.]$ and $[6.1542, 9.20146]$.
- 7) Along the interval of years: $[4., 6.]$.
- 8) Along the intervals of years: $[2., 4.05283]$ and $[5., 8.]$.

Exercise 8

Compute the limit: $\lim_{x \rightarrow \infty} \left(\frac{4 + 5x - 9x^2 - 6x^3}{4 - 4x - 3x^2 - 6x^3} \right)^{-5+2x}$

- 1) e^2
- 2) 1
- 3) ∞
- 4) $-\infty$
- 5) 0
- 6) $\frac{1}{e^4}$
- 7) $\frac{1}{e^5}$

Exercise 9

A factory produces certain type of devices. The marginal cost (cost of producing one unit) decreases when we produce a large amount of units and it is given by the function $C(x) = \frac{6 + 5x + 5x^2 + 3x^3}{8 + 4x + x^2 + x^3}$. Determine the expected cost per unit when a large amount of units is produced.

- 1) $-\frac{3}{7}$
- 2) 20000
- 3) 3
- 4) $-\infty$
- 5) 0
- 6) ∞
- 7) $\frac{77}{25}$

Exercise 10

We deposit 9000 euros in a bank account with a continuous compound rate of 8%. At the same time every year we also add in a safe-deposit box (therefore with no interest rate) 4000 euros. How long time is it necessary until the total ammount of money (jointly in the bank account and safe-depsit box) is 42000 euros? (the solution can be found for t between 3 and 8).

- 1) $t = **.\mathbf{0}****$
- 2) $t = **.\mathbf{2}****$
- 3) $t = **.\mathbf{4}****$
- 4) $t = **.\mathbf{6}****$
- 5) $t = **.\mathbf{8}****$

Exercise 11

Study the continuity of the function $f(x) = \begin{cases} -2 \sin(2-x) - \cos(2-x) & x \leq 2 \\ -e^{x-2} - 2 \sin(2-x) & 2 < x < 4 \\ e^{x-4} + 3 \sin(4-x) & 4 \leq x \end{cases}$

- 1) The functions is continuous for all points.
- 2) The functions is not continuous at any point.
- 3) The function is continuous for all the points except for $x=2$.
- 4) The function is continuous for all the points except for $x=4$.
- 5) The function is continuous for all the points except for $x=2$ and $x=4$.

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01-Functions for serial number: 17

Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a continuous compound rate of 10% and in the bank B we are paid a continuous compound rate of 3%. We initially deposit 5000 euros in the bank A and 12000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **6.***** years.
- 2) In **4.***** years.
- 3) In **2.***** years.
- 4) In **0.***** years.
- 5) In **5.***** years.

Exercise 2

We have one bank account that offers a periodic compound interest rate of 4% in 9 periods (compounding frequency) where we initially deposit 15000 euros. How long time is it necessary until the amount of money in the account reaches 19000 euros?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **6.***** years.
- 2) In **5.***** years.
- 3) In **0.***** years.
- 4) In **3.***** years.
- 5) In **4.***** years.

Exercise 3

We have a bank account that initially offers a compound interest rate of 6%, and after 4 years the conditions are modified and then we obtain a continuous compound rate of 9%. The initial deposit is 12000 euros. Compute the amount of money in the account after 6 years from the moment of the first deposit.

- 1) We will have ****6.***** euros.
- 2) We will have ****4.***** euros.
- 3) We will have ****7.***** euros.
- 4) We will have ****2.***** euros.
- 5) We will have ****3.***** euros.

Exercise 4

A firm sells Q tons of certain product. The price received per ton is given by the formula $P=100000-16Q$. On the other hand, the production cost per ton is $C=80000+9Q$. In addition, the transportation cost is 17500 per ton. Compute the maximum profit that can be obtained selling this product.

- 1) Profit = 97458 .
- 2) Profit = 47525 .
- 3) Profit = 62500 .
- 4) Profit = 67193 .
- 5) Profit = 91968 .

Exercise 5

Deposits in certain investment account vary from year to year alternating gains and losses periods. We have the following data about the deposits for different years:

year	deposits
1	3
2	5
3	9

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t . Employ that function to forecast the exact amount for year 5 .

- 1) The depositis in the account for year 5 are 33 .
- 2) The depositis in the account for year 5 are 23 .
- 3) The depositis in the account for year 5 are -7 .
- 4) The depositis in the account for year 5 are -5 .
- 5) The depositis in the account for year 5 are 5 .

Exercise 6

The funds of a public institution alternate periods of deficit and surplus.

We have the following information for several years (in millions of euros):

year	funds
1	2
4	-40
7	-46

Employ an interpolation polynomial to build a function that

yields the funds for each year t . We know that due to the legislation the funds of such an institution have to be kept between -40 and -16

. Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from $t=1$ to $t=7$).

- 1) The funds are inside the limits for the interval: $[2, 4]$.
- 2) The funds are inside the limits for the interval: $[2, 7]$.
- 3) The funds are inside the limits for the intervals: $[2, 4]$ y $[7, 10]$.
- 4) The funds are inside the limits for the interval: $[0, 8]$.
- 5) The funds are inside the limits for the intervals: $[0, 4]$ y $[8, 10]$.
- 6) The funds are inside the limits for the interval: $[2, 8]$.
- 7) The funds are inside the limits for the interval: $[0, 2]$.
- 8) The funds are inside the limits for the interval: $[7, 8]$.

Exercise 7

The population of a city is studied between years $t=3$ and $t=9$. In that

period the population is given by the function $P(t) = 10 + 420t - 72t^2 + 4t^3$

. Determine the intervals of years when the population is between 594 and 794.

- 1) Along the intervals of years: $[3, 3]$ and $[4, 9]$.
- 2) Along the intervals of years: $[3.31467, 4.31361]$ and $[5., 8.7096]$.
- 3) Along the intervals of years: $[3., 4.]$ and $[5.35403, 9.73203]$.
- 4) Along the interval of years: $[4.48949, 7.00981]$.
- 5) Along the intervals of years: $[3., 6.]$ and $[8.28064, 9.36401]$.
- 6) Along the interval of years: $[3, 4]$.
- 7) Along the intervals of years: $[3, 4]$ and $[7, 7]$.
- 8) Along the intervals of years: $[3., 4.50699]$ and $[5., 6.]$.

Exercise 8

Compute the limit: $\lim_{x \rightarrow \infty} \left(\frac{-4 + 6x - 2x^2 + 4x^3}{6 - 6x + x^2 + 4x^3} \right)^{9-8x+9x^2}$

- 1) $\frac{1}{e^2}$
- 2) ∞
- 3) $\frac{1}{e^5}$
- 4) $\frac{1}{e}$
- 5) 0
- 6) $-\infty$
- 7) 1

Exercise 9

A factory produces certain type of devices. The marginal cost (cost of producing one unit) decreases when we produce a large amount of units and it is given by the function $C(x) = \frac{4 + 7x + x^2 + 6x^3}{2 + 7x + 8x^2 + 2x^3}$. Determine the expected cost per unit when a large amount of units is produced.

- 1) 15000
- 2) $\frac{77}{25}$
- 3) ∞
- 4) -3
- 5) $-\infty$
- 6) 3
- 7) 0

Exercise 10

We deposit 10000 euros in a bank account with a continuous compound rate of 8%. At the same time every year we also add in a safe-deposit box (therefore with no interest rate) 3000 euros. How long time is it necessary until the total ammount of money (jointly in the bank account and safe-depsit box) is 61000 euros? (the solution can be found for t between 8 and 13).

- 1) $t = ** .1****$
- 2) $t = ** .3****$
- 3) $t = ** .5****$
- 4) $t = ** .7****$
- 5) $t = ** .9****$

Exercise 11

Study the continuity of the function $f(x) = \begin{cases} 3 \sin(x+1) + 2 \cos(x+1) & x \leq -1 \\ 3 - \cos(x+1) & -1 < x < 1 \\ 3 \log(x) + 1 & 1 \leq x \end{cases}$

- 1) The functions is continuous for all points.
- 2) The functions is not continuous at any point.
- 3) The function is continuous for all the points except for $x = -1$.
- 4) The function is continuous for all the points except for $x = 1$.
- 5) The function is continuous for all the points except for $x = -1$ and $x = 1$.

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01-Functions for serial number: 18

Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a periodic compound interest rate of 2% in 6 periods (compounding frequency) and in the bank B we are paid a continuous compound rate of 8% . We initially deposit 15000 euros in the bank A and 9000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **7.***** years.
- 2) In **8.***** years.
- 3) In **5.***** years.
- 4) In **2.***** years.
- 5) In **0.***** years.

Exercise 2

Certain parcel of land is devalued from an initial value of 490000 euros until a final value of 264000 euros along 10 years. Determine the rate of compound interest for that devaluation .

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) The interest rate is **4.***** %.
- 2) The interest rate is **9.***** %.
- 3) The interest rate is **8.***** %.
- 4) The interest rate is **2.***** %.
- 5) The interest rate is **5.***** %.

Exercise 3

We have a bank account that initially offers a compound interest rate of 4% , and after 1 year the conditions are modified and then we obtain a continuous compound rate of 7% . The initial deposit is 15000 euros. Compute the amount of money in the account after 6 years from the moment of the first deposit.

- 1) We will have ****7.***** euros.
- 2) We will have ****5.***** euros.
- 3) We will have ****2.***** euros.
- 4) We will have ****9.***** euros.
- 5) We will have ****4.***** euros.

Exercise 4

A firm sells Q tons of certain product. The price received per ton is given by the formula $P=11000-10Q$. On the other hand, the production cost per ton is $C=3000-5Q$. In addition, the transportation cost is 7730 per ton. Compute the maximum profit that can be obtained selling this product.

- 1) Profit = 4416 .
- 2) Profit = 3645 .
- 3) Profit = 4131 .
- 4) Profit = 5307 .
- 5) Profit = 4443 .

Exercise 5

Deposits in certain investment account vary from year to year alternating gains and losses periods. We have the following data about the deposits for different years:

year	deposits
2	28
3	14
4	4

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t . Employ that function to determine the minimum funds available in the investment account .

- 1) The minimum for the depositis in the account was -10 .
- 2) The minimum for the depositis in the account was 0 .
- 3) The minimum for the depositis in the account was -4 .
- 4) The minimum for the depositis in the account was 6 .
- 5) The minimum for the depositis in the account was -1 .

Exercise 6

The funds of a public institution alternate periods of deficit and surplus.

We have the following information for several years (in millions of euros):

year	funds
2	-45
6	-125
10	-141

Employ an interpolation polynomial to build a function that

yields the funds for each year t . We know that due to the legislation the funds of such an institution have to be kept between -125 and -71 .

. Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from $t=2$ to $t=10$).

- 1) The funds are inside the limits for the interval: $[0, 12]$.
- 2) The funds are inside the limits for the interval: $[3, 12]$.
- 3) The funds are inside the limits for the interval: $[10, 12]$.
- 4) The funds are inside the limits for the interval: $[3, 10]$.
- 5) The funds are inside the limits for the interval: $[0, 3]$.
- 6) The funds are inside the limits for the intervals: $[3, 6]$ y $[10, 15]$.
- 7) The funds are inside the limits for the interval: $[3, 6]$.
- 8) The funds are inside the limits for the intervals: $[0, 6]$ y $[12, 15]$.

Exercise 7

The population of certain type of rodents is analyzed in a region between years $t=2$ and $t=9$. Along that period the population is given by the function $P(t) = 3 + 420t - 72t^2 + 4t^3$ (thousands of rodents). Determine the intervals of years during which the number of rodents is between 355 and 1003.

- 1) Along the interval of years: $[2, 9]$.
- 2) Along the interval of years: $[4., 7.26502]$.
- 3) Along the interval of years: $[7., 9.21297]$.
- 4) Along the interval of years: $[2., 7.71956]$.
- 5) Along the intervals of years: $[2, 2]$ and $[9, 9]$.
- 6) Along the interval of years: $[6.12165, 8.12685]$.
- 7) Along the intervals of years: $[3., 5.00858]$ and $[6., 7.41058]$.
- 8) Along the intervals of years: $[3., 5.]$ and $[8., 9.]$.

Exercise 8

Compute the limit: $\lim_{x \rightarrow \infty} \left(\frac{-2 + 9x - 3x^2 + 3x^3}{6 - 7x - 2x^2 + 3x^3} \right)^{5+6x}$

- 1) ∞
- 2) $\frac{1}{e}$
- 3) 1
- 4) $\frac{1}{e^2}$
- 5) 0
- 6) $-\infty$
- 7) $\frac{1}{e^3}$

Exercise 9

From an initial deposit 9000, the interest rate varies every year in such a way that the total amount of money in the account is given by the function $C(t) =$

$$9000 \left(\frac{-2 + 9t - 3t^2 + 5t^3}{6 - 7t - 2t^2 + 5t^3} \right)^{5+6t}. \text{ Determine the future tendency for the}$$

deposits that we will have after a large number of years.

- 1) $-\infty$
- 2) ∞
- 3) 9000
- 4) $\frac{9000}{e^{6/5}}$
- 5) 0
- 6) $\frac{9000}{e^{601/500}}$
- 7) $\frac{9000}{e^4}$

Exercise 10

The population in certain turistic area

increases exponentially and is given by the function $P(t) = 56\,000 e^{t/100}$ that indicates the number of resident citizens for every year t . At the same time, depending on the season, the city receives a variable number of

tourists given by the trigonometric function $I(t) = 2000 + 1000 \sin\left[\frac{t}{2\pi}\right]$

that yields the amount of visitors in the area for every moment t (t in years).

Determine how many years are necessary until the total number of habitants is 104000. (the solution can be found for t between 56 and 61).

- 1) $t = \dots 0 \dots$
- 2) $t = \dots 2 \dots$
- 3) $t = \dots 4 \dots$
- 4) $t = \dots 6 \dots$
- 5) $t = \dots 8 \dots$

Exercise 11

Study the continuity of the function $f(x) = \begin{cases} -2e^{x-3} - 2\sin(3-x) & x \leq 3 \\ 3-x & 3 < x < 4 \\ 2\sin(4-x) - \cos(4-x) & 4 \leq x \end{cases}$

- 1) The functions is continuous for all points.
- 2) The functions is not continuous at any point.
- 3) The function is continuous for all the points except for $x=3$.
- 4) The function is continuous for all the points except for $x=4$.
- 5) The function is continuous for all the points except for $x=3$ and $x=4$.

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01-Functions for serial number: 19

Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a compound interest rate of 8% and in the bank B we are paid a compound interest rate of 4%. We initially deposit 1000 euros in the bank A and 5000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **5.***** years.
- 2) In **2.***** years.
- 3) In **9.***** years.
- 4) In **0.***** years.
- 5) In **1.***** years.

Exercise 2

We have one bank account that offers a periodic compound interest rate of 6% in 2 periods (compounding frequency) where we initially deposit 6000 euros. How long time is it necessary until the amount of money in the account reaches 12000 euros?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **5.***** years.
- 2) In **0.***** years.
- 3) In **8.***** years.
- 4) In **9.***** years.
- 5) In **1.***** years.

Exercise 3

We have a bank account that initially offers a continuous compound rate of 10%, and after 3 years the conditions are modified and then we obtain a periodic compound interest rate of 8% in 10 periods (compounding frequency). The initial deposit is 5000 euros. Compute the amount of money in the account after 3 years from the moment of the first deposit.

- 1) We will have ****1.***** euros.
- 2) We will have ****9.***** euros.
- 3) We will have ****8.***** euros.
- 4) We will have ****0.***** euros.
- 5) We will have ****5.***** euros.

Exercise 4

A firm sells Q tons of certain product. The price received per ton is given by the formula $P=1300-3Q$. On the other hand, the production cost per ton is $C=500+7Q$. In addition, the transportation cost is 740 per ton. Compute the maximum profit that can be obtained selling this product.

- 1) Profit = 90 .
- 2) Profit = 150 .
- 3) Profit = 145 .
- 4) Profit = 77 .
- 5) Profit = 122 .

Exercise 5

Deposits in certain investment account vary from year to year alternating gains and losses periods. We have the following data about the deposits for different years:

year	deposits
0	3
2	9
4	39

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t . Employ that function to forecast the exact amount for year 5 .

- 1) The depositis in the account for year 5 are 1 .
- 2) The depositis in the account for year 5 are 9 .
- 3) The depositis in the account for year 5 are 93 .
- 4) The depositis in the account for year 5 are -14 .
- 5) The depositis in the account for year 5 are 63 .

Exercise 6

The funds of a public institution alternate periods of deficit and surplus.

We have the following information for several years (in millions of euros):

year	funds
0	0
2	18
5	90

Employ an interpolation polynomial to build a function that

yields the funds for each year t . We know that due to the legislation the funds of such an institution have to be kept between 6 and 36

- . Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from $t=0$ to $t=5$).

- 1) The funds are inside the limits for the interval: $[-4, -2]$.
- 2) The funds are inside the limits for the interval: $[1, 3]$.
- 3) The funds are inside the limits for the interval: $[1, 5]$.
- 4) The funds are inside the limits for the interval: $[-4, 5]$.
- 5) The funds are inside the limits for the intervals: $[-4, -2]$ y $[3, 5]$.
- 6) The funds are inside the limits for the interval: $[0, 1]$.
- 7) The funds are inside the limits for the interval: $[-4, 1]$.
- 8) The funds are inside the limits for the interval: $[-4, 0]$.

Exercise 7

The deposits in certain account between the

months $t=0$ and $t=8$ is given by the function $C(t)=3+84t-48t^2+4t^3$

- . Determine the months for which the deposit is between -357 and -173 euros.

- 1) Along the interval of months: $[4., 5.]$.
- 2) Along the intervals of months: $[0, 4]$, $[6, 7.89898]$ and $[8, 8]$.
- 3) Along the intervals of months: $[1., 2.27717]$ and $[6., 8.]$.
- 4) Along the intervals of months: $[-4.45015 \times 10^{-308}, 1.19614]$ and $[3., 6.74362]$.
- 5) Along the intervals of months: $[4, 6]$ and $[7.89898, 8]$.
- 6) Along the interval of months: $[3., 4.]$.
- 7) Along the interval of months: $[2.02427, 8.]$.
- 8) Along the interval of months: $[3.26325, 4.74597]$.

Exercise 8

Compute the limit: $\lim_{x \rightarrow -\infty} \left(\frac{6 - 3x + 6x^2}{-8 + 7x + 6x^2} \right)^{5+3x+9x^2}$

- 1) $\frac{1}{e^5}$
- 2) 1
- 3) ∞
- 4) $\frac{1}{e}$
- 5) $\frac{1}{e^2}$
- 6) 0
- 7) $-\infty$

Exercise 9

The population of certain country (in millions of habitants) is given by the function $P(t) =$

$$32 \left(\frac{7 - 6t + 3t^2 - 7t^3}{-8 + 7t - 7t^2 - 7t^3} \right)^{4+3t+8t^2}. \text{ Determine the future tendency for this population.}$$

- 1) $\frac{32}{e^5}$
- 2) $-\infty$
- 3) 0
- 4) $\frac{32}{e}$
- 5) $\frac{32}{e^2}$
- 6) 32
- 7) ∞

Exercise 10

We deposit 4000 euros in a bank account with a periodic compound interest rate of 7% in 7 periods (compounding frequency). At the same time every year we also add in a safe-deposit box (therefore with no interest rate) 4000 euros. How long time is it necessary until the total ammount of money (jointly in the bank account and safe-depsit box) is 36000 euros? (the solution can be found for t between 7 and 12).

- 1) $t = \dots 1 \dots$
- 2) $t = \dots 3 \dots$
- 3) $t = \dots 5 \dots$
- 4) $t = \dots 7 \dots$
- 5) $t = \dots 9 \dots$

Exercise 11

Study the continuity of the function $f(x) = \begin{cases} \cos(x+3) - \sin(x+3) & x \leq -3 \\ \cos(x+3) - 3\sin(x+3) & -3 < x < -1 \\ 3\sin(x+1) & -1 \leq x \end{cases}$

- 1) The functions is continuous for all points.
- 2) The functions is not continuous at any point.
- 3) The function is continuous for all the points except for $x = -3$.
- 4) The function is continuous for all the points except for $x = -1$.
- 5) The function is continuous for all the points except for $x = -3$ and $x = -1$.

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01-Functions for serial number: 20

Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a periodic compound interest rate of 2% in 7 periods (compounding frequency) and in the bank B we are paid a periodic compound interest rate of 6% in 2 periods (compounding frequency). We initially deposit 15000 euros in the bank A and 11000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **0.***** years.
- 2) In **4.***** years.
- 3) In **1.***** years.
- 4) In **9.***** years.
- 5) In **7.***** years.

Exercise 2

Certain parcel of land is revalued from an initial value of 241000 euros until a final value of 348000 euros along 5 years. Determine the rate of continuous compound interest for that revaluation.

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) The interest rate is **2.***** %.
- 2) The interest rate is **6.***** %.
- 3) The interest rate is **9.***** %.
- 4) The interest rate is **8.***** %.
- 5) The interest rate is **7.***** %.

Exercise 3

We have a bank account that initially offers a periodic compound interest rate of 4% in 3 periods (compounding frequency), and after 2 years the conditions are modified and then we obtain a periodic compound interest rate of 7% in 6 periods (compounding frequency). The initial deposit is 15000 euros. Compute the amount of money in the account after 7 years from the moment of the first deposit.

- 1) We will have ****4.***** euros.
- 2) We will have ****6.***** euros.
- 3) We will have ****1.***** euros.
- 4) We will have ****9.***** euros.
- 5) We will have ****0.***** euros.

Exercise 4

A firm sells Q tons of certain product. The price received per ton is given by the formula $P=70000-15Q$. On the other hand, the production cost per ton is $C=30000+15Q$. In addition, the transportation cost is 38680 per ton. Compute the maximum profit that can be obtained selling this product.

- 1) Profit = 14520 .
- 2) Profit = 21326 .
- 3) Profit = 17850 .
- 4) Profit = 21556 .
- 5) Profit = 8273 .

Exercise 5

Deposits in certain investment account vary from year to year alternating gains and losses periods. We have the following data about the deposits for different years:

year	deposits
0	5
2	9
3	8

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t . Employ that function to determine the maximum funds available in the investment account .

- 1) The maximum for the depositis in the account was 18 .
- 2) The maximum for the depositis in the account was -7 .
- 3) The maximum for the depositis in the account was -8 .
- 4) The maximum for the depositis in the account was 2 .
- 5) The maximum for the depositis in the account was 9 .

Exercise 6

The funds of a public institution alternate periods of deficit and surplus.

We have the following information for several years (in millions of euros):

year	funds
2	12
6	104
8	186

Employ an interpolation polynomial to build a function that

yields the funds for each year t . We know that due to the legislation the funds of such an institution have to be kept between 4 and 12

- . Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from $t=2$ to $t=8$).

- 1) The funds are inside the limits for the interval: $[-\frac{5}{3}, 1]$.
- 2) The funds are inside the limits for the interval: $[2, 2]$.
- 3) The funds are inside the limits for the interval: $[1, 8]$.
- 4) The funds are inside the limits for the interval: $[-\frac{5}{3}, 8]$.
- 5) The funds are inside the limits for the interval: $[0, 1]$.
- 6) The funds are inside the limits for the intervals: $[-\frac{5}{3}, -\frac{2}{3}]$ y $[2, 8]$.
- 7) The funds are inside the limits for the interval: $[-\frac{5}{3}, -\frac{2}{3}]$.
- 8) The funds are inside the limits for the interval: $[-\frac{5}{3}, 0]$.

Exercise 7

The population of a city is studied between years $t=0$ and $t=10$. In that period the population is given by the function $P(t) = 4 + 24t - 18t^2 + 4t^3$

. Determine the intervals of years when the population is between 12 and 22.

- 1) Along the interval of years: $[2., 5.31538]$.
- 2) Along the interval of years: $[0.736877, 7.]$.
- 3) Along the intervals of years: $[2., 3.41547]$ and $[5., 9.23924]$.
- 4) Along the interval of years: $[0.5, 3]$.
- 5) Along the intervals of years: $[0.151816, 2.79633]$ and $[8., 10.616]$.
- 6) Along the intervals of years: $[0, 0.5]$, $[2, 2]$ and $[3, 10]$.
- 7) Along the intervals of years: $[-4.45015 \times 10^{-308}, 4.53324]$ and $[9., 10.]$.
- 8) Along the interval of years: $[1.67967, 8.]$.

Exercise 8

Compute the limit: $\lim_{x \rightarrow -\infty} \left(\frac{-4 - 7x - 6x^2 - 2x^3}{-9 - 2x - 3x^2 - 2x^3} \right)^{5+8x}$

- 1) $-\infty$
- 2) $\frac{1}{e^5}$
- 3) 0
- 4) $\frac{1}{e^3}$
- 5) ∞
- 6) e^{12}
- 7) 1

Exercise 9

From an initial deposit 4000, the interest rate varies every year in such a way that the total amount of money in the account is given by the function $C(t) =$

$$4000 \left(\frac{-8 + 4t + 4t^2 - 3t^3}{-7 - 6t - 9t^2 - 3t^3} \right)^{-5+2t}. \text{ Determine the future tendency for the}$$

deposits that we will have after a large number of years.

- 1) $\frac{4000}{e^5}$
- 2) $\frac{4000}{e^{4333/500}}$
- 3) $-\infty$
- 4) 0
- 5) 4000
- 6) ∞
- 7) $\frac{4000}{e^{26/3}}$

Exercise 10

The population in certain turistic area

increases exponentially and is given by the function $P(t) = 67\,000 e^{t/50}$ that indicates the number of resident citizens for every year t . At the same time, depending on the season, the city receives a variable number of

tourists given by the trigonometric function $I(t) = 3000 + 1000 \sin\left[\frac{t}{2\pi}\right]$

that yields the amount of visitors in the area for every moment t (t in years).

Determine how many years are necessary until the total number of habitants is 95000. (the solution can be found for t between 13 and 18).

- 1) $t = **.*1****$
- 2) $t = **.*3****$
- 3) $t = **.*5****$
- 4) $t = **.*7****$
- 5) $t = **.*9****$

Exercise 11

Study the continuity of the function $f(x) = \begin{cases} -2e^{x+1} - 2\sin(x+1) & x \leq -1 \\ -2e^{x+1} - \sin(x+1) & -1 < x < 2 \\ 2\log(x-1) & 2 \leq x \end{cases}$

- 1) The functions is continuous for all points.
- 2) The functions is not continuous at any point.
- 3) The function is continuous for all the points except for $x = -1$.
- 4) The function is continuous for all the points except for $x = 2$.
- 5) The function is continuous for all the points except for $x = -1$ and $x = 2$.

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01-Functions for serial number: 21

Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a periodic compound interest rate of 8% in 4 periods (compounding frequency) and in the bank B we are paid a compound interest rate of 5%. We initially deposit 2000 euros in the bank A and 12000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **4.***** years.
- 2) In **8.***** years.
- 3) In **3.***** years.
- 4) In **5.***** years.
- 5) In **0.***** years.

Exercise 2

We have one bank account that offers a continuous compound rate of 5% where we initially deposit 5000 euros. How long time is it necessary until the amount of money in the account reaches 7000 euros?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **8.***** years.
- 2) In **0.***** years.
- 3) In **5.***** years.
- 4) In **2.***** years.
- 5) In **6.***** years.

Exercise 3

We have a bank account that initially offers a periodic compound interest rate of 9% in 2 periods (compounding frequency), and after 2 years the conditions are modified and then we obtain a continuous compound rate of 10%. The initial deposit is 12000 euros. Compute the amount of money in the account after 2 years from the moment of the first deposit.

- 1) We will have ****8.***** euros.
- 2) We will have ****4.***** euros.
- 3) We will have ****2.***** euros.
- 4) We will have ****5.***** euros.
- 5) We will have ****0.***** euros.

Exercise 4

A firm sells Q tons of certain product. The price received per ton is given by the formula $P=3000-17Q$. On the other hand, the production cost per ton is $C=1000+18Q$. In addition, the transportation cost is 1720 per ton. Compute the maximum profit that can be obtained selling this product.

- 1) Profit = 560 .
- 2) Profit = 231 .
- 3) Profit = 797 .
- 4) Profit = 303 .
- 5) Profit = 220 .

Exercise 5

Deposits in certain investment account vary from year to year alternating gains and losses periods. We have the following data about the deposits for different years:

year	deposits
0	0
1	-1
3	-15

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t . Employ that function to forecast the exact amount for year 5 .

- 1) The depositis in the account for year 5 are 7 .
- 2) The depositis in the account for year 5 are -3 .
- 3) The depositis in the account for year 5 are -20 .
- 4) The depositis in the account for year 5 are -66 .
- 5) The depositis in the account for year 5 are -45 .

Exercise 6

The funds of a public institution alternate periods of deficit and surplus.

We have the following information for several years (in millions of euros):

year	funds
1	9
5	57
7	117

Employ an interpolation polynomial to build a function that

yields the funds for each year t . We know that due to the legislation the funds of such an institution have to be kept between 0 and 12

- . Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from $t=1$ to $t=7$).

- 1) The funds are inside the limits for the interval: $[2, 7]$.
- 2) The funds are inside the limits for the interval: $[-2, 5]$.
- 3) The funds are inside the limits for the interval: $[7, 7]$.
- 4) The funds are inside the limits for the interval: $[-2, 4]$.
- 5) The funds are inside the limits for the interval: $[1, 2]$.
- 6) The funds are inside the limits for the interval: $[-2, 3]$.
- 7) The funds are inside the limits for the interval: $[0, 7]$.
- 8) The funds are inside the limits for the interval: $[0, 2]$.

Exercise 7

The population of a city is studied between years $t=3$ and $t=10$. In

that period the population is given by the function $P(t) = 432t - 78t^2 + 4t^3$

- . Determine the intervals of years when the population is between 512 and 648.

- 1) Along the interval of years: $[4., 10.]$.
- 2) Along the intervals of years: $[6, 8]$ and $[9.88068, 10]$.
- 3) Along the intervals of years: $[4., 6.66514]$ and $[7.03904, 8.76241]$.
- 4) Along the intervals of years: $[3.05306, 5.7992]$ and $[6.53564, 10.]$.
- 5) Along the intervals of years: $[3, 6]$, $[8, 9.88068]$ and $[10, 10]$.
- 6) Along the interval of years: $[3.52752, 6.]$.
- 7) Along the interval of years: $[7., 10.0732]$.
- 8) Along the interval of years: $[3., 8.]$.

Exercise 8

Compute the limit: $\lim_{x \rightarrow -\infty} \left(\frac{7 - 5x - 8x^2 - 3x^3}{4 + 5x + 7x^2 - 3x^3} \right)^{-2+5x}$

- 1) $-\infty$
- 2) $\frac{1}{e^5}$
- 3) 1
- 4) ∞
- 5) 0
- 6) $\frac{1}{e^3}$
- 7) e^{25}

Exercise 9

The population of certain country (in millions of habitants) is given by the function $P(t) =$

$$13 \left(\frac{7 - 5t - 8t^2 - t^3}{4 + 5t + 7t^2 - t^3} \right)^{-2+5t}. \text{ Determine the future tendency for this population.}$$

- 1) 13
- 2) $\frac{13}{e^4}$
- 3) $\frac{13}{e^5}$
- 4) 0
- 5) $13 e^{75}$
- 6) ∞
- 7) $-\infty$

Exercise 10

We deposit 3000 euros in a bank account with a periodic compound interest rate of 1% in 3 periods (compounding frequency). At the same time every year we also add in a safe-deposit box (therefore with no interest rate) 1000 euros. How long time is it necessary until the total amount of money (jointly in the bank account and safe-deposit box) is 47000 euros? (the solution can be found for t between 38 and 43).

- 1) $t = **.0****$
- 2) $t = **.2****$
- 3) $t = **.4****$
- 4) $t = **.6****$
- 5) $t = **.8****$

Exercise 11

Study the continuity of the function $f(x) = \begin{cases} 3 \sin(1-x) - \cos(1-x) & x \leq 1 \\ \log(x) - 2 - \log(4) & 1 < x < 4 \\ -2 \sin(4-x) - 2 \cos(4-x) & 4 \leq x \end{cases}$

- 1) The functions is continuous for all points.
- 2) The functions is not continuous at any point.
- 3) The function is continuous for all the points except for $x=1$.
- 4) The function is continuous for all the points except for $x=4$.
- 5) The function is continuous for all the points except for $x=1$ and $x=4$.

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01-Functions for serial number: 22

Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a compound interest rate of 4% and in the bank B we are paid a periodic compound interest rate of 8% in 5 periods (compounding frequency). We initially deposit 12000 euros in the bank A and 8000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **7.***** years.
- 2) In **6.***** years.
- 3) In **4.***** years.
- 4) In **5.***** years.
- 5) In **0.***** years.

Exercise 2

We have one bank account that offers a continuous compound rate of 6% where we initially deposit 14000 euros. How long time is it necessary until the amount of money in the account reaches 16000 euros?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **3.***** years.
- 2) In **0.***** years.
- 3) In **2.***** years.
- 4) In **6.***** years.
- 5) In **5.***** years.

Exercise 3

We have a bank account that initially offers a compound interest rate of 3%, and after 3 years the conditions are modified and then we obtain a periodic compound interest rate of 3% in 7 periods (compounding frequency). The initial deposit is 12000 euros. Compute the amount of money in the account after 2 years from the moment of the first deposit.

- 1) We will have ****3.***** euros.
- 2) We will have ****0.***** euros.
- 3) We will have ****6.***** euros.
- 4) We will have ****5.***** euros.
- 5) We will have ****1.***** euros.

Exercise 4

A firm sells Q tons of certain product. The price received per ton is given by the formula $P=2000-17Q$. On the other hand, the production cost per ton is $C=1000+3Q$. In addition, the transportation cost is 80 per ton. Compute the maximum profit that can be obtained selling this product.

- 1) Profit = 4152 .
- 2) Profit = 8051 .
- 3) Profit = 10580 .
- 4) Profit = 16530 .
- 5) Profit = 4947 .

Exercise 5

Deposits in certain investment account vary from year to year alternating gains and losses periods. We have the following data about the deposits for different years:

year	deposits
2	9
4	15
5	18

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t . Employ that function to forecast the exact amount for year 6 .

- 1) The depositis in the account for year 6 are 24 .
- 2) The depositis in the account for year 6 are 21 .
- 3) The depositis in the account for year 6 are 5 .
- 4) The depositis in the account for year 6 are 0 .
- 5) The depositis in the account for year 6 are -18 .

Exercise 6

The funds of a public institution alternate periods of deficit and surplus.

We have the following information for several years (in millions of euros):

year	funds
1	2
3	8
7	44

Employ an interpolation polynomial to build a function that

yields the funds for each year t . We know that due to the legislation the funds of such an institution have to be kept between 22 and 32

- . Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from $t=1$ to $t=7$).

- 1) The funds are inside the limits for the intervals: $[-5, -4]$ y $[6, 7]$.
- 2) The funds are inside the limits for the interval: $[0, 5]$.
- 3) The funds are inside the limits for the interval: $[-5, 0]$.
- 4) The funds are inside the limits for the interval: $[-5, -4]$.
- 5) The funds are inside the limits for the interval: $[-5, 7]$.
- 6) The funds are inside the limits for the interval: $[-5, 5]$.
- 7) The funds are inside the limits for the interval: $[5, 6]$.
- 8) The funds are inside the limits for the interval: $[5, 7]$.

Exercise 7

The population of certain type of rodents is analyzed in a region between years $t=3$

and $t=10$. Along that period the population is given by the function $P(t) =$

$9 + 864t - 102t^2 + 4t^3$ (thousands of rodents). Determine the intervals of years during which the number of rodents is between 2441 and 2601.

- 1) Along the interval of years: $[5.70465, 8.7327]$.
- 2) Along the interval of years: $[4., 7.]$.
- 3) Along the interval of years: $[9.5, 10]$.
- 4) Along the interval of years: $[3., 8.47062]$.
- 5) Along the intervals of years: $[5., 8.51704]$ and $[9., 10.47]$.
- 6) Along the intervals of years: $[3, 9.5]$ and $[10, 10]$.
- 7) Along the intervals of years: $[8, 8]$ and $[9.5, 10]$.
- 8) Along the intervals of years: $[4., 5.]$ and $[8., 9.]$.

Exercise 8

Compute the limit: $\lim_{x \rightarrow -\infty} \left(\frac{-3 + 2x + 5x^2 + 6x^3}{5 + 6x + 7x^2 + 6x^3} \right)^{9-6x+6x^2}$

- 1) $\frac{1}{e^3}$
- 2) 1
- 3) 0
- 4) $-\infty$
- 5) $\frac{1}{e}$
- 6) $\frac{1}{e^4}$
- 7) ∞

Exercise 9

A factory produces certain type of devices. The marginal cost (cost of producing one unit) decreases when we produce a large amount of units and it is given by the function $C(x) = \frac{6 + x + 2x^2 + 5x^3 + 6x^4}{5 + 4x + 7x^2 + 3x^3 + 5x^4}$. Determine the expected cost per unit when a large amount of units is produced.

- 1) $\frac{123}{100}$
- 2) ∞
- 3) 16 000
- 4) 0
- 5) $\frac{6}{5}$
- 6) $-\infty$
- 7) -1

Exercise 10

We deposit 8000 euros in a bank account with a continuous compound rate of 2%. At the same time every year we also add in a safe-deposit box (therefore with no interest rate) 1000 euros. How long time is it necessary until the total ammount of money (jointly in the bank account and safe-depsit box) is 50000 euros? (the solution can be found for t between 34 and 39).

- 1) $t = **.1****$
- 2) $t = **.3****$
- 3) $t = **.5****$
- 4) $t = **.7****$
- 5) $t = **.9****$

Exercise 11

Study the continuity of the function $f(x) = \begin{cases} \sin(3-x) + \cos(3-x) & x \leq 3 \\ -3 \log(x-2) - 1 + 3 \log(4) & 3 < x < 6 \\ \sin(6-x) - \cos(6-x) & 6 \leq x \end{cases}$

- 1) The functions is continuous for all points.
- 2) The functions is not continuous at any point.
- 3) The function is continuous for all the points except for $x=3$.
- 4) The function is continuous for all the points except for $x=6$.
- 5) The function is continuous for all the points except for $x=3$ and $x=6$.

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01-Functions for serial number: 23

Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a compound interest rate of 5% and in the bank B we are paid a continuous compound rate of 10%. We initially deposit 15000 euros in the bank A and 5000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **2.***** years.
- 2) In **8.***** years.
- 3) In **0.***** years.
- 4) In **1.***** years.
- 5) In **3.***** years.

Exercise 2

Certain parcel of land is revalued from an initial value of 280000 euros until a final value of 458000 euros along 7 years. Determine the rate of periodic compound interest in 9 periods for that revaluation.

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) The interest rate is **0.***** %.
- 2) The interest rate is **6.***** %.
- 3) The interest rate is **1.***** %.
- 4) The interest rate is **7.***** %.
- 5) The interest rate is **9.***** %.

Exercise 3

We have a bank account that initially offers a compound interest rate of 2%, and after 3 years the conditions are modified and then we obtain a periodic compound interest rate of 3% in 2 periods (compounding frequency). The initial deposit is 15000 euros. Compute the amount of money in the account after 9 years from the moment of the first deposit.

- 1) We will have ****6.***** euros.
- 2) We will have ****2.***** euros.
- 3) We will have ****0.***** euros.
- 4) We will have ****1.***** euros.
- 5) We will have ****3.***** euros.

Exercise 4

A firm sells Q tons of certain product. The price received per ton is given by the formula $P=150000-11Q$. On the other hand, the production cost per ton is $C=130000+8Q$. In addition, the transportation cost is 18556 per ton. Compute the maximum profit that can be obtained selling this product.

- 1) Profit = 30409 .
- 2) Profit = 23897 .
- 3) Profit = 33089 .
- 4) Profit = 27436 .
- 5) Profit = 15670 .

Exercise 5

Deposits in certain investment account vary from year to year alternating gains and losses periods. We have the following data about the deposits for different years:

year	deposits
2	27
3	36
5	48

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t . Employ that function to determine the maximum funds available in the investment account .

- 1) The maximum for the depositis in the account was 52 .
- 2) The maximum for the depositis in the account was 11 .
- 3) The maximum for the depositis in the account was -2 .
- 4) The maximum for the depositis in the account was 7 .
- 5) The maximum for the depositis in the account was 16 .

Exercise 6

The funds of a public institution alternate periods of deficit and surplus.

We have the following information for several years (in millions of euros):

year	funds
2	60
6	76
9	46

Employ an interpolation polynomial to build a function that

yields the funds for each year t . We know that due to the legislation the funds of such an institution have to be kept between 46 and 70

. Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from $t=2$ to $t=9$).

- 1) The funds are inside the limits for the interval: $[3, 9]$.
- 2) The funds are inside the limits for the interval: $[0, 9]$.
- 3) The funds are inside the limits for the interval: $[1, 3]$.
- 4) The funds are inside the limits for the interval: $[9, 9]$.
- 5) The funds are inside the limits for the interval: $[0, 3]$.
- 6) The funds are inside the limits for the intervals: $[2, 3]$ y $[7, 9]$.
- 7) The funds are inside the limits for the intervals: $[0, 1]$ y $[7, 9]$.
- 8) The funds are inside the limits for the intervals: $[1, 3]$ y $[7, 9]$.

Exercise 7

The population of certain type of rodents is analyzed in a region between years $t=3$ and $t=8$. Along that period the population is given by the function $P(t) = 1 + 288t - 60t^2 + 4t^3$ (thousands of rodents). Determine the intervals of years during which the number of rodents is between 449 and 649.

- 1) Along the intervals of years: $[3.16226, 5.]$ and $[6., 8.]$.
- 2) Along the interval of years: $[5.58381, 8.]$.
- 3) Along the interval of years: $[3.75199, 8.]$.
- 4) Along the interval of years: $[7, 8]$.
- 5) Along the intervals of years: $[3.67225, 4.32629]$ and $[5., 8.14565]$.
- 6) Along the intervals of years: $[3, 7]$ and $[8, 8]$.
- 7) Along the intervals of years: $[3., 4.18191]$ and $[7.06825, 8.]$.
- 8) Along the intervals of years: $[4, 4]$ and $[7, 8]$.

Exercise 8

Compute the limit: $\lim_{x \rightarrow \infty} \left(\frac{8 + 8x - 9x^2}{-2 + 6x - 9x^2} \right)^{8-5x+3x^2}$

1) 0

2) 1

3) $\frac{1}{e^3}$

4) $-\infty$

5) $\frac{1}{e^2}$

6) ∞

7) $\frac{1}{e^5}$

Exercise 9

From an initial deposit 14000, the interest rate varies every year in such a way that the total amount of money in the account is given by the function $C(t) =$

$$14000 \left(\frac{-6 + 8t + 3t^2}{-2 + 6t + 3t^2} \right)^{8-5t+3t^2}. \text{ Determine the future tendency for the}$$

deposits that we will have after a large number of years.

1) ∞

2) 0

3) $\frac{14000}{e^3}$

4) 14000

5) $\frac{14000}{e^2}$

6) $-\infty$

7) $\frac{14000}{e^5}$

Exercise 10

The population in certain turistic area

increases exponentially and is given by the function $P(t) = 72\,000 e^{t/50}$

that indicates the number of resident citizens for every year t . At the same

time, depending on the season, the city receives a variable number of

tourists given by the trigonometric function $I(t) = 2000 + 1000 \sin\left[\frac{t}{2\pi}\right]$

that yields the amount of visitors in the area for every moment t (t in years).

Determine how many years are necessary until the total number of habitants is 103000.

(the solution can be found for t between 13 and 18).

- 1) $t = \dots 0 \dots$
- 2) $t = \dots 2 \dots$
- 3) $t = \dots 4 \dots$
- 4) $t = \dots 6 \dots$
- 5) $t = \dots 8 \dots$

Exercise 11

Study the continuity of the function $f(x) = \begin{cases} 2e^{x+1} + 3\sin(x+1) & x \leq -1 \\ -2\sin(x+1) - 2\cos(x+1) + 4 & -1 < x < 0 \\ 2e^x + 2\sin(x) & 0 \leq x \end{cases}$

- 1) The functions is continuous for all points.
- 2) The functions is not continuous at any point.
- 3) The function is continuous for all the points except for $x = -1$.
- 4) The function is continuous for all the points except for $x = 0$.
- 5) The function is continuous for all the points except for $x = -1$ and $x = 0$.

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01-Functions for serial number: 24

Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a periodic compound interest rate of 10% in 10 periods (compounding frequency) and in the bank B we are paid a continuous compound rate of 5% . We initially deposit 4000 euros in the bank A and 13000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **7.***** years.
- 2) In **3.***** years.
- 3) In **6.***** years.
- 4) In **0.***** years.
- 5) In **2.***** years.

Exercise 2

Certain parcel of land is revalued from an initial value of 160000 euros until a final value of 340000 euros along 6 years. Determine the rate of periodic compound interest in 10 periods for that revaluation .

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) The interest rate is **8.***** %.
- 2) The interest rate is **2.***** %.
- 3) The interest rate is **4.***** %.
- 4) The interest rate is **1.***** %.
- 5) The interest rate is **7.***** %.

Exercise 3

We have a bank account that initially offers a continuous compound rate of 1% , and after 3 years the conditions are modified and then we obtain a continuous compound rate of 7% . The initial deposit is 13000 euros. Compute the amount of money in the account after 10 years from the moment of the first deposit.

- 1) We will have ****0.***** euros.
- 2) We will have ****8.***** euros.
- 3) We will have ****2.***** euros.
- 4) We will have ****6.***** euros.
- 5) We will have ****7.***** euros.

Exercise 4

A firm sells Q tons of certain product. The price received per ton is given by the formula $P=5000-19Q$. On the other hand, the production cost per ton is $C=4000-10Q$. In addition, the transportation cost is 496 per ton. Compute the maximum profit that can be obtained selling this product.

- 1) Profit = 6951 .
- 2) Profit = 7056 .
- 3) Profit = 10 614 .
- 4) Profit = 4212 .
- 5) Profit = 5546 .

Exercise 5

Deposits in certain investment account vary from year to year alternating gains and losses periods. We have the following data about the deposits for different years:

year	deposits
1	33
3	81
5	113

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t . Employ that function to determine the maximum funds available in the investment account .

- 1) The maximum for the depositis in the account was 8 .
- 2) The maximum for the depositis in the account was 129 .
- 3) The maximum for the depositis in the account was 131 .
- 4) The maximum for the depositis in the account was -10 .
- 5) The maximum for the depositis in the account was 5 .

Exercise 6

The funds of a public institution alternate periods of deficit and surplus.

We have the following information for several years (in millions of euros):

year	funds
2	70
4	94
6	94

Employ an interpolation polynomial to build a function that

yields the funds for each year t . We know that due to the legislation the funds of such an institution have to be kept between 49 and 94

. Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from $t=2$ to $t=6$).

- 1) The funds are inside the limits for the intervals: $[0, 1]$ y $[6, 9]$.
- 2) The funds are inside the limits for the interval: $[4, 6]$.
- 3) The funds are inside the limits for the intervals: $[2, 4]$ y $[6, 6]$.
- 4) The funds are inside the limits for the interval: $[4, 9]$.
- 5) The funds are inside the limits for the interval: $[1, 4]$.
- 6) The funds are inside the limits for the interval: $[0, 4]$.
- 7) The funds are inside the limits for the interval: $[0, 9]$.
- 8) The funds are inside the limits for the interval: $[6, 9]$.

Exercise 7

The population of a city is studied between years $t=4$ and $t=8$. In that

period the population is given by the function $P(t) = 1 + 504t - 78t^2 + 4t^3$

. Determine the intervals of years when the population is between 1089 and 1135.

- 1) Along the interval of years: $[4, 8]$.
- 2) Along the interval of years: $[5.63481, 7.]$.
- 3) Along the interval of years: $[8, 8]$.
- 4) Along the intervals of years: $[4., 5.]$ and $[6., 7.05878]$.
- 5) Along the interval of years: $[6., 8.64617]$.
- 6) That number of mice is reach for no interval of years.
- 7) Along the intervals of years: $[4.50354, 6.368]$ and $[7.15939, 8.25132]$.
- 8) Along the interval of years: $[4., 6.43576]$.

Exercise 8

Compute the limit: $\lim_{x \rightarrow \infty} \left(\frac{-9 + 8x - 2x^2 - x^3}{-3 - 7x + 3x^2 - x^3} \right)^{5+7x+8x^2}$

- 1) ∞
- 2) 1
- 3) $\frac{1}{e^3}$
- 4) $\frac{1}{e}$
- 5) $-\infty$
- 6) 0
- 7) e

Exercise 9

The population of certain country (in millions of habitants) is given by the function $P(t) =$

$35 \left(\frac{3 - 8t + t^2}{-8 - 2t + t^2} \right)^{5+t}$. Determine the future tendency for this population.

- 1) $\frac{35}{e^6}$
- 2) $\frac{35}{e^2}$
- 3) $-\infty$
- 4) ∞
- 5) $\frac{35}{e^4}$
- 6) 0
- 7) 35

Exercise 10

The population in certain turistic area

increases exponentially and is given by the function $P(t) = 57\,000 e^{t/50}$ that indicates the number of resident citizens for every year t . At the same time, depending on the season, the city receives a variable number of

tourists given by the trigonometric function $I(t) = 2000 + 1000 \sin\left[\frac{t}{2\pi}\right]$

that yields the amount of visitors in the area for every moment t (t in years).

Determine how many years are necessary until the total number of habitants is 86000.

(the solution can be found for t between 17 and 22).

- 1) $t = ** .1****$
- 2) $t = ** .3****$
- 3) $t = ** .5****$
- 4) $t = ** .7****$
- 5) $t = ** .9****$

Exercise 11

Study the continuity of the function $f(x) = \begin{cases} \sin(x+3) - e^{x+3} & x \leq -3 \\ -1 & -3 < x < -1 \\ 2e^{x+1} + 2\sin(x+1) & -1 \leq x \end{cases}$

- 1) The functions is continuous for all points.
- 2) The functions is not continuous at any point.
- 3) The function is continuous for all the points except for $x = -3$.
- 4) The function is continuous for all the points except for $x = -1$.
- 5) The function is continuous for all the points except for $x = -3$ and $x = -1$.

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01-Functions for serial number: 25

Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a periodic compound interest rate of 9% in 2 periods (compounding frequency) and in the bank B we are paid a continuous compound rate of 1%. We initially deposit 5000 euros in the bank A and 13000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **2.***** years.
- 2) In **8.***** years.
- 3) In **4.***** years.
- 4) In **0.***** years.
- 5) In **5.***** years.

Exercise 2

Certain parcel of land is revalued from an initial value of 324000 euros until a final value of 452000 euros along 6 years. Determine the rate of compound interest for that revaluation.

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) The interest rate is **6.***** %.
- 2) The interest rate is **5.***** %.
- 3) The interest rate is **3.***** %.
- 4) The interest rate is **1.***** %.
- 5) The interest rate is **7.***** %.

Exercise 3

We have a bank account that initially offers a continuous compound rate of 1%, and after 2 years the conditions are modified and then we obtain a continuous compound rate of 9%. The initial deposit is 13000 euros. Compute the amount of money in the account after 9 years from the moment of the first deposit.

- 1) We will have ****4.***** euros.
- 2) We will have ****2.***** euros.
- 3) We will have ****3.***** euros.
- 4) We will have ****0.***** euros.
- 5) We will have ****8.***** euros.

Exercise 4

A firm sells Q tons of certain product. The price received per ton is given by the formula $P=50000-2Q$. On the other hand, the production cost per ton is $C=30000+16Q$. In addition, the transportation cost is 18272 per ton. Compute the maximum profit that can be obtained selling this product.

- 1) Profit = 19305 .
- 2) Profit = 41472 .
- 3) Profit = 70180 .
- 4) Profit = 13437 .
- 5) Profit = 23397 .

Exercise 5

Deposits in certain investment account vary from year to year alternating gains and losses periods. We have the following data about the deposits for different years:

year	deposits
1	20
2	43
3	64

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t . Employ that function to determine the maximum funds available in the investment account .

- 1) The maximum for the depositis in the account was 6 .
- 2) The maximum for the depositis in the account was 164 .
- 3) The maximum for the depositis in the account was 13 .
- 4) The maximum for the depositis in the account was 115 .
- 5) The maximum for the depositis in the account was -9 .

Exercise 6

The funds of a public institution alternate periods of deficit and surplus.

We have the following information for several years (in millions of euros):

year	funds
2	0
6	24
8	72

Employ an interpolation polynomial to build a function that

yields the funds for each year t . We know that due to the legislation the funds of such an institution have to be kept between 24 and 72

- . Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from $t=2$ to $t=8$).

- 1) The funds are inside the limits for the interval: $[0, 4]$.
- 2) The funds are inside the limits for the interval: $[1, 3]$.
- 3) The funds are inside the limits for the interval: $[0, 8]$.
- 4) The funds are inside the limits for the interval: $[-1, 5]$.
- 5) The funds are inside the limits for the interval: $[6, 8]$.
- 6) The funds are inside the limits for the interval: $[0, 6]$.
- 7) The funds are inside the limits for the interval: $[8, 8]$.
- 8) The funds are inside the limits for the interval: $[-2, 9]$.

Exercise 7

The deposits in certain account between the

months $t=0$ and $t=7$ is given by the function $C(t) = 4 + 60t - 36t^2 + 4t^3$

- . Determine the months for which the deposit is between -32 and 12 euros.

- 1) Along the intervals of months: $[1., 2.]$ and $[5.11596, 7.30399]$.
- 2) Along the interval of months: $[1., 7.]$.
- 3) Along the intervals of months: $[-4.45015 \times 10^{-308}, 1.31186]$ and $[6.66362, 7.25952]$.
- 4) Along the interval of months: $[0.623654, 1.52126]$.
- 5) Along the intervals of months: $[0, 0]$, $[0.145898, 2]$, $[3, 6.4641]$ and $[6.8541, 7]$.
- 6) Along the intervals of months: $[0, 0.145898]$, $[2, 3]$ and $[6.4641, 6.8541]$.
- 7) Along the intervals of months: $[-4.45015 \times 10^{-308}, 1.29911]$ and $[3.09486, 6.75579]$.
- 8) Along the interval of months: $[1., 6.]$.

Exercise 8

Compute the limit: $\lim_{x \rightarrow -\infty} \left(\frac{-1 + 9x + 2x^2 - 2x^3}{5 - x + x^2 - 2x^3} \right)^{-2+4x+9x^2}$

- 1) $\frac{1}{e^4}$
- 2) 0
- 3) ∞
- 4) 1
- 5) $\frac{1}{e^5}$
- 6) $\frac{1}{e^3}$
- 7) $-\infty$

Exercise 9

From an initial deposit 2000, the interest rate varies every year in such a way that the total amount of money in the account is given by the function $C(t) =$

$$2000 \left(\frac{9 - 4t + 9t^2 - t^3}{2 + 5t - t^2 - t^3} \right)^{-9+2t+t^2}. \text{ Determine the future tendency for the}$$

deposits that we will have after a large number of years.

- 1) 0
- 2) 2000 €
- 3) $-\infty$
- 4) 2000
- 5) ∞
- 6) $\frac{2000}{e^5}$
- 7) $\frac{2000}{e^4}$

Exercise 10

The population in certain turistic area

increases exponentially and is given by the function $P(t) = 78\,000 e^{t/100}$ that indicates the number of resident citizens for every year t . At the same time, depending on the season, the city receives a variable number of

tourists given by the trigonometric function $I(t) = 2000 + 1000 \sin\left[\frac{t}{2\pi}\right]$

that yields the amount of visitors in the area for every moment t (t in years).

Determine how many years are necessary until the total number of habitants is 104000. (the solution can be found for t between 26 and 31).

- 1) $t = ** .1****$
- 2) $t = ** .3****$
- 3) $t = ** .5****$
- 4) $t = ** .7****$
- 5) $t = ** .9****$

Exercise 11

Study the continuity of the function $f(x) = \begin{cases} \sin(x) - 2e^x & x \leq 0 \\ 3\sin(x) - 2e^x & 0 < x < 3 \\ -\sin(3-x) & 3 \leq x \end{cases}$

- 1) The functions is continuous for all points.
- 2) The functions is not continuous at any point.
- 3) The function is continuous for all the points except for $x=0$.
- 4) The function is continuous for all the points except for $x=3$.
- 5) The function is continuous for all the points except for $x=0$ and $x=3$.

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01-Functions for serial number: 26

Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a continuous compound rate of 10% and in the bank B we are paid a compound interest rate of 4%. We initially deposit 3000 euros in the bank A and 9000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **0.***** years.
- 2) In **8.***** years.
- 3) In **7.***** years.
- 4) In **5.***** years.
- 5) In **4.***** years.

Exercise 2

We have one bank account that offers a continuous compound rate of 5% where we initially deposit 14000 euros. How long time is it necessary until the amount of money in the account reaches 22000 euros?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **0.***** years.
- 2) In **4.***** years.
- 3) In **3.***** years.
- 4) In **9.***** years.
- 5) In **7.***** years.

Exercise 3

We have a bank account that initially offers a continuous compound rate of 8%, and after 2 years the conditions are modified and then we obtain a periodic compound interest rate of 9% in 3 periods (compounding frequency). The initial deposit is 9000 euros. Compute the amount of money in the account after 9 years from the moment of the first deposit.

- 1) We will have ****0.***** euros.
- 2) We will have ****7.***** euros.
- 3) We will have ****9.***** euros.
- 4) We will have ****6.***** euros.
- 5) We will have ****4.***** euros.

Exercise 4

A firm sells Q tons of certain product. The price received per ton is given by the formula $P=11000-11Q$. On the other hand, the production cost per ton is $C=8000+Q$. In addition, the transportation cost is 2424 per ton. Compute the maximum profit that can be obtained selling this product.

- 1) Profit = 3871 .
- 2) Profit = 6912 .
- 3) Profit = 4118 .
- 4) Profit = 8198 .
- 5) Profit = 3746 .

Exercise 5

Deposits in certain investment account vary from year to year alternating gains and losses periods. We have the following data about the deposits for different years:

year	deposits
2	15
4	53
5	81

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t . Employ that function to forecast the exact amount for year 7 .

- 1) The depositis in the account for year 7 are 7 .
- 2) The depositis in the account for year 7 are 155 .
- 3) The depositis in the account for year 7 are 201 .
- 4) The depositis in the account for year 7 are 3 .
- 5) The depositis in the account for year 7 are -4 .

Exercise 6

The funds of a public institution alternate periods of deficit and surplus.

We have the following information for several years (in millions of euros):

year	funds
1	35
3	35
5	11

Employ an interpolation polynomial to build a function that

yields the funds for each year t . We know that due to the legislation the funds of such an institution have to be kept between 26 and 35

. Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from $t=1$ to $t=5$).

- 1) The funds are inside the limits for the interval: $[1, 5]$.
- 2) The funds are inside the limits for the interval: $[1, 4]$.
- 3) The funds are inside the limits for the intervals: $[0, 0]$ y $[3, 4]$.
- 4) The funds are inside the limits for the interval: $[0, 1]$.
- 5) The funds are inside the limits for the intervals: $[0, 1]$ y $[3, 5]$.
- 6) The funds are inside the limits for the interval: $[0, 4]$.
- 7) The funds are inside the limits for the interval: $[4, 5]$.
- 8) The funds are inside the limits for the intervals: $[1, 1]$ y $[3, 4]$.

Exercise 7

The population of a city is studied between years $t=2$ and $t=8$. In that

period the population is given by the function $P(t) = 9 + 180t - 48t^2 + 4t^3$

. Determine the intervals of years when the population is between 9 and 209.

- 1) That number of mice is reach for no interval of years.
- 2) Along the interval of years: $[3.65891, 5.40334]$.
- 3) Along the intervals of years: $[2., 5.]$ and $[6.24515, 7.]$.
- 4) Along the intervals of years: $[2, 2]$ and $[5, 5]$.
- 5) Along the intervals of years: $[3.67613, 4.]$ and $[7., 8.]$.
- 6) Along the intervals of years: $[2.63337, 3.49495]$ and $[4., 5.27332]$.
- 7) Along the intervals of years: $[2.59618, 5.7693]$ and $[7.23718, 8.]$.
- 8) Along the interval of years: $[2, 8]$.

Exercise 8

Compute the limit: $\lim_{x \rightarrow \infty} \left(\frac{5 - 9x + x^2}{-9 + 7x + x^2} \right)^{4+7x+4x^2}$

- 1) $-\infty$
- 2) 0
- 3) $\frac{1}{e^3}$
- 4) $\frac{1}{e}$
- 5) 1
- 6) ∞
- 7) $\frac{1}{e^4}$

Exercise 9

A factory produces certain type of devices. The marginal cost (cost of producing one unit) decreases when we produce a large amount of units and it is given by the function $C(x) = \frac{8 + 8x + 5x^2 + 4x^3}{7 + 6x + x^2 + 9x^3}$. Determine the expected cost per unit when a large amount of units is produced.

- 1) $-\infty$
- 2) $13\,000$
- 3) -1
- 4) 0
- 5) ∞
- 6) $\frac{13}{25}$
- 7) $\frac{4}{9}$

Exercise 10

We deposit 20000 euros in a bank account with a periodic compound interest rate of 4% in 9 periods (compounding frequency). At the same time every year we also add in a safe-deposit box (therefore with no interest rate) 3000 euros. How long time is it necessary until the total amount of money (jointly in the bank account and safe-deposit box) is 73000 euros? (the solution can be found for t between 11 and 16).

- 1) $t = **.\mathbf{0}****$
- 2) $t = **.\mathbf{2}****$
- 3) $t = **.\mathbf{4}****$
- 4) $t = **.\mathbf{6}****$
- 5) $t = **.\mathbf{8}****$

Exercise 11

Study the continuity of the function $f(x) = \begin{cases} \sin(1-x) + \cos(1-x) & x \leq 1 \\ \frac{4}{3} - \frac{x}{3} & 1 < x < 4 \end{cases}$

- 1) The function is continuous for all points.
- 2) The function is not continuous at any point.
- 3) The function is continuous for all the points except for $x=1$.
- 4) The function is continuous for all the points except for $x=4$.
- 5) The function is continuous for all the points except for $x=1$ and $x=4$.

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01-Functions for serial number: 27

Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a compound interest rate of 6% and in the bank B we are paid a compound interest rate of 10%. We initially deposit 7000 euros in the bank A and 3000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **5.***** years.
- 2) In **8.***** years.
- 3) In **4.***** years.
- 4) In **0.***** years.
- 5) In **2.***** years.

Exercise 2

Certain parcel of land is devalued from an initial value of 343000 euros until a final value of 116000 euros along 8 years. Determine the rate of continuous compound interest for that devaluation.

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) The interest rate is **7.***** %.
- 2) The interest rate is **6.***** %.
- 3) The interest rate is **2.***** %.
- 4) The interest rate is **9.***** %.
- 5) The interest rate is **3.***** %.

Exercise 3

We have a bank account that initially offers a compound interest rate of 5%, and after 1 year the conditions are modified and then we obtain a periodic compound interest rate of 5% in 5 periods (compounding frequency). The initial deposit is 7000 euros. Compute the amount of money in the account after 10 years from the moment of the first deposit.

- 1) We will have ****2.***** euros.
- 2) We will have ****9.***** euros.
- 3) We will have ****4.***** euros.
- 4) We will have ****8.***** euros.
- 5) We will have ****1.***** euros.

Exercise 4

A firm sells Q tons of certain product. The price received per ton is given by the formula $P=20000-16Q$. On the other hand, the production cost per ton is $C=10000+15Q$. In addition, the transportation cost is 8326 per ton. Compute the maximum profit that can be obtained selling this product.

- 1) Profit = 18608 .
- 2) Profit = 22599 .
- 3) Profit = 31654 .
- 4) Profit = 33147 .
- 5) Profit = 23780 .

Exercise 5

Deposits in certain investment account vary from year to year alternating gains and losses periods. We have the following data about the deposits for different years:

year	deposits
2	57
3	82
4	105

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t . Employ that function to determine the maximum funds available in the investment account .

- 1) The maximum for the depositis in the account was 10 .
- 2) The maximum for the depositis in the account was 145 .
- 3) The maximum for the depositis in the account was -8 .
- 4) The maximum for the depositis in the account was 15 .
- 5) The maximum for the depositis in the account was 226 .

Exercise 6

The funds of a public institution alternate periods of deficit and surplus.

We have the following information for several years (in millions of euros):

year	funds
2	-30
4	-54
7	-60

Employ an interpolation polynomial to build a function that

yields the funds for each year t . We know that due to the legislation the funds of such an institution have to be kept between -60 and -54.

. Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from $t=2$ to $t=7$).

- 1) The funds are inside the limits for the interval: $[7, 7]$.
- 2) The funds are inside the limits for the interval: $[0, 7]$.
- 3) The funds are inside the limits for the interval: $[4, 5]$.
- 4) The funds are inside the limits for the intervals: $[4, 5]$ y $[7, 8]$.
- 5) The funds are inside the limits for the interval: $[0, 4]$.
- 6) The funds are inside the limits for the intervals: $[4, 5]$ y $[7, 7]$.
- 7) The funds are inside the limits for the interval: $[4, 7]$.
- 8) The funds are inside the limits for the intervals: $[0, 5]$ y $[7, 8]$.

Exercise 7

The population of certain type of rodents is analyzed in a region between years $t=1$ and $t=9$. Along that period the population is given by the function $P(t) = 1 + 288t - 66t^2 + 4t^3$ (thousands of rodents). Determine the intervals of years during which the number of rodents is between 217 and 353.

- 1) Along the interval of years: $[3., 5.19687]$.
- 2) Along the intervals of years: $[1, 2.11932]$ and $[4, 6]$.
- 3) Along the intervals of years: $[1, 1]$, $[2.11932, 4]$ and $[6, 9]$.
- 4) Along the intervals of years: $[2., 5.32047]$ and $[6., 7.]$.
- 5) Along the intervals of years: $[1., 3.]$ and $[4., 8.39855]$.
- 6) Along the intervals of years: $[3., 4.]$ and $[5., 6.]$.
- 7) Along the interval of years: $[5.60192, 8.66853]$.
- 8) Along the intervals of years: $[2., 3.02809]$ and $[6.27294, 7.]$.

Exercise 8

Compute the limit: $\lim_{x \rightarrow -\infty} \left(\frac{7 - 7x - 5x^2}{6 - 6x - 5x^2} \right)^{-9 - 8x + 9x^2}$

- 1) 0
- 2) ∞
- 3) $-\infty$
- 4) 1
- 5) $\frac{1}{e^4}$
- 6) $\frac{1}{e^3}$
- 7) $\frac{1}{e^2}$

Exercise 9

From an initial deposit 17000, the interest rate varies every year in such a way that the total amount of money in the account is given by the function $C(t) =$

$$17000 \left(\frac{-3 + 7t - 7t^2 - 9t^3}{6 - 6t + 9t^2 - 9t^3} \right)^{-8+5t}. \text{ Determine the future tendency for the}$$

deposits that we will have after a large number of years.

- 1) $-\infty$
- 2) $17000 \text{ €}^{8887/1000}$
- 3) 17000
- 4) 0
- 5) $\frac{17000}{e^5}$
- 6) $17000 \text{ €}^{80/9}$
- 7) ∞

Exercise 10

The population in certain turistic area

increases exponentially and is given by the function $P(t) = 80\,000 e^{t/100}$ that indicates the number of resident citizens for every year t . At the same time, depending on the season, the city receives a variable number of

tourists given by the trigonometric function $I(t) = 5000 + 2000 \sin\left[\frac{t}{2\pi}\right]$

that yields the amount of visitors in the area for every moment t (t in years).

Determine how many years are necessary until the total number of habitants is 129000. (the solution can be found for t between 40 and 45).

- 1) $t = **.*$
- 2) $t = **.*$
- 3) $t = **.*$
- 4) $t = **.*$
- 5) $t = **.*$

Exercise 11

Study the continuity of the function $f(x) = \begin{cases} e^x + 3 \sin(x) & x \leq 0 \\ \log(x+1) - \log(2) & 0 < x < 1 \\ 2 \sin(1-x) & 1 \leq x \end{cases}$

- 1) The functions is continuous for all points.
- 2) The functions is not continuous at any point.
- 3) The function is continuous for all the points except for $x=0$.
- 4) The function is continuous for all the points except for $x=1$.
- 5) The function is continuous for all the points except for $x=0$ and $x=1$.

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01-Functions for serial number: 28

Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a periodic compound interest rate of 3% in 12 periods (compounding frequency) and in the bank B we are paid a continuous compound rate of 10%. We initially deposit 11000 euros in the bank A and 3000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **0.***** years.
- 2) In **7.***** years.
- 3) In **4.***** years.
- 4) In **8.***** years.
- 5) In **2.***** years.

Exercise 2

We have one bank account that offers a periodic compound interest rate of 3% in 6 periods (compounding frequency) where we initially deposit 14000 euros. How long time is it necessary until the amount of money in the account reaches 22000 euros?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **4.***** years.
- 2) In **0.***** years.
- 3) In **8.***** years.
- 4) In **7.***** years.
- 5) In **5.***** years.

Exercise 3

We have a bank account that initially offers a continuous compound rate of 5%, and after 3 years the conditions are modified and then we obtain a continuous compound rate of 4%. The initial deposit is 11000 euros. Compute the amount of money in the account after 8 years from the moment of the first deposit.

- 1) We will have ****4.***** euros.
- 2) We will have ****0.***** euros.
- 3) We will have ****7.***** euros.
- 4) We will have ****9.***** euros.
- 5) We will have ****5.***** euros.

Exercise 4

A firm sells Q tons of certain product. The price received per ton is given by the formula $P=6000-14Q$. On the other hand, the production cost per ton is $C=3000-6Q$. In addition, the transportation cost is 2520 per ton. Compute the maximum profit that can be obtained selling this product.

- 1) Profit = 7200 .
- 2) Profit = 9782 .
- 3) Profit = 8733 .
- 4) Profit = 2218 .
- 5) Profit = 6614 .

Exercise 5

Deposits in certain investment account vary from year to year alternating gains and losses periods. We have the following data about the deposits for different years:

year	deposits
1	3
2	3
4	-3

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t . Employ that function to forecast the exact amount for year 6 .

- 1) The depositis in the account for year 6 are -3 .
- 2) The depositis in the account for year 6 are -27 .
- 3) The depositis in the account for year 6 are -1 .
- 4) The depositis in the account for year 6 are -17 .
- 5) The depositis in the account for year 6 are -15 .

Exercise 6

The funds of a public institution alternate periods of deficit and surplus.

We have the following information for several years (in millions of euros):

year	funds
1	40
5	40
8	-23

Employ an interpolation polynomial to build a function that

yields the funds for each year t . We know that due to the legislation the funds of such an institution have to be kept between 4 and 40

- . Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from $t=1$ to $t=8$).

- 1) The funds are inside the limits for the interval: $[7, 8]$.
- 2) The funds are inside the limits for the interval: $[0, 7]$.
- 3) The funds are inside the limits for the intervals: $[-1, 0]$ y $[5, 7]$.
- 4) The funds are inside the limits for the interval: $[1, 8]$.
- 5) The funds are inside the limits for the interval: $[0, 1]$.
- 6) The funds are inside the limits for the intervals: $[1, 1]$ y $[5, 7]$.
- 7) The funds are inside the limits for the interval: $[-1, 1]$.
- 8) The funds are inside the limits for the interval: $[1, 7]$.

Exercise 7

The population of a city is studied between years $t=3$ and $t=7$. In that

period the population is given by the function $P(t) = 9 + 240t - 54t^2 + 4t^3$

- . Determine the intervals of years when the population is between 351 and 415.

- 1) Along the interval of years: $[5.54687, 7.]$.
- 2) Along the intervals of years: $[3, 3]$ and $[7, 7]$.
- 3) Along the interval of years: $[5., 7.0478]$.
- 4) Along the interval of years: $[4.38523, 7.55759]$.
- 5) Along the intervals of years: $[3., 4.]$ and $[6., 7.46602]$.
- 6) Along the intervals of years: $[3.78913, 5.31086]$ and $[6., 7.69966]$.
- 7) Along the intervals of years: $[4., 5.30758]$ and $[6.35245, 7.61925]$.
- 8) Along the interval of years: $[3, 7]$.

Exercise 8

Compute the limit: $\lim_{x \rightarrow \infty} \left(\frac{4 - 6x + 7x^2 - 4x^3}{-9 + 7x + 4x^2 - 4x^3} \right)^{8+3x}$

- 1) $\frac{1}{e^{9/4}}$
- 2) $\frac{1}{e^5}$
- 3) ∞
- 4) 0
- 5) $\frac{1}{e^4}$
- 6) $-\infty$
- 7) 1

Exercise 9

The population of certain country (in millions of habitants) is given by the function $P(t) =$

$$30 \left(\frac{4 - 6t + 7t^2 + 4t^3}{-9 + 7t + 4t^2 + 4t^3} \right)^{8+3t}. \text{ Determine the future tendency for this population.}$$

- 1) $30 e^{281/125}$
- 2) ∞
- 3) $30 e^{9/4}$
- 4) 30
- 5) $\frac{30}{e^5}$
- 6) $-\infty$
- 7) 0

Exercise 10

We deposit 6000 euros in a bank account with a periodic compound interest rate of 7% in 6 periods (compounding frequency). At the same time every year we also add in a safe-deposit box (therefore with no interest rate) 4000 euros. How long time is it necessary until the total amount of money (jointly in the bank account and safe-deposit box) is 57000 euros? (the solution can be found for t between 9 and 14).

- 1) $t = **.0****$
- 2) $t = **.2****$
- 3) $t = **.4****$
- 4) $t = **.6****$
- 5) $t = **.8****$

Exercise 11

Study the continuity of the function $f(x) = \begin{cases} \sin(3-x) & x \leq 3 \\ -e^{x-3} - 3 \sin(3-x) + 1 & 3 < x < 4 \\ 2 \log(x-3) - 2 & 4 \leq x \end{cases}$

- 1) The functions is continuous for all points.
- 2) The functions is not continuous at any point.
- 3) The function is continuous for all the points except for $x=3$.
- 4) The function is continuous for all the points except for $x=4$.
- 5) The function is continuous for all the points except for $x=3$ and $x=4$.

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01-Functions for serial number: 29

Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a continuous compound rate of 9% and in the bank B we are paid a compound interest rate of 6%. We initially deposit 4000 euros in the bank A and 8000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **0.***** years.
- 2) In **1.***** years.
- 3) In **5.***** years.
- 4) In **2.***** years.
- 5) In **7.***** years.

Exercise 2

Certain parcel of land is revalued from an initial value of 294000 euros until a final value of 462000 euros along 9 years. Determine the rate of continuous compound interest for that revaluation.

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) The interest rate is **6.***** %.
- 2) The interest rate is **5.***** %.
- 3) The interest rate is **8.***** %.
- 4) The interest rate is **3.***** %.
- 5) The interest rate is **1.***** %.

Exercise 3

We have a bank account that initially offers a compound interest rate of 8%, and after 2 years the conditions are modified and then we obtain a compound interest rate of 7%. The initial deposit is 8000 euros. Compute the amount of money in the account after 8 years from the moment of the first deposit.

- 1) We will have ****7.***** euros.
- 2) We will have ****4.***** euros.
- 3) We will have ****3.***** euros.
- 4) We will have ****5.***** euros.
- 5) We will have ****2.***** euros.

Exercise 4

A firm sells Q tons of certain product. The price received per ton is given by the formula $P=70000-17Q$. On the other hand, the production cost per ton is $C=20000+13Q$. In addition, the transportation cost is 48500 per ton. Compute the maximum profit that can be obtained selling this product.

- 1) Profit = 9448 .
- 2) Profit = 9419 .
- 3) Profit = 18750 .
- 4) Profit = 31374 .
- 5) Profit = 25015 .

Exercise 5

Deposits in certain investment account vary from year to year alternating gains and losses periods. We have the following data about the deposits for different years:

year	deposits
2	138
4	82
6	42

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t . Employ that function to determine the minimum funds available in the investment account .

- 1) The minimum for the depositis in the account was 12 .
- 2) The minimum for the depositis in the account was 10 .
- 3) The minimum for the depositis in the account was 11 .
- 4) The minimum for the depositis in the account was 8 .
- 5) The minimum for the depositis in the account was 19 .

Exercise 6

The funds of a public institution alternate periods of deficit and surplus.

We have the following information for several years (in millions of euros):

year	funds
0	26
3	56
5	56

Employ an interpolation polynomial to build a function that

yields the funds for each year t . We know that due to the legislation the funds of such an institution have to be kept between 50 and 56

. Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from $t=0$ to $t=5$).

- 1) The funds are inside the limits for the intervals: $[0, 2]$ y $[5, 6]$.
- 2) The funds are inside the limits for the interval: $[0, 6]$.
- 3) The funds are inside the limits for the interval: $[3, 5]$.
- 4) The funds are inside the limits for the interval: $[0, 3]$.
- 5) The funds are inside the limits for the interval: $[2, 3]$.
- 6) The funds are inside the limits for the intervals: $[2, 3]$ y $[5, 5]$.
- 7) The funds are inside the limits for the interval: $[3, 6]$.
- 8) The funds are inside the limits for the interval: $[5, 6]$.

Exercise 7

The population of certain type of rodents is analyzed in a region between years $t=4$

and $t=10$. Along that period the population is given by the function $P(t) =$

$7 + 756t - 96t^2 + 4t^3$ (thousands of rodents). Determine the intervals of years during which the number of rodents is between 1519 and 1751.

- 1) Along the interval of years: $[4., 7.]$.
- 2) Along the interval of years: $[8.15584, 9.]$.
- 3) Along the intervals of years: $[4.18822, 5.56579]$ and $[8.18461, 10.2314]$.
- 4) Along the interval of years: $[7.41921, 9.27108]$.
- 5) Along the interval of years: $[4, 4]$.
- 6) Along the intervals of years: $[4.65727, 8.]$ and $[9.50658, 10.5432]$.
- 7) That number of mice is reach for no interval of years.
- 8) Along the interval of years: $[4, 10]$.

Exercise 8

Compute the limit: $\lim_{x \rightarrow \infty} \left(\frac{-5 - 8x + 8x^2}{4 - 3x + 8x^2} \right)^{-9+8x}$

- 1) 0
- 2) ∞
- 3) $\frac{1}{e^2}$
- 4) $\frac{1}{e^4}$
- 5) $\frac{1}{e^5}$
- 6) $-\infty$
- 7) 1

Exercise 9

A factory produces certain type of devices. The marginal cost (cost of producing one unit) decreases when we produce a large amount

of units and it is given by the function $C(x) = \frac{6 + 2x + x^2 + 8x^3 + 5x^4}{7 + 2x + 4x^2 + x^3 + 6x^4}$

. Determine the expected cost per unit when a large amount of units is produced.

- 1) $-\frac{3}{4}$
- 2) $\frac{5}{6}$
- 3) $-\infty$
- 4) 0
- 5) 16 000
- 6) ∞
- 7) $\frac{91}{100}$

Exercise 10

The population in certain turistic area

increases exponentially and is given by the function $P(t) = 52\,000 e^{t/50}$ that indicates the number of resident citizens for every year t . At the same time, depending on the season, the city receives a variable number of

tourists given by the trigonometric function $I(t) = 5000 + 3000 \sin\left[\frac{t}{2\pi}\right]$

that yields the amount of visitors in the area for every moment t (t in years).

Determine how many years are necessary until the total number of habitants is 91000. (the solution can be found for t between 24 and 29).

- 1) $t = \dots 0 \dots$
- 2) $t = \dots 2 \dots$
- 3) $t = \dots 4 \dots$
- 4) $t = \dots 6 \dots$
- 5) $t = \dots 8 \dots$

Exercise 11

Study the continuity of the function $f(x) = \begin{cases} 3 \sin(x+2) - 2 e^{x+2} & x \leq -2 \\ -2 & -2 < x < -1 \\ 1 - 2 \log(x+2) & -1 \leq x \end{cases}$

- 1) The functions is continuous for all points.
- 2) The functions is not continuous at any point.
- 3) The function is continuous for all the points except for $x = -2$.
- 4) The function is continuous for all the points except for $x = -1$.
- 5) The function is continuous for all the points except for $x = -2$ and $x = -1$.

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01-Functions for serial number: 30

Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a periodic compound interest rate of 10% in 9 periods (compounding frequency) and in the bank B we are paid a periodic compound interest rate of 2% in 8 periods (compounding frequency). We initially deposit 5000 euros in the bank A and 10000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **3.***** years.
- 2) In **1.***** years.
- 3) In **6.***** years.
- 4) In **8.***** years.
- 5) In **0.***** years.

Exercise 2

We have one bank account that offers a periodic compound interest rate of 3% in 11 periods (compounding frequency) where we initially deposit 13000 euros. How long time is it necessary until the amount of money in the account reaches 20000 euros?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **3.***** years.
- 2) In **1.***** years.
- 3) In **7.***** years.
- 4) In **4.***** years.
- 5) In **0.***** years.

Exercise 3

We have a bank account that initially offers a periodic compound interest rate of 7% in 7 periods (compounding frequency), and after 2 years the conditions are modified and then we obtain a continuous compound rate of 3%. The initial deposit is 10000 euros. Compute the amount of money in the account after 10 years from the moment of the first deposit.

- 1) We will have 6.***** euros.
- 2) We will have 7.***** euros.
- 3) We will have 2.***** euros.
- 4) We will have 8.***** euros.
- 5) We will have 1.***** euros.

Exercise 4

A firm sells Q tons of certain product. The price received per ton is given by the formula $P=70000-13Q$. On the other hand, the production cost per ton is $C=50000+3Q$. In addition, the transportation cost is 18784 per ton. Compute the maximum profit that can be obtained selling this product.

- 1) Profit = 15532 .
- 2) Profit = 12136 .
- 3) Profit = 9418 .
- 4) Profit = 23104 .
- 5) Profit = 30419 .

Exercise 5

Deposits in certain investment account vary from year to year alternating gains and losses periods. We have the following data about the deposits for different years:

year	deposits
0	0
2	16
3	33

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t . Employ that function to forecast the exact amount for year 5.

- 1) The depositis in the account for year 5 are -1 .
- 2) The depositis in the account for year 5 are 8 .
- 3) The depositis in the account for year 5 are 120 .
- 4) The depositis in the account for year 5 are 85 .
- 5) The depositis in the account for year 5 are 1 .

Exercise 6

The funds of a public institution alternate periods of deficit and surplus.

We have the following information for several years (in millions of euros):

year	funds
1	16
4	25
6	61

Employ an interpolation polynomial to build a function that

yields the funds for each year t . We know that due to the legislation the funds of such an institution have to be kept between 25 and 61

- . Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from $t=1$ to $t=6$).

- 1) The funds are inside the limits for the interval: $[1, 4]$.
- 2) The funds are inside the limits for the interval: $[-1, 7]$.
- 3) The funds are inside the limits for the interval: $[0, 6]$.
- 4) The funds are inside the limits for the interval: $[0, 3]$.
- 5) The funds are inside the limits for the interval: $[0, 7]$.
- 6) The funds are inside the limits for the interval: $[6, 6]$.
- 7) The funds are inside the limits for the interval: $[0, 4]$.
- 8) The funds are inside the limits for the interval: $[4, 6]$.

Exercise 7

The population of certain type of rodents is analyzed in a region between years $t=2$

and $t=10$. Along that period the population is given by the function $P(t) =$

$8 + 504t - 78t^2 + 4t^3$ (thousands of rodents). Determine the intervals of years during which the number of rodents is between 1086 and 1438.

- 1) Along the intervals of years: $[2, 5.5]$, $[7, 7]$ and $[10, 10]$.
- 2) Along the interval of years: $[5.5, 10]$.
- 3) Along the interval of years: $[6., 9.]$.
- 4) Along the intervals of years: $[2.3757, 4.18621]$ and $[6.33365, 9.34577]$.
- 5) Along the intervals of years: $[5., 6.28368]$ and $[9.33328, 10.]$.
- 6) Along the intervals of years: $[6., 7.06233]$ and $[9., 10.]$.
- 7) Along the interval of years: $[8.01303, 9.]$.
- 8) Along the interval of years: $[4.08174, 7.37334]$.

Exercise 8

Compute the limit: $\lim_{x \rightarrow \infty} \left(\frac{-8 + 8x - 5x^2}{-6 - 3x - 5x^2} \right)^{-9+5x}$

- 1) $-\infty$
- 2) $\frac{1}{e^{11}}$
- 3) $\frac{1}{e}$
- 4) 0
- 5) ∞
- 6) $\frac{1}{e^3}$
- 7) 1

Exercise 9

A factory produces certain type of devices. The marginal cost (cost of producing one unit) decreases when we produce a large amount

of units and it is given by the function $C(x) = \frac{5 + 4x + 9x^2 + 8x^3}{8 + 9x + 6x^2 + 4x^3 + 5x^4}$

. Determine the expected cost per unit when a large amount of units is produced.

- 1) $-\frac{2}{5}$
- 2) $-\infty$
- 3) 0
- 4) ∞
- 5) 13000
- 6) $-\frac{1}{2}$
- 7) $-\frac{1}{3}$

Exercise 10

We deposit 4000 euros in a bank account with a continuous compound rate of 3%. At the same time every year we also add in a safe-deposit box (therefore with no interest rate) 4000 euros. How long time is it necessary until the total ammount of money (jointly in the bank account and safe-depsit box) is 35000 euros? (the solution can be found for t between 3 and 8).

- 1) $t = **.0****$
- 2) $t = **.2****$
- 3) $t = **.4****$
- 4) $t = **.6****$
- 5) $t = **.8****$

Exercise 11

Study the continuity of the function $f(x) = \begin{cases} -\sin(2-x) - \cos(2-x) & x \leq 2 \\ \log(x-1) + 2 - \log(4) & 2 < x < 5 \\ 2 \log(x-4) + 2 & 5 \leq x \end{cases}$

- 1) The functions is continuous for all points.
- 2) The functions is not continuous at any point.
- 3) The function is continuous for all the points except for $x=2$.
- 4) The function is continuous for all the points except for $x=5$.
- 5) The function is continuous for all the points except for $x=2$ and $x=5$.

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01-Functions for serial number: 31

Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a compound interest rate of 9% and in the bank B we are paid a continuous compound rate of 4%. We initially deposit 6000 euros in the bank A and 12000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **5.***** years.
- 2) In **9.***** years.
- 3) In **6.***** years.
- 4) In **0.***** years.
- 5) In **2.***** years.

Exercise 2

We have one bank account that offers a continuous compound rate of 2% where we initially deposit 12000 euros. How long time is it necessary until the amount of money in the account reaches 16000 euros?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **2.***** years.
- 2) In **4.***** years.
- 3) In **0.***** years.
- 4) In **6.***** years.
- 5) In **1.***** years.

Exercise 3

We have a bank account that initially offers a periodic compound interest rate of 8% in 10 periods (compounding frequency), and after 4 years the conditions are modified and then we obtain a compound interest rate of 6%. The initial deposit is 12000 euros. Compute the amount of money in the account after 7 years from the moment of the first deposit.

- 1) We will have ****2.***** euros.
- 2) We will have ****7.***** euros.
- 3) We will have ****0.***** euros.
- 4) We will have ****6.***** euros.
- 5) We will have ****1.***** euros.

Exercise 4

A firm sells Q tons of certain product. The price received per ton is given by the formula $P=12000-16Q$. On the other hand, the production cost per ton is $C=10000-9Q$. In addition, the transportation cost is 1594 per ton. Compute the maximum profit that can be obtained selling this product.

- 1) Profit = 3188 .
- 2) Profit = 5887 .
- 3) Profit = 7583 .
- 4) Profit = 4862 .
- 5) Profit = 5821 .

Exercise 5

Deposits in certain investment account vary from year to year alternating gains and losses periods. We have the following data about the deposits for different years:

year	deposits
2	10
3	20
4	34

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t . Employ that function to forecast the exact amount for year 6 .

- 1) The depositis in the account for year 6 are -19 .
- 2) The depositis in the account for year 6 are 6 .
- 3) The depositis in the account for year 6 are 4 .
- 4) The depositis in the account for year 6 are 74 .
- 5) The depositis in the account for year 6 are 100 .

Exercise 6

The funds of a public institution alternate periods of deficit and surplus.

We have the following information for several years (in millions of euros):

year	funds
1	27
4	33
7	3

Employ an interpolation polynomial to build a function that

yields the funds for each year t . We know that due to the legislation the funds of such an institution have to be kept between 27 and 33

- . Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from $t=1$ to $t=7$).

- 1) The funds are inside the limits for the interval: $[5, 7]$.
- 2) The funds are inside the limits for the intervals: $[0, 1]$ y $[4, 5]$.
- 3) The funds are inside the limits for the interval: $[0, 2]$.
- 4) The funds are inside the limits for the intervals: $[1, 2]$ y $[4, 5]$.
- 5) The funds are inside the limits for the interval: $[0, 5]$.
- 6) The funds are inside the limits for the interval: $[1, 2]$.
- 7) The funds are inside the limits for the interval: $[2, 7]$.
- 8) The funds are inside the limits for the interval: $[2, 5]$.

Exercise 7

The population of certain type of rodents is analyzed in a region between years

$t=3$ and $t=9$. Along that period the population is given by the function $P(t) = 7 + 336t - 66t^2 + 4t^3$ (thousands of rodents). Determine the intervals of years during which the number of rodents is between 511 and 537.

- 1) Along the intervals of years: $[3, 3.18826]$, $[5, 6]$ and $[7.81174, 8.31174]$.
- 2) Along the intervals of years: $[3.65608, 5.49651]$ and $[7., 9.]$.
- 3) Along the interval of years: $[4., 6.23354]$.
- 4) Along the intervals of years: $[3, 3]$, $[3.18826, 5]$, $[6, 7.81174]$ and $[8.31174, 9]$.
- 5) Along the intervals of years: $[5., 6.]$ and $[8.10211, 9.56983]$.
- 6) Along the intervals of years: $[3., 6.55338]$ and $[7., 9.]$.
- 7) Along the interval of years: $[3.7396, 9.]$.
- 8) Along the intervals of years: $[3.67413, 6.]$ and $[7., 9.34461]$.

Exercise 8

Compute the limit: $\lim_{x \rightarrow \infty} \left(\frac{-7 - 2x - 8x^2}{-7 - 6x - 8x^2} \right)^{-6+6x+x^2}$

- 1) $\frac{1}{e^4}$
- 2) $\frac{1}{e^3}$
- 3) $\frac{1}{e^5}$
- 4) 1
- 5) ∞
- 6) 0
- 7) $-\infty$

Exercise 9

A factory produces certain type of devices. The marginal cost (cost of producing one unit) decreases when we produce a large amount of units and it is given by the function $C(x) = \frac{9 + 8x + x^2 + 7x^3}{2 + 2x + 9x^2 + 6x^3}$.

. Determine the expected cost per unit when a large amount of units is produced.

- 1) $\frac{7}{6}$
- 2) $\frac{61}{50}$
- 3) $-\frac{3}{2}$
- 4) $-\infty$
- 5) ∞
- 6) 0
- 7) 4000

Exercise 10

We deposit 15000 euros in a bank account with a compound interest rate of 4%. At the same time every year we also add in a safe-deposit box (therefore with no interest rate) 5000 euros. How long time is it necessary until the total amount of money (jointly in the bank account and safe-deposit box) is 61000 euros? (the solution can be found for t between 7 and 12).

- 1) $t = \dots 0 \dots$
- 2) $t = \dots 2 \dots$
- 3) $t = \dots 4 \dots$
- 4) $t = \dots 6 \dots$
- 5) $t = \dots 8 \dots$

Exercise 11

Study the continuity of the function $f(x) = \begin{cases} 3 \sin(x) - \cos(x) & x \leq 0 \\ 3 \sin(x) + 2 \cos(x) + 1 - 3 \sin(2) - 2 \cos(2) & 0 < x < 2 \\ e^{x-2} + \sin(2-x) & 2 \leq x \end{cases}$

- 1) The functions is continuous for all points.
- 2) The functions is not continuous at any point.
- 3) The function is continuous for all the points except for $x=0$.
- 4) The function is continuous for all the points except for $x=2$.
- 5) The function is continuous for all the points except for $x=0$ and $x=2$.

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01-Functions for serial number: 32

Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a continuous compound rate of 4% and in the bank B we are paid a periodic compound interest rate of 1% in 5 periods (compounding frequency). We initially deposit 3000 euros in the bank A and 14000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **7.***** years.
- 2) In **5.***** years.
- 3) In **0.***** years.
- 4) In **2.***** years.
- 5) In **1.***** years.

Exercise 2

Certain parcel of land is revalued from an initial value of 169000 euros until a final value of 439000 euros along 9 years. Determine the rate of continuous compound interest for that revaluation.

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) The interest rate is **6.***** %.
- 2) The interest rate is **0.***** %.
- 3) The interest rate is **1.***** %.
- 4) The interest rate is **3.***** %.
- 5) The interest rate is **5.***** %.

Exercise 3

We have a bank account that initially offers a periodic compound interest rate of 2% in 11 periods (compounding frequency), and after 1 year the conditions are modified and then we obtain a periodic compound interest rate of 5% in 7 periods (compounding frequency). The initial deposit is 14000 euros. Compute the amount of money in the account after 5 years from the moment of the first deposit.

- 1) We will have ****4.***** euros.
- 2) We will have ****5.***** euros.
- 3) We will have ****0.***** euros.
- 4) We will have ****1.***** euros.
- 5) We will have ****2.***** euros.

Exercise 4

A firm sells Q tons of certain product. The price received per ton is given by the formula $P=8000-20Q$. On the other hand, the production cost per ton is $C=5000+9Q$. In addition, the transportation cost is 2478 per ton. Compute the maximum profit that can be obtained selling this product.

- 1) Profit = 1936 .
- 2) Profit = 2349 .
- 3) Profit = 2164 .
- 4) Profit = 2023 .
- 5) Profit = 3807 .

Exercise 5

Deposits in certain investment account vary from year to year alternating gains and losses periods. We have the following data about the deposits for different years:

year	deposits
0	6
2	70
3	96

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t . Employ that function to determine the maximum funds available in the investment account .

- 1) The maximum for the depositis in the account was 136 .
- 2) The maximum for the depositis in the account was -5 .
- 3) The maximum for the depositis in the account was 9 .
- 4) The maximum for the depositis in the account was 168 .
- 5) The maximum for the depositis in the account was -6 .

Exercise 6

The funds of a public institution alternate periods of deficit and surplus.

We have the following information for several years (in millions of euros):

year	funds
2	16
5	19
7	31

Employ an interpolation polynomial to build a function that

yields the funds for each year t . We know that due to the legislation the funds of such an institution have to be kept between 19 and 38

- . Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from $t=2$ to $t=7$).

- 1) The funds are inside the limits for the interval: $[-1, 7]$.
- 2) The funds are inside the limits for the interval: $[-2, 4]$.
- 3) The funds are inside the limits for the interval: $[7, 7]$.
- 4) The funds are inside the limits for the interval: $[0, 7]$.
- 5) The funds are inside the limits for the interval: $[5, 7]$.
- 6) The funds are inside the limits for the interval: $[-1, 6]$.
- 7) The funds are inside the limits for the interval: $[1, 7]$.
- 8) The funds are inside the limits for the interval: $[0, 5]$.

Exercise 7

The population of certain type of rodents is analyzed in a region between years $t=4$ and $t=9$. Along that period the population is given by the function $P(t) = 2 + 360t - 66t^2 + 4t^3$ (thousands of rodents). Determine the intervals of years during which the number of rodents is between 650 and 1002.

- 1) Along the interval of years: $[6., 9.04184]$.
- 2) Along the intervals of years: $[5., 7.]$ and $[8.23708, 9.27701]$.
- 3) Along the intervals of years: $[6., 7.65034]$ and $[8., 9.]$.
- 4) Along the intervals of years: $[4.38077, 6.44418]$ and $[8., 9.68436]$.
- 5) Along the interval of years: $[4.04088, 9.]$.
- 6) Along the interval of years: $[4.5, 9]$.
- 7) Along the intervals of years: $[4, 4.5]$, $[6, 6]$ and $[9, 9]$.
- 8) Along the intervals of years: $[5.34342, 7.77518]$ and $[8., 9.31322]$.

Exercise 8

Compute the limit: $\lim_{x \rightarrow -\infty} \left(\frac{4 + 8x + 2x^2 - 6x^3}{5 + 9x + 7x^2 - 6x^3} \right)^{-6+8x}$

- 1) 0
- 2) $-\infty$
- 3) 1
- 4) $e^{20/3}$
- 5) $\frac{1}{e^3}$
- 6) ∞
- 7) $\frac{1}{e^5}$

Exercise 9

The population of certain country (in millions of habitants) is given by the function $P(t) =$

$$39 \left(\frac{6 - 8t + 2t^2 - 9t^3}{5 + 9t + 7t^2 - 9t^3} \right)^{-6+8t}. \text{ Determine the future tendency for this population.}$$

- 1) $-\infty$
- 2) $39 e^{4443/1000}$
- 3) 39
- 4) 0
- 5) ∞
- 6) $\frac{39}{e^4}$
- 7) $39 e^{40/9}$

Exercise 10

The population in certain turistic area

increases exponentially and is given by the function $P(t) = 58000 e^{t/50}$

that indicates the number of resident citizens for every year t . At the same time, depending on the season, the city receives a variable number of

tourists given by the trigonometric function $I(t) = 3000 + 2000 \sin\left[\frac{t}{2\pi}\right]$

that yields the amount of visitors in the area for every moment t (t in years).

Determine how many years are necessary until the total number of habitants is 85000. (the solution can be found for t between 15 and 20).

- 1) $t = *.1****$
- 2) $t = *.3****$
- 3) $t = *.5****$
- 4) $t = *.7****$
- 5) $t = *.9****$

Exercise 11

Study the continuity of the function $f(x) = \begin{cases} 2e^{x+2} - 3\sin(x+2) & x \leq -2 \\ -2x - 2 & -2 < x < -1 \end{cases}$

- 1) The function is continuous for all points.
- 2) The function is not continuous at any point.
- 3) The function is continuous for all the points except for $x = -2$.
- 4) The function is continuous for all the points except for $x = -1$.
- 5) The function is continuous for all the points except for $x = -2$ and $x = -1$.

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01-Functions for serial number: 33

Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a periodic compound interest rate of 6% in 5 periods (compounding frequency) and in the bank B we are paid a continuous compound rate of 10%. We initially deposit 15000 euros in the bank A and 8000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **6.***** years.
- 2) In **8.***** years.
- 3) In **9.***** years.
- 4) In **0.***** years.
- 5) In **5.***** years.

Exercise 2

Certain parcel of land is revalued from an initial value of 290000 euros until a final value of 404000 euros along 10 years. Determine the rate of periodic compound interest in 10 periods for that revaluation.

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) The interest rate is **9.***** %.
- 2) The interest rate is **6.***** %.
- 3) The interest rate is **5.***** %.
- 4) The interest rate is **0.***** %.
- 5) The interest rate is **3.***** %.

Exercise 3

We have a bank account that initially offers a continuous compound rate of 4%, and after 2 years the conditions are modified and then we obtain a periodic compound interest rate of 5% in 10 periods (compounding frequency). The initial deposit is 15000 euros. Compute the amount of money in the account after 7 years from the moment of the first deposit.

- 1) We will have ****9.***** euros.
- 2) We will have ****5.***** euros.
- 3) We will have ****1.***** euros.
- 4) We will have ****8.***** euros.
- 5) We will have ****6.***** euros.

Exercise 4

A firm sells Q tons of certain product. The price received per ton is given by the formula $P=5000-17Q$. On the other hand, the production cost per ton is $C=3000+5Q$. In addition, the transportation cost is 1032 per ton. Compute the maximum profit that can be obtained selling this product.

- 1) Profit = 15149 .
- 2) Profit = 10648 .
- 3) Profit = 5936 .
- 4) Profit = 5328 .
- 5) Profit = 3674 .

Exercise 5

Deposits in certain investment account vary from year to year alternating gains and losses periods. We have the following data about the deposits for different years:

year	deposits
1	23
2	36
4	56

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t . Employ that function to determine the maximum funds available in the investment account .

- 1) The maximum for the depositis in the account was 71 .
- 2) The maximum for the depositis in the account was -9 .
- 3) The maximum for the depositis in the account was 9 .
- 4) The maximum for the depositis in the account was 8 .
- 5) The maximum for the depositis in the account was 72 .

Exercise 6

The funds of a public institution alternate periods of deficit and surplus.

We have the following information for several years (in millions of euros):

year	funds
2	31
6	31
10	-1

Employ an interpolation polynomial to build a function that

yields the funds for each year t . We know that due to the legislation the funds of such an institution have to be kept between 10 and 43

- . Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from $t=2$ to $t=10$).

- 1) The funds are inside the limits for the interval: $[10, 10]$.
- 2) The funds are inside the limits for the interval: $[-1, 10]$.
- 3) The funds are inside the limits for the interval: $[-2, 6]$.
- 4) The funds are inside the limits for the interval: $[0, 10]$.
- 5) The funds are inside the limits for the interval: $[-2, 8]$.
- 6) The funds are inside the limits for the interval: $[0, 9]$.
- 7) The funds are inside the limits for the interval: $[9, 10]$.
- 8) The funds are inside the limits for the interval: $[2, 9]$.

Exercise 7

The population of a city is studied between years $t=3$ and $t=10$. In that

period the population is given by the function $P(t) = 10 + 384t - 72t^2 + 4t^3$

- . Determine the intervals of years when the population is between 542 and 586.

- 1) Along the interval of years: $[5.03858, 8.59314]$.
- 2) Along the intervals of years: $[6, 7]$ and $[8.8541, 9.4641]$.
- 3) Along the interval of years: $[8.4934, 9.38673]$.
- 4) Along the intervals of years: $[4., 6.]$ and $[8., 10.1321]$.
- 5) Along the intervals of years: $[4., 5.10645]$ and $[8.23582, 9.39631]$.
- 6) Along the intervals of years: $[3.31627, 5.]$ and $[7.13238, 9.78693]$.
- 7) Along the intervals of years: $[3, 6]$, $[7, 8.8541]$ and $[9.4641, 10]$.
- 8) Along the intervals of years: $[3.06068, 4.18809]$ and $[5.06473, 10.09]$.

Exercise 8

Compute the limit: $\lim_{x \rightarrow \infty} \left(\frac{-6 + 9x + 8x^2 - 6x^3}{-1 + 6x - 9x^2 - 6x^3} \right)^{2-3x+6x^2}$

- 1) $\frac{1}{e}$
- 2) 1
- 3) 0
- 4) ∞
- 5) $\frac{1}{e^2}$
- 6) $-\infty$
- 7) $\frac{1}{e^3}$

Exercise 9

From an initial deposit 16000, the interest rate varies every year in such a way that the total amount of money in the account is given by the function $C(t) =$

$$16000 \left(\frac{7 - 6t + 9t^2 + 9t^3}{8 - t + 6t^2 + 9t^3} \right)^{6+3t}. \text{ Determine the future tendency for the}$$

deposits that we will have after a large number of years.

- 1) ∞
- 2) $\frac{16000}{e^5}$
- 3) 0
- 4) 16000 €
- 5) $-\infty$
- 6) 16000
- 7) $\frac{16000}{e^4}$

Exercise 10

The population in certain turistic area

increases exponentially and is given by the function $P(t) = 73\,000 e^{t/50}$ that indicates the number of resident citizens for every year t . At the same time, depending on the season, the city receives a variable number of

tourists given by the trigonometric function $I(t) = 4000 + 3000 \sin\left[\frac{t}{2\pi}\right]$

that yields the amount of visitors in the area for every moment t (t in years).

Determine how many years are necessary until the total number of habitants is 120000. (the solution can be found for t between 23 and 28).

- 1) $t = **.1****$
- 2) $t = **.3****$
- 3) $t = **.5****$
- 4) $t = **.7****$
- 5) $t = **.9****$

Exercise 11

Study the continuity of the function $f(x) = \begin{cases} e^{x+1} + 3 \sin(x+1) & x \leq -1 \\ \frac{x}{3} + \frac{4}{3} & -1 < x < 2 \\ 2e^{x-2} & 2 \leq x \end{cases}$

- 1) The functions is continuous for all points.
- 2) The functions is not continuous at any point.
- 3) The function is continuous for all the points except for $x = -1$.
- 4) The function is continuous for all the points except for $x = 2$.
- 5) The function is continuous for all the points except for $x = -1$ and $x = 2$.

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01-Functions for serial number: 34

Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a compound interest rate of 6% and in the bank B we are paid a periodic compound interest rate of 1% in 10 periods (compounding frequency). We initially deposit 2000 euros in the bank A and 8000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **5.***** years.
- 2) In **7.***** years.
- 3) In **6.***** years.
- 4) In **0.***** years.
- 5) In **8.***** years.

Exercise 2

We have one bank account that offers a compound interest rate of 1% where we initially deposit 11000 euros. How long time is it necessary until the amount of money in the account reaches 18000 euros?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **5.***** years.
- 2) In **7.***** years.
- 3) In **6.***** years.
- 4) In **0.***** years.
- 5) In **9.***** years.

Exercise 3

We have a bank account that initially offers a continuous compound rate of 1%, and after 3 years the conditions are modified and then we obtain a compound interest rate of 5%. The initial deposit is 8000 euros. Compute the amount of money in the account after 8 years from the moment of the first deposit.

- 1) We will have ****9.***** euros.
- 2) We will have ****5.***** euros.
- 3) We will have ****0.***** euros.
- 4) We will have ****6.***** euros.
- 5) We will have ****1.***** euros.

Exercise 4

A firm sells Q tons of certain product. The price received per ton is given by the formula $P=20000-8Q$. On the other hand, the production cost per ton is $C=10000+18Q$. In addition, the transportation cost is 7972 per ton. Compute the maximum profit that can be obtained selling this product.

- 1) Profit = 58280 .
- 2) Profit = 20608 .
- 3) Profit = 26699 .
- 4) Profit = 51092 .
- 5) Profit = 39546 .

Exercise 5

Deposits in certain investment account vary from year to year alternating gains and losses periods. We have the following data about the deposits for different years:

year	deposits
1	-2
2	-11
3	-26

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t . Employ that function to forecast the exact amount for year 5 .

- 1) The depositis in the account for year 5 are 2 .
- 2) The depositis in the account for year 5 are -2 .
- 3) The depositis in the account for year 5 are 5 .
- 4) The depositis in the account for year 5 are -107 .
- 5) The depositis in the account for year 5 are -74 .

Exercise 6

The funds of a public institution alternate periods of deficit and surplus.

We have the following information for several years (in millions of euros):

year	funds
0	25
2	17
4	17

Employ an interpolation polynomial to build a function that

yields the funds for each year t . We know that due to the legislation the funds of such an institution have to be kept between 17 and 20

. Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from $t=0$ to $t=4$).

- 1) The funds are inside the limits for the interval: $[1, 4]$.
- 2) The funds are inside the limits for the interval: $[0, 4]$.
- 3) The funds are inside the limits for the interval: $[1, 2]$.
- 4) The funds are inside the limits for the interval: $[0, 1]$.
- 5) The funds are inside the limits for the intervals: $[1, 2]$ y $[4, 4]$.
- 6) The funds are inside the limits for the interval: $[4, 4]$.
- 7) The funds are inside the limits for the intervals: $[0, 2]$ y $[4, 5]$.
- 8) The funds are inside the limits for the intervals: $[1, 2]$ y $[4, 5]$.

Exercise 7

The population of a city is studied between years $t=1$ and $t=9$. In that

period the population is given by the function $P(t) = 1 + 180t - 48t^2 + 4t^3$

. Determine the intervals of years when the population is between 201 and 649.

- 1) Along the intervals of years: $[3., 4.]$ and $[5., 7.]$.
- 2) Along the intervals of years: $[1., 4.]$ and $[5.2561, 7.]$.
- 3) Along the interval of years: $[5.59828, 9.11801]$.
- 4) Along the interval of years: $[2.37628, 9.15376]$.
- 5) Along the interval of years: $[2, 9]$.
- 6) Along the intervals of years: $[1, 2]$, $[5, 5]$ and $[9, 9]$.
- 7) Along the intervals of years: $[1.4578, 3.]$ and $[4., 9.]$.
- 8) Along the interval of years: $[6., 8.07704]$.

Exercise 8

Compute the limit: $\lim_{x \rightarrow \infty} \left(\frac{6 + 4x + 3x^2 + 6x^3}{4 - 5x + 3x^2 + 6x^3} \right)^{-3+3x}$

- 1) $-\infty$
- 2) 0
- 3) $\frac{1}{e^4}$
- 4) $\frac{1}{e^2}$
- 5) ∞
- 6) 1
- 7) $\frac{1}{e^3}$

Exercise 9

From an initial deposit 17000, the interest rate varies every year in such a way that the total amount of money in the account is given by the function $C(t) =$

$$17000 \left(\frac{6 + 4t + 3t^2 + 6t^3}{4 - 5t + 3t^2 + 6t^3} \right)^{-3+3t}. \text{ Determine the future tendency for the}$$

deposits that we will have after a large number of years.

- 1) $\frac{17000}{e^5}$
- 2) $\frac{17000}{e^3}$
- 3) ∞
- 4) 0
- 5) $-\infty$
- 6) $\frac{17000}{e^2}$
- 7) 17000

Exercise 10

We deposit 13000 euros in a bank account with a compound interest rate of 3%. At the same time every year we also add in a safe-deposit box (therefore with no interest rate) 5000 euros. How long time is it necessary until the total amount of money (jointly in the bank account and safe-deposit box) is 62000 euros? (the solution can be found for t between 5 and 10).

- 1) $t = **.*0****$
- 2) $t = **.*2****$
- 3) $t = **.*4****$
- 4) $t = **.*6****$
- 5) $t = **.*8****$

Exercise 11

Study the continuity of the function $f(x) = \begin{cases} -\sin(x) - 2 \cos(x) & x \leq 0 \\ -2 \log(x+1) - 2 + 2 \log(3) & 0 < x < 2 \\ \log(x-1) - 2 & 2 \leq x \end{cases}$

- 1) The functions is continuous for all points.
- 2) The functions is not continuous at any point.
- 3) The function is continuous for all the points except for $x=0$.
- 4) The function is continuous for all the points except for $x=2$.
- 5) The function is continuous for all the points except for $x=0$ and $x=2$.

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01-Functions for serial number: 35

Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a periodic compound interest rate of 4% in 9 periods (compounding frequency) and in the bank B we are paid a continuous compound rate of 8% . We initially deposit 12000 euros in the bank A and 8000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **8.***** years.
- 2) In **0.***** years.
- 3) In **2.***** years.
- 4) In **7.***** years.
- 5) In **4.***** years.

Exercise 2

We have one bank account that offers a compound interest rate of 6% where we initially deposit 15000 euros. How long time is it necessary until the amount of money in the account reaches 24000 euros?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **4.***** years.
- 2) In **2.***** years.
- 3) In **6.***** years.
- 4) In **8.***** years.
- 5) In **0.***** years.

Exercise 3

We have a bank account that initially offers a periodic compound interest rate of 8% in 7 periods (compounding frequency) , and after 4 years the conditions are modified and then we obtain a periodic compound interest rate of 10% in 7 periods (compounding frequency) . The initial deposit is 12000 euros. Compute the amount of money in the account after 10 years from the moment of the first deposit.

- 1) We will have ****3.***** euros.
- 2) We will have ****9.***** euros.
- 3) We will have ****8.***** euros.
- 4) We will have ****0.***** euros.
- 5) We will have ****5.***** euros.

Exercise 4

A firm sells Q tons of certain product. The price received per ton is given by the formula $P=120000-16Q$. On the other hand, the production cost per ton is $C=80000+16Q$. In addition, the transportation cost is 38016 per ton. Compute the maximum profit that can be obtained selling this product.

- 1) Profit = 16 278 .
- 2) Profit = 30 752 .
- 3) Profit = 50 346 .
- 4) Profit = 48 943 .
- 5) Profit = 51 558 .

Exercise 5

Deposits in certain investment account vary from year to year alternating gains and losses periods. We have the following data about the deposits for different years:

year	deposits
0	2
1	1
2	-2

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t . Employ that function to forecast the exact amount for year 4.

- 1) The depositis in the account for year 4 are -23 .
- 2) The depositis in the account for year 4 are 1 .
- 3) The depositis in the account for year 4 are -14 .
- 4) The depositis in the account for year 4 are 4 .
- 5) The depositis in the account for year 4 are -16 .

Exercise 6

The funds of a public institution alternate periods of deficit and surplus.

We have the following information for several years (in millions of euros):

year	funds
1	8
4	-22
7	-16

Employ an interpolation polynomial to build a function that

yields the funds for each year t . We know that due to the legislation the funds of such an institution have to be kept between -22 and 8

. Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from $t=1$ to $t=7$).

- 1) The funds are inside the limits for the interval: $[1, 4]$.
- 2) The funds are inside the limits for the interval: $[1, 6]$.
- 3) The funds are inside the limits for the intervals: $[0, 4]$ y $[6, 9]$.
- 4) The funds are inside the limits for the interval: $[1, 7]$.
- 5) The funds are inside the limits for the interval: $[6, 7]$.
- 6) The funds are inside the limits for the intervals: $[1, 4]$ y $[6, 7]$.
- 7) The funds are inside the limits for the interval: $[0, 6]$.
- 8) The funds are inside the limits for the interval: $[0, 1]$.

Exercise 7

The population of a city is studied between years $t=3$ and $t=9$. In that

period the population is given by the function $P(t) = 10 + 336t - 66t^2 + 4t^3$

. Determine the intervals of years when the population is between 514 and 540.

- 1) Along the intervals of years: $[3, 3]$, $[3.18826, 5]$, $[6, 7.81174]$ and $[8.31174, 9]$.
- 2) Along the interval of years: $[3.04293, 5.02602]$.
- 3) Along the intervals of years: $[3.43393, 4.]$ and $[5., 8.]$.
- 4) Along the interval of years: $[3.26774, 4.35333]$.
- 5) Along the interval of years: $[5., 9.]$.
- 6) Along the intervals of years: $[3., 6.]$ and $[7., 9.30774]$.
- 7) Along the intervals of years: $[3, 3.18826]$, $[5, 6]$ and $[7.81174, 8.31174]$.
- 8) Along the interval of years: $[5.71338, 8.]$.

Exercise 8

Compute the limit: $\lim_{x \rightarrow \infty} \left(\frac{-3 + x - 2x^2 - 9x^3}{3 - x - 7x^2 - 9x^3} \right)^{9+7x}$

- 1) $\frac{1}{e}$
- 2) $\frac{1}{e^{35/9}}$
- 3) ∞
- 4) 1
- 5) 0
- 6) $-\infty$
- 7) $\frac{1}{e^3}$

Exercise 9

A factory produces certain type of devices. The marginal cost (cost of producing one unit) decreases when we produce a large amount

of units and it is given by the function $C(x) = \frac{7 + 3x + 2x^2 + x^3 + x^4}{3 + 5x + 7x^2 + 5x^3 + x^4}$

. Determine the expected cost per unit when a large amount of units is produced.

- 1) 0
- 2) $-\frac{1}{2}$
- 3) ∞
- 4) $-\infty$
- 5) 1
- 6) $\frac{101}{100}$
- 7) 11 000

Exercise 10

We deposit 7000 euros in a bank account with a periodic compound interest rate of 2% in 7 periods (compounding frequency). At the same time every year we also add in a safe-deposit box (therefore with no interest rate) 3000 euros. How long time is it necessary until the total amount of money (jointly in the bank account and safe-deposit box) is 36000 euros? (the solution can be found for t between 6 and 11).

- 1) $t = **.*$
- 2) $t = **.*$
- 3) $t = **.*$
- 4) $t = **.*$
- 5) $t = **.*$

Exercise 11

Study the continuity of the function $f(x) = \begin{cases} 2 \sin(x) & x \leq 0 \\ -2x & 0 < x < 1 \\ -2 & 1 \leq x \end{cases}$

- 1) The function is continuous for all points.
- 2) The function is not continuous at any point.
- 3) The function is continuous for all the points except for $x=0$.
- 4) The function is continuous for all the points except for $x=1$.
- 5) The function is continuous for all the points except for $x=0$ and $x=1$.

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01-Functions for serial number: 36

Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a continuous compound rate of 9% and in the bank B we are paid a compound interest rate of 6%. We initially deposit 1000 euros in the bank A and 8000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **5.***** years.
- 2) In **3.***** years.
- 3) In **8.***** years.
- 4) In **1.***** years.
- 5) In **0.***** years.

Exercise 2

We have one bank account that offers a periodic compound interest rate of 3% in 9 periods (compounding frequency) where we initially deposit 12000 euros. How long time is it necessary until the amount of money in the account reaches 14000 euros?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **5.***** years.
- 2) In **3.***** years.
- 3) In **8.***** years.
- 4) In **1.***** years.
- 5) In **0.***** years.

Exercise 3

We have a bank account that initially offers a continuous compound rate of 1%, and after 4 years the conditions are modified and then we obtain a continuous compound rate of 1%. The initial deposit is 8000 euros. Compute the amount of money in the account after 9 years from the moment of the first deposit.

- 1) We will have ****0.***** euros.
- 2) We will have ****1.***** euros.
- 3) We will have ****3.***** euros.
- 4) We will have ****7.***** euros.
- 5) We will have ****8.***** euros.

Exercise 4

A firm sells Q tons of certain product. The price received per ton is given by the formula $P=12000-9Q$. On the other hand, the production cost per ton is $C=8000+12Q$. In addition, the transportation cost is 3496 per ton. Compute the maximum profit that can be obtained selling this product.

- 1) Profit = 3024 .
- 2) Profit = 2104 .
- 3) Profit = 5035 .
- 4) Profit = 2310 .
- 5) Profit = 1953 .

Exercise 5

Deposits in certain investment account vary from year to year alternating gains and losses periods. We have the following data about the deposits for different years:

year	deposits
0	0
1	2
3	18

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t . Employ that function to forecast the exact amount for year 4 .

- 1) The depositis in the account for year 4 are 32 .
- 2) The depositis in the account for year 4 are 50 .
- 3) The depositis in the account for year 4 are -12 .
- 4) The depositis in the account for year 4 are -16 .
- 5) The depositis in the account for year 4 are 2 .

Exercise 6

The funds of a public institution alternate periods of deficit and surplus.

We have the following information for several years (in millions of euros):

year	funds
0	17
4	33
8	-15

Employ an interpolation polynomial to build a function that

yields the funds for each year t . We know that due to the legislation the funds of such an institution have to be kept between 3 and 17

. Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from $t=0$ to $t=8$).

- 1) The funds are inside the limits for the interval: $[7, 8]$.
- 2) The funds are inside the limits for the interval: $[0, 7]$.
- 3) The funds are inside the limits for the intervals: $[-1, 0]$ y $[6, 7]$.
- 4) The funds are inside the limits for the interval: $[0, 0]$.
- 5) The funds are inside the limits for the intervals: $[0, 0]$ y $[6, 7]$.
- 6) The funds are inside the limits for the interval: $[0, 8]$.
- 7) The funds are inside the limits for the intervals: $[-1, 0]$ y $[6, 8]$.
- 8) The funds are inside the limits for the interval: $[-1, 0]$.

Exercise 7

The population of certain type of rodents is analyzed in a region between years $t=1$

and $t=10$. Along that period the population is given by the function $P(t) =$

$4 + 72t - 30t^2 + 4t^3$ (thousands of rodents). Determine the intervals of years during which the number of rodents is between 4 and 708.

- 1) Along the interval of years: $[5.16295, 8.06007]$.
- 2) Along the interval of years: $[1., 8.]$.
- 3) Along the intervals of years: $[3.50614, 4.]$ and $[6.07107, 8.]$.
- 4) Along the intervals of years: $[1, 1]$ and $[8, 10]$.
- 5) Along the intervals of years: $[1.5298, 3.00453]$ and $[5.61506, 10.654]$.
- 6) Along the intervals of years: $[1.69309, 2.]$ and $[3., 8.]$.
- 7) Along the interval of years: $[1, 8]$.
- 8) Along the interval of years: $[6.6233, 8.]$.

Exercise 8

Compute the limit: $\lim_{x \rightarrow -\infty} \left(\frac{-2 + 5x + x^2}{4 + x + x^2} \right)^{-2+8x+7x^2}$

1) ∞

2) 0

3) $\frac{1}{e^5}$

4) $\frac{1}{e^4}$

5) $-\infty$

6) $\frac{1}{e^3}$

7) 1

Exercise 9

From an initial deposit 2000, the interest rate varies every year in such a way that the total amount of money in the account is given by the function $C(t) =$

$$2000 \left(\frac{-1 + 5t - 5t^2}{4 + t - 5t^2} \right)^{-2+8t+7t^2}. \text{ Determine the future tendency for the}$$

deposits that we will have after a large number of years.

1) ∞

2) 0

3) $\frac{2000}{e^5}$

4) $\frac{2000}{e^4}$

5) $-\infty$

6) $\frac{2000}{e^3}$

7) 2000

Exercise 10

We deposit 15000 euros in a bank account with a continuous compound rate of 9%. At the same time every year we also add in a safe-deposit box (therefore with no interest rate) 2000 euros. How long time is it necessary until the total ammount of money (jointly in the bank account and safe-depsit box) is 52000 euros? (the solution can be found for t between 5 and 10).

- 1) $t = \dots 0 \dots$
- 2) $t = \dots 2 \dots$
- 3) $t = \dots 4 \dots$
- 4) $t = \dots 6 \dots$
- 5) $t = \dots 8 \dots$

Exercise 11

Study the continuity of the function $f(x) = \begin{cases} -2 \sin(x) - 2 \cos(x) & x \leq 0 \\ -2 & 0 < x < 2 \\ 2 \sin(2-x) - 2e^{x-2} & 2 \leq x \end{cases}$

- 1) The functions is continuous for all points.
- 2) The functions is not continuous at any point.
- 3) The function is continuous for all the points except for $x=0$.
- 4) The function is continuous for all the points except for $x=2$.
- 5) The function is continuous for all the points except for $x=0$ and $x=2$.

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01-Functions for serial number: 37

Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a periodic compound interest rate of 2% in 7 periods (compounding frequency) and in the bank B we are paid a periodic compound interest rate of 9% in 12 periods (compounding frequency). We initially deposit 5000 euros in the bank A and 1000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **2.***** years.
- 2) In **8.***** years.
- 3) In **0.***** years.
- 4) In **3.***** years.
- 5) In **1.***** years.

Exercise 2

We have one bank account that offers a continuous compound rate of 4% where we initially deposit 5000 euros. How long time is it necessary until the amount of money in the account reaches 12000 euros?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **2.***** years.
- 2) In **8.***** years.
- 3) In **0.***** years.
- 4) In **1.***** years.
- 5) In **7.***** years.

Exercise 3

We have a bank account that initially offers a continuous compound rate of 4%, and after 4 years the conditions are modified and then we obtain a periodic compound interest rate of 4% in 5 periods (compounding frequency). The initial deposit is 5000 euros. Compute the amount of money in the account after 7 years from the moment of the first deposit.

- 1) We will have ****4.***** euros.
- 2) We will have ****1.***** euros.
- 3) We will have ****2.***** euros.
- 4) We will have ****5.***** euros.
- 5) We will have ****7.***** euros.

Exercise 4

A firm sells Q tons of certain product. The price received per ton is given by the formula $P=15000-2Q$. On the other hand, the production cost per ton is $C=3000+6Q$. In addition, the transportation cost is 11648 per ton. Compute the maximum profit that can be obtained selling this product.

- 1) Profit = 2808 .
- 2) Profit = 3636 .
- 3) Profit = 3872 .
- 4) Profit = 6318 .
- 5) Profit = 6136 .

Exercise 5

Deposits in certain investment account vary from year to year alternating gains and losses periods. We have the following data about the deposits for different years:

year	deposits
1	-2
3	-24
5	-62

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t . Employ that function to forecast the exact amount for year 7 .

- 1) The depositis in the account for year 7 are -116 .
- 2) The depositis in the account for year 7 are -149 .
- 3) The depositis in the account for year 7 are -2 .
- 4) The depositis in the account for year 7 are 4 .
- 5) The depositis in the account for year 7 are -10 .

Exercise 6

The funds of a public institution alternate periods of deficit and surplus.

We have the following information for several years (in millions of euros):

year	funds
0	19
2	19
4	43

Employ an interpolation polynomial to build a function that

yields the funds for each year t . We know that due to the legislation the funds of such an institution have to be kept between 19 and 28

- . Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from $t=0$ to $t=4$).

- 1) The funds are inside the limits for the intervals: $[-1, 0]$ y $[3, 4]$.
- 2) The funds are inside the limits for the interval: $[-2, 3]$.
- 3) The funds are inside the limits for the interval: $[0, 2]$.
- 4) The funds are inside the limits for the interval: $[2, 4]$.
- 5) The funds are inside the limits for the intervals: $[0, 0]$ y $[2, 3]$.
- 6) The funds are inside the limits for the interval: $[-1, 2]$.
- 7) The funds are inside the limits for the interval: $[-1, 0]$.
- 8) The funds are inside the limits for the interval: $[-1, 4]$.

Exercise 7

The population of certain type of rodents is analyzed in a region between years

$t=0$ and $t=7$. Along that period the population is given by the function $P(t) = 7 + 216t - 54t^2 + 4t^3$ (thousands of rodents). Determine the intervals of years during which the number of rodents is between 237 and 263.

- 1) Along the interval of years: $[1.0324, 5.]$.
- 2) Along the interval of years: $[1., 6.69146]$.
- 3) Along the intervals of years: $[1.43254, 2.15249]$ and $[6.20185, 7.]$.
- 4) Along the intervals of years: $[0, 1.68826]$, $[2.18826, 4]$, $[5, 6.81174]$ and $[7, 7]$.
- 5) Along the intervals of years: $[0.403922, 2.41]$ and $[4., 7.65024]$.
- 6) Along the interval of years: $[5., 6.13741]$.
- 7) Along the intervals of years: $[1.68826, 2.18826]$, $[4, 5]$ and $[6.81174, 7]$.
- 8) Along the interval of years: $[1.18426, 4.69477]$.

Exercise 8

Compute the limit: $\lim_{x \rightarrow -\infty} \left(\frac{-9 + 5x - 5x^2}{8 - 8x - 5x^2} \right)^{-6+7x+4x^2}$

- 1) $\frac{1}{e^5}$
- 2) 1
- 3) $\frac{1}{e^4}$
- 4) 0
- 5) $\frac{1}{e^3}$
- 6) $-\infty$
- 7) ∞

Exercise 9

The population of certain country (in millions of habitants) is given by the function $P(t) =$

$12 \left(\frac{-9 + 5t - 5t^2}{8 - 8t - 5t^2} \right)^{-6+7t+4t^2}$. Determine the future tendency for this population.

- 1) $\frac{12}{e^5}$
- 2) $-\infty$
- 3) $\frac{12}{e^4}$
- 4) 12
- 5) $\frac{12}{e^3}$
- 6) ∞
- 7) 0

Exercise 10

We deposit 1000 euros in a bank account with a compound interest rate of 2%. At the same time every year we also add in a safe-deposit box (therefore with no interest rate) 3000 euros. How long time is it necessary until the total amount of money (jointly in the bank account and safe-deposit box) is 53000 euros? (the solution can be found for t between 13 and 18).

- 1) $t = \dots 1 \dots$
- 2) $t = \dots 3 \dots$
- 3) $t = \dots 5 \dots$
- 4) $t = \dots 7 \dots$
- 5) $t = \dots 9 \dots$

Exercise 11

Study the continuity of the function $f(x) = \begin{cases} 3 \sin(x+3) - \cos(x+3) & x \leq -3 \\ -\frac{x}{2} - \frac{5}{2} & -3 < x < -1 \\ -\sin(x+1) & -1 \leq x \end{cases}$

- 1) The functions is continuous for all points.
- 2) The functions is not continuous at any point.
- 3) The function is continuous for all the points except for $x = -3$.
- 4) The function is continuous for all the points except for $x = -1$.
- 5) The function is continuous for all the points except for $x = -3$ and $x = -1$.

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01-Functions for serial number: 38

Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a compound interest rate of 7% and in the bank B we are paid a periodic compound interest rate of 1% in 10 periods (compounding frequency). We initially deposit 2000 euros in the bank A and 13000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **0.***** years.
- 2) In **1.***** years.
- 3) In **5.***** years.
- 4) In **2.***** years.
- 5) In **8.***** years.

Exercise 2

Certain parcel of land is revalued from an initial value of 107000 euros until a final value of 372000 euros along 8 years. Determine the rate of compound interest for that revaluation.

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) The interest rate is **7.***** %.
- 2) The interest rate is **6.***** %.
- 3) The interest rate is **0.***** %.
- 4) The interest rate is **2.***** %.
- 5) The interest rate is **1.***** %.

Exercise 3

We have a bank account that initially offers a periodic compound interest rate of 2% in 4 periods (compounding frequency), and after 4 years the conditions are modified and then we obtain a compound interest rate of 5%. The initial deposit is 13000 euros. Compute the amount of money in the account after 8 years from the moment of the first deposit.

- 1) We will have ****2.***** euros.
- 2) We will have ****9.***** euros.
- 3) We will have ****5.***** euros.
- 4) We will have ****4.***** euros.
- 5) We will have ****8.***** euros.

Exercise 4

A firm sells Q tons of certain product. The price received per ton is given by the formula $P=140000-18Q$. On the other hand, the production cost per ton is $C=20000+6Q$. In addition, the transportation cost is 118848 per ton. Compute the maximum profit that can be obtained selling this product.

- 1) Profit = 15 870 .
- 2) Profit = 22 517 .
- 3) Profit = 13 824 .
- 4) Profit = 13 357 .
- 5) Profit = 22 180 .

Exercise 5

Deposits in certain investment account vary from year to year alternating gains and losses periods. We have the following data about the deposits for different years:

year	deposits
0	9
1	11
3	3

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t . Employ that function to determine the maximum funds available in the investment account .

- 1) The maximum for the depositis in the account was 1 .
- 2) The maximum for the depositis in the account was -9 .
- 3) The maximum for the depositis in the account was 7 .
- 4) The maximum for the depositis in the account was 11 .
- 5) The maximum for the depositis in the account was -21 .

Exercise 6

The funds of a public institution alternate periods of deficit and surplus.

We have the following information for several years (in millions of euros):

year	funds
2	22
4	6
6	-26

Employ an interpolation polynomial to build a function that

yields the funds for each year t . We know that due to the legislation the funds of such an institution have to be kept between -8 and 16

- . Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from $t=2$ to $t=6$).

- 1) The funds are inside the limits for the interval: $[-1, 6]$.
- 2) The funds are inside the limits for the interval: $[3, 5]$.
- 3) The funds are inside the limits for the interval: $[-1, 0]$.
- 4) The funds are inside the limits for the intervals: $[-3, -1]$ y $[3, 6]$.
- 5) The funds are inside the limits for the interval: $[-3, -1]$.
- 6) The funds are inside the limits for the interval: $[5, 6]$.
- 7) The funds are inside the limits for the interval: $[0, 5]$.
- 8) The funds are inside the limits for the interval: $[-1, 5]$.

Exercise 7

The population of a city is studied between years $t=4$ and $t=7$. In that

period the population is given by the function $P(t) = 3 + 360t - 66t^2 + 4t^3$

- . Determine the intervals of years when the population is between 491 and 661.

- 1) Along the interval of years: $[4, 7]$.
- 2) Along the intervals of years: $[4., 5.]$ and $[6., 7.]$.
- 3) Along the intervals of years: $[4., 5.52337]$ and $[6.10267, 7.04309]$.
- 4) Along the intervals of years: $[4.63208, 5.17683]$ and $[6., 7.61796]$.
- 5) Along the interval of years: $[6., 7.]$.
- 6) Along the intervals of years: $[4., 5.33499]$ and $[6.40206, 7.55216]$.
- 7) Along the intervals of years: $[4, 4]$ and $[7, 7]$.
- 8) Along the interval of years: $[5.50373, 7.27971]$.

Exercise 8

Compute the limit: $\lim_{x \rightarrow -\infty} \left(\frac{-2 - x - 6x^2}{9 - 8x - 6x^2} \right)^{-3+5x+9x^2}$

- 1) $\frac{1}{e^5}$
- 2) $\frac{1}{e^2}$
- 3) ∞
- 4) $-\infty$
- 5) $\frac{1}{e^3}$
- 6) 1
- 7) 0

Exercise 9

The population of certain country (in millions of habitants) is given by the function $P(t) =$

$8 \left(\frac{4 - 2t - t^2 - 9t^3}{9 - 8t + 9t^2 - 9t^3} \right)^{-5+8t}$. Determine the future tendency for this population.

- 1) 0
- 2) 8
- 3) $-\infty$
- 4) $8e^{80/9}$
- 5) $\frac{8}{e^5}$
- 6) ∞
- 7) $8e^{8889/1000}$

Exercise 10

The population in certain turistic area

increases exponentially and is given by the function $P(t) = 50\,000 e^{t/50}$ that indicates the number of resident citizens for every year t . At the same time, depending on the season, the city receives a variable number of

tourists given by the trigonometric function $I(t) = 5000 + 2000 \sin\left[\frac{t}{2\pi}\right]$

that yields the amount of visitors in the area for every moment t (t in years).

Determine how many years are necessary until the total number of habitants is 103000. (the solution can be found for t between 32 and 37).

- 1) $t = **.*$
- 2) $t = **.*$
- 3) $t = **.*$
- 4) $t = **.*$
- 5) $t = **.*$

Exercise 11

Study the continuity of the function $f(x) = \begin{cases} e^{x+3} - 3 \sin(x+3) & x \leq -3 \\ 3 - 2 \cos(x+3) & -3 < x < -1 \\ 2 \sin(x+1) + \cos(x+1) & -1 \leq x \end{cases}$

- 1) The functions is continuous for all points.
- 2) The functions is not continuous at any point.
- 3) The function is continuous for all the points except for $x = -3$.
- 4) The function is continuous for all the points except for $x = -1$.
- 5) The function is continuous for all the points except for $x = -3$ and $x = -1$.

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01-Functions for serial number: 39

Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a compound interest rate of 7% and in the bank B we are paid a continuous compound rate of 1%. We initially deposit 10 000 euros in the bank A and 15 000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **1.***** years.
- 2) In **4.***** years.
- 3) In **0.***** years.
- 4) In **5.***** years.
- 5) In **7.***** years.

Exercise 2

Certain parcel of land is revalued from an initial value of 232 000 euros until a final value of 375 000 euros along 10 years. Determine the rate of compound interest for that revaluation.

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) The interest rate is **1.***** %.
- 2) The interest rate is **4.***** %.
- 3) The interest rate is **8.***** %.
- 4) The interest rate is **2.***** %.
- 5) The interest rate is **7.***** %.

Exercise 3

We have a bank account that initially offers a compound interest rate of 2%, and after 3 years the conditions are modified and then we obtain a periodic compound interest rate of 3% in 7 periods (compounding frequency). The initial deposit is 15 000 euros. Compute the amount of money in the account after 4 years from the moment of the first deposit.

- 1) We will have ****1.***** euros.
- 2) We will have ****4.***** euros.
- 3) We will have ****6.***** euros.
- 4) We will have ****3.***** euros.
- 5) We will have ****0.***** euros.

Exercise 4

A firm sells Q tons of certain product. The price received per ton is given by the formula $P=1000-6Q$. On the other hand, the production cost per ton is $C=700-4Q$. In addition, the transportation cost is 280 per ton. Compute the maximum profit that can be obtained selling this product.

- 1) Profit = 74 .
- 2) Profit = 56 .
- 3) Profit = 67 .
- 4) Profit = 50 .
- 5) Profit = 68 .

Exercise 5

Deposits in certain investment account vary from year to year alternating gains and losses periods. We have the following data about the deposits for different years:

year	deposits
1	5
3	1
5	-11

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t . Employ that function to determine the maximum funds available in the investment account .

- 1) The maximum for the depositis in the account was 5 .
- 2) The maximum for the depositis in the account was 13 .
- 3) The maximum for the depositis in the account was -1 .
- 4) The maximum for the depositis in the account was 1 .
- 5) The maximum for the depositis in the account was -31 .

Exercise 6

The funds of a public institution alternate periods of deficit and surplus.

We have the following information for several years (in millions of euros):

year	funds
2	27
6	19
8	3

Employ an interpolation polynomial to build a function that

yields the funds for each year t . We know that due to the legislation the funds of such an institution have to be kept between 24 and 27

- . Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from $t=2$ to $t=8$).

- 1) The funds are inside the limits for the interval: $[2, 5]$.
- 2) The funds are inside the limits for the intervals: $[0, 1]$ y $[4, 5]$.
- 3) The funds are inside the limits for the interval: $[2, 8]$.
- 4) The funds are inside the limits for the interval: $[5, 8]$.
- 5) The funds are inside the limits for the intervals: $[2, 2]$ y $[4, 5]$.
- 6) The funds are inside the limits for the interval: $[0, 5]$.
- 7) The funds are inside the limits for the interval: $[1, 2]$.
- 8) The funds are inside the limits for the interval: $[0, 2]$.

Exercise 7

The population of certain type of rodents is analyzed in a region between years $t=0$ and $t=8$. Along that period the population is given by the function $P(t) = 2 + 144t - 42t^2 + 4t^3$ (thousands of rodents). Determine the intervals of years during which the number of rodents is between 108 and 1242.

- 1) Along the interval of years: $[3., 7.79759]$.
- 2) Along the interval of years: $[2.27215, 4.]$.
- 3) Along the interval of years: $[1.48931, 7.]$.
- 4) Along the intervals of years: $[1.77863, 2.]$ and $[4.0974, 8.]$.
- 5) Along the intervals of years: $[0, 1]$ and $[8, 8]$.
- 6) Along the intervals of years: $[0.562088, 2.]$ and $[4., 5.36065]$.
- 7) Along the interval of years: $[1, 8]$.
- 8) Along the intervals of years: $[-4.45015 \times 10^{-308}, 3.50105]$ and $[5., 8.]$.

Exercise 8

Compute the limit: $\lim_{x \rightarrow \infty} \left(\frac{4 + 3x + 4x^2 - 5x^3}{-6 - 9x + 5x^2 - 5x^3} \right)^{-1+6x}$

- 1) 1
- 2) $\frac{1}{e^4}$
- 3) 0
- 4) $e^{6/5}$
- 5) $-\infty$
- 6) $\frac{1}{e^5}$
- 7) ∞

Exercise 9

From an initial deposit 2000, the interest rate varies every year in such a way that the total amount of money in the account is given by the function $C(t) =$

$$2000 \left(\frac{-5 + 8t - 4t^2 + 4t^3}{3 + 4t - 6t^2 + 4t^3} \right)^{-9+4t}. \text{ Determine the future tendency for the}$$

deposits that we will have after a large number of years.

- 1) $\frac{2000}{e^3}$
- 2) ∞
- 3) $2000 e^2$
- 4) $-\infty$
- 5) 2000
- 6) 0
- 7) $\frac{2000}{e^5}$

Exercise 10

The population in certain turistic area

increases exponentially and is given by the function $P(t) = 66\,000 e^{t/50}$ that indicates the number of resident citizens for every year t . At the same time, depending on the season, the city receives a variable number of

tourists given by the trigonometric function $I(t) = 2000 + 1000 \sin\left[\frac{t}{2\pi}\right]$

that yields the amount of visitors in the area for every moment t (t in years).

Determine how many years are necessary until the total number of habitants is 111000. (the solution can be found for t between 25 and 30).

- 1) $t = ** .0****$
- 2) $t = ** .2****$
- 3) $t = ** .4****$
- 4) $t = ** .6****$
- 5) $t = ** .8****$

Exercise 11

Study the continuity of the function $f(x) = \begin{cases} 2e^{x+1} - 3\sin(x+1) & x \leq -1 \\ 1-x & -1 < x < 2 \\ -2\log(x-1) - 1 & 2 \leq x \end{cases}$

- 1) The functions is continuous for all points.
- 2) The functions is not continuous at any point.
- 3) The function is continuous for all the points except for $x = -1$.
- 4) The function is continuous for all the points except for $x = 2$.
- 5) The function is continuous for all the points except for $x = -1$ and $x = 2$.

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01-Functions for serial number: 40

Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a continuous compound rate of 10% and in the bank B we are paid a periodic compound interest rate of 6% in 11 periods (compounding frequency). We initially deposit 3000 euros in the bank A and 11000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **6.***** years.
- 2) In **0.***** years.
- 3) In **4.***** years.
- 4) In **3.***** years.
- 5) In **2.***** years.

Exercise 2

We have one bank account that offers a periodic compound interest rate of 3% in 12 periods (compounding frequency) where we initially deposit 10000 euros. How long time is it necessary until the amount of money in the account reaches 18000 euros?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **5.***** years.
- 2) In **0.***** years.
- 3) In **4.***** years.
- 4) In **3.***** years.
- 5) In **9.***** years.

Exercise 3

We have a bank account that initially offers a continuous compound rate of 3%, and after 2 years the conditions are modified and then we obtain a continuous compound rate of 7%. The initial deposit is 11000 euros. Compute the amount of money in the account after 5 years from the moment of the first deposit.

- 1) We will have ****0.***** euros.
- 2) We will have ****4.***** euros.
- 3) We will have ****5.***** euros.
- 4) We will have ****3.***** euros.
- 5) We will have ****9.***** euros.

Exercise 4

A firm sells Q tons of certain product. The price received per ton is given by the formula $P=12000-15Q$. On the other hand, the production cost per ton is $C=6000-2Q$. In addition, the transportation cost is 5324 per ton. Compute the maximum profit that can be obtained selling this product.

- 1) Profit = 8788 .
- 2) Profit = 9390 .
- 3) Profit = 5999 .
- 4) Profit = 12038 .
- 5) Profit = 14521 .

Exercise 5

Deposits in certain investment account vary from year to year alternating gains and losses periods. We have the following data about the deposits for different years:

year	deposits
1	6
2	15
4	45

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t . Employ that function to forecast the exact amount for year 6 .

- 1) The depositis in the account for year 6 are 120 .
- 2) The depositis in the account for year 6 are 91 .
- 3) The depositis in the account for year 6 are 0 .
- 4) The depositis in the account for year 6 are 11 .
- 5) The depositis in the account for year 6 are -2 .

Exercise 6

The funds of a public institution alternate periods of deficit and surplus.

We have the following information for several years (in millions of euros):

year	funds
1	-11
5	-75
9	-75

Employ an interpolation polynomial to build a function that

yields the funds for each year t . We know that due to the legislation the funds of such an institution have to be kept between -88 and -75

. Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from $t=1$ to $t=9$).

- 1) The funds are inside the limits for the interval: $[0, 9]$.
- 2) The funds are inside the limits for the interval: $[-1, 8]$.
- 3) The funds are inside the limits for the interval: $[-1, 3]$.
- 4) The funds are inside the limits for the interval: $[1, 3]$.
- 5) The funds are inside the limits for the interval: $[0, 7]$.
- 6) The funds are inside the limits for the interval: $[-2, 10]$.
- 7) The funds are inside the limits for the interval: $[5, 9]$.
- 8) The funds are inside the limits for the interval: $[9, 9]$.

Exercise 7

The population of a city is studied between years $t=3$ and $t=8$. In that period the population is given by the function $P(t) = 5 + 288t - 60t^2 + 4t^3$

. Determine the intervals of years when the population is between 445 and 453.

- 1) Along the intervals of years: $[3.26795, 5]$ and $[6.73205, 7]$.
- 2) Along the interval of years: $[3., 8.76729]$.
- 3) Along the interval of years: $[5.08314, 7.64532]$.
- 4) Along the interval of years: $[7., 8.57169]$.
- 5) Along the intervals of years: $[3., 4.19346]$ and $[5., 6.]$.
- 6) Along the intervals of years: $[3., 4.54133]$ and $[7., 8.]$.
- 7) Along the intervals of years: $[3, 3.26795]$, $[4, 4]$, $[5, 6.73205]$ and $[7, 8]$.
- 8) Along the intervals of years: $[4., 5.40084]$ and $[6.1474, 7.38556]$.

Exercise 8

Compute the limit: $\lim_{x \rightarrow -\infty} \left(\frac{2 - 8x + 5x^2 + 3x^3}{8 + x - 7x^2 + 3x^3} \right)^{-3+9x}$

- 1) e^{36}
- 2) 0
- 3) $\frac{1}{e^2}$
- 4) 1
- 5) $\frac{1}{e^5}$
- 6) $-\infty$
- 7) ∞

Exercise 9

From an initial deposit 11000, the interest rate varies every year in such a way that the total amount of money in the account is given by the function $C(t) =$

$$11000 \left(\frac{2 - 8t + 5t^2 - 3t^3}{8 + t - 7t^2 - 3t^3} \right)^{-3+9t}. \text{ Determine the future tendency for the}$$

deposits that we will have after a large number of years.

- 1) 0
- 2) $\frac{11000}{e^{36}}$
- 3) $-\infty$
- 4) 11000
- 5) $\frac{11000}{e^2}$
- 6) ∞
- 7) $\frac{11000}{e^5}$

Exercise 10

We deposit 13000 euros in a bank account with a periodic compound interest rate of 3% in 4 periods (compounding frequency). At the same time every year we also add in a safe-deposit box (therefore with no interest rate) 2000 euros. How long time is it necessary until the total amount of money (jointly in the bank account and safe-deposit box) is 55000 euros? (the solution can be found for t between 12 and 17).

- 1) $t = **.*$
- 2) $t = **.*$
- 3) $t = **.*$
- 4) $t = **.*$
- 5) $t = **.*$

Exercise 11

Study the continuity of the function $f(x) = \begin{cases} -2 \sin(3-x) & x \leq 3 \\ \frac{13}{2} - \frac{3x}{2} & 3 < x < 5 \\ 2 \log(x-4) - 1 & 5 \leq x \end{cases}$

- 1) The function is continuous for all points.
- 2) The function is not continuous at any point.
- 3) The function is continuous for all the points except for $x=3$.
- 4) The function is continuous for all the points except for $x=5$.
- 5) The function is continuous for all the points except for $x=3$ and $x=5$.

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01-Functions for serial number: 41

Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a continuous compound rate of 9% and in the bank B we are paid a continuous compound rate of 6%. We initially deposit 11000 euros in the bank A and 15000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **5.***** years.
- 2) In **0.***** years.
- 3) In **4.***** years.
- 4) In **6.***** years.
- 5) In **3.***** years.

Exercise 2

Certain parcel of land is devalued from an initial value of 398000 euros until a final value of 148000 euros along 8 years. Determine the rate of periodic compound interest in 6 periods for that devaluation.

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) The interest rate is **5.***** %.
- 2) The interest rate is **6.***** %.
- 3) The interest rate is **2.***** %.
- 4) The interest rate is **0.***** %.
- 5) The interest rate is **7.***** %.

Exercise 3

We have a bank account that initially offers a continuous compound rate of 5%, and after 3 years the conditions are modified and then we obtain a periodic compound interest rate of 9% in 2 periods (compounding frequency). The initial deposit is 15000 euros. Compute the amount of money in the account after 5 years from the moment of the first deposit.

- 1) We will have ****0.***** euros.
- 2) We will have ****6.***** euros.
- 3) We will have ****7.***** euros.
- 4) We will have ****2.***** euros.
- 5) We will have ****4.***** euros.

Exercise 4

A firm sells Q tons of certain product. The price received per ton is given by the formula $P=7000-12Q$. On the other hand, the production cost per ton is $C=4000-10Q$. In addition, the transportation cost is 2840 per ton. Compute the maximum profit that can be obtained selling this product.

- 1) Profit = 5310 .
- 2) Profit = 3200 .
- 3) Profit = 5277 .
- 4) Profit = 3731 .
- 5) Profit = 2432 .

Exercise 5

Deposits in certain investment account vary from year to year alternating gains and losses periods. We have the following data about the deposits for different years:

year	deposits
1	25
3	9
5	1

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t . Employ that function to determine the minimum funds available in the investment account .

- 1) The minimum for the depositis in the account was 2 .
- 2) The minimum for the depositis in the account was 0 .
- 3) The minimum for the depositis in the account was 4 .
- 4) The minimum for the depositis in the account was 6 .
- 5) The minimum for the depositis in the account was 3 .

Exercise 6

The funds of a public institution alternate periods of deficit and surplus.

We have the following information for several years (in millions of euros):

year	funds
0	21
4	53
8	21

Employ an interpolation polynomial to build a function that

yields the funds for each year t . We know that due to the legislation the funds of such an institution have to be kept between 45 and 51

- . Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from $t=0$ to $t=8$).

- 1) The funds are inside the limits for the interval: $[0, 3]$.
- 2) The funds are inside the limits for the interval: $[2, 3]$.
- 3) The funds are inside the limits for the interval: $[3, 6]$.
- 4) The funds are inside the limits for the intervals: $[0, 2]$ y $[5, 6]$.
- 5) The funds are inside the limits for the interval: $[0, 6]$.
- 6) The funds are inside the limits for the interval: $[6, 8]$.
- 7) The funds are inside the limits for the interval: $[3, 8]$.
- 8) The funds are inside the limits for the intervals: $[2, 3]$ y $[5, 6]$.

Exercise 7

The population of a city is studied between years $t=2$ and $t=9$. In that period the population is given by the function $P(t) = 4 + 216t - 54t^2 + 4t^3$

- . Determine the intervals of years when the population is between 234 and 260.

- 1) Along the interval of years: $[3.01736, 6.]$.
- 2) Along the interval of years: $[6.43371, 7.]$.
- 3) Along the intervals of years: $[2, 2.18826]$, $[4, 5]$ and $[6.81174, 7.31174]$.
- 4) Along the intervals of years: $[2, 2]$, $[2.18826, 4]$, $[5, 6.81174]$ and $[7.31174, 9]$.
- 5) Along the intervals of years: $[2., 3.68581]$ and $[7.70709, 9.02111]$.
- 6) Along the intervals of years: $[2., 6.0942]$ and $[7.73492, 9.68577]$.
- 7) Along the interval of years: $[6., 7.60647]$.
- 8) Along the intervals of years: $[3.20869, 4.]$ and $[7.68343, 8.]$.

Exercise 8

Compute the limit: $\lim_{x \rightarrow \infty} \left(\frac{-7 - 6x - 8x^2}{-2 + 8x - 8x^2} \right)^{-2+4x}$

- 1) 1
- 2) 0
- 3) e^7
- 4) $-\infty$
- 5) e^2
- 6) ∞
- 7) $\frac{1}{e}$

Exercise 9

A factory produces certain type of devices. The marginal cost (cost of producing one unit) decreases when we produce a large amount

of units and it is given by the function $C(x) = \frac{9 + 8x + 2x^2 + 9x^3}{5 + 2x + 8x^2 + 4x^3 + x^4}$

. Determine the expected cost per unit when a large amount of units is produced.

- 1) ∞
- 2) -1
- 3) $-\frac{1}{3}$
- 4) $-\infty$
- 5) $-\frac{1}{2}$
- 6) 11000
- 7) 0

Exercise 10

The population in certain turistic area

increases exponentially and is given by the function $P(t) = 87\,000 e^{t/100}$ that indicates the number of resident citizens for every year t . At the same time, depending on the season, the city receives a variable number of

tourists given by the trigonometric function $I(t) = 4000 + 3000 \sin\left[\frac{t}{2\pi}\right]$

that yields the amount of visitors in the area for every moment t (t in years).

Determine how many years are necessary until the total number of habitants is 141000. (the solution can be found for t between 42 and 47).

- 1) $t = ** .1****$
- 2) $t = ** .3****$
- 3) $t = ** .5****$
- 4) $t = ** .7****$
- 5) $t = ** .9****$

Exercise 11

Study the continuity of the function $f(x) = \begin{cases} -2 \sin(1-x) & x \leq 1 \\ \sin(1-x) + 1 + \sin(2) & 1 < x < 3 \\ 1 - \log(x-2) & 3 \leq x \end{cases}$

- 1) The functions is continuous for all points.
- 2) The functions is not continuous at any point.
- 3) The function is continuous for all the points except for $x=1$.
- 4) The function is continuous for all the points except for $x=3$.
- 5) The function is continuous for all the points except for $x=1$ and $x=3$.

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01-Functions for serial number: 42

Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a continuous compound rate of 5% and in the bank B we are paid a compound interest rate of 10%. We initially deposit 15000 euros in the bank A and 2000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **1.***** years.
- 2) In **5.***** years.
- 3) In **4.***** years.
- 4) In **9.***** years.
- 5) In **0.***** years.

Exercise 2

Certain parcel of land is devalued from an initial value of 354000 euros until a final value of 133000 euros along 10 years. Determine the rate of continuous compound interest for that devaluation.

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) The interest rate is **0.***** %.
- 2) The interest rate is **7.***** %.
- 3) The interest rate is **4.***** %.
- 4) The interest rate is **1.***** %.
- 5) The interest rate is **9.***** %.

Exercise 3

We have a bank account that initially offers a periodic compound interest rate of 1% in 3 periods (compounding frequency), and after 2 years the conditions are modified and then we obtain a compound interest rate of 1%. The initial deposit is 15000 euros. Compute the amount of money in the account after 9 years from the moment of the first deposit.

- 1) We will have ****1.***** euros.
- 2) We will have ****5.***** euros.
- 3) We will have ****6.***** euros.
- 4) We will have ****9.***** euros.
- 5) We will have ****0.***** euros.

Exercise 4

A firm sells Q tons of certain product. The price received per ton is given by the formula $P=7000-18Q$. On the other hand, the production cost per ton is $C=5000-8Q$. In addition, the transportation cost is 1100 per ton. Compute the maximum profit that can be obtained selling this product.

- 1) Profit = 15994 .
- 2) Profit = 32503 .
- 3) Profit = 20250 .
- 4) Profit = 7341 .
- 5) Profit = 29815 .

Exercise 5

Deposits in certain investment account vary from year to year alternating gains and losses periods. We have the following data about the deposits for different years:

year	deposits
2	53
3	76
4	97

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t . Employ that function to determine the maximum funds available in the investment account .

- 1) The maximum for the depositis in the account was 14 .
- 2) The maximum for the depositis in the account was 197 .
- 3) The maximum for the depositis in the account was 8 .
- 4) The maximum for the depositis in the account was 133 .
- 5) The maximum for the depositis in the account was -4 .

Exercise 6

The funds of a public institution alternate periods of deficit and surplus.

We have the following information for several years (in millions of euros):

year	funds
2	5
6	57
10	173

Employ an interpolation polynomial to build a function that

yields the funds for each year t . We know that due to the legislation the funds of such an institution have to be kept between 5 and 138

- . Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from $t=2$ to $t=10$).

- 1) The funds are inside the limits for the interval: $[-\frac{15}{2}, 10]$.
- 2) The funds are inside the limits for the interval: $[-\frac{15}{2}, -\frac{1}{2}]$.
- 3) The funds are inside the limits for the interval: $[2, 9]$.
- 4) The funds are inside the limits for the interval: $[0, 2]$.
- 5) The funds are inside the limits for the intervals: $[-\frac{15}{2}, -\frac{1}{2}]$ y $[9, 10]$.
- 6) The funds are inside the limits for the interval: $[2, 10]$.
- 7) The funds are inside the limits for the interval: $[-\frac{15}{2}, 2]$.
- 8) The funds are inside the limits for the interval: $[-\frac{15}{2}, 0]$.

Exercise 7

The population of certain type of rodents is analyzed in a region between years $t=2$ and $t=10$. Along that period the population is given by the function $P(t) =$

$4 + 504t - 78t^2 + 4t^3$ (thousands of rodents). Determine the intervals of years during which the number of rodents is between 434 and 732.

- 1) Along the interval of years: $[2, 10]$.
- 2) Along the interval of years: $[6.54985, 10.0736]$.
- 3) Along the interval of years: $[3.06772, 8.41181]$.
- 4) Along the interval of years: $[3., 6.11479]$.
- 5) Along the intervals of years: $[3., 4.43542]$ and $[6.25744, 9.]$.
- 6) That number of mice is reach for no interval of years.
- 7) Along the interval of years: $[2.57465, 5.7818]$.
- 8) Along the interval of years: $[2, 2]$.

Exercise 8

Compute the limit: $\lim_{x \rightarrow \infty} \left(\frac{-7 - 8x - 7x^2}{1 + x - 7x^2} \right)^{3-2x+9x^2}$

- 1) e
- 2) ∞
- 3) $\frac{1}{e^3}$
- 4) 0
- 5) 1
- 6) $-\infty$
- 7) $\frac{1}{e^5}$

Exercise 9

From an initial deposit 4000, the interest rate varies every year in such a way that the total amount of money in the account is given by the function $C(t) =$

$$4000 \left(\frac{-7 - 8t + 2t^2}{1 + t + 2t^2} \right)^{3-2t+9t^2}. \text{ Determine the future tendency for the}$$

deposits that we will have after a large number of years.

- 1) 4000 €
- 2) 0
- 3) $\frac{4000}{e^3}$
- 4) 4000
- 5) $-\infty$
- 6) ∞
- 7) $\frac{4000}{e^5}$

Exercise 10

The population in certain turistic area

increases exponentially and is given by the function $P(t) = 81000 e^{t/50}$ that indicates the number of resident citizens for every year t . At the same time, depending on the season, the city receives a variable number of

tourists given by the trigonometric function $I(t) = 4000 + 3000 \sin\left[\frac{t}{2\pi}\right]$

that yields the amount of visitors in the area for every moment t (t in years).

Determine how many years are necessary until the total number of habitants is 131000. (the solution can be found for t between 23 and 28).

- 1) $t = \dots 0 \dots$
- 2) $t = \dots 2 \dots$
- 3) $t = \dots 4 \dots$
- 4) $t = \dots 6 \dots$
- 5) $t = \dots 8 \dots$

Exercise 11

Study the continuity of the function $f(x) = \begin{cases} 3 \sin(x) - 2 e^x & x \leq 0 \\ \frac{x}{2} - 2 & 0 < x < 2 \\ -\cos(2 - x) & 2 \leq x \end{cases}$

- 1) The functions is continuous for all points.
- 2) The functions is not continuous at any point.
- 3) The function is continuous for all the points except for $x=0$.
- 4) The function is continuous for all the points except for $x=2$.
- 5) The function is continuous for all the points except for $x=0$ and $x=2$.

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01-Functions for serial number: 43

Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a periodic compound interest rate of 5% in 11 periods (compounding frequency) and in the bank B we are paid a continuous compound rate of 2%. We initially deposit 6000 euros in the bank A and 13000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **0.***** years.
- 2) In **1.***** years.
- 3) In **9.***** years.
- 4) In **5.***** years.
- 5) In **8.***** years.

Exercise 2

Certain parcel of land is revalued from an initial value of 163000 euros until a final value of 411000 euros along 6 years. Determine the rate of periodic compound interest in 11 periods for that revaluation.

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) The interest rate is **5.***** %.
- 2) The interest rate is **3.***** %.
- 3) The interest rate is **2.***** %.
- 4) The interest rate is **1.***** %.
- 5) The interest rate is **0.***** %.

Exercise 3

We have a bank account that initially offers a periodic compound interest rate of 3% in 2 periods (compounding frequency), and after 3 years the conditions are modified and then we obtain a periodic compound interest rate of 10% in 7 periods (compounding frequency). The initial deposit is 13000 euros. Compute the amount of money in the account after 4 years from the moment of the first deposit.

- 1) We will have ****2.***** euros.
- 2) We will have ****6.***** euros.
- 3) We will have ****8.***** euros.
- 4) We will have ****9.***** euros.
- 5) We will have ****4.***** euros.

Exercise 4

A firm sells Q tons of certain product. The price received per ton is given by the formula $P=9000-19Q$. On the other hand, the production cost per ton is $C=4000-10Q$. In addition, the transportation cost is 4172 per ton. Compute the maximum profit that can be obtained selling this product.

- 1) Profit = 11 703 .
- 2) Profit = 19 044 .
- 3) Profit = 18 047 .
- 4) Profit = 6970 .
- 5) Profit = 14 515 .

Exercise 5

Deposits in certain investment account vary from year to year alternating gains and losses periods. We have the following data about the deposits for different years:

year	deposits
1	39
3	87
5	119

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t . Employ that function to determine the maximum funds available in the investment account .

- 1) The maximum for the depositis in the account was 8 .
- 2) The maximum for the depositis in the account was 9 .
- 3) The maximum for the depositis in the account was 137 .
- 4) The maximum for the depositis in the account was 5 .
- 5) The maximum for the depositis in the account was 135 .

Exercise 6

The funds of a public institution alternate periods of deficit and surplus.

We have the following information for several years (in millions of euros):

year	funds
2	-10
4	-22
6	-10

Employ an interpolation polynomial to build a function that

yields the funds for each year t . We know that due to the legislation the funds of such an institution have to be kept between -10 and 5

- . Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from $t=2$ to $t=6$).

- 1) The funds are inside the limits for the intervals: $[1, 2]$ y $[6, 7]$.
- 2) The funds are inside the limits for the interval: $[1, 6]$.
- 3) The funds are inside the limits for the intervals: $[2, 2]$ y $[6, 6]$.
- 4) The funds are inside the limits for the interval: $[0, 1]$.
- 5) The funds are inside the limits for the interval: $[0, 6]$.
- 6) The funds are inside the limits for the intervals: $[0, 2]$ y $[6, 7]$.
- 7) The funds are inside the limits for the interval: $[6, 6]$.
- 8) The funds are inside the limits for the interval: $[1, 2]$.

Exercise 7

The population of a city is studied between years $t=4$ and $t=8$. In that period the population is given by the function $P(t) = 9 + 504t - 78t^2 + 4t^3$

- . Determine the intervals of years when the population is between 1033 and 1143.

- 1) Along the intervals of years: $[4., 6.]$ and $[7., 8.]$.
- 2) Along the interval of years: $[6., 8.68292]$.
- 3) Along the interval of years: $[4, 8]$.
- 4) Along the intervals of years: $[4., 6.]$ and $[7., 8.69932]$.
- 5) Along the intervals of years: $[4, 4]$ and $[8, 8]$.
- 6) Along the intervals of years: $[4.77652, 6.]$ and $[7.19925, 8.]$.
- 7) Along the interval of years: $[4., 8.]$.
- 8) Along the interval of years: $[5., 6.48191]$.

Exercise 8

Compute the limit: $\lim_{x \rightarrow \infty} \left(\frac{1 - 3x - 3x^2 - 6x^3}{4 + 7x + 6x^2 - 6x^3} \right)^{-1+x}$

- 1) $\frac{1}{e^5}$
- 2) $e^{3/2}$
- 3) ∞
- 4) $\frac{1}{e^4}$
- 5) $-\infty$
- 6) 1
- 7) 0

Exercise 9

The population of certain country (in millions of habitants) is given by the function $P(t) =$

$36 \left(\frac{1 - 3t - 3t^2 + 2t^3}{4 + 7t + 6t^2 + 2t^3} \right)^{-1+t}$. Determine the future tendency for this population.

- 1) $\frac{36}{e^4}$
- 2) $\frac{36}{e^{9/2}}$
- 3) 0
- 4) $\frac{36}{e^5}$
- 5) ∞
- 6) 36
- 7) $-\infty$

Exercise 10

The population in certain turistic area

increases exponentially and is given by the function $P(t) = 57\,000 e^{t/50}$ that indicates the number of resident citizens for every year t . At the same time, depending on the season, the city receives a variable number of

tourists given by the trigonometric function $I(t) = 5000 + 1000 \sin\left[\frac{t}{2\pi}\right]$

that yields the amount of visitors in the area for every moment t (t in years).

Determine how many years are necessary until the total number of habitants is 111000. (the solution can be found for t between 28 and 33).

- 1) $t = \dots 0 \dots$
- 2) $t = \dots 2 \dots$
- 3) $t = \dots 4 \dots$
- 4) $t = \dots 6 \dots$
- 5) $t = \dots 8 \dots$

Exercise 11

Study the continuity of the function $f(x) = \begin{cases} -2e^{x+3} - 2\sin(x+3) & x \leq -3 \\ 2x + 4 & -3 < x < -1 \\ 3\log(x+2) + 2 & -1 \leq x \end{cases}$

- 1) The functions is continuous for all points.
- 2) The functions is not continuous at any point.
- 3) The function is continuous for all the points except for $x = -3$.
- 4) The function is continuous for all the points except for $x = -1$.
- 5) The function is continuous for all the points except for $x = -3$ and $x = -1$.

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01-Functions for serial number: 44

Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a compound interest rate of 10% and in the bank B we are paid a periodic compound interest rate of 6% in 6 periods (compounding frequency). We initially deposit 2000 euros in the bank A and 6000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **6.***** years.
- 2) In **1.***** years.
- 3) In **9.***** years.
- 4) In **5.***** years.
- 5) In **0.***** years.

Exercise 2

We have one bank account that offers a periodic compound interest rate of 4% in 6 periods (compounding frequency) where we initially deposit 8000 euros. How long time is it necessary until the amount of money in the account reaches 17000 euros?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **7.***** years.
- 2) In **6.***** years.
- 3) In **8.***** years.
- 4) In **1.***** years.
- 5) In **0.***** years.

Exercise 3

We have a bank account that initially offers a periodic compound interest rate of 2% in 6 periods (compounding frequency), and after 4 years the conditions are modified and then we obtain a compound interest rate of 4%. The initial deposit is 6000 euros. Compute the amount of money in the account after 7 years from the moment of the first deposit.

- 1) We will have ****6.***** euros.
- 2) We will have ****1.***** euros.
- 3) We will have ****2.***** euros.
- 4) We will have ****5.***** euros.
- 5) We will have ****0.***** euros.

Exercise 4

A firm sells Q tons of certain product. The price received per ton is given by the formula $P=3000-5Q$. On the other hand, the production cost per ton is $C=1000+5Q$. In addition, the transportation cost is 1140 per ton. Compute the maximum profit that can be obtained selling this product.

- 1) Profit = 16404 .
- 2) Profit = 18338 .
- 3) Profit = 31316 .
- 4) Profit = 27045 .
- 5) Profit = 18490 .

Exercise 5

Deposits in certain investment account vary from year to year alternating gains and losses periods. We have the following data about the deposits for different years:

year	deposits
1	3
2	7
4	27

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t . Employ that function to forecast the exact amount for year 5 .

- 1) The depositis in the account for year 5 are 63 .
- 2) The depositis in the account for year 5 are 7 .
- 3) The depositis in the account for year 5 are 43 .
- 4) The depositis in the account for year 5 are 18 .
- 5) The depositis in the account for year 5 are 9 .

Exercise 6

The funds of a public institution alternate periods of deficit and surplus.

We have the following information for several years (in millions of euros):

year	funds
0	17
3	35
7	3

Employ an interpolation polynomial to build a function that

yields the funds for each year t . We know that due to the legislation the funds of such an institution have to be kept between 27 and 45

- . Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from $t=0$ to $t=7$).

- 1) The funds are inside the limits for the interval: $[1, 5]$.
- 2) The funds are inside the limits for the interval: $[0, 5]$.
- 3) The funds are inside the limits for the interval: $[1, 7]$.
- 4) The funds are inside the limits for the interval: $[-1, 3]$.
- 5) The funds are inside the limits for the interval: $[5, 7]$.
- 6) The funds are inside the limits for the interval: $[7, 7]$.
- 7) The funds are inside the limits for the interval: $[0, 7]$.
- 8) The funds are inside the limits for the interval: $[-2, 6]$.

Exercise 7

The deposits in certain account between the months

$t=0$ and $t=10$ is given by the function $C(t) = 7 + 168t - 54t^2 + 4t^3$

- . Determine the months for which the deposit is between -3 and 133 euros.

- 1) Along the intervals of months: $[0, 0]$, $[1.11932, 3]$, $[5, 8.55842]$ and $[9.38068, 10]$.
- 2) Along the intervals of months: $[0.50807, 2.]$ and $[7.23351, 8.]$.
- 3) Along the intervals of months: $[3., 5.30611]$ and $[8., 10.2347]$.
- 4) Along the intervals of months: $[0.679695, 1.78034]$ and $[3.41883, 5.06669]$.
- 5) Along the interval of months: $[5., 8.04759]$.
- 6) Along the intervals of months: $[0, 1.11932]$, $[3, 5]$ and $[8.55842, 9.38068]$.
- 7) Along the intervals of months: $[3., 4.]$ and $[5., 8.]$.
- 8) Along the intervals of months: $[2., 6.38793]$ and $[8., 9.42516]$.

Exercise 8

Compute the limit: $\lim_{x \rightarrow \infty} \left(\frac{6 + 3x + x^2 + 9x^3}{-4 - 3x - 8x^2 + 9x^3} \right)^{-6+4x}$

- 1) $\frac{1}{e^4}$
- 2) $-\infty$
- 3) e^4
- 4) ∞
- 5) 1
- 6) $\frac{1}{e^5}$
- 7) 0

Exercise 9

The population of certain country (in millions of habitants) is given by the function $P(t) =$

$$7 \left(\frac{6 + 3t + t^2 + 9t^3}{-4 - 3t - 8t^2 + 9t^3} \right)^{-6+4t}. \text{ Determine the future tendency for this population.}$$

- 1) ∞
- 2) 0
- 3) $-\infty$
- 4) $\frac{7}{e^4}$
- 5) $7e^4$
- 6) 7
- 7) $\frac{7}{e^3}$

Exercise 10

We deposit 7000 euros in a bank account with a continuous compound rate of 9%. At the same time every year we also add in a safe-deposit box (therefore with no interest rate) 3000 euros. How long time is it necessary until the total ammount of money (jointly in the bank account and safe-depsit box) is 50000 euros? (the solution can be found for t between 6 and 11).

- 1) $t = **.0****$
- 2) $t = **.2****$
- 3) $t = **.4****$
- 4) $t = **.6****$
- 5) $t = **.8****$

Exercise 11

Study the continuity of the function $f(x) = \begin{cases} -3 \sin(x+2) & x \leq -2 \\ \frac{x}{3} + \frac{2}{3} & -2 < x < 1 \\ \log(x) + 1 & 1 \leq x \end{cases}$

- 1) The functions is continuous for all points.
- 2) The functions is not continuous at any point.
- 3) The function is continuous for all the points except for $x = -2$.
- 4) The function is continuous for all the points except for $x = 1$.
- 5) The function is continuous for all the points except for $x = -2$ and $x = 1$.

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01-Functions for serial number: 45

Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a compound interest rate of 9% and in the bank B we are paid a periodic compound interest rate of 2% in 7 periods (compounding frequency). We initially deposit 7000 euros in the bank A and 11000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **5.***** years.
- 2) In **6.***** years.
- 3) In **9.***** years.
- 4) In **0.***** years.
- 5) In **4.***** years.

Exercise 2

Certain parcel of land is revalued from an initial value of 387000 euros until a final value of 495000 euros along 10 years. Determine the rate of compound interest for that revaluation.

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) The interest rate is **7.***** %.
- 2) The interest rate is **9.***** %.
- 3) The interest rate is **2.***** %.
- 4) The interest rate is **1.***** %.
- 5) The interest rate is **5.***** %.

Exercise 3

We have a bank account that initially offers a periodic compound interest rate of 4% in 3 periods (compounding frequency), and after 4 years the conditions are modified and then we obtain a compound interest rate of 1%. The initial deposit is 11000 euros. Compute the amount of money in the account after 9 years from the moment of the first deposit.

- 1) We will have ****2.***** euros.
- 2) We will have ****5.***** euros.
- 3) We will have ****7.***** euros.
- 4) We will have ****3.***** euros.
- 5) We will have ****9.***** euros.

Exercise 4

A firm sells Q tons of certain product. The price received per ton is given by the formula $P=140000-15Q$. On the other hand, the production cost per ton is $C=100000+13Q$. In addition, the transportation cost is 37872 per ton. Compute the maximum profit that can be obtained selling this product.

- 1) Profit = 13463 .
- 2) Profit = 33422 .
- 3) Profit = 44954 .
- 4) Profit = 40432 .
- 5) Profit = 49441 .

Exercise 5

Deposits in certain investment account vary from year to year alternating gains and losses periods. We have the following data about the deposits for different years:

year	deposits
0	78
1	56
3	24

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t . Employ that function to determine the minimum funds available in the investment account .

- 1) The minimum for the depositis in the account was 14 .
- 2) The minimum for the depositis in the account was 12 .
- 3) The minimum for the depositis in the account was 19 .
- 4) The minimum for the depositis in the account was 6 .
- 5) The minimum for the depositis in the account was 11 .

Exercise 6

The funds of a public institution alternate periods of deficit and surplus.

We have the following information for several years (in millions of euros):

year	funds
2	-10
6	-106
9	-241

Employ an interpolation polynomial to build a function that

yields the funds for each year t . We know that due to the legislation the funds of such an institution have to be kept between -190 and -25

- . Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from $t=2$ to $t=9$).

- 1) The funds are inside the limits for the interval: $[-3, 8]$.
- 2) The funds are inside the limits for the interval: $[-3, 9]$.
- 3) The funds are inside the limits for the interval: $[0, 8]$.
- 4) The funds are inside the limits for the interval: $[3, 8]$.
- 5) The funds are inside the limits for the intervals: $[-8, -3]$ y $[3, 9]$.
- 6) The funds are inside the limits for the interval: $[-3, 0]$.
- 7) The funds are inside the limits for the interval: $[8, 9]$.
- 8) The funds are inside the limits for the interval: $[-8, -3]$.

Exercise 7

The population of certain type of rodents is analyzed in a region between years $t=2$

and $t=10$. Along that period the population is given by the function $P(t) =$

$6 + 432t - 78t^2 + 4t^3$ (thousands of rodents). Determine the intervals of years during which the number of rodents is between 518 and 654.

- 1) Along the intervals of years: $[2, 2]$, $[2.44158, 6]$, $[8, 9.88068]$ and $[10, 10]$.
- 2) Along the intervals of years: $[4., 5.36803]$ and $[6.35768, 8.07231]$.
- 3) Along the intervals of years: $[2, 2.44158]$, $[6, 8]$ and $[9.88068, 10]$.
- 4) Along the interval of years: $[6., 7.03027]$.
- 5) Along the intervals of years: $[2.51987, 8.1606]$ and $[9.58524, 10.]$.
- 6) Along the intervals of years: $[2., 4.]$ and $[9., 10.682]$.
- 7) Along the intervals of years: $[3.32997, 5.32453]$ and $[7., 10.]$.
- 8) Along the interval of years: $[7.49705, 10.5884]$.

Exercise 8

Compute the limit: $\lim_{x \rightarrow -\infty} \left(\frac{-5 - 8x + 7x^2}{-1 - 2x + 7x^2} \right)^{5+2x}$

- 1) $\frac{1}{e^2}$
- 2) 0
- 3) ∞
- 4) 1
- 5) $-\infty$
- 6) $\frac{1}{e^4}$
- 7) $\frac{1}{e^{12/7}}$

Exercise 9

From an initial deposit 14000, the interest rate varies every year in such a way that the total amount of money in the account is given by the function $C(t) =$

$$14000 \left(\frac{-5 - 8t - 6t^2}{-1 - 2t - 6t^2} \right)^{5+2t}. \text{ Determine the future tendency for the}$$

deposits that we will have after a large number of years.

- 1) $14000 \text{ €}^{999/500}$
- 2) $\frac{14000}{e^4}$
- 3) $-\infty$
- 4) 0
- 5) ∞
- 6) 14000 €^2
- 7) 14000

Exercise 10

The population in certain turistic area

increases exponentially and is given by the function $P(t) = 94\,000 e^{t/100}$ that indicates the number of resident citizens for every year t . At the same time, depending on the season, the city receives a variable number of

tourists given by the trigonometric function $I(t) = 5000 + 4000 \sin\left[\frac{t}{2\pi}\right]$

that yields the amount of visitors in the area for every moment t (t in years).

Determine how many years are necessary until the total number of habitants is 145000. (the solution can be found for t between 38 and 43).

- 1) $t = **.*****$
- 2) $t = **.*****$
- 3) $t = **.*****$
- 4) $t = **.*****$
- 5) $t = **.*****$

Exercise 11

Study the continuity of the function $f(x) = \begin{cases} 2e^{x-3} - 2\sin(3-x) & x \leq 3 \\ -\log(x-2) + 1 + \log(4) & 3 < x < 6 \\ e^{x-6} - \sin(6-x) & 6 \leq x \end{cases}$

- 1) The functions is continuous for all points.
- 2) The functions is not continuous at any point.
- 3) The function is continuous for all the points except for $x=3$.
- 4) The function is continuous for all the points except for $x=6$.
- 5) The function is continuous for all the points except for $x=3$ and $x=6$.

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01-Functions for serial number: 46

Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a compound interest rate of 7% and in the bank B we are paid a compound interest rate of 2%. We initially deposit 1000 euros in the bank A and 7000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **4.***** years.
- 2) In **0.***** years.
- 3) In **7.***** years.
- 4) In **2.***** years.
- 5) In **1.***** years.

Exercise 2

We have one bank account that offers a periodic compound interest rate of 3% in 10 periods (compounding frequency) where we initially deposit 9000 euros. How long time is it necessary until the amount of money in the account reaches 12000 euros?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **1.***** years.
- 2) In **9.***** years.
- 3) In **7.***** years.
- 4) In **0.***** years.
- 5) In **4.***** years.

Exercise 3

We have a bank account that initially offers a compound interest rate of 3%, and after 3 years the conditions are modified and then we obtain a continuous compound rate of 7%. The initial deposit is 7000 euros. Compute the amount of money in the account after 4 years from the moment of the first deposit.

- 1) We will have ****1.***** euros.
- 2) We will have ****8.***** euros.
- 3) We will have ****4.***** euros.
- 4) We will have ****3.***** euros.
- 5) We will have ****0.***** euros.

Exercise 4

A firm sells Q tons of certain product. The price received per ton is given by the formula $P=40000-6Q$. On the other hand, the production cost per ton is $C=30000+12Q$. In addition, the transportation cost is 8380 per ton. Compute the maximum profit that can be obtained selling this product.

- 1) Profit = 36450 .
- 2) Profit = 31732 .
- 3) Profit = 30963 .
- 4) Profit = 42412 .
- 5) Profit = 33143 .

Exercise 5

Deposits in certain investment account vary from year to year alternating gains and losses periods. We have the following data about the deposits for different years:

year	deposits
1	-3
2	-10
4	-36

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t . Employ that function to forecast the exact amount for year 6 .

- 1) The depositis in the account for year 6 are -15 .
- 2) The depositis in the account for year 6 are -78 .
- 3) The depositis in the account for year 6 are -13 .
- 4) The depositis in the account for year 6 are -105 .
- 5) The depositis in the account for year 6 are -1 .

Exercise 6

The funds of a public institution alternate periods of deficit and surplus.

We have the following information for several years (in millions of euros):

year	funds
0	0
4	12
6	30

Employ an interpolation polynomial to build a function that

yields the funds for each year t . We know that due to the legislation the funds of such an institution have to be kept between 2 and 20

- . Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from $t=0$ to $t=6$).

- 1) The funds are inside the limits for the interval: $[2, 6]$.
- 2) The funds are inside the limits for the interval: $[-4, 6]$.
- 3) The funds are inside the limits for the intervals: $[-4, -1]$ y $[5, 6]$.
- 4) The funds are inside the limits for the interval: $[-4, 0]$.
- 5) The funds are inside the limits for the interval: $[0, 2]$.
- 6) The funds are inside the limits for the interval: $[2, 5]$.
- 7) The funds are inside the limits for the interval: $[-4, -1]$.
- 8) The funds are inside the limits for the interval: $[-4, 2]$.

Exercise 7

The population of certain type of rodents is analyzed in a region between years

$t=1$ and $t=7$. Along that period the population is given by the function $P(t) = 4 + 120t - 42t^2 + 4t^3$ (thousands of rodents). Determine the intervals of years during which the number of rodents is between 68 and 94.

- 1) Along the interval of years: $[2.20675, 5.]$.
- 2) Along the interval of years: $[2.36868, 6.62998]$.
- 3) Along the intervals of years: $[1., 4.55712]$ and $[6.63833, 7.]$.
- 4) Along the intervals of years: $[1., 2.63816]$ and $[4., 5.]$.
- 5) Along the intervals of years: $[2., 3.37844]$ and $[4., 5.]$.
- 6) Along the intervals of years: $[1, 1.18826]$, $[3, 4]$ and $[5.81174, 6.31174]$.
- 7) Along the intervals of years: $[1, 1]$, $[1.18826, 3]$, $[4, 5.81174]$ and $[6.31174, 7]$.
- 8) Along the interval of years: $[5., 6.]$.

Exercise 8

Compute the limit: $\lim_{x \rightarrow -\infty} \left(\frac{9 - 7x + 6x^2 + 5x^3}{4 - 7x + 2x^2 + 5x^3} \right)^{4+x}$

- 1) $e^{4/5}$
- 2) 0
- 3) ∞
- 4) $\frac{1}{e^4}$
- 5) $\frac{1}{e^5}$
- 6) 1
- 7) $-\infty$

Exercise 9

From an initial deposit 3000, the interest rate varies every year in such a way that the total amount of money in the account is given by the function $C(t) =$

$$3000 \left(\frac{9 - 7t - 6t^2}{6 + 4t - 6t^2} \right)^{-5 - 4t + 7t^2}. \text{ Determine the future tendency for the}$$

deposits that we will have after a large number of years.

- 1) ∞
- 2) 0
- 3) $\frac{3000}{e^5}$
- 4) $\frac{3000}{e^3}$
- 5) $\frac{3000}{e^4}$
- 6) 3000
- 7) $-\infty$

Exercise 10

We deposit 9000 euros in a bank account with a compound interest rate of 9%. At the same time every year we also add in a safe-deposit box (therefore with no interest rate) 5000 euros. How long time is it necessary until the total amount of money (jointly in the bank account and safe-deposit box) is 39000 euros? (the solution can be found for t between 5 and 10).

- 1) $t = ** .0****$
- 2) $t = ** .2****$
- 3) $t = ** .4****$
- 4) $t = ** .6****$
- 5) $t = ** .8****$

Exercise 11

Study the continuity of the function $f(x) = \begin{cases} -3 \sin(x+1) - \cos(x+1) & x \leq -1 \\ x & -1 < x < 0 \\ -2 \log(x+1) & 0 \leq x \end{cases}$

- 1) The functions is continuous for all points.
- 2) The functions is not continuous at any point.
- 3) The function is continuous for all the points except for $x = -1$.
- 4) The function is continuous for all the points except for $x = 0$.
- 5) The function is continuous for all the points except for $x = -1$ and $x = 0$.

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01-Functions for serial number: 47

Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a continuous compound rate of 4% and in the bank B we are paid a continuous compound rate of 10%. We initially deposit 14000 euros in the bank A and 8000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **9.***** years.
- 2) In **8.***** years.
- 3) In **7.***** years.
- 4) In **1.***** years.
- 5) In **0.***** years.

Exercise 2

Certain parcel of land is devalued from an initial value of 330000 euros until a final value of 156000 euros along 7 years. Determine the rate of compound interest for that devaluation.

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) The interest rate is **7.***** %.
- 2) The interest rate is **9.***** %.
- 3) The interest rate is **8.***** %.
- 4) The interest rate is **0.***** %.
- 5) The interest rate is **1.***** %.

Exercise 3

We have a bank account that initially offers a continuous compound rate of 2%, and after 1 year the conditions are modified and then we obtain a compound interest rate of 2%. The initial deposit is 14000 euros. Compute the amount of money in the account after 9 years from the moment of the first deposit.

- 1) We will have ****0.***** euros.
- 2) We will have ****9.***** euros.
- 3) We will have ****4.***** euros.
- 4) We will have ****1.***** euros.
- 5) We will have ****7.***** euros.

Exercise 4

A firm sells Q tons of certain product. The price received per ton is given by the formula $P=300-16Q$. On the other hand, the production cost per ton is $C=200-8Q$. In addition, the transportation cost is 36 per ton. Compute the maximum profit that can be obtained selling this product.

- 1) Profit = 128 .
- 2) Profit = 198 .
- 3) Profit = 110 .
- 4) Profit = 171 .
- 5) Profit = 44 .

Exercise 5

Deposits in certain investment account vary from year to year alternating gains and losses periods. We have the following data about the deposits for different years:

year	deposits
2	345
3	295
5	207

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t . Employ that function to determine the minimum funds available in the investment account .

- 1) The minimum for the depositis in the account was -7 .
- 2) The minimum for the depositis in the account was 7 .
- 3) The minimum for the depositis in the account was 15 .
- 4) The minimum for the depositis in the account was 20 .
- 5) The minimum for the depositis in the account was 105 .

Exercise 6

The funds of a public institution alternate periods of deficit and surplus.

We have the following information for several years (in millions of euros):

year	funds
1	47
5	71
8	26

Employ an interpolation polynomial to build a function that

yields the funds for each year t . We know that due to the legislation the funds of such an institution have to be kept between 47 and 98

- . Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from $t=1$ to $t=8$).

- 1) The funds are inside the limits for the interval: $[1, 8]$.
- 2) The funds are inside the limits for the interval: $[-2, 3]$.
- 3) The funds are inside the limits for the interval: $[0, 7]$.
- 4) The funds are inside the limits for the interval: $[1, 7]$.
- 5) The funds are inside the limits for the interval: $[-2, 7]$.
- 6) The funds are inside the limits for the interval: $[8, 8]$.
- 7) The funds are inside the limits for the interval: $[7, 8]$.
- 8) The funds are inside the limits for the interval: $[0, 8]$.

Exercise 7

The population of certain type of rodents is analyzed in a region between years

$t=3$ and $t=7$. Along that period the population is given by the function $P(t) = 6 + 240t - 54t^2 + 4t^3$ (thousands of rodents). Determine the intervals of years during which the number of rodents is between 356 and 708.

- 1) Along the interval of years: $[3.46272, 6.]$.
- 2) Along the interval of years: $[4., 7.16783]$.
- 3) Along the intervals of years: $[3.38231, 5.]$ and $[6., 7.21739]$.
- 4) Along the intervals of years: $[3, 3.5]$, $[5, 5]$ and $[7, 7]$.
- 5) Along the intervals of years: $[3., 4.]$ and $[6., 7.69674]$.
- 6) Along the interval of years: $[3., 7.]$.
- 7) Along the intervals of years: $[3.75883, 4.52416]$ and $[5.39217, 7.]$.
- 8) Along the interval of years: $[3.5, 7]$.

Exercise 8

Compute the limit: $\lim_{x \rightarrow -\infty} \left(\frac{-1 - 4x + 8x^2}{2 - 2x + 8x^2} \right)^{1-7x+4x^2}$

- 1) $\frac{1}{e^4}$
- 2) 0
- 3) $\frac{1}{e^5}$
- 4) $-\infty$
- 5) $\frac{1}{e^2}$
- 6) 1
- 7) ∞

Exercise 9

A factory produces certain type of devices. The marginal cost (cost of producing one unit) decreases when we produce a large amount of units and it is given by the function $C(x) = \frac{8 + 2x + 4x^2}{1 + 9x + 4x^2}$. Determine the expected cost per unit when a large amount of units is produced.

- 1) ∞
- 2) 0
- 3) 1
- 4) -3
- 5) $-\infty$
- 6) 2000
- 7) $\frac{109}{100}$

Exercise 10

The population in certain turistic area

increases exponentially and is given by the function $P(t) = 88\,000 e^{t/50}$ that indicates the number of resident citizens for every year t . At the same time, depending on the season, the city receives a variable number of

tourists given by the trigonometric function $I(t) = 5000 + 4000 \sin\left[\frac{t}{2\pi}\right]$

that yields the amount of visitors in the area for every moment t (t in years).

Determine how many years are necessary until the total number of habitants is 133000. (the solution can be found for t between 17 and 22).

- 1) $t = \dots 0 \dots$
- 2) $t = \dots 2 \dots$
- 3) $t = \dots 4 \dots$
- 4) $t = \dots 6 \dots$
- 5) $t = \dots 8 \dots$

Exercise 11

Study the continuity of the function $f(x) = \begin{cases} e^{x-3} - 3 \sin(3-x) & x \leq 3 \\ \frac{x}{2} - \frac{1}{2} & 3 < x < 5 \\ 2 \log(x-4) + 2 & 5 \leq x \end{cases}$

- 1) The functions is continuous for all points.
- 2) The functions is not continuous at any point.
- 3) The function is continuous for all the points except for $x=3$.
- 4) The function is continuous for all the points except for $x=5$.
- 5) The function is continuous for all the points except for $x=3$ and $x=5$.

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01-Functions for serial number: 48

Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a periodic compound interest rate of 5% in 2 periods (compounding frequency) and in the bank B we are paid a compound interest rate of 10%. We initially deposit 6000 euros in the bank A and 2000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **3.***** years.
- 2) In **8.***** years.
- 3) In **4.***** years.
- 4) In **5.***** years.
- 5) In **0.***** years.

Exercise 2

Certain parcel of land is devalued from an initial value of 426000 euros until a final value of 149000 euros along 8 years. Determine the rate of compound interest for that devaluation.

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) The interest rate is **6.***** %.
- 2) The interest rate is **2.***** %.
- 3) The interest rate is **9.***** %.
- 4) The interest rate is **3.***** %.
- 5) The interest rate is **0.***** %.

Exercise 3

We have a bank account that initially offers a continuous compound rate of 10%, and after 2 years the conditions are modified and then we obtain a compound interest rate of 1%. The initial deposit is 6000 euros. Compute the amount of money in the account after 2 years from the moment of the first deposit.

- 1) We will have ****4.***** euros.
- 2) We will have ****0.***** euros.
- 3) We will have ****9.***** euros.
- 4) We will have ****5.***** euros.
- 5) We will have ****8.***** euros.

Exercise 4

A firm sells Q tons of certain product. The price received per ton is given by the formula $P=100000-8Q$. On the other hand, the production cost per ton is $C=20000+8Q$. In addition, the transportation cost is 78912 per ton. Compute the maximum profit that can be obtained selling this product.

- 1) Profit = 18496 .
- 2) Profit = 12037 .
- 3) Profit = 7804 .
- 4) Profit = 11328 .
- 5) Profit = 18110 .

Exercise 5

Deposits in certain investment account vary from year to year alternating gains and losses periods. We have the following data about the deposits for different years:

year	deposits
0	88
2	56
3	43

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t . Employ that function to determine the minimum funds available in the investment account .

- 1) The minimum for the depositis in the account was 9 .
- 2) The minimum for the depositis in the account was 17 .
- 3) The minimum for the depositis in the account was 23 .
- 4) The minimum for the depositis in the account was 7 .
- 5) The minimum for the depositis in the account was 2 .

Exercise 6

The funds of a public institution alternate periods of deficit and surplus.

We have the following information for several years (in millions of euros):

year	funds
1	5
3	27
6	90

Employ an interpolation polynomial to build a function that

yields the funds for each year t . We know that due to the legislation the funds of such an institution have to be kept between 5 and 14

- . Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from $t=1$ to $t=6$).

- 1) The funds are inside the limits for the interval: $[-\frac{7}{2}, 6]$.
- 2) The funds are inside the limits for the interval: $[1, 2]$.
- 3) The funds are inside the limits for the intervals: $[-\frac{7}{2}, -\frac{5}{2}]$ y $[2, 6]$.
- 4) The funds are inside the limits for the interval: $[-\frac{7}{2}, 0]$.
- 5) The funds are inside the limits for the interval: $[0, 1]$.
- 6) The funds are inside the limits for the interval: $[1, 6]$.
- 7) The funds are inside the limits for the interval: $[-\frac{7}{2}, 1]$.
- 8) The funds are inside the limits for the interval: $[-\frac{7}{2}, -\frac{5}{2}]$.

Exercise 7

The population of certain type of rodents is analyzed in a region between years $t=4$ and $t=8$. Along that period the population is given by the function $P(t) = 9 + 504t - 78t^2 + 4t^3$ (thousands of rodents). Determine the intervals of years during which the number of rodents is between 927 and 1097.

- 1) Along the interval of years: $[6., 8.]$.
- 2) Along the interval of years: $[4.44065, 5.48772]$.
- 3) Along the intervals of years: $[4.55903, 5.]$ and $[6., 7.11618]$.
- 4) Along the intervals of years: $[4., 5.]$ and $[7., 8.75182]$.
- 5) Along the interval of years: $[4., 7.]$.
- 6) Along the interval of years: $[4., 5.]$.
- 7) Along the intervals of years: $[4, 4]$ and $[8, 8]$.
- 8) Along the interval of years: $[4, 8]$.

Exercise 8

Compute the limit: $\lim_{x \rightarrow \infty} \left(\frac{3 - x - 4x^2}{7 - 3x - 4x^2} \right)^{7+6x+3x^2}$

1) $-\infty$

2) 1

3) $\frac{1}{e}$

4) $\frac{1}{e^2}$

5) ∞

6) 0

7) $\frac{1}{e^3}$

Exercise 9

A factory produces certain type of devices. The marginal cost (cost of producing one unit) decreases when we produce a large amount

of units and it is given by the function $C(x) = \frac{1 + 5x + 9x^2 + x^3}{7 + 9x + 3x^2 + 3x^3 + 6x^4}$

. Determine the expected cost per unit when a large amount of units is produced.

1) 0

2) $-\frac{1}{3}$

3) ∞

4) -1

5) $-\infty$

6) 18000

7) $-\frac{3}{4}$

Exercise 10

The population in certain turistic area

increases exponentially and is given by the function $P(t) = 90\,000 e^{t/50}$ that indicates the number of resident citizens for every year t . At the same time, depending on the season, the city receives a variable number of

tourists given by the trigonometric function $I(t) = 4000 + 2000 \sin\left[\frac{t}{2\pi}\right]$

that yields the amount of visitors in the area for every moment t (t in years).

Determine how many years are necessary until the total number of habitants is 132000. (the solution can be found for t between 17 and 22).

- 1) $t = **.*$
- 2) $t = **.*$
- 3) $t = **.*$
- 4) $t = **.*$
- 5) $t = **.*$

Exercise 11

Study the continuity of the function $f(x) = \begin{cases} e^{x-2} + 3 \sin(2-x) & x \leq 2 \\ 3-x & 2 < x < 5 \\ -3 \sin(5-x) - 2 \cos(5-x) & 5 \leq x \end{cases}$

- 1) The functions is continuous for all points.
- 2) The functions is not continuous at any point.
- 3) The function is continuous for all the points except for $x=2$.
- 4) The function is continuous for all the points except for $x=5$.
- 5) The function is continuous for all the points except for $x=2$ and $x=5$.

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01-Functions for serial number: 49

Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a continuous compound rate of 5% and in the bank B we are paid a periodic compound interest rate of 9% in 4 periods (compounding frequency). We initially deposit 11000 euros in the bank A and 4000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **8.***** years.
- 2) In **0.***** years.
- 3) In **2.***** years.
- 4) In **5.***** years.
- 5) In **4.***** years.

Exercise 2

We have one bank account that offers a periodic compound interest rate of 5% in 9 periods (compounding frequency) where we initially deposit 8000 euros. How long time is it necessary until the amount of money in the account reaches 11000 euros?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **8.***** years.
- 2) In **0.***** years.
- 3) In **2.***** years.
- 4) In **6.***** years.
- 5) In **4.***** years.

Exercise 3

We have a bank account that initially offers a periodic compound interest rate of 8% in 9 periods (compounding frequency), and after 3 years the conditions are modified and then we obtain a periodic compound interest rate of 7% in 4 periods (compounding frequency). The initial deposit is 11000 euros. Compute the amount of money in the account after 10 years from the moment of the first deposit.

- 1) We will have ****0.***** euros.
- 2) We will have ****9.***** euros.
- 3) We will have ****2.***** euros.
- 4) We will have ****5.***** euros.
- 5) We will have ****4.***** euros.

Exercise 4

A firm sells Q tons of certain product. The price received per ton is given by the formula $P=14000-15Q$. On the other hand, the production cost per ton is $C=3000+6Q$. In addition, the transportation cost is 10328 per ton. Compute the maximum profit that can be obtained selling this product.

- 1) Profit = 5124 .
- 2) Profit = 7707 .
- 3) Profit = 5298 .
- 4) Profit = 5376 .
- 5) Profit = 7512 .

Exercise 5

Deposits in certain investment account vary from year to year alternating gains and losses periods. We have the following data about the deposits for different years:

year	deposits
0	3
2	21
4	63

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t . Employ that function to forecast the exact amount for year 6.

- 1) The depositis in the account for year 6 are 171 .
- 2) The depositis in the account for year 6 are 3 .
- 3) The depositis in the account for year 6 are 129 .
- 4) The depositis in the account for year 6 are 14 .
- 5) The depositis in the account for year 6 are -18 .

Exercise 6

The funds of a public institution alternate periods of deficit and surplus.

We have the following information for several years (in millions of euros):

year	funds
1	64
5	160
8	169

Employ an interpolation polynomial to build a function that

yields the funds for each year t . We know that due to the legislation the funds of such an institution have to be kept between 64 and 174

- . Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from $t=1$ to $t=8$).

- 1) The funds are inside the limits for the interval: $[0, 13]$.
- 2) The funds are inside the limits for the interval: $[1, 8]$.
- 3) The funds are inside the limits for the interval: $[-1, 4]$.
- 4) The funds are inside the limits for the interval: $[8, 8]$.
- 5) The funds are inside the limits for the interval: $[0, 8]$.
- 6) The funds are inside the limits for the interval: $[-2, 4]$.
- 7) The funds are inside the limits for the interval: $[-2, 8]$.
- 8) The funds are inside the limits for the interval: $[8, 13]$.

Exercise 7

The population of certain type of rodents is analyzed in a region between years $t=3$ and $t=8$. Along that period the population is given by the function $P(t) = 3 + 288t - 60t^2 + 4t^3$ (thousands of rodents). Determine the intervals of years during which the number of rodents is between 451 and 883.

- 1) Along the intervals of years: $[4, 4]$ and $[7, 8]$.
- 2) Along the interval of years: $[5.46739, 8.]$.
- 3) Along the interval of years: $[4.22776, 5.]$.
- 4) Along the intervals of years: $[3., 4.37487]$ and $[5.28104, 8.3217]$.
- 5) Along the interval of years: $[7, 8]$.
- 6) Along the intervals of years: $[3, 7]$ and $[8, 8]$.
- 7) Along the intervals of years: $[3.19446, 4.7458]$ and $[5., 7.40901]$.
- 8) Along the interval of years: $[3., 8.]$.

Exercise 8

Compute the limit: $\lim_{x \rightarrow -\infty} \left(\frac{-8 - 9x + 5x^2 - x^3}{-2 + 3x - 4x^2 - x^3} \right)^{4+7x}$

- 1) $-\infty$
- 2) $\frac{1}{e^{63}}$
- 3) 1
- 4) ∞
- 5) $\frac{1}{e^4}$
- 6) 0
- 7) $\frac{1}{e^3}$

Exercise 9

From an initial deposit 20000, the interest rate varies every year in such a way that the total amount of money in the account is given by the function $C(t) =$

$$20000 \left(\frac{-2 - 9t - 9t^2}{5 - 2t - 9t^2} \right)^{-4+8t}. \text{ Determine the future tendency for the}$$

deposits that we will have after a large number of years.

- 1) 0
- 2) $20000 e^{56/9}$
- 3) ∞
- 4) 20000
- 5) $-\infty$
- 6) $20000 e^{6223/1000}$
- 7) $\frac{20000}{e^4}$

Exercise 10

We deposit 16000 euros in a bank account with a compound interest rate of 4%. At the same time every year we also add in a safe-deposit box (therefore with no interest rate) 3000 euros. How long time is it necessary until the total amount of money (jointly in the bank account and safe-deposit box) is 54000 euros? (the solution can be found for t between 9 and 14).

- 1) $t = \dots 0 \dots$
- 2) $t = \dots 2 \dots$
- 3) $t = \dots 4 \dots$
- 4) $t = \dots 6 \dots$
- 5) $t = \dots 8 \dots$

Exercise 11

Study the continuity of the function $f(x) = \begin{cases} 2 \cos(3 - x) & x \leq 3 \\ \sin(3 - x) - \cos(3 - x) + 3 & 3 < x < 6 \\ -e^{x-6} - 2 \sin(6 - x) & 6 \leq x \end{cases}$

- 1) The functions is continuous for all points.
- 2) The functions is not continuous at any point.
- 3) The function is continuous for all the points except for $x=3$.
- 4) The function is continuous for all the points except for $x=6$.
- 5) The function is continuous for all the points except for $x=3$ and $x=6$.

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01-Functions for serial number: 50

Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a continuous compound rate of 2% and in the bank B we are paid a continuous compound rate of 10%. We initially deposit 11000 euros in the bank A and 3000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **3.***** years.
- 2) In **6.***** years.
- 3) In **0.***** years.
- 4) In **5.***** years.
- 5) In **8.***** years.

Exercise 2

Certain parcel of land is devalued from an initial value of 442000 euros until a final value of 306000 euros along 9 years. Determine the rate of compound interest for that devaluation.

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) The interest rate is **0.***** %.
- 2) The interest rate is **4.***** %.
- 3) The interest rate is **8.***** %.
- 4) The interest rate is **7.***** %.
- 5) The interest rate is **1.***** %.

Exercise 3

We have a bank account that initially offers a continuous compound rate of 3%, and after 3 years the conditions are modified and then we obtain a compound interest rate of 10%. The initial deposit is 11000 euros. Compute the amount of money in the account after 2 years from the moment of the first deposit.

- 1) We will have ****3.***** euros.
- 2) We will have ****0.***** euros.
- 3) We will have ****8.***** euros.
- 4) We will have ****4.***** euros.
- 5) We will have ****6.***** euros.

Exercise 4

A firm sells Q tons of certain product. The price received per ton is given by the formula $P=40000-15Q$. On the other hand, the production cost per ton is $C=10000+20Q$. In addition, the transportation cost is 26710 per ton. Compute the maximum profit that can be obtained selling this product.

- 1) Profit = 110981 .
- 2) Profit = 83263 .
- 3) Profit = 109950 .
- 4) Profit = 101526 .
- 5) Profit = 77315 .

Exercise 5

Deposits in certain investment account vary from year to year alternating gains and losses periods. We have the following data about the deposits for different years:

year	deposits
1	14
2	4
4	-4

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t . Employ that function to determine the minimum funds available in the investment account .

- 1) The minimum for the depositis in the account was 16 .
- 2) The minimum for the depositis in the account was 4 .
- 3) The minimum for the depositis in the account was 10 .
- 4) The minimum for the depositis in the account was -4 .
- 5) The minimum for the depositis in the account was 15 .

Exercise 6

The funds of a public institution alternate periods of deficit and surplus.

We have the following information for several years (in millions of euros):

year	funds
2	46
5	40
9	-24

Employ an interpolation polynomial to build a function that

yields the funds for each year t . We know that due to the legislation the funds of such an institution have to be kept between 30 and 40

- . Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from $t=2$ to $t=9$).

- 1) The funds are inside the limits for the intervals: $[0, 1]$ y $[5, 9]$.
- 2) The funds are inside the limits for the interval: $[5, 6]$.
- 3) The funds are inside the limits for the interval: $[0, 6]$.
- 4) The funds are inside the limits for the interval: $[0, 1]$.
- 5) The funds are inside the limits for the intervals: $[0, 0]$ y $[5, 6]$.
- 6) The funds are inside the limits for the interval: $[1, 9]$.
- 7) The funds are inside the limits for the interval: $[1, 6]$.
- 8) The funds are inside the limits for the interval: $[6, 9]$.

Exercise 7

The population of a city is studied between years $t=1$ and $t=9$. In that period the population is given by the function $P(t) = 2 + 480t - 78t^2 + 4t^3$

- . Determine the intervals of years when the population is between 912 and 938.

- 1) Along the intervals of years: $[1.6553, 2.]$ and $[7.46963, 8.]$.
- 2) Along the interval of years: $[2.77889, 9.]$.
- 3) Along the interval of years: $[4., 7.]$.
- 4) Along the intervals of years: $[1, 3.68826]$, $[4.18826, 6]$, $[7, 8.81174]$ and $[9, 9]$.
- 5) Along the interval of years: $[6., 8.23893]$.
- 6) Along the intervals of years: $[3., 6.75021]$ and $[7.1979, 8.2321]$.
- 7) Along the intervals of years: $[3.68826, 4.18826]$, $[6, 7]$ and $[8.81174, 9]$.
- 8) Along the interval of years: $[1.60534, 5.66812]$.

Exercise 8

Compute the limit: $\lim_{x \rightarrow -\infty} \left(\frac{-7 - 2x + 4x^2}{-7 - 4x + 4x^2} \right)^{9+9x}$

- 1) ∞
- 2) $\frac{1}{e^4}$
- 3) $-\infty$
- 4) $e^{9/2}$
- 5) $\frac{1}{e^2}$
- 6) 0
- 7) 1

Exercise 9

The population of certain country (in millions of habitants) is given by the function $P(t) =$

$26 \left(\frac{-7 - 2t - 4t^2}{-7 - 4t - 4t^2} \right)^{9+9t}$. Determine the future tendency for this population.

- 1) ∞
- 2) $\frac{26}{e^4}$
- 3) $-\infty$
- 4) $\frac{26}{e^{9/2}}$
- 5) $\frac{26}{e^2}$
- 6) 0
- 7) 26

Exercise 10

The population in certain turistic area

increases exponentially and is given by the function $P(t) = 55\,000 e^{t/100}$ that indicates the number of resident citizens for every year t . At the same time, depending on the season, the city receives a variable number of

tourists given by the trigonometric function $I(t) = 4000 + 2000 \sin\left[\frac{t}{2\pi}\right]$

that yields the amount of visitors in the area for every moment t (t in years).

Determine how many years are necessary until the total number of habitants is 79000. (the solution can be found for t between 31 and 36).

- 1) $t = \dots 0 \dots$
- 2) $t = \dots 2 \dots$
- 3) $t = \dots 4 \dots$
- 4) $t = \dots 6 \dots$
- 5) $t = \dots 8 \dots$

Exercise 11

Study the continuity of the function $f(x) = \begin{cases} -2e^{x-3} & x \leq 3 \\ -2 & 3 < x < 6 \\ 2\log(x-5) - 2 & 6 \leq x \end{cases}$

- 1) The functions is continuous for all points.
- 2) The functions is not continuous at any point.
- 3) The function is continuous for all the points except for $x = 3$.
- 4) The function is continuous for all the points except for $x = 6$.
- 5) The function is continuous for all the points except for $x = 3$ and $x = 6$.

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01-Functions for serial number: 51

Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a continuous compound rate of 1% and in the bank B we are paid a periodic compound interest rate of 8% in 12 periods (compounding frequency). We initially deposit 14000 euros in the bank A and 8000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **2.***** years.
- 2) In **8.***** years.
- 3) In **4.***** years.
- 4) In **5.***** years.
- 5) In **0.***** years.

Exercise 2

Certain parcel of land is revalued from an initial value of 170000 euros until a final value of 290000 euros along 6 years. Determine the rate of continuous compound interest for that revaluation.

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) The interest rate is **8.***** %.
- 2) The interest rate is **2.***** %.
- 3) The interest rate is **1.***** %.
- 4) The interest rate is **7.***** %.
- 5) The interest rate is **9.***** %.

Exercise 3

We have a bank account that initially offers a continuous compound rate of 2%, and after 1 year the conditions are modified and then we obtain a continuous compound rate of 6%. The initial deposit is 14000 euros. Compute the amount of money in the account after 5 years from the moment of the first deposit.

- 1) We will have ****6.***** euros.
- 2) We will have ****9.***** euros.
- 3) We will have ****2.***** euros.
- 4) We will have ****0.***** euros.
- 5) We will have ****7.***** euros.

Exercise 4

A firm sells Q tons of certain product. The price received per ton is given by the formula $P=90000-20Q$. On the other hand, the production cost per ton is $C=40000+8Q$. In addition, the transportation cost is 48264 per ton. Compute the maximum profit that can be obtained selling this product.

- 1) Profit = 29733 .
- 2) Profit = 39633 .
- 3) Profit = 43045 .
- 4) Profit = 26908 .
- 5) Profit = 28874 .

Exercise 5

Deposits in certain investment account vary from year to year alternating gains and losses periods. We have the following data about the deposits for different years:

year	deposits
1	41
3	97
5	137

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t . Employ that function to determine the maximum funds available in the investment account .

- 1) The maximum for the depositis in the account was 169 .
- 2) The maximum for the depositis in the account was 19 .
- 3) The maximum for the depositis in the account was 167 .
- 4) The maximum for the depositis in the account was -2 .
- 5) The maximum for the depositis in the account was 9 .

Exercise 6

The funds of a public institution alternate periods of deficit and surplus.

We have the following information for several years (in millions of euros):

year	funds
2	24
5	-21
7	-81

Employ an interpolation polynomial to build a function that

yields the funds for each year t . We know that due to the legislation the funds of such an institution have to be kept between -83 and 0

. Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from $t=2$ to $t=7$).

- 1) The funds are inside the limits for the interval: $[0, 4]$.
- 2) The funds are inside the limits for the interval: $[0, 7]$.
- 3) The funds are inside the limits for the interval: $[-2, 7]$.
- 4) The funds are inside the limits for the interval: $[4, 7]$.
- 5) The funds are inside the limits for the interval: $[-1, 3]$.
- 6) The funds are inside the limits for the interval: $[7, 7]$.
- 7) The funds are inside the limits for the interval: $[-2, 8]$.
- 8) The funds are inside the limits for the interval: $[-1, 4]$.

Exercise 7

The population of certain type of rodents is analyzed in a region between years $t=4$ and $t=9$. Along that period the population is given by the function $P(t) = 3 + 672t - 90t^2 + 4t^3$ (thousands of rodents). Determine the intervals of years during which the number of rodents is between 1317 and 1669.

- 1) Along the interval of years: $[4, 8.5]$.
- 2) Along the interval of years: $[4.51529, 7.]$.
- 3) Along the interval of years: $[4.10506, 8.]$.
- 4) Along the interval of years: $[7.53832, 9.4091]$.
- 5) Along the intervals of years: $[4, 4]$, $[7, 7]$ and $[8.5, 9]$.
- 6) Along the intervals of years: $[4.53095, 5.]$ and $[7.07252, 8.45241]$.
- 7) Along the intervals of years: $[4.58295, 6.]$ and $[8., 9.28486]$.
- 8) Along the intervals of years: $[4., 6.]$ and $[8., 9.01109]$.

Exercise 8

Compute the limit: $\lim_{x \rightarrow -\infty} \left(\frac{8 - 2x - 2x^2}{-3 - 2x - 2x^2} \right)^{-1+9x}$

- 1) ∞
- 2) $-\infty$
- 3) $\frac{1}{e^3}$
- 4) 1
- 5) $\frac{1}{e^4}$
- 6) 0
- 7) $\frac{1}{e^5}$

Exercise 9

The population of certain country (in millions of habitants) is given by the function $P(t) =$

$40 \left(\frac{8 - 2t - 2t^2}{-3 - 2t - 2t^2} \right)^{-1+9t}$. Determine the future tendency for this population.

- 1) $\frac{40}{e^{1/500}}$
- 2) 0
- 3) $\frac{40}{e}$
- 4) $\frac{40}{e^3}$
- 5) 40
- 6) $-\infty$
- 7) ∞

Exercise 10

The population in certain turistic area

increases exponentially and is given by the function $P(t) = 58\,000 e^{t/50}$ that indicates the number of resident citizens for every year t . At the same time, depending on the season, the city receives a variable number of

tourists given by the trigonometric function $I(t) = 4000 + 1000 \sin\left[\frac{t}{2\pi}\right]$

that yields the amount of visitors in the area for every moment t (t in years).

Determine how many years are necessary until the total number of habitants is 112000. (the solution can be found for t between 28 and 33).

- 1) $t = **.*$
- 2) $t = **.*$
- 3) $t = **.*$
- 4) $t = **.*$
- 5) $t = **.*$

Exercise 11

Study the continuity of the function $f(x) = \begin{cases} -e^{x+2} - 3 \sin(x+2) & x \leq -2 \\ -e^{x+2} - 3 \sin(x+2) + e^2 - 2 + 3 \sin(2) & -2 < x < 0 \\ 3 \log(x+1) - 2 & 0 \leq x \end{cases}$

- 1) The functions is continuous for all points.
- 2) The functions is not continuous at any point.
- 3) The function is continuous for all the points except for $x = -2$.
- 4) The function is continuous for all the points except for $x = 0$.
- 5) The function is continuous for all the points except for $x = -2$ and $x = 0$.

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01-Functions for serial number: 52

Exercise 1

We have two bank accounts, the first in the

bank A and the second in the bank B. In the bank A we obtain a continuous compound rate of 8% and in the bank B we are paid a continuous compound rate of 1%. We initially deposit 2000 euros in the bank A and 6000

in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **1.***** years.
- 2) In **4.***** years.
- 3) In **2.***** years.
- 4) In **0.***** years.
- 5) In **5.***** years.

Exercise 2

We have one bank account that offers a

continuous compound rate of 2% where we initially deposit 7000 euros. How long time is it necessary until the amount of money in the account reaches 13000 euros?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **1.***** years.
- 2) In **9.***** years.
- 3) In **2.***** years.
- 4) In **3.***** years.
- 5) In **0.***** years.

Exercise 3

We have a bank account that initially offers a continuous compound rate of 2%

, and after 2 years the conditions are modified and then we obtain a

periodic compound interest rate of 6% in 11 periods (compounding frequency)

. The initial deposit is 6000 euros. Compute the amount of money in the account after 7 years from the moment of the first deposit.

- 1) We will have ****3.***** euros.
- 2) We will have ****1.***** euros.
- 3) We will have ****9.***** euros.
- 4) We will have ****2.***** euros.
- 5) We will have ****7.***** euros.

Exercise 4

A firm sells Q tons of certain product. The price received per ton is given by the formula $P=7000-4Q$. On the other hand, the production cost per ton is $C=2000+14Q$. In addition, the transportation cost is 4208 per ton. Compute the maximum profit that can be obtained selling this product.

- 1) Profit = 4939 .
- 2) Profit = 10175 .
- 3) Profit = 8712 .
- 4) Profit = 7663 .
- 5) Profit = 14808 .

Exercise 5

Deposits in certain investment account vary from year to year alternating gains and losses periods. We have the following data about the deposits for different years:

year	deposits
0	3
2	-13
3	-30

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t . Employ that function to forecast the exact amount for year 5 .

- 1) The depositis in the account for year 5 are -10 .
- 2) The depositis in the account for year 5 are -117 .
- 3) The depositis in the account for year 5 are 2 .
- 4) The depositis in the account for year 5 are -82 .
- 5) The depositis in the account for year 5 are 18 .

Exercise 6

The funds of a public institution alternate periods of deficit and surplus.

We have the following information for several years (in millions of euros):

year	funds
0	20
3	14
5	-10

Employ an interpolation polynomial to build a function that

yields the funds for each year t . We know that due to the legislation the funds of such an institution have to be kept between 4 and 20

. Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from $t=0$ to $t=5$).

- 1) The funds are inside the limits for the interval: $[4, 5]$.
- 2) The funds are inside the limits for the intervals: $[-2, 0]$ y $[2, 5]$.
- 3) The funds are inside the limits for the interval: $[-2, 0]$.
- 4) The funds are inside the limits for the interval: $[0, 5]$.
- 5) The funds are inside the limits for the intervals: $[-2, 0]$ y $[2, 4]$.
- 6) The funds are inside the limits for the interval: $[0, 4]$.
- 7) The funds are inside the limits for the interval: $[0, 0]$.
- 8) The funds are inside the limits for the intervals: $[0, 0]$ y $[2, 4]$.

Exercise 7

The population of certain type of rodents is analyzed in a region between years $t=0$ and $t=9$. Along that period the population is given by the function $P(t) = 3 + 72t - 30t^2 + 4t^3$ (thousands of rodents). Determine the intervals of years during which the number of rodents is between 59 and 1723.

- 1) Along the interval of years: $[3.5, 9]$.
- 2) Along the interval of years: $[1.34559, 9.]$.
- 3) Along the interval of years: $[3.78479, 7.]$.
- 4) Along the intervals of years: $[0, 3.5]$ and $[9, 9]$.
- 5) Along the intervals of years: $[2, 2]$ and $[3.5, 9]$.
- 6) Along the intervals of years: $[5., 6.55193]$ and $[7., 9.77221]$.
- 7) Along the intervals of years: $[1., 2.]$ and $[6.31644, 9.]$.
- 8) Along the interval of years: $[3.37284, 7.]$.

Exercise 8

Compute the limit: $\lim_{x \rightarrow -\infty} \left(\frac{-3 + 8x + 7x^2 - 8x^3}{-6 - 7x + 2x^2 - 8x^3} \right)^{7+3x}$

- 1) 0
- 2) 1
- 3) $\frac{1}{e^2}$
- 4) ∞
- 5) $-\infty$
- 6) e^2
- 7) $\frac{1}{e^{15/8}}$

Exercise 9

The population of certain country (in millions of habitants) is given by the function $P(t) =$

$$40 \left(\frac{-3 + 8t + 7t^2 - 8t^3}{-6 - 7t + 2t^2 - 8t^3} \right)^{7+3t}. \text{ Determine the future tendency for this population.}$$

- 1) $\frac{40}{e^{15/8}}$
- 2) 40
- 3) $\frac{40}{e}$
- 4) ∞
- 5) 0
- 6) $-\infty$
- 7) $\frac{40}{e^3}$

Exercise 10

We deposit 5000 euros in a bank account with a periodic compound interest rate of 7% in 4 periods (compounding frequency). At the same time every year we also add in a safe-deposit box (therefore with no interest rate) 3000 euros. How long time is it necessary until the total ammount of money (jointly in the bank account and safe-depsit box) is 49000 euros? (the solution can be found for t between 10 and 15).

- 1) $t = ** .1****$
- 2) $t = ** .3****$
- 3) $t = ** .5****$
- 4) $t = ** .7****$
- 5) $t = ** .9****$

Exercise 11

Study the continuity of the function $f(x) = \begin{cases} 3 \sin(x+2) - 2 \cos(x+2) & x \leq -2 \\ \frac{x}{2} - 1 & -2 < x < 0 \\ -e^x - \sin(x) & 0 \leq x \end{cases}$

- 1) The functions is continuous for all points.
- 2) The functions is not continuous at any point.
- 3) The function is continuous for all the points except for $x = -2$.
- 4) The function is continuous for all the points except for $x = 0$.
- 5) The function is continuous for all the points except for $x = -2$ and $x = 0$.

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01-Functions for serial number: 53

Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a periodic compound interest rate of 8% in 2 periods (compounding frequency) and in the bank B we are paid a periodic compound interest rate of 2% in 12 periods (compounding frequency). We initially deposit 2000 euros in the bank A and 8000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **1.***** years.
- 2) In **2.***** years.
- 3) In **0.***** years.
- 4) In **3.***** years.
- 5) In **4.***** years.

Exercise 2

We have one bank account that offers a compound interest rate of 3% where we initially deposit 12000 euros. How long time is it necessary until the amount of money in the account reaches 21000 euros?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **1.***** years.
- 2) In **2.***** years.
- 3) In **0.***** years.
- 4) In **8.***** years.
- 5) In **5.***** years.

Exercise 3

We have a bank account that initially offers a compound interest rate of 6%, and after 4 years the conditions are modified and then we obtain a continuous compound rate of 5%. The initial deposit is 8000 euros. Compute the amount of money in the account after 8 years from the moment of the first deposit.

- 1) We will have ****0.***** euros.
- 2) We will have ****7.***** euros.
- 3) We will have ****1.***** euros.
- 4) We will have ****9.***** euros.
- 5) We will have ****5.***** euros.

Exercise 4

A firm sells Q tons of certain product. The price received per ton is given by the formula $P=15000-9Q$. On the other hand, the production cost per ton is $C=11000-6Q$. In addition, the transportation cost is 3826 per ton. Compute the maximum profit that can be obtained selling this product.

- 1) Profit = 3096 .
- 2) Profit = 2523 .
- 3) Profit = 3024 .
- 4) Profit = 1823 .
- 5) Profit = 2005 .

Exercise 5

Deposits in certain investment account vary from year to year alternating gains and losses periods. We have the following data about the deposits for different years:

year	deposits
0	1
2	-7
4	-31

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t . Employ that function to forecast the exact amount for year 5 .

- 1) The depositis in the account for year 5 are -4 .
- 2) The depositis in the account for year 5 are -2 .
- 3) The depositis in the account for year 5 are -71 .
- 4) The depositis in the account for year 5 are -49 .
- 5) The depositis in the account for year 5 are -1 .

Exercise 6

The funds of a public institution alternate periods of deficit and surplus.

We have the following information for several years (in millions of euros):

year	funds
0	23
4	95
7	86

Employ an interpolation polynomial to build a function that

yields the funds for each year t . We know that due to the legislation the funds of such an institution have to be kept between 50 and 86

. Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from $t=0$ to $t=7$).

- 1) The funds are inside the limits for the interval: $[3, 9]$.
- 2) The funds are inside the limits for the interval: $[0, 3]$.
- 3) The funds are inside the limits for the intervals: $[1, 3]$ y $[7, 7]$.
- 4) The funds are inside the limits for the interval: $[7, 9]$.
- 5) The funds are inside the limits for the interval: $[3, 7]$.
- 6) The funds are inside the limits for the interval: $[1, 3]$.
- 7) The funds are inside the limits for the interval: $[0, 9]$.
- 8) The funds are inside the limits for the intervals: $[0, 1]$ y $[7, 9]$.

Exercise 7

The population of a city is studied between years $t=1$ and $t=10$. In that period the population is given by the function $P(t) = 9 + 72t - 30t^2 + 4t^3$

. Determine the intervals of years when the population is between -97 and 73.

- 1) Along the intervals of years: $[2.73734, 3.]$ and $[6.74425, 9.44258]$.
- 2) Along the interval of years: $[5.76591, 8.14784]$.
- 3) Along the interval of years: $[3., 6.07681]$.
- 4) Along the intervals of years: $[3., 5.]$ and $[6.05499, 9.]$.
- 5) Along the interval of years: $[3., 7.]$.
- 6) Along the intervals of years: $[1, 1]$ and $[4, 10]$.
- 7) Along the interval of years: $[2.57494, 7.]$.
- 8) Along the interval of years: $[1, 4]$.

Exercise 8

Compute the limit: $\lim_{x \rightarrow \infty} \left(\frac{3 + 8x + x^2}{-4 - 6x + x^2} \right)^{-7+6x}$

- 1) ∞
- 2) 0
- 3) 1
- 4) $-\infty$
- 5) $\frac{1}{e^4}$
- 6) e^{84}
- 7) $\frac{1}{e^2}$

Exercise 9

From an initial deposit 12000, the interest rate varies every year in such a way that the total amount of money in the account is given by the function $C(t) =$

$$12000 \left(\frac{3 + 8t + t^2}{-4 - 6t + t^2} \right)^{-7+6t}. \text{ Determine the future tendency for the}$$

deposits that we will have after a large number of years.

- 1) 12000
- 2) $-\infty$
- 3) ∞
- 4) $\frac{12000}{e^4}$
- 5) $\frac{12000}{e^2}$
- 6) $12000 e^{84}$
- 7) 0

Exercise 10

We deposit 16000 euros in a bank account with a periodic compound interest rate of 10% in 12 periods (compounding frequency). At the same time every year we also add in a safe-deposit box (therefore with no interest rate) 4000 euros. How long time is it necessary until the total amount of money (jointly in the bank account and safe-deposit box) is 59000 euros? (the solution can be found for t between 2 and 7).

- 1) $t = \dots 0 \dots$
- 2) $t = \dots 2 \dots$
- 3) $t = \dots 4 \dots$
- 4) $t = \dots 6 \dots$
- 5) $t = \dots 8 \dots$

Exercise 11

Study the continuity of the function $f(x) = \begin{cases} -\cos(x) & x \leq 0 \\ \frac{x}{2} - 2 & 0 < x < 2 \\ 2 \log(x - 1) + 1 & 2 \leq x \end{cases}$

- 1) The functions is continuous for all points.
- 2) The functions is not continuous at any point.
- 3) The function is continuous for all the points except for $x = 0$.
- 4) The function is continuous for all the points except for $x = 2$.
- 5) The function is continuous for all the points except for $x = 0$ and $x = 2$.

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01-Functions for serial number: 54

Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a compound interest rate of 10% and in the bank B we are paid a periodic compound interest rate of 4% in 9 periods (compounding frequency). We initially deposit 2000 euros in the bank A and 7000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **2.***** years.
- 2) In **5.***** years.
- 3) In **7.***** years.
- 4) In **0.***** years.
- 5) In **4.***** years.

Exercise 2

We have one bank account that offers a compound interest rate of 3% where we initially deposit 9000 euros. How long time is it necessary until the amount of money in the account reaches 18000 euros?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **3.***** years.
- 2) In **6.***** years.
- 3) In **7.***** years.
- 4) In **0.***** years.
- 5) In **4.***** years.

Exercise 3

We have a bank account that initially offers a continuous compound rate of 7%, and after 3 years the conditions are modified and then we obtain a compound interest rate of 8%. The initial deposit is 7000 euros. Compute the amount of money in the account after 7 years from the moment of the first deposit.

- 1) We will have ****8.***** euros.
- 2) We will have ****6.***** euros.
- 3) We will have ****7.***** euros.
- 4) We will have ****1.***** euros.
- 5) We will have ****0.***** euros.

Exercise 4

A firm sells Q tons of certain product. The price received per ton is given by the formula $P=6000-6Q$. On the other hand, the production cost per ton is $C=4000-2Q$. In addition, the transportation cost is 1712 per ton. Compute the maximum profit that can be obtained selling this product.

- 1) Profit = 5584 .
- 2) Profit = 2069 .
- 3) Profit = 2216 .
- 4) Profit = 2247 .
- 5) Profit = 5184 .

Exercise 5

Deposits in certain investment account vary from year to year alternating gains and losses periods. We have the following data about the deposits for different years:

year	deposits
1	0
2	-1
4	-3

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t . Employ that function to forecast the exact amount for year 6 .

- 1) The depositis in the account for year 6 are -10 .
- 2) The depositis in the account for year 6 are -5 .
- 3) The depositis in the account for year 6 are 8 .
- 4) The depositis in the account for year 6 are 2 .
- 5) The depositis in the account for year 6 are -6 .

Exercise 6

The funds of a public institution alternate periods of deficit and surplus.

We have the following information for several years (in millions of euros):

year	funds
0	15
4	-33
7	-27

Employ an interpolation polynomial to build a function that

yields the funds for each year t . We know that due to the legislation the funds of such an institution have to be kept between -27 and -3

. Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from $t=0$ to $t=7$).

- 1) The funds are inside the limits for the interval: $[1, 3]$.
- 2) The funds are inside the limits for the intervals: $[1, 3]$ y $[7, 9]$.
- 3) The funds are inside the limits for the interval: $[0, 1]$.
- 4) The funds are inside the limits for the intervals: $[1, 3]$ y $[7, 7]$.
- 5) The funds are inside the limits for the interval: $[0, 7]$.
- 6) The funds are inside the limits for the interval: $[1, 7]$.
- 7) The funds are inside the limits for the intervals: $[0, 3]$ y $[7, 9]$.
- 8) The funds are inside the limits for the interval: $[7, 7]$.

Exercise 7

The population of certain type of rodents is analyzed in a region between years $t=1$ and $t=7$. Along that period the population is given by the function $P(t) = 7 + 360t - 66t^2 + 4t^3$ (thousands of rodents). Determine the intervals of years during which the number of rodents is between 7 and 495.

- 1) Along the intervals of years: $[1., 3.6514]$ and $[4., 6.6061]$.
- 2) Along the intervals of years: $[3., 4.]$ and $[6., 7.49604]$.
- 3) Along the intervals of years: $[1, 1]$ and $[2, 7]$.
- 4) Along the intervals of years: $[1.1777, 2.32877]$ and $[4.70085, 7.]$.
- 5) Along the interval of years: $[2., 7.54134]$.
- 6) Along the intervals of years: $[1., 2.4871]$ and $[5., 7.]$.
- 7) Along the interval of years: $[1, 2]$.
- 8) Along the intervals of years: $[3., 5.30456]$ and $[6.75282, 7.67868]$.

Exercise 8

Compute the limit: $\lim_{x \rightarrow \infty} \left(\frac{-2 + 3x - 6x^2 - 3x^3}{-8 - 4x + 3x^2 - 3x^3} \right)^{-2-4x+3x^2}$

- 1) 0
- 2) $\frac{1}{e^4}$
- 3) $-\infty$
- 4) 1
- 5) $\frac{1}{e}$
- 6) $\frac{1}{e^5}$
- 7) ∞

Exercise 9

From an initial deposit 7000, the interest rate varies every year in such a way that the total amount of money in the account is given by the function $C(t) =$

$7000 \left(\frac{-2 + 3t - 6t^2 + 3t^3}{-8 - 4t + 3t^2 + 3t^3} \right)^{-2-4t+3t^2}$. Determine the future tendency for

the deposits that we will have after a large number of years.

- 1) 7000
- 2) $\frac{7000}{e^4}$
- 3) ∞
- 4) $-\infty$
- 5) $\frac{7000}{e}$
- 6) $\frac{7000}{e^5}$
- 7) 0

Exercise 10

We deposit 10000 euros in a bank account with a periodic compound interest rate of 6% in 7 periods (compounding frequency). At the same time every year we also add in a safe-deposit box (therefore with no interest rate) 1000 euros. How long time is it necessary until the total amount of money (jointly in the bank account and safe-deposit box) is 57000 euros? (the solution can be found for t between 17 and 22).

- 1) $t = **.*1****$
- 2) $t = **.*3****$
- 3) $t = **.*5****$
- 4) $t = **.*7****$
- 5) $t = **.*9****$

Exercise 11

Study the continuity of the function $f(x) =$

$$f(x) = \begin{cases} \cos(x+1) & x \leq -1 \\ -\sin(x+1) + \cos(x+1) + 1 + \sin(3) - \cos(3) & -1 < x < 2 \\ 1 - 2 \log(x-1) & 2 \leq x \end{cases}$$

- 1) The function is continuous for all points.
- 2) The function is not continuous at any point.
- 3) The function is continuous for all the points except for $x = -1$.
- 4) The function is continuous for all the points except for $x = 2$.
- 5) The function is continuous for all the points except for $x = -1$ and $x = 2$.

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01-Functions for serial number: 55

Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a continuous compound rate of 9% and in the bank B we are paid a periodic compound interest rate of 4% in 6 periods (compounding frequency). We initially deposit 6000 euros in the bank A and 14000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **8.***** years.
- 2) In **7.***** years.
- 3) In **3.***** years.
- 4) In **0.***** years.
- 5) In **6.***** years.

Exercise 2

Certain parcel of land is revalued from an initial value of 190000 euros until a final value of 466000 euros along 7 years. Determine the rate of continuous compound interest for that revaluation.

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) The interest rate is **9.***** %.
- 2) The interest rate is **6.***** %.
- 3) The interest rate is **7.***** %.
- 4) The interest rate is **5.***** %.
- 5) The interest rate is **2.***** %.

Exercise 3

We have a bank account that initially offers a continuous compound rate of 7%, and after 4 years the conditions are modified and then we obtain a continuous compound rate of 7%. The initial deposit is 14000 euros. Compute the amount of money in the account after 4 years from the moment of the first deposit.

- 1) We will have ****9.***** euros.
- 2) We will have ****7.***** euros.
- 3) We will have ****4.***** euros.
- 4) We will have ****0.***** euros.
- 5) We will have ****3.***** euros.

Exercise 4

A firm sells Q tons of certain product. The price received per ton is given by the formula $P=1400-20Q$. On the other hand, the production cost per ton is $C=300-18Q$. In addition, the transportation cost is 1056 per ton. Compute the maximum profit that can be obtained selling this product.

- 1) Profit = 78 .
- 2) Profit = 90 .
- 3) Profit = 143 .
- 4) Profit = 86 .
- 5) Profit = 242 .

Exercise 5

Deposits in certain investment account vary from year to year alternating gains and losses periods. We have the following data about the deposits for different years:

year	deposits
2	88
3	126
5	190

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t . Employ that function to determine the maximum funds available in the investment account .

- 1) The maximum for the depositis in the account was 238 .
- 2) The maximum for the depositis in the account was 16 .
- 3) The maximum for the depositis in the account was 18 .
- 4) The maximum for the depositis in the account was 12 .
- 5) The maximum for the depositis in the account was 288 .

Exercise 6

The funds of a public institution alternate periods of deficit and surplus.

We have the following information for several years (in millions of euros):

year	funds
2	8
5	35
8	116

Employ an interpolation polynomial to build a function that

yields the funds for each year t . We know that due to the legislation the funds of such an institution have to be kept between 11 and 134

- . Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from $t=2$ to $t=8$).

- 1) The funds are inside the limits for the interval: $[-2, 6]$.
- 2) The funds are inside the limits for the interval: $[1, 8]$.
- 3) The funds are inside the limits for the interval: $[3, 8]$.
- 4) The funds are inside the limits for the interval: $[-2, 5]$.
- 5) The funds are inside the limits for the interval: $[-2, 4]$.
- 6) The funds are inside the limits for the interval: $[0, 8]$.
- 7) The funds are inside the limits for the interval: $[0, 3]$.
- 8) The funds are inside the limits for the interval: $[8, 8]$.

Exercise 7

The population of a city is studied between years $t=4$ and $t=9$. In that period the population is given by the function $P(t) = 6 + 672t - 90t^2 + 4t^3$

- . Determine the intervals of years when the population is between 1616 and 1670.

- 1) Along the intervals of years: $[4., 6.1654]$ and $[7.16485, 8.]$.
- 2) Along the interval of years: $[5.20164, 9.]$.
- 3) Along the interval of years: $[4.39838, 5.]$.
- 4) Along the intervals of years: $[5, 6.5]$ and $[8, 8]$.
- 5) Along the intervals of years: $[4., 6.]$ and $[8., 9.28753]$.
- 6) Along the interval of years: $[4., 9.]$.
- 7) Along the interval of years: $[5, 6.5]$.
- 8) Along the intervals of years: $[4, 5]$ and $[6.5, 9]$.

Exercise 8

Compute the limit: $\lim_{x \rightarrow \infty} \left(\frac{8 + 9x - 9x^2 - 3x^3}{-9 - 9x + 6x^2 - 3x^3} \right)^{-2+x}$

- 1) 1
- 2) $\frac{1}{e^3}$
- 3) ∞
- 4) e^5
- 5) $\frac{1}{e^4}$
- 6) $-\infty$
- 7) 0

Exercise 9

The population of certain country (in millions of habitants) is given by the function $P(t) =$

$30 \left(\frac{8 + 9t - 9t^2 + 3t^3}{-9 - 9t + 6t^2 + 3t^3} \right)^{-2+t}$. Determine the future tendency for this population.

- 1) ∞
- 2) $\frac{30}{e^4}$
- 3) $\frac{30}{e^{2501/500}}$
- 4) 0
- 5) $\frac{30}{e^5}$
- 6) $-\infty$
- 7) 30

Exercise 10

The population in certain turistic area

increases exponentially and is given by the function $P(t) = 61\,000 e^{t/100}$ that indicates the number of resident citizens for every year t . At the same time, depending on the season, the city receives a variable number of

tourists given by the trigonometric function $I(t) = 4000 + 1000 \sin\left[\frac{t}{2\pi}\right]$

that yields the amount of visitors in the area for every moment t (t in years).

Determine how many years are necessary until the total number of habitants is 105000. (the solution can be found for t between 46 and 51).

- 1) $t = \dots 0 \dots$
- 2) $t = \dots 2 \dots$
- 3) $t = \dots 4 \dots$
- 4) $t = \dots 6 \dots$
- 5) $t = \dots 8 \dots$

Exercise 11

Study the continuity of the function $f(x) = \begin{cases} 0 & x \leq -2 \\ \frac{4x}{3} + \frac{2}{3} & -2 < x < 1 \\ 2 \cos(1-x) - 2 \sin(1-x) & 1 \leq x \end{cases}$

- 1) The functions is continuous for all points.
- 2) The functions is not continuous at any point.
- 3) The function is continuous for all the points except for $x = -2$.
- 4) The function is continuous for all the points except for $x = 1$.
- 5) The function is continuous for all the points except for $x = -2$ and $x = 1$.

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01-Functions for serial number: 56

Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a compound interest rate of 2% and in the bank B we are paid a continuous compound rate of 5%. We initially deposit 12000 euros in the bank A and 1000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **6.***** years.
- 2) In **7.***** years.
- 3) In **2.***** years.
- 4) In **9.***** years.
- 5) In **0.***** years.

Exercise 2

We have one bank account that offers a continuous compound rate of 1% where we initially deposit 9000 euros. How long time is it necessary until the amount of money in the account reaches 11000 euros?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **6.***** years.
- 2) In **7.***** years.
- 3) In **0.***** years.
- 4) In **9.***** years.
- 5) In **2.***** years.

Exercise 3

We have a bank account that initially offers a compound interest rate of 3%, and after 1 year the conditions are modified and then we obtain a compound interest rate of 9%. The initial deposit is 12000 euros. Compute the amount of money in the account after 3 years from the moment of the first deposit.

- 1) We will have ****7.***** euros.
- 2) We will have ****2.***** euros.
- 3) We will have ****6.***** euros.
- 4) We will have ****0.***** euros.
- 5) We will have ****4.***** euros.

Exercise 4

A firm sells Q tons of certain product. The price received per ton is given by the formula $P=8000-16Q$. On the other hand, the production cost per ton is $C=6000+4Q$. In addition, the transportation cost is 1880 per ton. Compute the maximum profit that can be obtained selling this product.

- 1) Profit = 180 .
- 2) Profit = 259 .
- 3) Profit = 113 .
- 4) Profit = 159 .
- 5) Profit = 303 .

Exercise 5

Deposits in certain investment account vary from year to year alternating gains and losses periods. We have the following data about the deposits for different years:

year	deposits
0	0
1	-5
3	-33

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t . Employ that function to forecast the exact amount for year 4 .

- 1) The depositis in the account for year 4 are -1 .
- 2) The depositis in the account for year 4 are 16 .
- 3) The depositis in the account for year 4 are -13 .
- 4) The depositis in the account for year 4 are -85 .
- 5) The depositis in the account for year 4 are -56 .

Exercise 6

The funds of a public institution alternate periods of deficit and surplus.

We have the following information for several years (in millions of euros):

year	funds
1	20
3	32
7	128

Employ an interpolation polynomial to build a function that

yields the funds for each year t . We know that due to the legislation the funds of such an institution have to be kept between 23 and 95

- . Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from $t=1$ to $t=7$).

- 1) The funds are inside the limits for the interval: $[-4, 0]$.
- 2) The funds are inside the limits for the interval: $[2, 7]$.
- 3) The funds are inside the limits for the interval: $[0, 2]$.
- 4) The funds are inside the limits for the interval: $[-4, 7]$.
- 5) The funds are inside the limits for the interval: $[-4, 2]$.
- 6) The funds are inside the limits for the intervals: $[-4, 0]$ y $[6, 7]$.
- 7) The funds are inside the limits for the intervals: $[0, 0]$ y $[2, 6]$.
- 8) The funds are inside the limits for the interval: $[2, 6]$.

Exercise 7

The population of certain type of rodents is analyzed in a region between years $t=3$ and $t=9$. Along that period the population is given by the function $P(t) = 4 + 384t - 72t^2 + 4t^3$ (thousands of rodents). Determine the intervals of years during which the number of rodents is between 536 and 580.

- 1) Along the intervals of years: $[6, 7]$ and $[8.8541, 9]$.
- 2) Along the interval of years: $[7., 8.]$.
- 3) Along the interval of years: $[6., 8.06716]$.
- 4) Along the interval of years: $[4., 5.00127]$.
- 5) Along the interval of years: $[5., 8.]$.
- 6) Along the intervals of years: $[4., 6.49804]$ and $[7., 8.46373]$.
- 7) Along the intervals of years: $[3, 6]$, $[7, 8.8541]$ and $[9, 9]$.
- 8) Along the intervals of years: $[4.56719, 5.46009]$ and $[6.20489, 7.28695]$.

Exercise 8

Compute the limit: $\lim_{x \rightarrow -\infty} \left(\frac{1 - 7x - 3x^2 + 5x^3}{3 - 3x - 3x^2 + 5x^3} \right)^{3-x+x^2}$

- 1) 1
- 2) $\frac{1}{e^{4/5}}$
- 3) $\frac{1}{e^4}$
- 4) 0
- 5) $-\infty$
- 6) ∞
- 7) $\frac{1}{e}$

Exercise 9

A factory produces certain type of devices. The marginal cost (cost of producing one unit) decreases when we produce a large amount

of units and it is given by the function $C(x) = \frac{8 + 3x + 7x^2}{1 + 7x + 3x^2 + 5x^3 + 3x^4}$

. Determine the expected cost per unit when a large amount of units is produced.

- 1) $-\frac{3}{5}$
- 2) -1
- 3) 9000
- 4) 0
- 5) $-\infty$
- 6) $-\frac{1}{6}$
- 7) ∞

Exercise 10

We deposit 17000 euros in a bank account with a compound interest rate of 1%. At the same time every year we also add in a safe-deposit box (therefore with no interest rate) 5000 euros. How long time is it necessary until the total amount of money (jointly in the bank account and safe-deposit box) is 68000 euros? (the solution can be found for t between 8 and 13).

- 1) $t = ** .0****$
- 2) $t = ** .2****$
- 3) $t = ** .4****$
- 4) $t = ** .6****$
- 5) $t = ** .8****$

Exercise 11

Study the continuity of the function $f(x) = \begin{cases} -3 \sin(x+2) - 2 \cos(x+2) & x \leq -2 \\ -3 \log(x+3) + 1 + 3 \log(4) & -2 < x < 1 \\ \sin(1-x) + \cos(1-x) & 1 \leq x \end{cases}$

- 1) The functions is continuous for all points.
- 2) The functions is not continuous at any point.
- 3) The function is continuous for all the points except for $x = -2$.
- 4) The function is continuous for all the points except for $x = 1$.
- 5) The function is continuous for all the points except for $x = -2$ and $x = 1$.

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01-Functions for serial number: 57

Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a continuous compound rate of 2% and in the bank B we are paid a continuous compound rate of 5%. We initially deposit 7000 euros in the bank A and 2000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **9.***** years.
- 2) In **3.***** years.
- 3) In **0.***** years.
- 4) In **6.***** years.
- 5) In **1.***** years.

Exercise 2

We have one bank account that offers a compound interest rate of 4% where we initially deposit 9000 euros. How long time is it necessary until the amount of money in the account reaches 16000 euros?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **9.***** years.
- 2) In **3.***** years.
- 3) In **0.***** years.
- 4) In **7.***** years.
- 5) In **4.***** years.

Exercise 3

We have a bank account that initially offers a continuous compound rate of 4%, and after 3 years the conditions are modified and then we obtain a continuous compound rate of 2%. The initial deposit is 7000 euros. Compute the amount of money in the account after 4 years from the moment of the first deposit.

- 1) We will have ****1.***** euros.
- 2) We will have ****9.***** euros.
- 3) We will have ****3.***** euros.
- 4) We will have ****5.***** euros.
- 5) We will have ****4.***** euros.

Exercise 4

A firm sells Q tons of certain product. The price received per ton is given by the formula $P=3000-6Q$. On the other hand, the production cost per ton is $C=1000+6Q$. In addition, the transportation cost is 1160 per ton. Compute the maximum profit that can be obtained selling this product.

- 1) Profit = 14 379 .
- 2) Profit = 8710 .
- 3) Profit = 6328 .
- 4) Profit = 10 874 .
- 5) Profit = 14 700 .

Exercise 5

Deposits in certain investment account vary from year to year alternating gains and losses periods. We have the following data about the deposits for different years:

year	deposits
1	0
2	-7
3	-18

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t . Employ that function to forecast the exact amount for year 4 .

- 1) The depositis in the account for year 4 are -10 .
- 2) The depositis in the account for year 4 are -8 .
- 3) The depositis in the account for year 4 are -33 .
- 4) The depositis in the account for year 4 are 2 .
- 5) The depositis in the account for year 4 are -52 .

Exercise 6

The funds of a public institution alternate periods of deficit and surplus.

We have the following information for several years (in millions of euros):

year	funds
0	12
4	12
6	48

Employ an interpolation polynomial to build a function that

yields the funds for each year t . We know that due to the legislation the funds of such an institution have to be kept between 3 and 27

- . Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from $t=0$ to $t=6$).

- 1) The funds are inside the limits for the interval: $[3, 6]$.
- 2) The funds are inside the limits for the intervals: $[-1, 1]$ y $[5, 6]$.
- 3) The funds are inside the limits for the interval: $[-1, 1]$.
- 4) The funds are inside the limits for the interval: $[-1, 6]$.
- 5) The funds are inside the limits for the intervals: $[0, 1]$ y $[3, 5]$.
- 6) The funds are inside the limits for the interval: $[-1, 0]$.
- 7) The funds are inside the limits for the interval: $[-1, 3]$.
- 8) The funds are inside the limits for the interval: $[0, 3]$.

Exercise 7

The population of certain type of rodents is analyzed in a region between years

$t=1$ and $t=7$. Along that period the population is given by the function $P(t) = 7 + 216t - 54t^2 + 4t^3$ (thousands of rodents). Determine the intervals of years during which the number of rodents is between 237 and 263.

- 1) Along the interval of years: $[3.56976, 4.09527]$.
- 2) Along the intervals of years: $[1, 1.68826]$, $[2.18826, 4]$, $[5, 6.81174]$ and $[7, 7]$.
- 3) Along the intervals of years: $[1., 2.]$ and $[3., 4.]$.
- 4) Along the interval of years: $[2.00153, 5.34645]$.
- 5) Along the intervals of years: $[1.68826, 2.18826]$, $[4, 5]$ and $[6.81174, 7]$.
- 6) Along the intervals of years: $[2., 4.]$ and $[5., 7.60503]$.
- 7) Along the interval of years: $[5.32358, 7.05653]$.
- 8) Along the intervals of years: $[2., 3.]$ and $[6.69344, 7.]$.

Exercise 8

Compute the limit: $\lim_{x \rightarrow -\infty} \left(\frac{3 + 9x - x^2 - 3x^3}{7 - x + 7x^2 - 3x^3} \right)^{-7+9x}$

- 1) $\frac{1}{e^3}$
- 2) $-\infty$
- 3) ∞
- 4) 0
- 5) 1
- 6) e^{24}
- 7) $\frac{1}{e^4}$

Exercise 9

From an initial deposit 4000, the interest rate varies every year in such a way that the total amount of money in the account is given by the function $C(t) =$

$$4000 \left(\frac{3 + 9t - t^2 - 3t^3}{7 - t + 7t^2 - 3t^3} \right)^{-7+9t}. \text{ Determine the future tendency for the}$$

deposits that we will have after a large number of years.

- 1) $\frac{4000}{e^4}$
- 2) $4000 \text{ €}^{11999/500}$
- 3) $-\infty$
- 4) 0
- 5) 4000
- 6) 4000 €^{24}
- 7) ∞

Exercise 10

We deposit 9000 euros in a bank account with a periodic compound interest rate of 9% in 6 periods (compounding frequency). At the same time every year we also add in a safe-deposit box (therefore with no interest rate) 1000 euros. How long time is it necessary until the total amount of money (jointly in the bank account and safe-deposit box) is 48000 euros? (the solution can be found for t between 10 and 15).

- 1) $t = \dots 0 \dots$
- 2) $t = \dots 2 \dots$
- 3) $t = \dots 4 \dots$
- 4) $t = \dots 6 \dots$
- 5) $t = \dots 8 \dots$

Exercise 11

Study the continuity of the function $f(x) = \begin{cases} 3 \sin(x+1) - \cos(x+1) & x \leq -1 \\ 3 \sin(x+1) + 2 \cos(x+1) - 3 & -1 < x < 0 \\ 2 \log(x+1) - 2 & 0 \leq x \end{cases}$

- 1) The functions is continuous for all points.
- 2) The functions is not continuous at any point.
- 3) The function is continuous for all the points except for $x = -1$.
- 4) The function is continuous for all the points except for $x = 0$.
- 5) The function is continuous for all the points except for $x = -1$ and $x = 0$.

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01-Functions for serial number: 58

Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a compound interest rate of 10% and in the bank B we are paid a continuous compound rate of 6%. We initially deposit 4000 euros in the bank A and 9000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **0.***** years.
- 2) In **6.***** years.
- 3) In **5.***** years.
- 4) In **2.***** years.
- 5) In **8.***** years.

Exercise 2

We have one bank account that offers a continuous compound rate of 3% where we initially deposit 14000 euros. How long time is it necessary until the amount of money in the account reaches 23000 euros?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **5.***** years.
- 2) In **6.***** years.
- 3) In **2.***** years.
- 4) In **8.***** years.
- 5) In **0.***** years.

Exercise 3

We have a bank account that initially offers a continuous compound rate of 2%, and after 2 years the conditions are modified and then we obtain a continuous compound rate of 4%. The initial deposit is 9000 euros. Compute the amount of money in the account after 2 years from the moment of the first deposit.

- 1) We will have ****0.***** euros.
- 2) We will have ****6.***** euros.
- 3) We will have ****5.***** euros.
- 4) We will have ****7.***** euros.
- 5) We will have ****8.***** euros.

Exercise 4

A firm sells Q tons of certain product. The price received per ton is given by the formula $P=80000-11Q$. On the other hand, the production cost per ton is $C=40000+9Q$. In addition, the transportation cost is 38000 per ton. Compute the maximum profit that can be obtained selling this product.

- 1) Profit = 33146 .
- 2) Profit = 50000 .
- 3) Profit = 30684 .
- 4) Profit = 75039 .
- 5) Profit = 42692 .

Exercise 5

Deposits in certain investment account vary from year to year alternating gains and losses periods. We have the following data about the deposits for different years:

year	deposits
2	11
3	22
4	37

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t . Employ that function to forecast the exact amount for year 6 .

- 1) The depositis in the account for year 6 are 12 .
- 2) The depositis in the account for year 6 are 106 .
- 3) The depositis in the account for year 6 are 79 .
- 4) The depositis in the account for year 6 are 1 .
- 5) The depositis in the account for year 6 are 2 .

Exercise 6

The funds of a public institution alternate periods of deficit and surplus.

We have the following information for several years (in millions of euros):

year	funds
1	49
3	85
7	85

Employ an interpolation polynomial to build a function that

yields the funds for each year t . We know that due to the legislation the funds of such an institution have to be kept between 20 and 70

- . Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from $t=1$ to $t=7$).

- 1) The funds are inside the limits for the interval: $[7, 8]$.
- 2) The funds are inside the limits for the interval: $[0, 7]$.
- 3) The funds are inside the limits for the interval: $[1, 2]$.
- 4) The funds are inside the limits for the interval: $[-2, 5]$.
- 5) The funds are inside the limits for the interval: $[7, 7]$.
- 6) The funds are inside the limits for the interval: $[2, 7]$.
- 7) The funds are inside the limits for the interval: $[0, 8]$.
- 8) The funds are inside the limits for the interval: $[-1, 4]$.

Exercise 7

The population of a city is studied between years $t=2$ and $t=8$. In that period the population is given by the function $P(t) = 5 + 420t - 72t^2 + 4t^3$

- . Determine the intervals of years when the population is between 589 and 1005.

- 1) Along the interval of years: $[7.0635, 8.3419]$.
- 2) Along the interval of years: $[2.20135, 5.]$.
- 3) Along the interval of years: $[3., 4.]$.
- 4) Along the intervals of years: $[2.66503, 4.12137]$ and $[6., 7.]$.
- 5) Along the intervals of years: $[2, 2]$ and $[8, 8]$.
- 6) Along the intervals of years: $[3.26956, 4.]$ and $[5., 7.43886]$.
- 7) Along the interval of years: $[2, 8]$.
- 8) Along the intervals of years: $[2., 4.]$ and $[5.62692, 6.05211]$.

Exercise 8

Compute the limit: $\lim_{x \rightarrow \infty} \left(\frac{-8 - 5x + 6x^2}{5 - 4x + 6x^2} \right)^{-5+2x+6x^2}$

- 1) $\frac{1}{e^3}$
- 2) 1
- 3) ∞
- 4) $\frac{1}{e^4}$
- 5) $-\infty$
- 6) 0
- 7) $\frac{1}{e^5}$

Exercise 9

A factory produces certain type of devices. The marginal cost (cost of producing one unit) decreases when we produce a large amount

of units and it is given by the function $C(x) = \frac{6 + 7x + x^2 + 8x^3 + 3x^4}{6 + 8x + x^2 + 7x^3 + 3x^4}$

. Determine the expected cost per unit when a large amount of units is produced.

- 1) 0
- 2) 1
- 3) ∞
- 4) $\frac{51}{50}$
- 5) -2
- 6) $-\infty$
- 7) 11000

Exercise 10

We deposit 19000 euros in a bank account with a continuous compound rate of 8%. At the same time every year we also add in a safe-deposit box (therefore with no interest rate) 5000 euros. How long time is it necessary until the total ammount of money (jointly in the bank account and safe-depsit box) is 69000 euros? (the solution can be found for t between 4 and 9).

- 1) $t = \dots 0 \dots$
- 2) $t = \dots 2 \dots$
- 3) $t = \dots 4 \dots$
- 4) $t = \dots 6 \dots$
- 5) $t = \dots 8 \dots$

Exercise 11

Study the continuity of the function $f(x) = \begin{cases} \cos(1-x) - 3\sin(1-x) & x \leq 1 \\ -e^{x-1} - \sin(1-x) + e + 1 - \sin(1) & 1 < x < 2 \\ 2\sin(2-x) + \cos(2-x) & 2 \leq x \end{cases}$

- 1) The functions is continuous for all points.
- 2) The functions is not continuous at any point.
- 3) The function is continuous for all the points except for $x=1$.
- 4) The function is continuous for all the points except for $x=2$.
- 5) The function is continuous for all the points except for $x=1$ and $x=2$.

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01-Functions for serial number: 59

Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a continuous compound rate of 3% and in the bank B we are paid a periodic compound interest rate of 9% in 3 periods (compounding frequency). We initially deposit 15000 euros in the bank A and 7000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **5.***** years.
- 2) In **8.***** years.
- 3) In **2.***** years.
- 4) In **0.***** years.
- 5) In **6.***** years.

Exercise 2

Certain parcel of land is revalued from an initial value of 250000 euros until a final value of 423000 euros along 6 years. Determine the rate of continuous compound interest for that revaluation.

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) The interest rate is **4.***** %.
- 2) The interest rate is **1.***** %.
- 3) The interest rate is **8.***** %.
- 4) The interest rate is **0.***** %.
- 5) The interest rate is **6.***** %.

Exercise 3

We have a bank account that initially offers a continuous compound rate of 6%, and after 1 year the conditions are modified and then we obtain a continuous compound rate of 10%. The initial deposit is 15000 euros. Compute the amount of money in the account after 10 years from the moment of the first deposit.

- 1) We will have ****4.***** euros.
- 2) We will have ****8.***** euros.
- 3) We will have ****5.***** euros.
- 4) We will have ****0.***** euros.
- 5) We will have ****1.***** euros.

Exercise 4

A firm sells Q tons of certain product. The price received per ton is given by the formula $P=4000-8Q$. On the other hand, the production cost per ton is $C=2000+2Q$. In addition, the transportation cost is 1780 per ton. Compute the maximum profit that can be obtained selling this product.

- 1) Profit = 1253 .
- 2) Profit = 1602 .
- 3) Profit = 1210 .
- 4) Profit = 675 .
- 5) Profit = 929 .

Exercise 5

Deposits in certain investment account vary from year to year alternating gains and losses periods. We have the following data about the deposits for different years:

year	deposits
1	12
3	16
4	15

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t . Employ that function to determine the maximum funds available in the investment account .

- 1) The maximum for the depositis in the account was 3 .
- 2) The maximum for the depositis in the account was -2 .
- 3) The maximum for the depositis in the account was 16 .
- 4) The maximum for the depositis in the account was 6 .
- 5) The maximum for the depositis in the account was 0 .

Exercise 6

The funds of a public institution alternate periods of deficit and surplus.

We have the following information for several years (in millions of euros):

year	funds
2	28
6	-44
9	-161

Employ an interpolation polynomial to build a function that

yields the funds for each year t . We know that due to the legislation the funds of such an institution have to be kept between -77 and -44

- . Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from $t=2$ to $t=9$).

- 1) The funds are inside the limits for the interval: $[-4, 0]$.
- 2) The funds are inside the limits for the interval: $[6, 7]$.
- 3) The funds are inside the limits for the interval: $[0, 7]$.
- 4) The funds are inside the limits for the interval: $[-4, 9]$.
- 5) The funds are inside the limits for the interval: $[7, 9]$.
- 6) The funds are inside the limits for the intervals: $[-5, -4]$ y $[6, 9]$.
- 7) The funds are inside the limits for the interval: $[-5, -4]$.
- 8) The funds are inside the limits for the interval: $[-4, 7]$.

Exercise 7

The population of certain type of rodents is analyzed in a region between years $t=1$ and $t=8$. Along that period the population is given by the function $P(t) = 8 + 144t - 42t^2 + 4t^3$ (thousands of rodents). Determine the intervals of years during which the number of rodents is between 520 and 818.

- 1) Along the intervals of years: $[1.79325, 2.78743]$ and $[6.65424, 8.4642]$.
- 2) Along the interval of years: $[8, 8]$.
- 3) Along the intervals of years: $[1.31989, 3.]$ and $[5., 6.47213]$.
- 4) Along the interval of years: $[7., 8.]$.
- 5) Along the interval of years: $[1, 8]$.
- 6) Along the interval of years: $[1.76407, 6.]$.
- 7) That number of mice is reach for no interval of years.
- 8) Along the intervals of years: $[3., 4.1086]$ and $[5., 6.]$.

Exercise 8

Compute the limit: $\lim_{x \rightarrow \infty} \left(\frac{6 - 7x - 5x^2}{-9 - 6x - 5x^2} \right)^{-7+3x+5x^2}$

- 1) 0
- 2) ∞
- 3) $\frac{1}{e^2}$
- 4) 1
- 5) $\frac{1}{e^3}$
- 6) $\frac{1}{e}$
- 7) $-\infty$

Exercise 9

From an initial deposit 6000, the interest rate varies every year in such a way that the total amount of money in the account is given by the function $C(t) =$

$$6000 \left(\frac{-6 + 9t + 2t^2}{3 - 4t + 2t^2} \right)^{2+6t}. \text{ Determine the future tendency for the}$$

deposits that we will have after a large number of years.

- 1) 0
- 2) ∞
- 3) $\frac{6000}{e^2}$
- 4) 6000
- 5) $\frac{6000}{e^3}$
- 6) $6000 e^{39}$
- 7) $-\infty$

Exercise 10

The population in certain turistic area

increases exponentially and is given by the function $P(t) = 68\,000 e^{t/50}$ that indicates the number of resident citizens for every year t . At the same time, depending on the season, the city receives a variable number of

tourists given by the trigonometric function $I(t) = 4000 + 1000 \sin\left[\frac{t}{2\pi}\right]$

that yields the amount of visitors in the area for every moment t (t in years).

Determine how many years are necessary until the total number of habitants is 119000. (the solution can be found for t between 25 and 30).

- 1) $t = **.*0****$
- 2) $t = **.*2****$
- 3) $t = **.*4****$
- 4) $t = **.*6****$
- 5) $t = **.*8****$

Exercise 11

Study the continuity of the function $f(x) = \begin{cases} -e^{x+1} - \sin(x+1) & x \leq -1 \\ x & -1 < x < 2 \\ \log(x-1) + 2 & 2 \leq x \end{cases}$

- 1) The functions is continuous for all points.
- 2) The functions is not continuous at any point.
- 3) The function is continuous for all the points except for $x = -1$.
- 4) The function is continuous for all the points except for $x = 2$.
- 5) The function is continuous for all the points except for $x = -1$ and $x = 2$.

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01-Functions for serial number: 60

Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a compound interest rate of 10% and in the bank B we are paid a periodic compound interest rate of 4% in 6 periods (compounding frequency). We initially deposit 2000 euros in the bank A and 7000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **0.***** years.
- 2) In **9.***** years.
- 3) In **2.***** years.
- 4) In **7.***** years.
- 5) In **5.***** years.

Exercise 2

We have one bank account that offers a continuous compound rate of 6% where we initially deposit 9000 euros. How long time is it necessary until the amount of money in the account reaches 17000 euros?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **0.***** years.
- 2) In **1.***** years.
- 3) In **6.***** years.
- 4) In **9.***** years.
- 5) In **7.***** years.

Exercise 3

We have a bank account that initially offers a continuous compound rate of 8%, and after 4 years the conditions are modified and then we obtain a periodic compound interest rate of 2% in 10 periods (compounding frequency). The initial deposit is 7000 euros. Compute the amount of money in the account after 10 years from the moment of the first deposit.

- 1) We will have ****1.***** euros.
- 2) We will have ****9.***** euros.
- 3) We will have ****7.***** euros.
- 4) We will have ****8.***** euros.
- 5) We will have ****2.***** euros.

Exercise 4

A firm sells Q tons of certain product. The price received per ton is given by the formula $P=110000-6Q$. On the other hand, the production cost per ton is $C=20000+12Q$. In addition, the transportation cost is 88848 per ton. Compute the maximum profit that can be obtained selling this product.

- 1) Profit = 13568 .
- 2) Profit = 21274 .
- 3) Profit = 11612 .
- 4) Profit = 18432 .
- 5) Profit = 23802 .

Exercise 5

Deposits in certain investment account vary from year to year alternating gains and losses periods. We have the following data about the deposits for different years:

year	deposits
1	2
3	0
5	-2

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t . Employ that function to forecast the exact amount for year 6 .

- 1) The depositis in the account for year 6 are 10 .
- 2) The depositis in the account for year 6 are 8 .
- 3) The depositis in the account for year 6 are 4 .
- 4) The depositis in the account for year 6 are -3 .
- 5) The depositis in the account for year 6 are -4 .

Exercise 6

The funds of a public institution alternate periods of deficit and surplus.

We have the following information for several years (in millions of euros):

year	funds
0	13
4	-83
7	-92

Employ an interpolation polynomial to build a function that

yields the funds for each year t . We know that due to the legislation the funds of such an institution have to be kept between -68 and 13

- . Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from $t=0$ to $t=7$).

- 1) The funds are inside the limits for the interval: $[-2, 3]$.
- 2) The funds are inside the limits for the interval: $[7, 7]$.
- 3) The funds are inside the limits for the interval: $[3, 7]$.
- 4) The funds are inside the limits for the interval: $[-2, 5]$.
- 5) The funds are inside the limits for the interval: $[0, 7]$.
- 6) The funds are inside the limits for the interval: $[0, 9]$.
- 7) The funds are inside the limits for the interval: $[0, 3]$.
- 8) The funds are inside the limits for the interval: $[7, 9]$.

Exercise 7

The population of a city is studied between years $t=1$ and $t=7$. In that

period the population is given by the function $P(t) = 7 + 360t - 66t^2 + 4t^3$

- . Determine the intervals of years when the population is between 305 and 655.

- 1) Along the interval of years: $[1.20161, 7.]$.
- 2) Along the intervals of years: $[1, 4.5]$ and $[6, 6]$.
- 3) Along the intervals of years: $[1, 1]$ and $[4.5, 7]$.
- 4) Along the intervals of years: $[2.02599, 4.44298]$ and $[5.17152, 6.73088]$.
- 5) Along the intervals of years: $[1., 4.]$ and $[5.54079, 7.]$.
- 6) Along the interval of years: $[4., 7.78235]$.
- 7) Along the interval of years: $[5., 7.]$.
- 8) Along the interval of years: $[1, 4.5]$.

Exercise 8

Compute the limit: $\lim_{x \rightarrow \infty} \left(\frac{-8 - 4x + 7x^2}{7 + 7x + 7x^2} \right)^{-6-8x+x^2}$

- 1) ∞
- 2) $-\infty$
- 3) $\frac{1}{e^3}$
- 4) $\frac{1}{e^4}$
- 5) 0
- 6) 1
- 7) $\frac{1}{e^5}$

Exercise 9

From an initial deposit 8000, the interest rate varies every year in such a way that the total amount of money in the account is given by the function $C(t) =$

$$8000 \left(\frac{4 - 8t + 8t^2}{-4 + 7t + 8t^2} \right)^{-7+7t}. \text{ Determine the future tendency for the}$$

deposits that we will have after a large number of years.

- 1) $\frac{8000}{e^{13127/1000}}$
- 2) $\frac{8000}{e^5}$
- 3) $\frac{8000}{e^{105/8}}$
- 4) $-\infty$
- 5) 8000
- 6) ∞
- 7) 0

Exercise 10

We deposit 10000 euros in a bank account with a compound interest rate of 2%. At the same time every year we also add in a safe-deposit box (therefore with no interest rate) 3000 euros. How long time is it necessary until the total amount of money (jointly in the bank account and safe-deposit box) is 39000 euros? (the solution can be found for t between 6 and 11).

- 1) $t = \dots 0 \dots$
- 2) $t = \dots 2 \dots$
- 3) $t = \dots 4 \dots$
- 4) $t = \dots 6 \dots$
- 5) $t = \dots 8 \dots$

Exercise 11

Study the continuity of the function $f(x) = \begin{cases} 3 \sin(x+1) + \cos(x+1) & x \leq -1 \\ 2 \cos(x+1) - 1 - 2 \cos(3) & -1 < x < 2 \\ \log(x-1) - 1 & 2 \leq x \end{cases}$

- 1) The function is continuous for all points.
- 2) The function is not continuous at any point.
- 3) The function is continuous for all the points except for $x = -1$.
- 4) The function is continuous for all the points except for $x = 2$.
- 5) The function is continuous for all the points except for $x = -1$ and $x = 2$.

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01-Functions for serial number: 61

Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a compound interest rate of 4% and in the bank B we are paid a continuous compound rate of 8%. We initially deposit 14000 euros in the bank A and 5000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **1.***** years.
- 2) In **3.***** years.
- 3) In **5.***** years.
- 4) In **8.***** years.
- 5) In **0.***** years.

Exercise 2

Certain parcel of land is devalued from an initial value of 457000 euros until a final value of 218000 euros along 10 years. Determine the rate of compound interest for that devaluation.

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) The interest rate is **4.***** %.
- 2) The interest rate is **3.***** %.
- 3) The interest rate is **7.***** %.
- 4) The interest rate is **8.***** %.
- 5) The interest rate is **1.***** %.

Exercise 3

We have a bank account that initially offers a continuous compound rate of 7%, and after 1 year the conditions are modified and then we obtain a continuous compound rate of 9%. The initial deposit is 14000 euros. Compute the amount of money in the account after 6 years from the moment of the first deposit.

- 1) We will have ****8.***** euros.
- 2) We will have ****0.***** euros.
- 3) We will have ****3.***** euros.
- 4) We will have ****7.***** euros.
- 5) We will have ****6.***** euros.

Exercise 4

A firm sells Q tons of certain product. The price received per ton is given by the formula $P=11000-7Q$. On the other hand, the production cost per ton is $C=6000-Q$. In addition, the transportation cost is 4652 per ton. Compute the maximum profit that can be obtained selling this product.

- 1) Profit = 5056 .
- 2) Profit = 5046 .
- 3) Profit = 7737 .
- 4) Profit = 7748 .
- 5) Profit = 8052 .

Exercise 5

Deposits in certain investment account vary from year to year alternating gains and losses periods. We have the following data about the deposits for different years:

year	deposits
1	150
2	127
3	106

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t . Employ that function to determine the minimum funds available in the investment account .

- 1) The minimum for the depositis in the account was 13 .
- 2) The minimum for the depositis in the account was 6 .
- 3) The minimum for the depositis in the account was 2 .
- 4) The minimum for the depositis in the account was -3 .
- 5) The minimum for the depositis in the account was 70 .

Exercise 6

The funds of a public institution alternate periods of deficit and surplus.

We have the following information for several years (in millions of euros):

year	funds
1	7
5	7
8	49

Employ an interpolation polynomial to build a function that

yields the funds for each year t . We know that due to the legislation the funds of such an institution have to be kept between 1 and 7

- . Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from $t=1$ to $t=8$).

- 1) The funds are inside the limits for the interval: $[1, 2]$.
- 2) The funds are inside the limits for the interval: $[0, 4]$.
- 3) The funds are inside the limits for the intervals: $[1, 2]$ y $[4, 5]$.
- 4) The funds are inside the limits for the interval: $[1, 8]$.
- 5) The funds are inside the limits for the interval: $[1, 4]$.
- 6) The funds are inside the limits for the interval: $[0, 1]$.
- 7) The funds are inside the limits for the intervals: $[0, 2]$ y $[4, 5]$.
- 8) The funds are inside the limits for the interval: $[4, 8]$.

Exercise 7

The population of certain type of rodents is analyzed in a region between years $t=2$

and $t=10$. Along that period the population is given by the function $P(t) =$

$4 + 432t - 78t^2 + 4t^3$ (thousands of rodents). Determine the intervals of years during which the number of rodents is between 516 and 714.

- 1) Along the intervals of years: $[3., 4.51523]$ and $[6.70376, 7.03027]$.
- 2) Along the intervals of years: $[2., 3.]$ and $[4.69711, 6.16884]$.
- 3) Along the intervals of years: $[2, 3.11932]$, $[5, 8]$ and $[9.88068, 10]$.
- 4) Along the interval of years: $[3.19818, 7.]$.
- 5) Along the intervals of years: $[2, 2]$, $[3.11932, 5]$, $[8, 9.88068]$ and $[10, 10]$.
- 6) Along the intervals of years: $[4.1792, 6.56514]$ and $[8., 10.]$.
- 7) Along the interval of years: $[3., 6.09978]$.
- 8) Along the intervals of years: $[2., 5.06306]$ and $[6.44387, 8.]$.

Exercise 8

Compute the limit: $\lim_{x \rightarrow -\infty} \left(\frac{-8 + 3x - 4x^2}{2 - x - 4x^2} \right)^{-4+9x+5x^2}$

- 1) e
- 2) $-\infty$
- 3) 0
- 4) $\frac{1}{e^5}$
- 5) ∞
- 6) 1
- 7) $\frac{1}{e}$

Exercise 9

A factory produces certain type of devices. The marginal cost (cost of producing one unit) decreases when we produce a large amount of units and it is given by the function $C(x) = \frac{4 + x + 8x^2}{3 + 5x + 7x^2 + 4x^3}$. Determine the expected cost per unit when a large amount of units is produced.

- 1) $-\infty$
- 2) 0
- 3) $-\frac{3}{5}$
- 4) ∞
- 5) $14\,000$
- 6) $-\frac{1}{6}$
- 7) $-\frac{1}{2}$

Exercise 10

The population in certain turistic area

increases exponentially and is given by the function $P(t) = 94\,000 e^{t/50}$ that indicates the number of resident citizens for every year t . At the same time, depending on the season, the city receives a variable number of

tourists given by the trigonometric function $I(t) = 3000 + 2000 \sin\left[\frac{t}{2\pi}\right]$

that yields the amount of visitors in the area for every moment t (t in years).

Determine how many years are necessary until the total number of habitants is 125000. (the solution can be found for t between 11 and 16).

- 1) $t = \dots 0 \dots$
- 2) $t = \dots 2 \dots$
- 3) $t = \dots 4 \dots$
- 4) $t = \dots 6 \dots$
- 5) $t = \dots 8 \dots$

Exercise 11

Study the continuity of the function $f(x) = \begin{cases} -2e^{x-2} - \sin(2-x) & x \leq 2 \\ 2e^{x-2} - 2\sin(2-x) - 2e^2 - 2\sin(2) & 2 < x < 4 \\ -2\log(x-3) & 4 \leq x \end{cases}$

- 1) The functions is continuous for all points.
- 2) The functions is not continuous at any point.
- 3) The function is continuous for all the points except for $x=2$.
- 4) The function is continuous for all the points except for $x=4$.
- 5) The function is continuous for all the points except for $x=2$ and $x=4$.

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01-Functions for serial number: 62

Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a periodic compound interest rate of 1% in 11 periods (compounding frequency) and in the bank B we are paid a continuous compound rate of 5%. We initially deposit 7000 euros in the bank A and 3000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **9.***** years.
- 2) In **1.***** years.
- 3) In **8.***** years.
- 4) In **3.***** years.
- 5) In **0.***** years.

Exercise 2

We have one bank account that offers a continuous compound rate of 2% where we initially deposit 9000 euros. How long time is it necessary until the amount of money in the account reaches 11000 euros?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **8.***** years.
- 2) In **0.***** years.
- 3) In **9.***** years.
- 4) In **3.***** years.
- 5) In **1.***** years.

Exercise 3

We have a bank account that initially offers a compound interest rate of 2%, and after 2 years the conditions are modified and then we obtain a periodic compound interest rate of 10% in 5 periods (compounding frequency). The initial deposit is 7000 euros. Compute the amount of money in the account after 8 years from the moment of the first deposit.

- 1) We will have ****1.***** euros.
- 2) We will have ****3.***** euros.
- 3) We will have ****0.***** euros.
- 4) We will have ****8.***** euros.
- 5) We will have ****9.***** euros.

Exercise 4

A firm sells Q tons of certain product. The price received per ton is given by the formula $P=80000-6Q$. On the other hand, the production cost per ton is $C=10000+16Q$. In addition, the transportation cost is 68988 per ton. Compute the maximum profit that can be obtained selling this product.

- 1) Profit = 16848 .
- 2) Profit = 8479 .
- 3) Profit = 5659 .
- 4) Profit = 11638 .
- 5) Profit = 9656 .

Exercise 5

Deposits in certain investment account vary from year to year alternating gains and losses periods. We have the following data about the deposits for different years:

year	deposits
0	2
2	-12
3	-28

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t . Employ that function to forecast the exact amount for year 5 .

- 1) The depositis in the account for year 5 are 14 .
- 2) The depositis in the account for year 5 are -78 .
- 3) The depositis in the account for year 5 are 19 .
- 4) The depositis in the account for year 5 are -112 .
- 5) The depositis in the account for year 5 are 0 .

Exercise 6

The funds of a public institution alternate periods of deficit and surplus.

We have the following information for several years (in millions of euros):

year	funds
0	16
4	16
6	28

Employ an interpolation polynomial to build a function that

yields the funds for each year t . We know that due to the legislation the funds of such an institution have to be kept between 16 and 21

- . Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from $t=0$ to $t=6$).

- 1) The funds are inside the limits for the interval: $[-1, 0]$.
- 2) The funds are inside the limits for the interval: $[4, 6]$.
- 3) The funds are inside the limits for the intervals: $[-1, 0]$ y $[5, 6]$.
- 4) The funds are inside the limits for the intervals: $[0, 0]$ y $[4, 5]$.
- 5) The funds are inside the limits for the interval: $[-2, 6]$.
- 6) The funds are inside the limits for the interval: $[0, 4]$.
- 7) The funds are inside the limits for the interval: $[-1, 6]$.
- 8) The funds are inside the limits for the interval: $[-1, 4]$.

Exercise 7

The population of certain type of rodents is analyzed in a region between years $t=1$ and $t=7$. Along that period the population is given by the function $P(t) = 2 + 288t - 60t^2 + 4t^3$ (thousands of rodents). Determine the intervals of years during which the number of rodents is between 370 and 514.

- 1) Along the interval of years: $[2, 7]$.
- 2) Along the intervals of years: $[1, 2]$ and $[7, 7]$.
- 3) Along the interval of years: $[4., 6.]$.
- 4) Along the intervals of years: $[1., 2.54867]$ and $[5.15434, 7.]$.
- 5) Along the interval of years: $[4.34903, 5.22792]$.
- 6) Along the interval of years: $[4., 7.23694]$.
- 7) Along the intervals of years: $[1., 4.]$ and $[6., 7.]$.
- 8) Along the interval of years: $[1., 2.21712]$.

Exercise 8

Compute the limit: $\lim_{x \rightarrow \infty} \left(\frac{-4 + 9x - x^2}{9 - 8x - x^2} \right)^{-3+4x+8x^2}$

- 1) 0
- 2) ∞
- 3) $\frac{1}{e^5}$
- 4) e
- 5) 1
- 6) $-\infty$
- 7) $\frac{1}{e}$

Exercise 9

From an initial deposit 2000, the interest rate varies every year in such a way that the total amount of money in the account is given by the function $C(t) =$

$$2000 \left(\frac{-9 - 4t + 9t^2}{9 + 9t + 9t^2} \right)^{3+4t+2t^2}. \text{ Determine the future tendency for the}$$

deposits that we will have after a large number of years.

- 1) 0
- 2) ∞
- 3) $\frac{2000}{e^5}$
- 4) 2000 €
- 5) 2000
- 6) $-\infty$
- 7) $\frac{2000}{e}$

Exercise 10

We deposit 9000 euros in a bank account with a continuous compound rate of 5%. At the same time every year we also add in a safe-deposit box (therefore with no interest rate) 3000 euros. How long time is it necessary until the total ammount of money (jointly in the bank account and safe-depsit box) is 57000 euros? (the solution can be found for t between 13 and 18).

- 1) $t = ** .1****$
- 2) $t = ** .3****$
- 3) $t = ** .5****$
- 4) $t = ** .7****$
- 5) $t = ** .9****$

Exercise 11

Study the continuity of the function $f(x) = \begin{cases} \sin(x+1) - 2\cos(x+1) & x \leq -1 \\ x-3 & -1 < x < 1 \\ -2e^{x-1} - \sin(1-x) & 1 \leq x \end{cases}$

- 1) The functions is continuous for all points.
- 2) The functions is not continuous at any point.
- 3) The function is continuous for all the points except for $x = -1$.
- 4) The function is continuous for all the points except for $x = 1$.
- 5) The function is continuous for all the points except for $x = -1$ and $x = 1$.

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01-Functions for serial number: 63

Exercise 1

We have two bank accounts, the first in the

bank A and the second in the bank B. In the bank A we obtain a continuous compound rate of 9% and in the bank B we are paid a compound interest rate of 6%. We initially deposit 5000 euros in the bank A and 11000

in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **4.***** years.
- 2) In **0.***** years.
- 3) In **8.***** years.
- 4) In **1.***** years.
- 5) In **7.***** years.

Exercise 2

We have one bank account that offers a

periodic compound interest rate of 1% in 6 periods (compounding frequency)

where we initially deposit 11000

euros. How long time is it necessary until the amount of money in the account reaches 15000 euros?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **1.***** years.
- 2) In **0.***** years.
- 3) In **8.***** years.
- 4) In **3.***** years.
- 5) In **4.***** years.

Exercise 3

We have a bank account that initially offers a periodic compound interest rate of 1% in 9 periods (compounding frequency), and after 3 years the conditions are modified and then we obtain a periodic compound interest rate of 4% in 9 periods (compounding frequency). The initial deposit is 11000 euros. Compute the amount of money in the account after 4 years from the moment of the first deposit.

- 1) We will have ****8.***** euros.
- 2) We will have ****0.***** euros.
- 3) We will have ****1.***** euros.
- 4) We will have ****6.***** euros.
- 5) We will have ****4.***** euros.

Exercise 4

A firm sells Q tons of certain product. The price received per ton is given by the formula $P=15000-15Q$. On the other hand, the production cost per ton is $C=5000-5Q$. In addition, the transportation cost is 9760 per ton. Compute the maximum profit that can be obtained selling this product.

- 1) Profit = 1177 .
- 2) Profit = 584 .
- 3) Profit = 1155 .
- 4) Profit = 1423 .
- 5) Profit = 1440 .

Exercise 5

Deposits in certain investment account vary from year to year alternating gains and losses periods. We have the following data about the deposits for different years:

year	deposits
0	2
1	7
2	16

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t . Employ that function to forecast the exact amount for year 4.

- 1) The depositis in the account for year 4 are 46 .
- 2) The depositis in the account for year 4 are 1 .
- 3) The depositis in the account for year 4 are 15 .
- 4) The depositis in the account for year 4 are 67 .
- 5) The depositis in the account for year 4 are 0 .

Exercise 6

The funds of a public institution alternate periods of deficit and surplus.

We have the following information for several years (in millions of euros):

year	funds
1	45
5	45
9	-51

Employ an interpolation polynomial to build a function that

yields the funds for each year t . We know that due to the legislation the funds of such an institution have to be kept between 45 and 54

- . Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from $t=1$ to $t=9$).

- 1) The funds are inside the limits for the intervals: $[1, 2]$ y $[4, 5]$.
- 2) The funds are inside the limits for the interval: $[0, 5]$.
- 3) The funds are inside the limits for the interval: $[0, 2]$.
- 4) The funds are inside the limits for the interval: $[2, 9]$.
- 5) The funds are inside the limits for the interval: $[1, 2]$.
- 6) The funds are inside the limits for the interval: $[2, 5]$.
- 7) The funds are inside the limits for the intervals: $[0, 1]$ y $[4, 5]$.
- 8) The funds are inside the limits for the interval: $[5, 9]$.

Exercise 7

The population of certain type of rodents is analyzed in a region between years $t=3$ and $t=8$. Along that period the population is given by the function $P(t) = 6 + 504t - 78t^2 + 4t^3$ (thousands of rodents). Determine the intervals of years during which the number of rodents is between 1030 and 1086.

- 1) Along the interval of years: $[4, 7.5]$.
- 2) Along the interval of years: $[3.54969, 6.22775]$.
- 3) Along the intervals of years: $[3, 4]$, $[6, 6]$ and $[7.5, 8]$.
- 4) Along the intervals of years: $[3., 4.]$ and $[5., 8.6338]$.
- 5) Along the interval of years: $[3.6736, 4.30282]$.
- 6) Along the interval of years: $[6.49014, 7.]$.
- 7) Along the intervals of years: $[3.16348, 5.]$ and $[7.28848, 8.]$.
- 8) Along the interval of years: $[6., 7.53278]$.

Exercise 8

Compute the limit: $\lim_{x \rightarrow -\infty} \left(\frac{5 + 9x + 5x^2}{-1 - 9x + 5x^2} \right)^{8-7x+x^2}$

1) ∞

2) $\frac{1}{e^2}$

3) 1

4) $\frac{1}{e^5}$

5) $-\infty$

6) 0

7) $\frac{1}{e^3}$

Exercise 9

From an initial deposit 13000, the interest rate varies every year in such a way that the total amount of money in the account is given by the function $C(t) =$

$$13000 \left(\frac{5 + 9t - 5t^2}{-1 - 9t - 5t^2} \right)^{8-7t+t^2}. \text{ Determine the future tendency for the}$$

deposits that we will have after a large number of years.

1) ∞

2) $\frac{13000}{e^2}$

3) 13000

4) $\frac{13000}{e^5}$

5) $-\infty$

6) 0

7) $\frac{13000}{e^3}$

Exercise 10

We deposit 6000 euros in a bank account with a periodic compound interest rate of 3% in 3 periods (compounding frequency). At the same time every year we also add in a safe-deposit box (therefore with no interest rate) 5000 euros. How long time is it necessary until the total amount of money (jointly in the bank account and safe-deposit box) is 50000 euros? (the solution can be found for t between 7 and 12).

- 1) $t = **.*0****$
- 2) $t = **.*2****$
- 3) $t = **.*4****$
- 4) $t = **.*6****$
- 5) $t = **.*8****$

Exercise 11

Study the continuity of the function $f(x) = \begin{cases} 3 \sin(3-x) + 2 \cos(3-x) & x \leq 3 \\ \frac{13}{2} - \frac{3x}{2} & 3 < x < 5 \\ -\log(x-4) - 1 & 5 \leq x \end{cases}$

- 1) The function is continuous for all points.
- 2) The function is not continuous at any point.
- 3) The function is continuous for all the points except for $x=3$.
- 4) The function is continuous for all the points except for $x=5$.
- 5) The function is continuous for all the points except for $x=3$ and $x=5$.

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01-Functions for serial number: 64

Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a continuous compound rate of 4% and in the bank B we are paid a continuous compound rate of 9%. We initially deposit 15000 euros in the bank A and 3000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **9.***** years.
- 2) In **2.***** years.
- 3) In **6.***** years.
- 4) In **0.***** years.
- 5) In **7.***** years.

Exercise 2

Certain parcel of land is devalued from an initial value of 258000 euros until a final value of 114000 euros along 9 years. Determine the rate of continuous compound interest for that devaluation.

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) The interest rate is **9.***** %.
- 2) The interest rate is **5.***** %.
- 3) The interest rate is **7.***** %.
- 4) The interest rate is **3.***** %.
- 5) The interest rate is **1.***** %.

Exercise 3

We have a bank account that initially offers a continuous compound rate of 8%, and after 3 years the conditions are modified and then we obtain a periodic compound interest rate of 5% in 4 periods (compounding frequency). The initial deposit is 15000 euros. Compute the amount of money in the account after 7 years from the moment of the first deposit.

- 1) We will have ****9.***** euros.
- 2) We will have ****1.***** euros.
- 3) We will have ****6.***** euros.
- 4) We will have ****0.***** euros.
- 5) We will have ****7.***** euros.

Exercise 4

A firm sells Q tons of certain product. The price received per ton is given by the formula $P=400-20Q$. On the other hand, the production cost per ton is $C=100-19Q$. In addition, the transportation cost is 264 per ton. Compute the maximum profit that can be obtained selling this product.

- 1) Profit = 416 .
- 2) Profit = 332 .
- 3) Profit = 324 .
- 4) Profit = 378 .
- 5) Profit = 315 .

Exercise 5

Deposits in certain investment account vary from year to year alternating gains and losses periods. We have the following data about the deposits for different years:

year	deposits
0	8
2	20
3	23

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t . Employ that function to determine the maximum funds available in the investment account .

- 1) The maximum for the depositis in the account was 4 .
- 2) The maximum for the depositis in the account was 24 .
- 3) The maximum for the depositis in the account was 3 .
- 4) The maximum for the depositis in the account was 20 .
- 5) The maximum for the depositis in the account was 7 .

Exercise 6

The funds of a public institution alternate periods of deficit and surplus.

We have the following information for several years (in millions of euros):

year	funds
2	38
6	22
9	-32

Employ an interpolation polynomial to build a function that

yields the funds for each year t . We know that due to the legislation the funds of such an institution have to be kept between -10 and 32

- . Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from $t=2$ to $t=9$).

- 1) The funds are inside the limits for the interval: $[8, 9]$.
- 2) The funds are inside the limits for the interval: $[5, 8]$.
- 3) The funds are inside the limits for the interval: $[-2, 1]$.
- 4) The funds are inside the limits for the intervals: $[-2, 0]$ y $[5, 8]$.
- 5) The funds are inside the limits for the interval: $[1, 9]$.
- 6) The funds are inside the limits for the interval: $[0, 8]$.
- 7) The funds are inside the limits for the interval: $[1, 8]$.
- 8) The funds are inside the limits for the interval: $[0, 1]$.

Exercise 7

The population of a city is studied between years $t=1$ and $t=10$. In that

period the population is given by the function $P(t) = 10 + 864t - 102t^2 + 4t^3$

- . Determine the intervals of years when the population is between 2432 and 2440.

- 1) Along the intervals of years: $[7, 7.5]$ and $[9, 9]$.
- 2) Along the intervals of years: $[2., 4.]$ and $[7.46663, 10.]$.
- 3) Along the intervals of years: $[1, 7]$ and $[7.5, 10]$.
- 4) Along the interval of years: $[1.58438, 6.]$.
- 5) Along the interval of years: $[1., 2.76991]$.
- 6) Along the intervals of years: $[2.22144, 4.49083]$ and $[8., 10.6387]$.
- 7) Along the interval of years: $[2., 8.52923]$.
- 8) Along the interval of years: $[7, 7.5]$.

Exercise 8

Compute the limit: $\lim_{x \rightarrow \infty} \left(\frac{8 - 4x + 5x^2 - 8x^3}{8 - x + 7x^2 - 8x^3} \right)^{2+2x}$

- 1) $\frac{1}{e^3}$
- 2) ∞
- 3) e^2
- 4) 1
- 5) 0
- 6) $\sqrt{e}$
- 7) $-\infty$

Exercise 9

From an initial deposit 8000, the interest rate varies every year in such a way that the total amount of money in the account is given by the function $C(t) =$

$$8000 \left(\frac{8 - 4t + 5t^2 + 2t^3}{8 - t + 7t^2 + 2t^3} \right)^{2+2t}. \text{ Determine the future tendency for the}$$

deposits that we will have after a large number of years.

- 1) $\frac{8000}{e^3}$
- 2) $\frac{8000}{e^2}$
- 3) 0
- 4) $-\infty$
- 5) $\frac{8000}{e^4}$
- 6) ∞
- 7) 8000

Exercise 10

The population in certain turistic area

increases exponentially and is given by the function $P(t) = 69\,000 e^{t/50}$ that indicates the number of resident citizens for every year t . At the same time, depending on the season, the city receives a variable number of

tourists given by the trigonometric function $I(t) = 4000 + 3000 \sin\left[\frac{t}{2\pi}\right]$

that yields the amount of visitors in the area for every moment t (t in years).

Determine how many years are necessary until the total number of habitants is 103000. (the solution can be found for t between 15 and 20).

- 1) $t = \dots 1 \dots$
- 2) $t = \dots 3 \dots$
- 3) $t = \dots 5 \dots$
- 4) $t = \dots 7 \dots$
- 5) $t = \dots 9 \dots$

Exercise 11

Study the continuity of the function $f(x) = \begin{cases} 2e^{x+1} & x \leq -1 \\ \frac{5}{3} - \frac{x}{3} & -1 < x < 2 \\ 1 - \log(x-1) & 2 \leq x \end{cases}$

- 1) The functions is continuous for all points.
- 2) The functions is not continuous at any point.
- 3) The function is continuous for all the points except for $x = -1$.
- 4) The function is continuous for all the points except for $x = 2$.
- 5) The function is continuous for all the points except for $x = -1$ and $x = 2$.

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01-Functions for serial number: 65

Exercise 1

We have two bank accounts, the first in the

bank A and the second in the bank B. In the bank A we obtain a continuous compound rate of 10% and in the bank B we are paid a compound interest rate of 5%. We initially deposit 1000 euros in the bank A and 8000

in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **3.***** years.
- 2) In **5.***** years.
- 3) In **6.***** years.
- 4) In **2.***** years.
- 5) In **0.***** years.

Exercise 2

Certain parcel of land is devalued from an initial value of 468000

euros until a final value of 282000 euros along 5 years. Determine the rate of periodic compound interest in 5 periods for that devaluation.

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) The interest rate is **0.***** %.
- 2) The interest rate is **8.***** %.
- 3) The interest rate is **7.***** %.
- 4) The interest rate is **9.***** %.
- 5) The interest rate is **4.***** %.

Exercise 3

We have a bank account that initially offers a

periodic compound interest rate of 9% in 9 periods (compounding frequency), and after 2 years the conditions are modified and then we obtain a compound interest rate of 7%. The initial deposit is 8000 euros. Compute the amount of money in the account after 4 years from the moment of the first deposit.

- 1) We will have ****6.***** euros.
- 2) We will have ****3.***** euros.
- 3) We will have ****9.***** euros.
- 4) We will have ****0.***** euros.
- 5) We will have ****5.***** euros.

Exercise 4

A firm sells Q tons of certain product. The price received per ton is given by the formula $P=4000-18Q$. On the other hand, the production cost per ton is $C=1000-9Q$. In addition, the transportation cost is 2460 per ton. Compute the maximum profit that can be obtained selling this product.

- 1) Profit = 8100 .
- 2) Profit = 13285 .
- 3) Profit = 13563 .
- 4) Profit = 3727 .
- 5) Profit = 5939 .

Exercise 5

Deposits in certain investment account vary from year to year alternating gains and losses periods. We have the following data about the deposits for different years:

year	deposits
0	221
1	192
2	165

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t . Employ that function to determine the minimum funds available in the investment account .

- 1) The minimum for the depositis in the account was 15 .
- 2) The minimum for the depositis in the account was -4 .
- 3) The minimum for the depositis in the account was 3 .
- 4) The minimum for the depositis in the account was 14 .
- 5) The minimum for the depositis in the account was 96 .

Exercise 6

The funds of a public institution alternate periods of deficit and surplus.

We have the following information for several years (in millions of euros):

year	funds
1	26
3	26
5	2

Employ an interpolation polynomial to build a function that

yields the funds for each year t . We know that due to the legislation the funds of such an institution have to be kept between 17 and 26

- . Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from $t=1$ to $t=5$).

- 1) The funds are inside the limits for the interval: $[4, 5]$.
- 2) The funds are inside the limits for the intervals: $[0, 1]$ y $[3, 5]$.
- 3) The funds are inside the limits for the interval: $[0, 4]$.
- 4) The funds are inside the limits for the interval: $[1, 5]$.
- 5) The funds are inside the limits for the intervals: $[0, 0]$ y $[3, 4]$.
- 6) The funds are inside the limits for the interval: $[1, 4]$.
- 7) The funds are inside the limits for the intervals: $[1, 1]$ y $[3, 4]$.
- 8) The funds are inside the limits for the interval: $[0, 1]$.

Exercise 7

The deposits in certain account between the

months $t=0$ and $t=8$ is given by the function $C(t)=3+84t-48t^2+4t^3$

- . Determine the months for which the deposit is between -357 and 11 euros.

- 1) Along the interval of months: $[1.0911, 6.]$.
- 2) Along the interval of months: $[1.54654, 8.]$.
- 3) Along the intervals of months: $[0, 0]$, $[0.101021, 2]$, $[6, 7.89898]$ and $[8, 8]$.
- 4) Along the intervals of months: $[2., 4.]$ and $[5., 6.30121]$.
- 5) Along the intervals of months: $[4.08213, 6.]$ and $[7., 8.03082]$.
- 6) Along the intervals of months: $[2., 4.]$ and $[5.58541, 8.32941]$.
- 7) Along the intervals of months: $[2.42487, 4.]$ and $[7.2016, 8.]$.
- 8) Along the intervals of months: $[0, 0.101021]$, $[2, 6]$ and $[7.89898, 8]$.

Exercise 8

Compute the limit: $\lim_{x \rightarrow -\infty} \left(\frac{-6 + 4x - 5x^2}{6 + 3x - 5x^2} \right)^{3+7x}$

- 1) $\frac{1}{e^{7/5}}$
- 2) $\frac{1}{e^3}$
- 3) $-\infty$
- 4) $\frac{1}{e}$
- 5) 0
- 6) 1
- 7) ∞

Exercise 9

A factory produces certain type of devices. The marginal cost (cost of producing one unit) decreases when we produce a large amount of units and it is given by the function $C(x) = \frac{4 + 7x + 4x^2}{2 + 6x + 4x^2}$. Determine the expected cost per unit when a large amount of units is produced.

- 1) $\frac{101}{100}$
- 2) 0
- 3) $-\infty$
- 4) ∞
- 5) $-\frac{3}{7}$
- 6) 8000
- 7) 1

Exercise 10

The population in certain turistic area

increases exponentially and is given by the function $P(t) = 96\,000 e^{t/100}$ that indicates the number of resident citizens for every year t . At the same time, depending on the season, the city receives a variable number of

tourists given by the trigonometric function $I(t) = 2000 + 1000 \sin\left[\frac{t}{2\pi}\right]$

that yields the amount of visitors in the area for every moment t (t in years).

Determine how many years are necessary until the total number of habitants is 146000. (the solution can be found for t between 39 and 44).

- 1) $t = ** .0****$
- 2) $t = ** .2****$
- 3) $t = ** .4****$
- 4) $t = ** .6****$
- 5) $t = ** .8****$

Exercise 11

Study the continuity of the function $f(x) = \begin{cases} -2e^{x-2} - 3\sin(2-x) & x \leq 2 \\ 5x - 13 & 2 < x < 3 \\ 2 & 3 \leq x \end{cases}$

- 1) The functions is continuous for all points.
- 2) The functions is not continuous at any point.
- 3) The function is continuous for all the points except for $x=2$.
- 4) The function is continuous for all the points except for $x=3$.
- 5) The function is continuous for all the points except for $x=2$ and $x=3$.

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01-Functions for serial number: 66

Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a periodic compound interest rate of 7% in 10 periods (compounding frequency) and in the bank B we are paid a compound interest rate of 3%. We initially deposit 2000 euros in the bank A and 7000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **7.***** years.
- 2) In **0.***** years.
- 3) In **1.***** years.
- 4) In **5.***** years.
- 5) In **6.***** years.

Exercise 2

We have one bank account that offers a continuous compound rate of 5% where we initially deposit 10000 euros. How long time is it necessary until the amount of money in the account reaches 16000 euros?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **0.***** years.
- 2) In **6.***** years.
- 3) In **1.***** years.
- 4) In **8.***** years.
- 5) In **9.***** years.

Exercise 3

We have a bank account that initially offers a compound interest rate of 10%, and after 3 years the conditions are modified and then we obtain a compound interest rate of 4%. The initial deposit is 7000 euros. Compute the amount of money in the account after 5 years from the moment of the first deposit.

- 1) We will have ****5.***** euros.
- 2) We will have ****8.***** euros.
- 3) We will have ****7.***** euros.
- 4) We will have ****3.***** euros.
- 5) We will have ****0.***** euros.

Exercise 4

A firm sells Q tons of certain product. The price received per ton is given by the formula $P=5000-7Q$. On the other hand, the production cost per ton is $C=4000+2Q$. In addition, the transportation cost is 658 per ton. Compute the maximum profit that can be obtained selling this product.

- 1) Profit = 3371 .
- 2) Profit = 2389 .
- 3) Profit = 3249 .
- 4) Profit = 5288 .
- 5) Profit = 994 .

Exercise 5

Deposits in certain investment account vary from year to year alternating gains and losses periods. We have the following data about the deposits for different years:

year	deposits
0	1
2	11
3	25

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t . Employ that function to forecast the exact amount for year 4 .

- 1) The depositis in the account for year 4 are -5 .
- 2) The depositis in the account for year 4 are 15 .
- 3) The depositis in the account for year 4 are 71 .
- 4) The depositis in the account for year 4 are 5 .
- 5) The depositis in the account for year 4 are 45 .

Exercise 6

The funds of a public institution alternate periods of deficit and surplus.

We have the following information for several years (in millions of euros):

year	funds
0	0
4	52
6	114

Employ an interpolation polynomial to build a function that

yields the funds for each year t . We know that due to the legislation the funds of such an institution have to be kept between 80 and 129

- . Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from $t=0$ to $t=6$).

- 1) The funds are inside the limits for the interval: $[-2, 7]$.
- 2) The funds are inside the limits for the interval: $[-\frac{16}{3}, 6]$.
- 3) The funds are inside the limits for the interval: $[6, 6]$.
- 4) The funds are inside the limits for the interval: $[0, 6]$.
- 5) The funds are inside the limits for the interval: $[5, 6]$.
- 6) The funds are inside the limits for the interval: $[-1, 6]$.
- 7) The funds are inside the limits for the interval: $[-2, 3]$.
- 8) The funds are inside the limits for the interval: $[0, 5]$.

Exercise 7

The population of certain type of rodents is analyzed in a region between years $t=1$ and $t=8$. Along that period the population is given by the function $P(t) = 9 + 360t - 66t^2 + 4t^3$ (thousands of rodents). Determine the intervals of years during which the number of rodents is between 603 and 667.

- 1) Along the interval of years: $[2.35718, 7.05239]$.
- 2) Along the interval of years: $[2.74265, 7.]$.
- 3) Along the interval of years: $[1., 3.]$.
- 4) Along the interval of years: $[3, 7]$.
- 5) Along the intervals of years: $[2.75473, 4.48527]$ and $[7.48304, 8.48384]$.
- 6) Along the interval of years: $[3., 5.11444]$.
- 7) Along the intervals of years: $[2., 3.]$ and $[6.68756, 8.]$.
- 8) Along the intervals of years: $[1, 3]$ and $[7, 8]$.

Exercise 8

Compute the limit: $\lim_{x \rightarrow -\infty} \left(\frac{-8 + 8x - 7x^2 - 2x^3}{-7 + 4x + 2x^2 - 2x^3} \right)^{-3+5x}$

- 1) 0
- 2) ∞
- 3) $\frac{1}{e^4}$
- 4) $-\infty$
- 5) $\frac{1}{e^5}$
- 6) $e^{45/2}$
- 7) 1

Exercise 9

From an initial deposit 13000, the interest rate varies every year in such a way that the total amount of money in the account is given by the function $C(t) =$

$$13000 \left(\frac{-8 + 8t - 7t^2 - 2t^3}{-7 + 4t + 2t^2 - 2t^3} \right)^{-3+5t}. \text{ Determine the future tendency for the}$$

deposits that we will have after a large number of years.

- 1) $13000 e^{45/2}$
- 2) $13000 e^{11\,249/500}$
- 3) 13000
- 4) ∞
- 5) $\frac{13000}{e^3}$
- 6) 0
- 7) $-\infty$

Exercise 10

We deposit 12000 euros in a bank account with a compound interest rate of 3%. At the same time every year we also add in a safe-deposit box (therefore with no interest rate) 3000 euros. How long time is it necessary until the total amount of money (jointly in the bank account and safe-deposit box) is 43000 euros? (the solution can be found for t between 8 and 13).

- 1) $t = \dots 0 \dots$
- 2) $t = \dots 2 \dots$
- 3) $t = \dots 4 \dots$
- 4) $t = \dots 6 \dots$
- 5) $t = \dots 8 \dots$

Exercise 11

Study the continuity of the function $f(x) = \begin{cases} -\sin(x+1) & x \leq -1 \\ 2x+2 & -1 < x < 0 \\ 2e^x & 0 \leq x \end{cases}$

- 1) The functions is continuous for all points.
- 2) The functions is not continuous at any point.
- 3) The function is continuous for all the points except for $x = -1$.
- 4) The function is continuous for all the points except for $x = 0$.
- 5) The function is continuous for all the points except for $x = -1$ and $x = 0$.

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01-Functions for serial number: 67

Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a periodic compound interest rate of 8% in 7 periods (compounding frequency) and in the bank B we are paid a periodic compound interest rate of 3% in 5 periods (compounding frequency). We initially deposit 8000 euros in the bank A and 12000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **3.***** years.
- 2) In **8.***** years.
- 3) In **7.***** years.
- 4) In **6.***** years.
- 5) In **0.***** years.

Exercise 2

We have one bank account that offers a periodic compound interest rate of 5% in 11 periods (compounding frequency) where we initially deposit 9000 euros. How long time is it necessary until the amount of money in the account reaches 17000 euros?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **5.***** years.
- 2) In **6.***** years.
- 3) In **1.***** years.
- 4) In **0.***** years.
- 5) In **2.***** years.

Exercise 3

We have a bank account that initially offers a continuous compound rate of 6% , and after 3 years the conditions are modified and then we obtain a periodic compound interest rate of 4% in 12 periods (compounding frequency) . The initial deposit is 12000 euros. Compute the amount of money in the account after 5 years from the moment of the first deposit.

- 1) We will have ***** euros.
- 2) We will have ***** euros.
- 3) We will have ***** euros.
- 4) We will have ***** euros.
- 5) We will have ***** euros.

Exercise 4

A firm sells Q tons of certain product. The price received per ton is given by the formula $P=150000-16Q$. On the other hand, the production cost per ton is $C=100000-Q$. In addition, the transportation cost is 48830 per ton. Compute the maximum profit that can be obtained selling this product.

- 1) Profit = 35375 .
- 2) Profit = 18068 .
- 3) Profit = 8616 .
- 4) Profit = 22815 .
- 5) Profit = 32130 .

Exercise 5

Deposits in certain investment account vary from year to year alternating gains and losses periods. We have the following data about the deposits for different years:

year	deposits
0	1
2	7
3	16

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t . Employ that function to forecast the exact amount for year 4 .

- 1) The depositis in the account for year 4 are 4 .
- 2) The depositis in the account for year 4 are 46 .
- 3) The depositis in the account for year 4 are 1 .
- 4) The depositis in the account for year 4 are 18 .
- 5) The depositis in the account for year 4 are 29 .

Exercise 6

The funds of a public institution alternate periods of deficit and surplus.

We have the following information for several years (in millions of euros):

year	funds
1	31
4	46
7	43

Employ an interpolation polynomial to build a function that

yields the funds for each year t . We know that due to the legislation the funds of such an institution have to be kept between 38 and 43

- . Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from $t=1$ to $t=7$).

- 1) The funds are inside the limits for the interval: $[0, 3]$.
- 2) The funds are inside the limits for the interval: $[2, 3]$.
- 3) The funds are inside the limits for the interval: $[0, 8]$.
- 4) The funds are inside the limits for the interval: $[3, 8]$.
- 5) The funds are inside the limits for the intervals: $[2, 3]$ y $[7, 7]$.
- 6) The funds are inside the limits for the interval: $[3, 7]$.
- 7) The funds are inside the limits for the interval: $[7, 8]$.
- 8) The funds are inside the limits for the intervals: $[0, 2]$ y $[7, 8]$.

Exercise 7

The population of a city is studied between years $t=3$ and $t=9$. In that period the population is given by the function $P(t) = 4 + 576t - 84t^2 + 4t^3$

- . Determine the intervals of years when the population is between 852 and 1300.

- 1) Along the intervals of years: $[3.66213, 6.7012]$ and $[8., 9.09981]$.
- 2) Along the interval of years: $[5.53452, 7.20517]$.
- 3) Along the interval of years: $[3, 9]$.
- 4) Along the intervals of years: $[4., 6.22994]$ and $[7.28198, 9.]$.
- 5) Along the intervals of years: $[3, 3]$, $[6, 6]$ and $[9, 9]$.
- 6) Along the interval of years: $[6.75849, 9.]$.
- 7) Along the intervals of years: $[4.36503, 5.515]$ and $[7., 8.4327]$.
- 8) Along the intervals of years: $[5., 6.77697]$ and $[8., 9.05618]$.

Exercise 8

Compute the limit: $\lim_{x \rightarrow \infty} \left(\frac{1 + 3x + 6x^2 + 7x^3}{-3 + 5x - 6x^2 + 7x^3} \right)^{9-7x+2x^2}$

- 1) e
- 2) 0
- 3) 1
- 4) $-\infty$
- 5) $\frac{1}{e^4}$
- 6) $\frac{1}{e^5}$
- 7) ∞

Exercise 9

A factory produces certain type of devices. The marginal cost (cost of producing one unit) decreases when we produce a large amount of units and it is given by the function $C(x) = \frac{6 + x + 3x^2 + 6x^3}{3 + 7x + 6x^2 + x^3}$. Determine the expected cost per unit when a large amount of units is produced.

- 1) $\frac{603}{100}$
- 2) ∞
- 3) 5000
- 4) 6
- 5) $-\infty$
- 6) -2
- 7) 0

Exercise 10

We deposit 16000 euros in a bank account with a periodic compound interest rate of 6% in 11 periods (compounding frequency). At the same time every year we also add in a safe-deposit box (therefore with no interest rate) 2000 euros. How long time is it necessary until the total amount of money (jointly in the bank account and safe-deposit box) is 44000 euros? (the solution can be found for t between 6 and 11).

- 1) $t = \dots 0 \dots$
- 2) $t = \dots 2 \dots$
- 3) $t = \dots 4 \dots$
- 4) $t = \dots 6 \dots$
- 5) $t = \dots 8 \dots$

Exercise 11

Study the continuity of the function $f(x) = \begin{cases} -\sin(x+1) & x \leq -1 \\ e^{x+1} - 1 & -1 < x < 2 \\ -3 \sin(2-x) & 2 \leq x \end{cases}$

- 1) The functions is continuous for all points.
- 2) The functions is not continuous at any point.
- 3) The function is continuous for all the points except for $x = -1$.
- 4) The function is continuous for all the points except for $x = 2$.
- 5) The function is continuous for all the points except for $x = -1$ and $x = 2$.

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01-Functions for serial number: 68

Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a compound interest rate of 10% and in the bank B we are paid a periodic compound interest rate of 6% in 11 periods (compounding frequency). We initially deposit 4000 euros in the bank A and 15000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **3.***** years.
- 2) In **9.***** years.
- 3) In **7.***** years.
- 4) In **5.***** years.
- 5) In **0.***** years.

Exercise 2

Certain parcel of land is devalued from an initial value of 354000 euros until a final value of 207000 euros along 10 years. Determine the rate of periodic compound interest in 11 periods for that devaluation.

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) The interest rate is **2.***** %.
- 2) The interest rate is **5.***** %.
- 3) The interest rate is **0.***** %.
- 4) The interest rate is **3.***** %.
- 5) The interest rate is **1.***** %.

Exercise 3

We have a bank account that initially offers a periodic compound interest rate of 8% in 11 periods (compounding frequency), and after 4 years the conditions are modified and then we obtain a periodic compound interest rate of 9% in 9 periods (compounding frequency). The initial deposit is 15000 euros. Compute the amount of money in the account after 4 years from the moment of the first deposit.

- 1) We will have ****1.***** euros.
- 2) We will have ****9.***** euros.
- 3) We will have ****3.***** euros.
- 4) We will have ****5.***** euros.
- 5) We will have ****0.***** euros.

Exercise 4

A firm sells Q tons of certain product. The price received per ton is given by the formula $P=600-9Q$. On the other hand, the production cost per ton is $C=300-8Q$. In addition, the transportation cost is 270 per ton. Compute the maximum profit that can be obtained selling this product.

- 1) Profit = 138 .
- 2) Profit = 374 .
- 3) Profit = 225 .
- 4) Profit = 367 .
- 5) Profit = 106 .

Exercise 5

Deposits in certain investment account vary from year to year alternating gains and losses periods. We have the following data about the deposits for different years:

year	deposits
0	0
2	52
4	96

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t . Employ that function to determine the maximum funds available in the investment account .

- 1) The maximum for the depositis in the account was 147 .
- 2) The maximum for the depositis in the account was 196 .
- 3) The maximum for the depositis in the account was 14 .
- 4) The maximum for the depositis in the account was 12 .
- 5) The maximum for the depositis in the account was -4 .

Exercise 6

The funds of a public institution alternate periods of deficit and surplus.

We have the following information for several years (in millions of euros):

year	funds
2	-53
6	-125
10	-101

Employ an interpolation polynomial to build a function that

yields the funds for each year t . We know that due to the legislation the funds of such an institution have to be kept between -116 and -20

. Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from $t=2$ to $t=10$).

- 1) The funds are inside the limits for the interval: $[0, 9]$.
- 2) The funds are inside the limits for the interval: $[0, 1]$.
- 3) The funds are inside the limits for the interval: $[1, 9]$.
- 4) The funds are inside the limits for the intervals: $[2, 5]$ y $[9, 10]$.
- 5) The funds are inside the limits for the interval: $[1, 5]$.
- 6) The funds are inside the limits for the interval: $[9, 10]$.
- 7) The funds are inside the limits for the interval: $[1, 10]$.
- 8) The funds are inside the limits for the intervals: $[0, 5]$ y $[9, 13]$.

Exercise 7

The population of a city is studied between years $t=2$ and $t=9$. In that period the population is given by the function $P(t) = 9 + 384t - 72t^2 + 4t^3$

. Determine the intervals of years when the population is between 541 and 585.

- 1) Along the intervals of years: $[2., 3.]$ and $[5.58631, 9.]$.
- 2) Along the interval of years: $[2., 3.47855]$.
- 3) Along the interval of years: $[4.49173, 6.78588]$.
- 4) Along the interval of years: $[2.45508, 4.23296]$.
- 5) Along the intervals of years: $[2.1459, 2.5359]$, $[6, 7]$ and $[8.8541, 9]$.
- 6) Along the intervals of years: $[2., 4.]$ and $[6.09076, 7.30477]$.
- 7) Along the intervals of years: $[2, 2.1459]$, $[2.5359, 6]$, $[7, 8.8541]$ and $[9, 9]$.
- 8) Along the intervals of years: $[4.00072, 6.27516]$ and $[7., 9.59802]$.

Exercise 8

Compute the limit: $\lim_{x \rightarrow -\infty} \left(\frac{5 + 9x - 8x^2 + 7x^3}{9 - 2x - 8x^2 + 7x^3} \right)^{-1-3x+2x^2}$

- 1) $e^{22/7}$
- 2) 1
- 3) $\frac{1}{e^4}$
- 4) $\frac{1}{e^5}$
- 5) $-\infty$
- 6) 0
- 7) ∞

Exercise 9

From an initial deposit 10000, the interest rate varies every year in such a way that the total amount of money in the account is given by the function $C(t) =$

$$10000 \left(\frac{5 + 9t - 8t^2 - 7t^3}{9 - 2t - 8t^2 - 7t^3} \right)^{-1-3t+2t^2}. \text{ Determine the future tendency for}$$

the deposits that we will have after a large number of years.

- 1) $\frac{10000}{e^{393/125}}$
- 2) $\frac{10000}{e^{22/7}}$
- 3) $\frac{10000}{e^5}$
- 4) ∞
- 5) $-\infty$
- 6) 10000
- 7) 0

Exercise 10

The population in certain turistic area

increases exponentially and is given by the function $P(t) = 81000 e^{t/50}$ that indicates the number of resident citizens for every year t . At the same time, depending on the season, the city receives a variable number of

tourists given by the trigonometric function $I(t) = 4000 + 3000 \sin\left[\frac{t}{2\pi}\right]$

that yields the amount of visitors in the area for every moment t (t in years).

Determine how many years are necessary until the total number of habitants is 125000. (the solution can be found for t between 17 and 22).

- 1) $t = **.*$
- 2) $t = **.*$
- 3) $t = **.*$
- 4) $t = **.*$
- 5) $t = **.*$

Exercise 11

Study the continuity of the function $f(x) = \begin{cases} 3 \sin(x) & x \leq 0 \\ -\frac{x}{2} & 0 < x < 2 \\ -e^{x-2} - \sin(2-x) & 2 \leq x \end{cases}$

- 1) The functions is continuous for all points.
- 2) The functions is not continuous at any point.
- 3) The function is continuous for all the points except for $x=0$.
- 4) The function is continuous for all the points except for $x=2$.
- 5) The function is continuous for all the points except for $x=0$ and $x=2$.

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01-Functions for serial number: 69

Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a periodic compound interest rate of 7% in 5 periods (compounding frequency) and in the bank B we are paid a periodic compound interest rate of 3% in 9 periods (compounding frequency). We initially deposit 7000 euros in the bank A and 11000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **1.***** years.
- 2) In **7.***** years.
- 3) In **9.***** years.
- 4) In **6.***** years.
- 5) In **0.***** years.

Exercise 2

We have one bank account that offers a periodic compound interest rate of 3% in 5 periods (compounding frequency) where we initially deposit 6000 euros. How long time is it necessary until the amount of money in the account reaches 15000 euros?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **0.***** years.
- 2) In **7.***** years.
- 3) In **9.***** years.
- 4) In **3.***** years.
- 5) In **6.***** years.

Exercise 3

We have a bank account that initially offers a continuous compound rate of 6% , and after 1 year the conditions are modified and then we obtain a periodic compound interest rate of 5% in 2 periods (compounding frequency) . The initial deposit is 11000 euros. Compute the amount of money in the account after 7 years from the moment of the first deposit.

- 1) We will have 6.***** euros.
- 2) We will have 3.***** euros.
- 3) We will have 1.***** euros.
- 4) We will have 8.***** euros.
- 5) We will have 9.***** euros.

Exercise 4

A firm sells Q tons of certain product. The price received per ton is given by the formula $P=5000-14Q$. On the other hand, the production cost per ton is $C=1000-2Q$. In addition, the transportation cost is 3280 per ton. Compute the maximum profit that can be obtained selling this product.

- 1) Profit = 5014 .
- 2) Profit = 17270 .
- 3) Profit = 14210 .
- 4) Profit = 10800 .
- 5) Profit = 5593 .

Exercise 5

Deposits in certain investment account vary from year to year alternating gains and losses periods. We have the following data about the deposits for different years:

year	deposits
0	3
1	5
3	3

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t . Employ that function to forecast the exact amount for year 4 .

- 1) The depositis in the account for year 4 are -15 .
- 2) The depositis in the account for year 4 are 3 .
- 3) The depositis in the account for year 4 are 6 .
- 4) The depositis in the account for year 4 are -7 .
- 5) The depositis in the account for year 4 are -1 .

Exercise 6

The funds of a public institution alternate periods of deficit and surplus.

We have the following information for several years (in millions of euros):

year	funds
1	26
5	-6
8	-72

Employ an interpolation polynomial to build a function that

yields the funds for each year t . We know that due to the legislation the funds of such an institution have to be kept between -79 and 24

- . Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from $t=1$ to $t=8$).

- 1) The funds are inside the limits for the interval: $[-2, 7]$.
- 2) The funds are inside the limits for the interval: $[1, 3]$.
- 3) The funds are inside the limits for the interval: $[-2, 4]$.
- 4) The funds are inside the limits for the interval: $[8, 8]$.
- 5) The funds are inside the limits for the interval: $[2, 8]$.
- 6) The funds are inside the limits for the interval: $[0, 8]$.
- 7) The funds are inside the limits for the interval: $[0, 9]$.
- 8) The funds are inside the limits for the interval: $[0, 2]$.

Exercise 7

The population of a city is studied between years $t=3$ and $t=7$. In that period the population is given by the function $P(t) = 1 + 240t - 54t^2 + 4t^3$

- . Determine the intervals of years when the population is between 343 and 407.

- 1) Along the interval of years: $[4.17178, 6.05922]$.
- 2) Along the interval of years: $[4.68124, 7.]$.
- 3) Along the interval of years: $[3, 7]$.
- 4) Along the intervals of years: $[3.06914, 4.]$ and $[5., 6.69595]$.
- 5) Along the intervals of years: $[3., 4.50242]$ and $[6., 7.]$.
- 6) Along the intervals of years: $[3, 3]$ and $[7, 7]$.
- 7) Along the intervals of years: $[4., 5.29129]$ and $[6.73537, 7.46821]$.
- 8) Along the interval of years: $[6.30638, 7.70444]$.

Exercise 8

Compute the limit: $\lim_{x \rightarrow -\infty} \left(\frac{-6 - 2x + 7x^2 + 6x^3}{4 + 7x + 3x^2 + 6x^3} \right)^{-8+7x+8x^2}$

- 1) $\frac{1}{e^3}$
- 2) $-\infty$
- 3) $\frac{1}{e^5}$
- 4) 1
- 5) $\frac{1}{e^4}$
- 6) 0
- 7) ∞

Exercise 9

The population of certain country (in millions of habitants) is given by the function $P(t) =$

$26 \left(\frac{-6 - 2t + 7t^2 - 6t^3}{4 + 7t + 3t^2 - 6t^3} \right)^{-8+7t+8t^2}$. Determine the future tendency for this population.

- 1) $\frac{26}{e^3}$
- 2) $-\infty$
- 3) $\frac{26}{e^5}$
- 4) 26
- 5) $\frac{26}{e^4}$
- 6) 0
- 7) ∞

Exercise 10

We deposit 13000 euros in a bank account with a periodic compound interest rate of 6% in 5 periods (compounding frequency). At the same time every year we also add in a safe-deposit box (therefore with no interest rate) 4000 euros. How long time is it necessary until the total amount of money (jointly in the bank account and safe-deposit box) is 60000 euros? (the solution can be found for t between 8 and 13).

- 1) $t = **.*$
- 2) $t = **.*$
- 3) $t = **.*$
- 4) $t = **.*$
- 5) $t = **.*$

Exercise 11

Study the continuity of the function $f(x) = \begin{cases} -3 \sin(3-x) & x \leq 3 \\ \frac{x}{3} - 1 & 3 < x < 6 \\ \cos(6-x) - 2 \sin(6-x) & 6 \leq x \end{cases}$

- 1) The function is continuous for all points.
- 2) The function is not continuous at any point.
- 3) The function is continuous for all the points except for $x=3$.
- 4) The function is continuous for all the points except for $x=6$.
- 5) The function is continuous for all the points except for $x=3$ and $x=6$.

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01-Functions for serial number: 70

Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a compound interest rate of 8% and in the bank B we are paid a periodic compound interest rate of 2% in 6 periods (compounding frequency). We initially deposit 1000 euros in the bank A and 7000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **0.***** years.
- 2) In **5.***** years.
- 3) In **3.***** years.
- 4) In **4.***** years.
- 5) In **2.***** years.

Exercise 2

Certain parcel of land is devalued from an initial value of 367000 euros until a final value of 171000 euros along 9 years. Determine the rate of continuous compound interest for that devaluation.

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) The interest rate is **2.***** %.
- 2) The interest rate is **5.***** %.
- 3) The interest rate is **8.***** %.
- 4) The interest rate is **9.***** %.
- 5) The interest rate is **4.***** %.

Exercise 3

We have a bank account that initially offers a periodic compound interest rate of 5% in 9 periods (compounding frequency), and after 4 years the conditions are modified and then we obtain a compound interest rate of 8%. The initial deposit is 7000 euros. Compute the amount of money in the account after 4 years from the moment of the first deposit.

- 1) We will have ****2.***** euros.
- 2) We will have ****5.***** euros.
- 3) We will have ****3.***** euros.
- 4) We will have ****0.***** euros.
- 5) We will have ****4.***** euros.

Exercise 4

A firm sells Q tons of certain product. The price received per ton is given by the formula $P=15000-13Q$. On the other hand, the production cost per ton is $C=12000+2Q$. In addition, the transportation cost is 2580 per ton. Compute the maximum profit that can be obtained selling this product.

- 1) Profit = 3307 .
- 2) Profit = 2940 .
- 3) Profit = 3413 .
- 4) Profit = 2801 .
- 5) Profit = 2203 .

Exercise 5

Deposits in certain investment account vary from year to year alternating gains and losses periods. We have the following data about the deposits for different years:

year	deposits
0	6
2	2
3	3

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t . Employ that function to determine the minimum funds available in the investment account .

- 1) The minimum for the depositis in the account was 5 .
- 2) The minimum for the depositis in the account was 8 .
- 3) The minimum for the depositis in the account was 11 .
- 4) The minimum for the depositis in the account was -6 .
- 5) The minimum for the depositis in the account was 2 .

Exercise 6

The funds of a public institution alternate periods of deficit and surplus.

We have the following information for several years (in millions of euros):

year	funds
0	11
2	11
6	-61

Employ an interpolation polynomial to build a function that

yields the funds for each year t . We know that due to the legislation the funds of such an institution have to be kept between -34 and -13

. Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from $t=0$ to $t=6$).

- 1) The funds are inside the limits for the intervals: $[-3, -2]$ y $[4, 6]$.
- 2) The funds are inside the limits for the interval: $[4, 5]$.
- 3) The funds are inside the limits for the interval: $[-2, 5]$.
- 4) The funds are inside the limits for the interval: $[-2, 6]$.
- 5) The funds are inside the limits for the interval: $[0, 5]$.
- 6) The funds are inside the limits for the interval: $[-3, -2]$.
- 7) The funds are inside the limits for the interval: $[-2, 0]$.
- 8) The funds are inside the limits for the interval: $[5, 6]$.

Exercise 7

The population of a city is studied between years $t=0$ and $t=9$. In that period the population is given by the function $P(t) = 4 + 144t - 42t^2 + 4t^3$

. Determine the intervals of years when the population is between 166 and 814.

- 1) Along the intervals of years: $[3, 3]$ and $[4.5, 9]$.
- 2) Along the intervals of years: $[2.41843, 3.61819]$ and $[4., 9.]$.
- 3) Along the interval of years: $[0.525547, 8.23011]$.
- 4) Along the interval of years: $[3.02447, 8.43949]$.
- 5) Along the intervals of years: $[2., 5.43789]$ and $[7.3903, 9.14443]$.
- 6) Along the intervals of years: $[0, 4.5]$ and $[9, 9]$.
- 7) Along the intervals of years: $[1., 5.]$ and $[8., 9.]$.
- 8) Along the interval of years: $[4.5, 9]$.

Exercise 8

Compute the limit: $\lim_{x \rightarrow -\infty} \left(\frac{8 - 8x + 3x^2 - 4x^3}{-3 - x - 8x^2 - 4x^3} \right)^{4+4x}$

- 1) 0
- 2) ∞
- 3) 1
- 4) $\frac{1}{e^{11}}$
- 5) $\frac{1}{e^2}$
- 6) $\frac{1}{e}$
- 7) $-\infty$

Exercise 9

A factory produces certain type of devices. The marginal cost (cost of producing one unit) decreases when we produce a large amount

of units and it is given by the function $C(x) = \frac{9 + 4x + 7x^2}{6 + 8x + 3x^2 + 4x^3 + 9x^4}$

. Determine the expected cost per unit when a large amount of units is produced.

- 1) -1
- 2) 0
- 3) $-\infty$
- 4) $-\frac{2}{7}$
- 5) 3000
- 6) $\frac{1}{8}$
- 7) ∞

Exercise 10

The population in certain turistic area

increases exponentially and is given by the function $P(t) = 83\,000 e^{t/100}$ that indicates the number of resident citizens for every year t . At the same time, depending on the season, the city receives a variable number of

tourists given by the trigonometric function $I(t) = 5000 + 3000 \sin\left[\frac{t}{2\pi}\right]$

that yields the amount of visitors in the area for every moment t (t in years).

Determine how many years are necessary until the total number of habitants is 116000. (the solution can be found for t between 28 and 33).

- 1) $t = **.*0****$
- 2) $t = **.*2****$
- 3) $t = **.*4****$
- 4) $t = **.*6****$
- 5) $t = **.*8****$

Exercise 11

Study the continuity of the function $f(x) = \begin{cases} e^{x-1} + 2 \sin(1-x) & x \leq 1 \\ \frac{x}{2} - \frac{1}{2} & 1 < x < 3 \\ 1 - 3 \log(x-2) & 3 \leq x \end{cases}$

- 1) The functions is continuous for all points.
- 2) The functions is not continuous at any point.
- 3) The function is continuous for all the points except for $x=1$.
- 4) The function is continuous for all the points except for $x=3$.
- 5) The function is continuous for all the points except for $x=1$ and $x=3$.

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01-Functions for serial number: 71

Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a periodic compound interest rate of 6% in 3 periods (compounding frequency) and in the bank B we are paid a periodic compound interest rate of 2% in 5 periods (compounding frequency). We initially deposit 1000 euros in the bank A and 11000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **6.***** years.
- 2) In **8.***** years.
- 3) In **3.***** years.
- 4) In **2.***** years.
- 5) In **0.***** years.

Exercise 2

We have one bank account that offers a compound interest rate of 1% where we initially deposit 9000 euros. How long time is it necessary until the amount of money in the account reaches 16000 euros?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **3.***** years.
- 2) In **1.***** years.
- 3) In **0.***** years.
- 4) In **6.***** years.
- 5) In **7.***** years.

Exercise 3

We have a bank account that initially offers a compound interest rate of 3%, and after 1 year the conditions are modified and then we obtain a periodic compound interest rate of 10% in 4 periods (compounding frequency). The initial deposit is 11000 euros. Compute the amount of money in the account after 8 years from the moment of the first deposit.

- 1) We will have ****3.***** euros.
- 2) We will have ****1.***** euros.
- 3) We will have ****4.***** euros.
- 4) We will have ****8.***** euros.
- 5) We will have ****0.***** euros.

Exercise 4

A firm sells Q tons of certain product. The price received per ton is given by the formula $P=15000-14Q$. On the other hand, the production cost per ton is $C=12000+4Q$. In addition, the transportation cost is 2244 per ton. Compute the maximum profit that can be obtained selling this product.

- 1) Profit = 10415 .
- 2) Profit = 2748 .
- 3) Profit = 7938 .
- 4) Profit = 9306 .
- 5) Profit = 9054 .

Exercise 5

Deposits in certain investment account vary from year to year alternating gains and losses periods. We have the following data about the deposits for different years:

year	deposits
0	0
1	1
3	-9

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t . Employ that function to forecast the exact amount for year 4 .

- 1) The depositis in the account for year 4 are -35 .
- 2) The depositis in the account for year 4 are -6 .
- 3) The depositis in the account for year 4 are -5 .
- 4) The depositis in the account for year 4 are -20 .
- 5) The depositis in the account for year 4 are -3 .

Exercise 6

The funds of a public institution alternate periods of deficit and surplus.

We have the following information for several years (in millions of euros):

year	funds
1	2
5	62
7	128

Employ an interpolation polynomial to build a function that

yields the funds for each year t . We know that due to the legislation the funds of such an institution have to be kept between 20 and 38

- . Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from $t=1$ to $t=7$).

- 1) The funds are inside the limits for the interval: $[-3, -2]$.
- 2) The funds are inside the limits for the interval: $[3, 7]$.
- 3) The funds are inside the limits for the interval: $[-3, 0]$.
- 4) The funds are inside the limits for the interval: $[-3, 7]$.
- 5) The funds are inside the limits for the interval: $[3, 4]$.
- 6) The funds are inside the limits for the interval: $[0, 3]$.
- 7) The funds are inside the limits for the intervals: $[-3, -2]$ y $[4, 7]$.
- 8) The funds are inside the limits for the interval: $[-3, 3]$.

Exercise 7

The population of certain type of rodents is analyzed in a region between years $t=3$ and $t=7$. Along that period the population is given by the function $P(t) = 4 + 240t - 54t^2 + 4t^3$ (thousands of rodents). Determine the intervals of years during which the number of rodents is between 354 and 356.

- 1) Along the interval of years: $[4., 6.06951]$.
- 2) Along the interval of years: $[3.44976, 6.63545]$.
- 3) Along the interval of years: $[3.5, 5.5]$.
- 4) Along the interval of years: $[5.66804, 6.48769]$.
- 5) Along the intervals of years: $[4., 5.]$ and $[6.23019, 7.19224]$.
- 6) Along the interval of years: $[6.07926, 7.]$.
- 7) Along the intervals of years: $[3, 3.5]$, $[4, 4]$, $[5, 5]$ and $[5.5, 7]$.
- 8) Along the interval of years: $[4., 7.]$.

Exercise 8

Compute the limit: $\lim_{x \rightarrow \infty} \left(\frac{7 + 6x - 5x^2}{-3 - 7x - 5x^2} \right)^{-3+6x+6x^2}$

- 1) $-\infty$
- 2) ∞
- 3) $\frac{1}{e^3}$
- 4) 1
- 5) $\frac{1}{e^4}$
- 6) 0
- 7) $\frac{1}{e^5}$

Exercise 9

The population of certain country (in millions of habitants) is given by the function $P(t) =$

$21 \left(\frac{-7 + 6t + 2t^2}{-3 - 7t + 2t^2} \right)^{-3+6t+6t^2}$. Determine the future tendency for this population.

- 1) 21
- 2) $-\infty$
- 3) $\frac{21}{e^3}$
- 4) 0
- 5) $\frac{21}{e^4}$
- 6) ∞
- 7) $\frac{21}{e^5}$

Exercise 10

We deposit 17000 euros in a bank account with a compound interest rate of 6%. At the same time every year we also add in a safe-deposit box (therefore with no interest rate) 2000 euros. How long time is it necessary until the total amount of money (jointly in the bank account and safe-deposit box) is 61000 euros? (the solution can be found for t between 12 and 17).

- 1) $t = \dots 0 \dots$
- 2) $t = \dots 2 \dots$
- 3) $t = \dots 4 \dots$
- 4) $t = \dots 6 \dots$
- 5) $t = \dots 8 \dots$

Exercise 11

Study the continuity of the function $f(x) = \begin{cases} 3 \sin(3-x) - \cos(3-x) & x \leq 3 \\ 3 \log(x-2) + 2 - 3 \log(4) & 3 < x < 6 \\ 2 \cos(6-x) - 3 \sin(6-x) & 6 \leq x \end{cases}$

- 1) The functions is continuous for all points.
- 2) The functions is not continuous at any point.
- 3) The function is continuous for all the points except for $x=3$.
- 4) The function is continuous for all the points except for $x=6$.
- 5) The function is continuous for all the points except for $x=3$ and $x=6$.

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01-Functions for serial number: 72

Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a continuous compound rate of 4% and in the bank B we are paid a periodic compound interest rate of 9% in 4 periods (compounding frequency). We initially deposit 5000 euros in the bank A and 1000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **4.***** years.
- 2) In **0.***** years.
- 3) In **7.***** years.
- 4) In **5.***** years.
- 5) In **2.***** years.

Exercise 2

We have one bank account that offers a periodic compound interest rate of 3% in 6 periods (compounding frequency) where we initially deposit 5000 euros. How long time is it necessary until the amount of money in the account reaches 9000 euros?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **5.***** years.
- 2) In **0.***** years.
- 3) In **9.***** years.
- 4) In **2.***** years.
- 5) In **7.***** years.

Exercise 3

We have a bank account that initially offers a periodic compound interest rate of 8% in 4 periods (compounding frequency), and after 2 years the conditions are modified and then we obtain a continuous compound rate of 9%. The initial deposit is 5000 euros. Compute the amount of money in the account after 6 years from the moment of the first deposit.

- 1) We will have ****3.***** euros.
- 2) We will have ****2.***** euros.
- 3) We will have ****6.***** euros.
- 4) We will have ****0.***** euros.
- 5) We will have ****7.***** euros.

Exercise 4

A firm sells Q tons of certain product. The price received per ton is given by the formula $P=50000-2Q$. On the other hand, the production cost per ton is $C=30000+16Q$. In addition, the transportation cost is 18560 per ton. Compute the maximum profit that can be obtained selling this product.

- 1) Profit = 26381 .
- 2) Profit = 28800 .
- 3) Profit = 20169 .
- 4) Profit = 10639 .
- 5) Profit = 28561 .

Exercise 5

Deposits in certain investment account vary from year to year alternating gains and losses periods. We have the following data about the deposits for different years:

year	deposits
2	-4
3	-7
5	-13

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t . Employ that function to forecast the exact amount for year 6 .

- 1) The depositis in the account for year 6 are 5 .
- 2) The depositis in the account for year 6 are -19 .
- 3) The depositis in the account for year 6 are 12 .
- 4) The depositis in the account for year 6 are 9 .
- 5) The depositis in the account for year 6 are -16 .

Exercise 6

The funds of a public institution alternate periods of deficit and surplus.

We have the following information for several years (in millions of euros):

year	funds
0	2
2	12
5	57

Employ an interpolation polynomial to build a function that

yields the funds for each year t . We know that due to the legislation the funds of such an institution have to be kept between 5 and 38

- . Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from $t=0$ to $t=5$).

- 1) The funds are inside the limits for the interval: $[0, 1]$.
- 2) The funds are inside the limits for the interval: $[-\frac{9}{2}, 1]$.
- 3) The funds are inside the limits for the interval: $[-\frac{9}{2}, -\frac{3}{2}]$.
- 4) The funds are inside the limits for the intervals: $[-\frac{9}{2}, -\frac{3}{2}]$ y $[4, 5]$.
- 5) The funds are inside the limits for the interval: $[1, 4]$.
- 6) The funds are inside the limits for the interval: $[1, 5]$.
- 7) The funds are inside the limits for the interval: $[-\frac{9}{2}, 5]$.
- 8) The funds are inside the limits for the interval: $[-\frac{9}{2}, 0]$.

Exercise 7

The deposits in certain account between the

months $t=0$ and $t=7$ is given by the function $C(t) = 9 + 60t - 36t^2 + 4t^3$

- . Determine the months for which the deposit is between -27 and 17 euros.

- 1) Along the intervals of months: $[1.79594, 2.33389]$ and $[4.26117, 7.58287]$.
- 2) Along the intervals of months: $[0.62452, 2.]$ and $[3., 6.34974]$.
- 3) Along the intervals of months: $[0, 0.145898]$, $[2, 3]$ and $[6.4641, 6.8541]$.
- 4) Along the intervals of months: $[-4.45015 \times 10^{-308}, 4.37885]$ and $[5.5738, 7.]$.
- 5) Along the interval of months: $[1., 2.38114]$.
- 6) Along the intervals of months: $[0, 0]$, $[0.145898, 2]$, $[3, 6.4641]$ and $[6.8541, 7]$.
- 7) Along the interval of months: $[4., 5.65129]$.
- 8) Along the intervals of months: $[3., 5.]$ and $[6.59879, 7.60878]$.

Exercise 8

Compute the limit: $\lim_{x \rightarrow \infty} \left(\frac{6 - 9x - 9x^2}{6 + 5x - 9x^2} \right)^{-1+7x+8x^2}$

- 1) ∞
- 2) $\frac{1}{e}$
- 3) 0
- 4) 1
- 5) $\frac{1}{e^3}$
- 6) $-\infty$
- 7) e

Exercise 9

The population of certain country (in millions of habitants) is given by the function $P(t) =$

$$19 \left(\frac{-8 + 6t + 3t^2}{-9 + 6t + 3t^2} \right)^{5+3t+7t^2}. \text{ Determine the future tendency for this population.}$$

- 1) 0
- 2) $\frac{19}{e^5}$
- 3) $19 e^{1167/500}$
- 4) $-\infty$
- 5) ∞
- 6) 19
- 7) $19 e^{7/3}$

Exercise 10

We deposit 2000 euros in a bank account with a compound interest rate of 3%. At the same time every year we also add in a safe-deposit box (therefore with no interest rate) 4000 euros. How long time is it necessary until the total amount of money (jointly in the bank account and safe-deposit box) is 39000 euros? (the solution can be found for t between 5 and 10).

- 1) $t = ** .0****$
- 2) $t = ** .2****$
- 3) $t = ** .4****$
- 4) $t = ** .6****$
- 5) $t = ** .8****$

Exercise 11

Study the continuity of the function $f(x) = \begin{cases} 2 \sin(x+3) + \cos(x+3) & x \leq -3 \\ 1 & -3 < x < 0 \\ \cos(x) & 0 \leq x \end{cases}$

- 1) The functions is continuous for all points.
- 2) The functions is not continuous at any point.
- 3) The function is continuous for all the points except for $x = -3$.
- 4) The function is continuous for all the points except for $x = 0$.
- 5) The function is continuous for all the points except for $x = -3$ and $x = 0$.

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01-Functions for serial number: 73

Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a compound interest rate of 4% and in the bank B we are paid a continuous compound rate of 7%. We initially deposit 9000 euros in the bank A and 4000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **7.***** years.
- 2) In **0.***** years.
- 3) In **6.***** years.
- 4) In **8.***** years.
- 5) In **3.***** years.

Exercise 2

Certain parcel of land is devalued from an initial value of 373000 euros until a final value of 215000 euros along 10 years. Determine the rate of continuous compound interest for that devaluation.

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) The interest rate is **0.***** %.
- 2) The interest rate is **5.***** %.
- 3) The interest rate is **3.***** %.
- 4) The interest rate is **4.***** %.
- 5) The interest rate is **9.***** %.

Exercise 3

We have a bank account that initially offers a compound interest rate of 7%, and after 4 years the conditions are modified and then we obtain a continuous compound rate of 2%. The initial deposit is 9000 euros. Compute the amount of money in the account after 5 years from the moment of the first deposit.

- 1) We will have ****7.***** euros.
- 2) We will have ****2.***** euros.
- 3) We will have ****5.***** euros.
- 4) We will have ****6.***** euros.
- 5) We will have ****0.***** euros.

Exercise 4

A firm sells Q tons of certain product. The price received per ton is given by the formula $P=11000-19Q$. On the other hand, the production cost per ton is $C=10000-13Q$. In addition, the transportation cost is 412 per ton. Compute the maximum profit that can be obtained selling this product.

- 1) Profit = 12986 .
- 2) Profit = 16787 .
- 3) Profit = 16858 .
- 4) Profit = 14406 .
- 5) Profit = 10572 .

Exercise 5

Deposits in certain investment account vary from year to year alternating gains and losses periods. We have the following data about the deposits for different years:

year	deposits
1	2
3	-2
4	-1

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t . Employ that function to determine the minimum funds available in the investment account .

- 1) The minimum for the depositis in the account was 19 .
- 2) The minimum for the depositis in the account was 7 .
- 3) The minimum for the depositis in the account was -2 .
- 4) The minimum for the depositis in the account was 2 .
- 5) The minimum for the depositis in the account was 3 .

Exercise 6

The funds of a public institution alternate periods of deficit and surplus.

We have the following information for several years (in millions of euros):

year	funds
0	17
3	20
5	12

Employ an interpolation polynomial to build a function that

yields the funds for each year t . We know that due to the legislation the funds of such an institution have to be kept between 3 and 20

. Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from $t=0$ to $t=5$).

- 1) The funds are inside the limits for the intervals: $[0, 1]$ y $[3, 5]$.
- 2) The funds are inside the limits for the interval: $[-2, 6]$.
- 3) The funds are inside the limits for the interval: $[3, 5]$.
- 4) The funds are inside the limits for the interval: $[-2, 4]$.
- 5) The funds are inside the limits for the interval: $[0, 5]$.
- 6) The funds are inside the limits for the interval: $[1, 5]$.
- 7) The funds are inside the limits for the interval: $[0, 3]$.
- 8) The funds are inside the limits for the interval: $[5, 5]$.

Exercise 7

The population of certain type of rodents is analyzed in a region between years $t=1$ and $t=7$. Along that period the population is given by the function $P(t) = 6 + 180t - 48t^2 + 4t^3$ (thousands of rodents). Determine the intervals of years during which the number of rodents is between 214 and 422.

- 1) Along the intervals of years: $[1., 2.]$ and $[5.01357, 6.71113]$.
- 2) Along the intervals of years: $[1, 2.26795]$, $[4, 5.73205]$ and $[7, 7]$.
- 3) Along the intervals of years: $[1., 2.]$ and $[4., 6.]$.
- 4) Along the interval of years: $[3.50475, 7.24962]$.
- 5) Along the interval of years: $[4.35759, 7.34531]$.
- 6) Along the intervals of years: $[2., 4.]$ and $[5., 6.]$.
- 7) Along the intervals of years: $[2.26795, 4]$ and $[5.73205, 7]$.
- 8) Along the intervals of years: $[1.61887, 3.58919]$ and $[5.32931, 6.40568]$.

Exercise 8

Compute the limit: $\lim_{x \rightarrow \infty} \left(\frac{8 + 5x + 3x^2}{-4 + 5x + 3x^2} \right)^{-1+5x}$

- 1) $\frac{1}{e^3}$
- 2) $\frac{1}{e}$
- 3) 1
- 4) 0
- 5) $-\infty$
- 6) ∞
- 7) $\frac{1}{e^5}$

Exercise 9

A factory produces certain type of devices. The marginal cost (cost of producing one unit) decreases when we produce a large amount of units and it is given by the function $C(x) = \frac{3 + 2x + 8x^2 + 5x^3}{4 + 5x + 5x^2 + x^3}$.

. Determine the expected cost per unit when a large amount of units is produced.

- 1) ∞
- 2) 5
- 3) $\frac{507}{100}$
- 4) $-\infty$
- 5) $-\frac{3}{2}$
- 6) 0
- 7) 5000

Exercise 10

The population in certain turistic area

increases exponentially and is given by the function $P(t) = 84\,000 e^{t/100}$ that indicates the number of resident citizens for every year t . At the same time, depending on the season, the city receives a variable number of

tourists given by the trigonometric function $I(t) = 3000 + 2000 \sin\left[\frac{t}{2\pi}\right]$

that yields the amount of visitors in the area for every moment t (t in years).

Determine how many years are necessary until the total number of habitants is 119000. (the solution can be found for t between 30 and 35).

- 1) $t = ** .0****$
- 2) $t = ** .2****$
- 3) $t = ** .4****$
- 4) $t = ** .6****$
- 5) $t = ** .8****$

Exercise 11

Study the continuity of the function $f(x) =$

$$\begin{cases} \sin(1-x) - e^{x-1} & x \leq 1 \\ -3 \sin(1-x) - 2 \cos(1-x) + 1 - 3 \sin(1) + 2 \cos(1) & 1 < x < 2 \\ 3 \log(x-1) + 1 & 2 \leq x \end{cases}$$

- 1) The functions is continuous for all points.
- 2) The functions is not continuous at any point.
- 3) The function is continuous for all the points except for $x=1$.
- 4) The function is continuous for all the points except for $x=2$.
- 5) The function is continuous for all the points except for $x=1$ and $x=2$.

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01-Functions for serial number: 74

Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a compound interest rate of 5% and in the bank B we are paid a periodic compound interest rate of 2% in 6 periods (compounding frequency). We initially deposit 4000 euros in the bank A and 10000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **1.***** years.
- 2) In **7.***** years.
- 3) In **3.***** years.
- 4) In **9.***** years.
- 5) In **0.***** years.

Exercise 2

Certain parcel of land is devalued from an initial value of 453000 euros until a final value of 217000 euros along 7 years. Determine the rate of periodic compound interest in 8 periods for that devaluation.

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) The interest rate is **5.***** %.
- 2) The interest rate is **9.***** %.
- 3) The interest rate is **8.***** %.
- 4) The interest rate is **0.***** %.
- 5) The interest rate is **6.***** %.

Exercise 3

We have a bank account that initially offers a compound interest rate of 3%, and after 1 year the conditions are modified and then we obtain a periodic compound interest rate of 8% in 10 periods (compounding frequency). The initial deposit is 10000 euros. Compute the amount of money in the account after 8 years from the moment of the first deposit.

- 1) We will have ****4.***** euros.
- 2) We will have ****9.***** euros.
- 3) We will have ****7.***** euros.
- 4) We will have ****1.***** euros.
- 5) We will have ****8.***** euros.

Exercise 4

A firm sells Q tons of certain product. The price received per ton is given by the formula $P=8000-4Q$. On the other hand, the production cost per ton is $C=2000+Q$. In addition, the transportation cost is 5840 per ton. Compute the maximum profit that can be obtained selling this product.

- 1) Profit = 886 .
- 2) Profit = 1674 .
- 3) Profit = 794 .
- 4) Profit = 872 .
- 5) Profit = 1280 .

Exercise 5

Deposits in certain investment account vary from year to year alternating gains and losses periods. We have the following data about the deposits for different years:

year	deposits
1	12
3	4
4	6

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t . Employ that function to determine the minimum funds available in the investment account .

- 1) The minimum for the depositis in the account was 4 .
- 2) The minimum for the depositis in the account was 13 .
- 3) The minimum for the depositis in the account was 22 .
- 4) The minimum for the depositis in the account was 15 .
- 5) The minimum for the depositis in the account was 3 .

Exercise 6

The funds of a public institution alternate periods of deficit and surplus.

We have the following information for several years (in millions of euros):

year	funds
2	8
5	5
8	20

Employ an interpolation polynomial to build a function that

yields the funds for each year t . We know that due to the legislation the funds of such an institution have to be kept between 5 and 13

- . Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from $t=2$ to $t=8$).

- 1) The funds are inside the limits for the interval: $[0, 5]$.
- 2) The funds are inside the limits for the intervals: $[2, 3]$ y $[5, 7]$.
- 3) The funds are inside the limits for the interval: $[1, 8]$.
- 4) The funds are inside the limits for the interval: $[0, 1]$.
- 5) The funds are inside the limits for the intervals: $[0, 3]$ y $[5, 7]$.
- 6) The funds are inside the limits for the interval: $[5, 8]$.
- 7) The funds are inside the limits for the interval: $[1, 5]$.
- 8) The funds are inside the limits for the interval: $[1, 3]$.

Exercise 7

The population of a city is studied between years $t=1$ and $t=8$. In that period the population is given by the function $P(t) = 2 + 144t - 42t^2 + 4t^3$

- . Determine the intervals of years when the population is between 108 and 812.

- 1) Along the intervals of years: $[3.00928, 5.31036]$ and $[7., 8.3004]$.
- 2) Along the interval of years: $[1, 8]$.
- 3) Along the intervals of years: $[2., 4.]$ and $[5., 8.32301]$.
- 4) Along the interval of years: $[3., 6.22906]$.
- 5) Along the interval of years: $[6.6862, 8.3016]$.
- 6) Along the interval of years: $[2.52909, 8.]$.
- 7) Along the intervals of years: $[1, 1]$ and $[8, 8]$.
- 8) Along the intervals of years: $[1., 5.11921]$ and $[6., 8.]$.

Exercise 8

Compute the limit: $\lim_{x \rightarrow -\infty} \left(\frac{8 + 7x + 8x^2}{6 - 3x + 8x^2} \right)^{-9+9x+3x^2}$

1) $-\infty$

2) $\frac{1}{e}$

3) ∞

4) $\frac{1}{e^2}$

5) $\frac{1}{e^4}$

6) $\emptyset$

7) 1

Exercise 9

The population of certain country (in millions of habitants) is given by the function $P(t) =$

$29 \left(\frac{8 + 7t - 8t^2}{6 - 3t - 8t^2} \right)^{-9+9t+3t^2}$. Determine the future tendency for this population.

1) $-\infty$

2) $\frac{29}{e}$

3) ∞

4) $\frac{29}{e^2}$

5) $\frac{29}{e^4}$

6) $\emptyset$

7) 29

Exercise 10

The population in certain turistic area increases

exponentially and is given by the function $P(t) = 100\,000 e^{t/50}$

that indicates the number of resident citizens for every year t . At the same time, depending on the season, the city receives a variable number of

tourists given by the trigonometric function $I(t) = 2000 + 1000 \sin\left[\frac{t}{2\pi}\right]$

that yields the amount of visitors in the area for every moment t (t in years).

Determine how many years are necessary until the total number of habitants is 144000. (the solution can be found for t between 17 and 22).

- 1) $t = \dots 0 \dots$
- 2) $t = \dots 2 \dots$
- 3) $t = \dots 4 \dots$
- 4) $t = \dots 6 \dots$
- 5) $t = \dots 8 \dots$

Exercise 11

Study the continuity of the function $f(x) = \begin{cases} 2e^{x-3} + \sin(3-x) & x \leq 3 \\ x-2 & 3 < x < 4 \\ -2\log(x-3) & 4 \leq x \end{cases}$

- 1) The functions is continuous for all points.
- 2) The functions is not continuous at any point.
- 3) The function is continuous for all the points except for $x=3$.
- 4) The function is continuous for all the points except for $x=4$.
- 5) The function is continuous for all the points except for $x=3$ and $x=4$.

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01-Functions for serial number: 75

Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a compound interest rate of 5% and in the bank B we are paid a compound interest rate of 9%. We initially deposit 8000 euros in the bank A and 3000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **3.***** years.
- 2) In **0.***** years.
- 3) In **1.***** years.
- 4) In **6.***** years.
- 5) In **9.***** years.

Exercise 2

We have one bank account that offers a periodic compound interest rate of 6% in 11 periods (compounding frequency) where we initially deposit 12000 euros. How long time is it necessary until the amount of money in the account reaches 15000 euros?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **3.***** years.
- 2) In **9.***** years.
- 3) In **7.***** years.
- 4) In **8.***** years.
- 5) In **0.***** years.

Exercise 3

We have a bank account that initially offers a periodic compound interest rate of 3% in 7 periods (compounding frequency), and after 3 years the conditions are modified and then we obtain a compound interest rate of 8%. The initial deposit is 8000 euros. Compute the amount of money in the account after 9 years from the moment of the first deposit.

- 1) We will have ****3.***** euros.
- 2) We will have ****0.***** euros.
- 3) We will have ****9.***** euros.
- 4) We will have ****4.***** euros.
- 5) We will have ****7.***** euros.

Exercise 4

A firm sells Q tons of certain product. The price received per ton is given by the formula $P=14000-9Q$. On the other hand, the production cost per ton is $C=13000-Q$. In addition, the transportation cost is 264 per ton. Compute the maximum profit that can be obtained selling this product.

- 1) Profit = 6139 .
- 2) Profit = 26130 .
- 3) Profit = 16928 .
- 4) Profit = 16745 .
- 5) Profit = 23761 .

Exercise 5

Deposits in certain investment account vary from year to year alternating gains and losses periods. We have the following data about the deposits for different years:

year	deposits
1	5
2	14
4	50

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t . Employ that function to forecast the exact amount for year 6 .

- 1) The depositis in the account for year 6 are -4 .
- 2) The depositis in the account for year 6 are 149 .
- 3) The depositis in the account for year 6 are 5 .
- 4) The depositis in the account for year 6 are 110 .
- 5) The depositis in the account for year 6 are -6 .

Exercise 6

The funds of a public institution alternate periods of deficit and surplus.

We have the following information for several years (in millions of euros):

year	funds
0	14
3	23
5	59

Employ an interpolation polynomial to build a function that

yields the funds for each year t . We know that due to the legislation the funds of such an institution have to be kept between 14 and 38

- . Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from $t=0$ to $t=5$).

- 1) The funds are inside the limits for the interval: $[-2, 5]$.
- 2) The funds are inside the limits for the intervals: $[0, 0]$ y $[2, 4]$.
- 3) The funds are inside the limits for the interval: $[-2, 0]$.
- 4) The funds are inside the limits for the interval: $[2, 5]$.
- 5) The funds are inside the limits for the interval: $[-1, 4]$.
- 6) The funds are inside the limits for the intervals: $[-2, 0]$ y $[4, 5]$.
- 7) The funds are inside the limits for the interval: $[0, 2]$.
- 8) The funds are inside the limits for the interval: $[-2, 2]$.

Exercise 7

The population of certain type of rodents is analyzed in a region between years $t=1$ and $t=10$. Along that period the population is given by the function $P(t) = 10 + 120t - 42t^2 + 4t^3$ (thousands of rodents). Determine the intervals of years during which the number of rodents is between 74 and 100.

- 1) Along the intervals of years: $[2.58969, 3.]$ and $[5., 7.]$.
- 2) Along the intervals of years: $[1, 1]$, $[1.18826, 3]$, $[4, 5.81174]$ and $[6.31174, 10]$.
- 3) Along the interval of years: $[9., 10.5722]$.
- 4) Along the intervals of years: $[2., 8.72262]$ and $[9.479, 10.]$.
- 5) Along the intervals of years: $[1.63792, 4.]$ and $[5., 10.5072]$.
- 6) Along the intervals of years: $[4.13379, 5.48786]$ and $[7., 10.]$.
- 7) Along the intervals of years: $[1, 1.18826]$, $[3, 4]$ and $[5.81174, 6.31174]$.
- 8) Along the intervals of years: $[3., 4.49066]$ and $[6.23432, 10.]$.

Exercise 8

Compute the limit: $\lim_{x \rightarrow -\infty} \left(\frac{9 - 7x + x^2}{4 + 7x + x^2} \right)^{7+4x}$

- 1) ∞
- 2) $\frac{1}{e^{56}}$
- 3) $-\infty$
- 4) $\frac{1}{e^3}$
- 5) $\frac{1}{e^5}$
- 6) 0
- 7) 1

Exercise 9

From an initial deposit 6000, the interest rate varies every year in such a way that the total amount of money in the account is given by the function $C(t) =$

$$6000 \left(\frac{9 - 7t - t^2}{4 + 7t - t^2} \right)^{7+4t}. \text{ Determine the future tendency for the deposits}$$

that we will have after a large number of years.

- 1) $6000 e^{27999/500}$
- 2) $6000 e^{56}$
- 3) 6000
- 4) $-\infty$
- 5) ∞
- 6) $\frac{6000}{e^5}$
- 7) 0

Exercise 10

We deposit 16000 euros in a bank account with a periodic compound interest rate of 5% in 11 periods (compounding frequency). At the same time every year we also add in a safe-deposit box (therefore with no interest rate) 4000 euros. How long time is it necessary until the total amount of money (jointly in the bank account and safe-deposit box) is 42000 euros? (the solution can be found for t between 4 and 9).

- 1) $t = \dots 0 \dots$
- 2) $t = \dots 2 \dots$
- 3) $t = \dots 4 \dots$
- 4) $t = \dots 6 \dots$
- 5) $t = \dots 8 \dots$

Exercise 11

Study the continuity of the function $f(x) = \begin{cases} 2 \sin(x) + 2 \cos(x) & x \leq 0 \\ 2e^x + 2 \sin(x) & 0 < x < 3 \\ -2 & 3 \leq x \end{cases}$

- 1) The functions is continuous for all points.
- 2) The functions is not continuous at any point.
- 3) The function is continuous for all the points except for $x=0$.
- 4) The function is continuous for all the points except for $x=3$.
- 5) The function is continuous for all the points except for $x=0$ and $x=3$.

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01-Functions for serial number: 76

Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a continuous compound rate of 2% and in the bank B we are paid a continuous compound rate of 7%. We initially deposit 5000 euros in the bank A and 1000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **6.***** years.
- 2) In **5.***** years.
- 3) In **2.***** years.
- 4) In **0.***** years.
- 5) In **9.***** years.

Exercise 2

We have one bank account that offers a periodic compound interest rate of 3% in 3 periods (compounding frequency) where we initially deposit 5000 euros. How long time is it necessary until the amount of money in the account reaches 12000 euros?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **9.***** years.
- 2) In **3.***** years.
- 3) In **5.***** years.
- 4) In **6.***** years.
- 5) In **0.***** years.

Exercise 3

We have a bank account that initially offers a continuous compound rate of 3%, and after 3 years the conditions are modified and then we obtain a compound interest rate of 4%. The initial deposit is 5000 euros. Compute the amount of money in the account after 7 years from the moment of the first deposit.

- 1) We will have ****7.***** euros.
- 2) We will have ****9.***** euros.
- 3) We will have ****8.***** euros.
- 4) We will have ****5.***** euros.
- 5) We will have ****0.***** euros.

Exercise 4

A firm sells Q tons of certain product. The price received per ton is given by the formula $P=70000-2Q$. On the other hand, the production cost per ton is $C=50000+10Q$. In addition, the transportation cost is 18872 per ton. Compute the maximum profit that can be obtained selling this product.

- 1) Profit = 43920 .
- 2) Profit = 22620 .
- 3) Profit = 26508 .
- 4) Profit = 31177 .
- 5) Profit = 17344 .

Exercise 5

Deposits in certain investment account vary from year to year alternating gains and losses periods. We have the following data about the deposits for different years:

year	deposits
1	-4
2	-13
4	-43

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t . Employ that function to forecast the exact amount for year 6 .

- 1) The depositis in the account for year 6 are 2 .
- 2) The depositis in the account for year 6 are 10 .
- 3) The depositis in the account for year 6 are 17 .
- 4) The depositis in the account for year 6 are -89 .
- 5) The depositis in the account for year 6 are -118 .

Exercise 6

The funds of a public institution alternate periods of deficit and surplus.

We have the following information for several years (in millions of euros):

year	funds
0	11
2	-13
4	-13

Employ an interpolation polynomial to build a function that

yields the funds for each year t . We know that due to the legislation the funds of such an institution have to be kept between -13 and -4

. Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from $t=0$ to $t=4$).

- 1) The funds are inside the limits for the interval: $[1, 4]$.
- 2) The funds are inside the limits for the interval: $[4, 4]$.
- 3) The funds are inside the limits for the intervals: $[1, 2]$ y $[4, 4]$.
- 4) The funds are inside the limits for the intervals: $[0, 2]$ y $[4, 5]$.
- 5) The funds are inside the limits for the interval: $[0, 4]$.
- 6) The funds are inside the limits for the interval: $[1, 2]$.
- 7) The funds are inside the limits for the interval: $[0, 1]$.
- 8) The funds are inside the limits for the intervals: $[1, 2]$ y $[4, 5]$.

Exercise 7

The population of a city is studied between years $t=0$ and $t=7$. In that period the population is given by the function $P(t) = 5 + 360t - 66t^2 + 4t^3$

. Determine the intervals of years when the population is between 653 and 709.

- 1) Along the interval of years: $[3., 7.]$.
- 2) Along the interval of years: $[4.65222, 7.]$.
- 3) Along the intervals of years: $[0, 4.5]$, $[6, 6]$ and $[7, 7]$.
- 4) Along the interval of years: $[3.09159, 5.06749]$.
- 5) Along the intervals of years: $[3., 4.]$ and $[5.17603, 6.]$.
- 6) Along the intervals of years: $[1.69761, 2.61167]$ and $[3.43091, 4.33512]$.
- 7) Along the interval of years: $[2.70967, 7.]$.
- 8) Along the interval of years: $[4.5, 7]$.

Exercise 8

Compute the limit: $\lim_{x \rightarrow \infty} \left(\frac{7 - 4x + 7x^2 + 8x^3}{-3 + 9x - 2x^2 + 8x^3} \right)^{4+5x}$

- 1) $\frac{1}{e^2}$
- 2) $\frac{1}{e^3}$
- 3) 0
- 4) $e^{45/8}$
- 5) $-\infty$
- 6) ∞
- 7) 1

Exercise 9

The population of certain country (in millions of habitants) is given by the function $P(t) =$

$10 \left(\frac{7 - 4t + 7t^2 + 6t^3}{-3 + 9t - 2t^2 + 6t^3} \right)^{4+5t}$. Determine the future tendency for this population.

- 1) $\frac{10}{e^5}$
- 2) 10
- 3) 0
- 4) $10 e^{15/2}$
- 5) $\frac{10}{e^4}$
- 6) $-\infty$
- 7) ∞

Exercise 10

We deposit 1000 euros in a bank account with a compound interest rate of 10%. At the same time every year we also add in a safe-deposit box (therefore with no interest rate) 4000 euros. How long time is it necessary until the total amount of money (jointly in the bank account and safe-deposit box) is 53000 euros? (the solution can be found for t between 8 and 13).

- 1) $t = **.0****$
- 2) $t = **.2****$
- 3) $t = **.4****$
- 4) $t = **.6****$
- 5) $t = **.8****$

Exercise 11

Study the continuity of the function $f(x) =$

$$\begin{cases} -\sin(x+3) - \cos(x+3) & x \leq -3 \\ 2\sin(x+3) + 2\cos(x+3) - 2 - 2\sin(3) - 2\cos(3) & -3 < x < 0 \\ -\log(x+1) - 2 & 0 \leq x \end{cases}$$

- 1) The functions is continuous for all points.
- 2) The functions is not continuous at any point.
- 3) The function is continuous for all the points except for $x = -3$.
- 4) The function is continuous for all the points except for $x = 0$.
- 5) The function is continuous for all the points except for $x = -3$ and $x = 0$.

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01-Functions for serial number: 77

Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a continuous compound rate of 4% and in the bank B we are paid a compound interest rate of 8%. We initially deposit 15000 euros in the bank A and 6000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **5.***** years.
- 2) In **0.***** years.
- 3) In **4.***** years.
- 4) In **7.***** years.
- 5) In **2.***** years.

Exercise 2

Certain parcel of land is devalued from an initial value of 397000 euros until a final value of 250000 euros along 10 years. Determine the rate of periodic compound interest in 3 periods for that devaluation.

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) The interest rate is **2.***** %.
- 2) The interest rate is **4.***** %.
- 3) The interest rate is **1.***** %.
- 4) The interest rate is **3.***** %.
- 5) The interest rate is **7.***** %.

Exercise 3

We have a bank account that initially offers a continuous compound rate of 7%, and after 3 years the conditions are modified and then we obtain a continuous compound rate of 1%. The initial deposit is 15000 euros. Compute the amount of money in the account after 5 years from the moment of the first deposit.

- 1) We will have ****4.***** euros.
- 2) We will have ****9.***** euros.
- 3) We will have ****2.***** euros.
- 4) We will have ****6.***** euros.
- 5) We will have ****3.***** euros.

Exercise 4

A firm sells Q tons of certain product. The price received per ton is given by the formula $P=9000-11Q$. On the other hand, the production cost per ton is $C=3000-2Q$. In addition, the transportation cost is 5550 per ton. Compute the maximum profit that can be obtained selling this product.

- 1) Profit = 3845 .
- 2) Profit = 4094 .
- 3) Profit = 3838 .
- 4) Profit = 5430 .
- 5) Profit = 5625 .

Exercise 5

Deposits in certain investment account vary from year to year alternating gains and losses periods. We have the following data about the deposits for different years:

year	deposits
1	23
2	14
4	2

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t . Employ that function to determine the minimum funds available in the investment account .

- 1) The minimum for the depositis in the account was -2 .
- 2) The minimum for the depositis in the account was 14 .
- 3) The minimum for the depositis in the account was 13 .
- 4) The minimum for the depositis in the account was 6 .
- 5) The minimum for the depositis in the account was 8 .

Exercise 6

The funds of a public institution alternate periods of deficit and surplus.

We have the following information for several years (in millions of euros):

year	funds
0	26
4	42
8	-6

Employ an interpolation polynomial to build a function that

yields the funds for each year t . We know that due to the legislation the funds of such an institution have to be kept between -6 and 36

. Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from $t=0$ to $t=8$).

- 1) The funds are inside the limits for the interval: $[0, 5]$.
- 2) The funds are inside the limits for the interval: $[-2, 9]$.
- 3) The funds are inside the limits for the intervals: $[0, 1]$ y $[5, 8]$.
- 4) The funds are inside the limits for the interval: $[5, 8]$.
- 5) The funds are inside the limits for the interval: $[8, 8]$.
- 6) The funds are inside the limits for the interval: $[0, 8]$.
- 7) The funds are inside the limits for the interval: $[1, 8]$.
- 8) The funds are inside the limits for the interval: $[-2, 7]$.

Exercise 7

The population of certain type of rodents is analyzed in a region between years $t=2$ and $t=9$. Along that period the population is given by the function $P(t) = 6 + 672t - 90t^2 + 4t^3$ (thousands of rodents). Determine the intervals of years during which the number of rodents is between 6 and 1616.

- 1) Along the interval of years: $[2, 5]$.
- 2) Along the interval of years: $[3., 6.06779]$.
- 3) Along the interval of years: $[3., 6.3706]$.
- 4) Along the intervals of years: $[2, 2]$ and $[5, 9]$.
- 5) Along the intervals of years: $[2.67823, 4.71073]$ and $[5., 7.08698]$.
- 6) Along the interval of years: $[5.02869, 8.25158]$.
- 7) Along the interval of years: $[4., 5.]$.
- 8) Along the interval of years: $[2., 6.]$.

Exercise 8

Compute the limit: $\lim_{x \rightarrow -\infty} \left(\frac{4 - 2x + 7x^2}{9 - 4x + 7x^2} \right)^{5+6x}$

- 1) $e^{12/7}$
- 2) $\frac{1}{e^5}$
- 3) 0
- 4) ∞
- 5) 1
- 6) $-\infty$
- 7) $\frac{1}{e^4}$

Exercise 9

A factory produces certain type of devices. The marginal cost (cost of producing one unit) decreases when we produce a large amount of units and it is given by the function $C(x) = \frac{9 + 7x + 2x^2 + 4x^3 + 3x^4}{9 + 2x + 8x^2 + 5x^3 + 8x^4}$

. Determine the expected cost per unit when a large amount of units is produced.

- 1) $-\infty$
- 2) ∞
- 3) -3
- 4) 0
- 5) $11\,000$
- 6) $\frac{3}{8}$
- 7) $\frac{11}{25}$

Exercise 10

The population in certain turistic area

increases exponentially and is given by the function $P(t) = 87\,000 e^{t/100}$ that indicates the number of resident citizens for every year t . At the same time, depending on the season, the city receives a variable number of

tourists given by the trigonometric function $I(t) = 3000 + 2000 \sin\left[\frac{t}{2\pi}\right]$

that yields the amount of visitors in the area for every moment t (t in years).

Determine how many years are necessary until the total number of habitants is 120000. (the solution can be found for t between 31 and 36).

- 1) $t = \dots 0 \dots$
- 2) $t = \dots 2 \dots$
- 3) $t = \dots 4 \dots$
- 4) $t = \dots 6 \dots$
- 5) $t = \dots 8 \dots$

Exercise 11

Study the continuity of the function $f(x) = \begin{cases} -e^{x-1} - 2 \sin(1-x) & x \leq 1 \\ x - 2 & 1 < x < 4 \\ 2 \log(x-3) + 2 & 4 \leq x \end{cases}$

- 1) The functions is continuous for all points.
- 2) The functions is not continuous at any point.
- 3) The function is continuous for all the points except for $x=1$.
- 4) The function is continuous for all the points except for $x=4$.
- 5) The function is continuous for all the points except for $x=1$ and $x=4$.

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01-Functions for serial number: 78

Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a periodic compound interest rate of 9% in 2 periods (compounding frequency) and in the bank B we are paid a compound interest rate of 6% . We initially deposit 1000 euros in the bank A and 6000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **4.***** years.
- 2) In **0.***** years.
- 3) In **7.***** years.
- 4) In **8.***** years.
- 5) In **5.***** years.

Exercise 2

We have one bank account that offers a periodic compound interest rate of 3% in 11 periods (compounding frequency) where we initially deposit 8000 euros. How long time is it necessary until the amount of money in the account reaches 10000 euros?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **4.***** years.
- 2) In **7.***** years.
- 3) In **8.***** years.
- 4) In **9.***** years.
- 5) In **0.***** years.

Exercise 3

We have a bank account that initially offers a compound interest rate of 1% , and after 3 years the conditions are modified and then we obtain a periodic compound interest rate of 4% in 6 periods (compounding frequency) . The initial deposit is 6000 euros. Compute the amount of money in the account after 3 years from the moment of the first deposit.

- 1) We will have ****0.***** euros.
- 2) We will have ****4.***** euros.
- 3) We will have ****8.***** euros.
- 4) We will have ****7.***** euros.
- 5) We will have ****1.***** euros.

Exercise 4

A firm sells Q tons of certain product. The price received per ton is given by the formula $P=14000-5Q$. On the other hand, the production cost per ton is $C=12000+12Q$. In addition, the transportation cost is 1456 per ton. Compute the maximum profit that can be obtained selling this product.

- 1) Profit = 4352 .
- 2) Profit = 6291 .
- 3) Profit = 5888 .
- 4) Profit = 1470 .
- 5) Profit = 6302 .

Exercise 5

Deposits in certain investment account vary from year to year alternating gains and losses periods. We have the following data about the deposits for different years:

year	deposits
0	0
1	0
3	12

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t . Employ that function to forecast the exact amount for year 5 .

- 1) The depositis in the account for year 5 are 60 .
- 2) The depositis in the account for year 5 are 20 .
- 3) The depositis in the account for year 5 are -18 .
- 4) The depositis in the account for year 5 are 4 .
- 5) The depositis in the account for year 5 are 40 .

Exercise 6

The funds of a public institution alternate periods of deficit and surplus.

We have the following information for several years (in millions of euros):

year	funds
0	2
3	2
7	30

Employ an interpolation polynomial to build a function that

yields the funds for each year t . We know that due to the legislation the funds of such an institution have to be kept between 2 and 36

- . Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from $t=0$ to $t=7$).

- 1) The funds are inside the limits for the intervals: $[0, 0]$ y $[3, 7]$.
- 2) The funds are inside the limits for the interval: $[-1, 4]$.
- 3) The funds are inside the limits for the interval: $[-2, 7]$.
- 4) The funds are inside the limits for the interval: $[-1, 6]$.
- 5) The funds are inside the limits for the interval: $[3, 7]$.
- 6) The funds are inside the limits for the interval: $[0, 7]$.
- 7) The funds are inside the limits for the interval: $[7, 7]$.
- 8) The funds are inside the limits for the interval: $[0, 3]$.

Exercise 7

The deposits in certain account between the months

$t=0$ and $t=10$ is given by the function $C(t) = 4 + 108t - 60t^2 + 4t^3$

- . Determine the months for which the deposit is between -456 and -268 euros.

- 1) Along the intervals of months: $[2.53306, 5.55609]$ and $[7.3971, 8.62229]$.
- 2) Along the intervals of months: $[4., 6.]$ and $[8.34143, 9.]$.
- 3) Along the interval of months: $[5., 8.0422]$.
- 4) Along the interval of months: $[7., 9.]$.
- 5) Along the intervals of months: $[1.36166, 3.]$ and $[4., 7.]$.
- 6) Along the interval of months: $[4, 5]$.
- 7) Along the intervals of months: $[0, 4]$ and $[5, 10]$.
- 8) Along the interval of months: $[4.64509, 5.]$.

Exercise 8

Compute the limit: $\lim_{x \rightarrow -\infty} \left(\frac{-8 + 7x - 3x^2 - 9x^3}{7 + 2x - 9x^2 - 9x^3} \right)^{-5+7x+5x^2}$

- 1) $\frac{1}{e^3}$
- 2) $\frac{1}{e^5}$
- 3) ∞
- 4) 1
- 5) $\frac{1}{e^4}$
- 6) $-\infty$
- 7) 0

Exercise 9

The population of certain country (in millions of habitants) is given by the function $P(t) =$

$$12 \left(\frac{4 + 8t - 3t^2}{7 - 3t - 3t^2} \right)^{-5+9t+7t^2}. \text{ Determine the future tendency for this population.}$$

- 1) ∞
- 2) $-\infty$
- 3) $\frac{12}{e^2}$
- 4) $\frac{12}{e^4}$
- 5) 0
- 6) 12
- 7) $\frac{12}{e}$

Exercise 10

We deposit 7000 euros in a bank account with a continuous compound rate of 9%. At the same time every year we also add in a safe-deposit box (therefore with no interest rate) 2000 euros. How long time is it necessary until the total ammount of money (jointly in the bank account and safe-depsit box) is 34000 euros? (the solution can be found for t between 9 and 14).

- 1) $t = \dots 0 \dots$
- 2) $t = \dots 2 \dots$
- 3) $t = \dots 4 \dots$
- 4) $t = \dots 6 \dots$
- 5) $t = \dots 8 \dots$

Exercise 11

Study the continuity of the function $f(x) = \begin{cases} -2 \sin(x+2) - 2 \cos(x+2) & x \leq -2 \\ -2 & -2 < x < 0 \vee 0 \leq x \end{cases}$

- 1) The functions is continuous for all points.
- 2) The functions is not continuous at any point.
- 3) The function is continuous for all the points except for $x = -2$.
- 4) The function is continuous for all the points except for $x = 0$.
- 5) The function is continuous for all the points except for $x = -2$ and $x = 0$.

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01-Functions for serial number: 79

Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a continuous compound rate of 3% and in the bank B we are paid a periodic compound interest rate of 7% in 3 periods (compounding frequency). We initially deposit 9000 euros in the bank A and 3000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **1.***** years.
- 2) In **6.***** years.
- 3) In **4.***** years.
- 4) In **0.***** years.
- 5) In **8.***** years.

Exercise 2

We have one bank account that offers a periodic compound interest rate of 5% in 7 periods (compounding frequency) where we initially deposit 13000 euros. How long time is it necessary until the amount of money in the account reaches 19000 euros?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **8.***** years.
- 2) In **1.***** years.
- 3) In **4.***** years.
- 4) In **0.***** years.
- 5) In **7.***** years.

Exercise 3

We have a bank account that initially offers a continuous compound rate of 5%, and after 1 year the conditions are modified and then we obtain a continuous compound rate of 2%. The initial deposit is 9000 euros. Compute the amount of money in the account after 4 years from the moment of the first deposit.

- 1) We will have ****6.***** euros.
- 2) We will have ****1.***** euros.
- 3) We will have ****8.***** euros.
- 4) We will have ****2.***** euros.
- 5) We will have ****9.***** euros.

Exercise 4

A firm sells Q tons of certain product. The price received per ton is given by the formula $P=4000-10Q$. On the other hand, the production cost per ton is $C=3000+2Q$. In addition, the transportation cost is 616 per ton. Compute the maximum profit that can be obtained selling this product.

- 1) Profit = 3072 .
- 2) Profit = 1750 .
- 3) Profit = 4697 .
- 4) Profit = 1655 .
- 5) Profit = 2040 .

Exercise 5

Deposits in certain investment account vary from year to year alternating gains and losses periods. We have the following data about the deposits for different years:

year	deposits
0	1
1	1
3	-5

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t . Employ that function to forecast the exact amount for year 5 .

- 1) The depositis in the account for year 5 are -14 .
- 2) The depositis in the account for year 5 are -1 .
- 3) The depositis in the account for year 5 are -19 .
- 4) The depositis in the account for year 5 are -2 .
- 5) The depositis in the account for year 5 are -29 .

Exercise 6

The funds of a public institution alternate periods of deficit and surplus.

We have the following information for several years (in millions of euros):

year	funds
1	23
3	11
6	-52

Employ an interpolation polynomial to build a function that

yields the funds for each year t . We know that due to the legislation the funds of such an institution have to be kept between -25 and -4

- . Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from $t=1$ to $t=6$).

- 1) The funds are inside the limits for the interval: $[-2, 6]$.
- 2) The funds are inside the limits for the interval: $[5, 6]$.
- 3) The funds are inside the limits for the interval: $[0, 5]$.
- 4) The funds are inside the limits for the intervals: $[-3, -2]$ y $[4, 6]$.
- 5) The funds are inside the limits for the interval: $[-2, 0]$.
- 6) The funds are inside the limits for the interval: $[-3, -2]$.
- 7) The funds are inside the limits for the interval: $[4, 5]$.
- 8) The funds are inside the limits for the interval: $[-2, 5]$.

Exercise 7

The population of certain type of rodents is analyzed in a region between years $t=2$ and $t=7$. Along that period the population is given by the function $P(t) = 9 + 144t - 42t^2 + 4t^3$ (thousands of rodents). Determine the intervals of years during which the number of rodents is between 179 and 331.

- 1) Along the interval of years: $[4.53442, 7.17618]$.
- 2) Along the intervals of years: $[2.49534, 3.]$ and $[4., 7.30581]$.
- 3) Along the interval of years: $[2., 3.]$.
- 4) Along the interval of years: $[5, 7]$.
- 5) Along the interval of years: $[2.30941, 7.]$.
- 6) Along the intervals of years: $[2.37432, 3.]$ and $[4., 5.51336]$.
- 7) Along the intervals of years: $[2, 5]$ and $[7, 7]$.
- 8) Along the intervals of years: $[2.65327, 4.14573]$ and $[5., 7.]$.

Exercise 8

Compute the limit: $\lim_{x \rightarrow -\infty} \left(\frac{5 + 5x + 9x^2}{-7 - 2x + 9x^2} \right)^{-7+7x}$

- 1) 1
- 2) 0
- 3) $\frac{1}{e^5}$
- 4) $e^{49/9}$
- 5) $-\infty$
- 6) $\frac{1}{e^4}$
- 7) ∞

Exercise 9

A factory produces certain type of devices. The marginal cost (cost of producing one unit) decreases when we produce a large amount of units and it is given by the function $C(x) = \frac{7 + x + 8x^2}{5 + 7x + 3x^2 + 7x^3}$. Determine the expected cost per unit when a large amount of units is produced.

- 1) 5000
- 2) $-\infty$
- 3) 0
- 4) ∞
- 5) $-\frac{2}{7}$
- 6) $-\frac{1}{5}$
- 7) $-\frac{1}{4}$

Exercise 10

We deposit 18000 euros in a bank account with a continuous compound rate of 3%. At the same time every year we also add in a safe-deposit box (therefore with no interest rate) 2000 euros. How long time is it necessary until the total ammount of money (jointly in the bank account and safe-depsit box) is 68000 euros? (the solution can be found for t between 14 and 19).

- 1) $t = ** .1****$
- 2) $t = ** .3****$
- 3) $t = ** .5****$
- 4) $t = ** .7****$
- 5) $t = ** .9****$

Exercise 11

Study the continuity of the function $f(x) = \begin{cases} \sin(1-x) & x \leq 1 \\ 0 & 1 < x < 2 \\ -2 \cos(2-x) & 2 \leq x \end{cases}$

- 1) The functions is continuous for all points.
- 2) The functions is not continuous at any point.
- 3) The function is continuous for all the points except for $x=1$.
- 4) The function is continuous for all the points except for $x=2$.
- 5) The function is continuous for all the points except for $x=1$ and $x=2$.

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01-Functions for serial number: 80

Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a periodic compound interest rate of 5% in 4 periods (compounding frequency) and in the bank B we are paid a periodic compound interest rate of 10% in 12 periods (compounding frequency). We initially deposit 12000 euros in the bank A and 6000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **0.***** years.
- 2) In **7.***** years.
- 3) In **5.***** years.
- 4) In **3.***** years.
- 5) In **1.***** years.

Exercise 2

Certain parcel of land is revalued from an initial value of 322000 euros until a final value of 431000 euros along 8 years. Determine the rate of compound interest for that revaluation.

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) The interest rate is **3.***** %.
- 2) The interest rate is **7.***** %.
- 3) The interest rate is **6.***** %.
- 4) The interest rate is **4.***** %.
- 5) The interest rate is **2.***** %.

Exercise 3

We have a bank account that initially offers a periodic compound interest rate of 10% in 9 periods (compounding frequency), and after 3 years the conditions are modified and then we obtain a periodic compound interest rate of 3% in 10 periods (compounding frequency). The initial deposit is 12000 euros. Compute the amount of money in the account after 4 years from the moment of the first deposit.

- 1) We will have ****5.***** euros.
- 2) We will have ****3.***** euros.
- 3) We will have ****4.***** euros.
- 4) We will have ****2.***** euros.
- 5) We will have ****0.***** euros.

Exercise 4

A firm sells Q tons of certain product. The price received per ton is given by the formula $P=3000-14Q$. On the other hand, the production cost per ton is $C=1000+11Q$. In addition, the transportation cost is 1650 per ton. Compute the maximum profit that can be obtained selling this product.

- 1) Profit = 655 .
- 2) Profit = 730 .
- 3) Profit = 1182 .
- 4) Profit = 635 .
- 5) Profit = 1225 .

Exercise 5

Deposits in certain investment account vary from year to year alternating gains and losses periods. We have the following data about the deposits for different years:

year	deposits
0	134
2	78
3	56

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t . Employ that function to determine the minimum funds available in the investment account .

- 1) The minimum for the depositis in the account was 10 .
- 2) The minimum for the depositis in the account was 14 .
- 3) The minimum for the depositis in the account was 13 .
- 4) The minimum for the depositis in the account was 8 .
- 5) The minimum for the depositis in the account was 6 .

Exercise 6

The funds of a public institution alternate periods of deficit and surplus.

We have the following information for several years (in millions of euros):

year	funds
2	101
5	164
9	164

Employ an interpolation polynomial to build a function that

yields the funds for each year t . We know that due to the legislation the funds of such an institution have to be kept between 101 and 173

- . Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from $t=2$ to $t=9$).

- 1) The funds are inside the limits for the interval: $[0, 12]$.
- 2) The funds are inside the limits for the interval: $[6, 9]$.
- 3) The funds are inside the limits for the interval: $[9, 12]$.
- 4) The funds are inside the limits for the interval: $[0, 6]$.
- 5) The funds are inside the limits for the intervals: $[2, 6]$ y $[8, 9]$.
- 6) The funds are inside the limits for the interval: $[6, 12]$.
- 7) The funds are inside the limits for the interval: $[2, 6]$.
- 8) The funds are inside the limits for the intervals: $[0, 2]$ y $[8, 12]$.

Exercise 7

The population of a city is studied between years $t=3$ and $t=10$. In that period the population is given by the function $P(t) = 7 + 540t - 84t^2 + 4t^3$

- . Determine the intervals of years when the population is between 1043 and 1087.

- 1) Along the interval of years: $[3.58456, 10.0775]$.
- 2) Along the interval of years: $[6.64665, 9.48682]$.
- 3) Along the interval of years: $[7., 8.56467]$.
- 4) Along the intervals of years: $[3.38746, 6.]$ and $[7.68255, 8.67226]$.
- 5) Along the intervals of years: $[3.5359, 4.1459]$ and $[6, 7]$.
- 6) Along the intervals of years: $[3, 3.5359]$, $[4.1459, 6]$ and $[7, 10]$.
- 7) Along the interval of years: $[5.76587, 9.02724]$.
- 8) Along the intervals of years: $[5., 6.78421]$ and $[8.60351, 10.]$.

Exercise 8

Compute the limit: $\lim_{x \rightarrow \infty} \left(\frac{-6 - 7x - 3x^2 + 4x^3}{4 - 4x + 6x^2 + 4x^3} \right)^{4+5x}$

- 1) $-\infty$
- 2) 1
- 3) $\frac{1}{e^4}$
- 4) $\frac{1}{e^{45/4}}$
- 5) ∞
- 6) $\frac{1}{e^5}$
- 7) 0

Exercise 9

From an initial deposit 13000, the interest rate varies every year in such a way that the total amount of money in the account is given by the function $C(t) =$

$$13000 \left(\frac{2 + 7t + 8t^2}{-3 + 4t + 8t^2} \right)^{-6+t+9t^2}. \text{ Determine the future tendency for the}$$

deposits that we will have after a large number of years.

- 1) $\frac{13000}{e^3}$
- 2) $\frac{13000}{e^4}$
- 3) ∞
- 4) 13000
- 5) $\frac{13000}{e^5}$
- 6) 0
- 7) $-\infty$

Exercise 10

The population in certain turistic area

increases exponentially and is given by the function $P(t) = 97\,000 e^{t/100}$ that indicates the number of resident citizens for every year t . At the same time, depending on the season, the city receives a variable number of

tourists given by the trigonometric function $I(t) = 3000 + 1000 \sin\left[\frac{t}{2\pi}\right]$

that yields the amount of visitors in the area for every moment t (t in years).

Determine how many years are necessary until the total number of habitants is 147000. (the solution can be found for t between 36 and 41).

- 1) $t = **.*1****$
- 2) $t = **.*3****$
- 3) $t = **.*5****$
- 4) $t = **.*7****$
- 5) $t = **.*9****$

Exercise 11

Study the continuity of the function $f(x) = \begin{cases} -e^{x-3} - 2 \sin(3-x) & x \leq 3 \\ \frac{2x}{3} - 3 & 3 < x < 6 \\ e^{x-6} - 3 \sin(6-x) & 6 \leq x \end{cases}$

- 1) The functions is continuous for all points.
- 2) The functions is not continuous at any point.
- 3) The function is continuous for all the points except for $x=3$.
- 4) The function is continuous for all the points except for $x=6$.
- 5) The function is continuous for all the points except for $x=3$ and $x=6$.

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01-Functions for serial number: 81

Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a continuous compound rate of 4% and in the bank B we are paid a periodic compound interest rate of 10% in 3 periods (compounding frequency). We initially deposit 5000 euros in the bank A and 1000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **7.***** years.
- 2) In **8.***** years.
- 3) In **2.***** years.
- 4) In **0.***** years.
- 5) In **5.***** years.

Exercise 2

We have one bank account that offers a compound interest rate of 5% where we initially deposit 5000 euros. How long time is it necessary until the amount of money in the account reaches 11000 euros?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **0.***** years.
- 2) In **8.***** years.
- 3) In **6.***** years.
- 4) In **2.***** years.
- 5) In **1.***** years.

Exercise 3

We have a bank account that initially offers a compound interest rate of 8%, and after 3 years the conditions are modified and then we obtain a periodic compound interest rate of 3% in 12 periods (compounding frequency). The initial deposit is 5000 euros. Compute the amount of money in the account after 3 years from the moment of the first deposit.

- 1) We will have ****1.***** euros.
- 2) We will have ****8.***** euros.
- 3) We will have ****0.***** euros.
- 4) We will have ****2.***** euros.
- 5) We will have ****5.***** euros.

Exercise 4

A firm sells Q tons of certain product. The price received per ton is given by the formula $P=30000-2Q$. On the other hand, the production cost per ton is $C=20000+19Q$. In addition, the transportation cost is 8866 per ton. Compute the maximum profit that can be obtained selling this product.

- 1) Profit = 7970 .
- 2) Profit = 15309 .
- 3) Profit = 22167 .
- 4) Profit = 7158 .
- 5) Profit = 7445 .

Exercise 5

Deposits in certain investment account vary from year to year alternating gains and losses periods. We have the following data about the deposits for different years:

year	deposits
2	-3
3	-6
5	-12

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t . Employ that function to forecast the exact amount for year 6 .

- 1) The depositis in the account for year 6 are -4 .
- 2) The depositis in the account for year 6 are -15 .
- 3) The depositis in the account for year 6 are -19 .
- 4) The depositis in the account for year 6 are -18 .
- 5) The depositis in the account for year 6 are 6 .

Exercise 6

The funds of a public institution alternate periods of deficit and surplus.

We have the following information for several years (in millions of euros):

year	funds
0	23
2	23
5	53

Employ an interpolation polynomial to build a function that

yields the funds for each year t . We know that due to the legislation the funds of such an institution have to be kept between 23 and 39

- . Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from $t=0$ to $t=5$).

- 1) The funds are inside the limits for the intervals: $[0, 0]$ y $[2, 4]$.
- 2) The funds are inside the limits for the intervals: $[-2, 0]$ y $[4, 5]$.
- 3) The funds are inside the limits for the interval: $[2, 5]$.
- 4) The funds are inside the limits for the interval: $[-2, 0]$.
- 5) The funds are inside the limits for the interval: $[0, 2]$.
- 6) The funds are inside the limits for the interval: $[-2, 6]$.
- 7) The funds are inside the limits for the interval: $[-2, 2]$.
- 8) The funds are inside the limits for the interval: $[-2, 5]$.

Exercise 7

The deposits in certain account between the

months $t=0$ and $t=7$ is given by the function $C(t) = 4 + 48t - 30t^2 + 4t^3$

- . Determine the months for which the deposit is between -14 and 12 euros.

- 1) Along the intervals of months: $[0.520999, 1.]$ and $[3.43304, 4.5062]$.
- 2) Along the interval of months: $[0.262832, 2.32546]$.
- 3) Along the interval of months: $[4., 5.00159]$.
- 4) Along the intervals of months: $[0, 0.188262]$, $[2, 3]$ and $[4.81174, 5.31174]$.
- 5) Along the intervals of months: $[0, 0]$, $[0.188262, 2]$, $[3, 4.81174]$ and $[5.31174, 7]$.
- 6) Along the interval of months: $[-4.45015 \times 10^{-308}, 5.62202]$.
- 7) Along the interval of months: $[2.70755, 6.]$.
- 8) Along the intervals of months: $[0.323741, 5.79334]$ and $[6.66089, 7.]$.

Exercise 8

Compute the limit: $\lim_{x \rightarrow -\infty} \left(\frac{1 - 3x - 2x^2 - 8x^3}{6 - x - 5x^2 - 8x^3} \right)^{-6+3x}$

- 1) ∞
- 2) 0
- 3) $-\infty$
- 4) $\frac{1}{e^{9/8}}$
- 5) $\frac{1}{e^4}$
- 6) 1
- 7) $\frac{1}{e^3}$

Exercise 9

The population of certain country (in millions of habitants) is given by the function $P(t) =$

$20 \left(\frac{1 - 3t - 2t^2 - 2t^3}{6 - t - 5t^2 - 2t^3} \right)^{-6+3t}$. Determine the future tendency for this population.

- 1) 20
- 2) $\frac{20}{e^{9/2}}$
- 3) ∞
- 4) 0
- 5) $\frac{20}{e^5}$
- 6) $\frac{20}{e^{2251/500}}$
- 7) $-\infty$

Exercise 10

We deposit 2000 euros in a bank account with a compound interest rate of 9%. At the same time every year we also add in a safe-deposit box (therefore with no interest rate) 3000 euros. How long time is it necessary until the total amount of money (jointly in the bank account and safe-deposit box) is 51000 euros? (the solution can be found for t between 11 and 16).

- 1) $t = \dots 0 \dots$
- 2) $t = \dots 2 \dots$
- 3) $t = \dots 4 \dots$
- 4) $t = \dots 6 \dots$
- 5) $t = \dots 8 \dots$

Exercise 11

Study the continuity of the function $f(x) = \begin{cases} 3 \sin(x+3) + \cos(x+3) & x \leq -3 \\ -x - 2 & -3 < x < -2 \\ e^{x+2} - 2 \sin(x+2) & -2 \leq x \end{cases}$

- 1) The functions is continuous for all points.
- 2) The functions is not continuous at any point.
- 3) The function is continuous for all the points except for $x = -3$.
- 4) The function is continuous for all the points except for $x = -2$.
- 5) The function is continuous for all the points except for $x = -3$ and $x = -2$.

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01-Functions for serial number: 82

Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a periodic compound interest rate of 10% in 10 periods (compounding frequency) and in the bank B we are paid a compound interest rate of 1% . We initially deposit 1000 euros in the bank A and 7000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **4.***** years.
- 2) In **2.***** years.
- 3) In **9.***** years.
- 4) In **1.***** years.
- 5) In **0.***** years.

Exercise 2

Certain parcel of land is devalued from an initial value of 359000 euros until a final value of 104000 euros along 5 years. Determine the rate of periodic compound interest in 9 periods for that devaluation.

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) The interest rate is **4.***** %.
- 2) The interest rate is **2.***** %.
- 3) The interest rate is **8.***** %.
- 4) The interest rate is **9.***** %.
- 5) The interest rate is **5.***** %.

Exercise 3

We have a bank account that initially offers a periodic compound interest rate of 1% in 10 periods (compounding frequency) , and after 2 years the conditions are modified and then we obtain a periodic compound interest rate of 9% in 3 periods (compounding frequency) . The initial deposit is 7000 euros. Compute the amount of money in the account after 8 years from the moment of the first deposit.

- 1) We will have ****7.***** euros.
- 2) We will have ****8.***** euros.
- 3) We will have ****6.***** euros.
- 4) We will have ****2.***** euros.
- 5) We will have ****1.***** euros.

Exercise 4

A firm sells Q tons of certain product. The price received per ton is given by the formula $P=900-14Q$. On the other hand, the production cost per ton is $C=500-13Q$. In addition, the transportation cost is 350 per ton. Compute the maximum profit that can be obtained selling this product.

- 1) Profit = 625 .
- 2) Profit = 1008 .
- 3) Profit = 215 .
- 4) Profit = 400 .
- 5) Profit = 699 .

Exercise 5

Deposits in certain investment account vary from year to year alternating gains and losses periods. We have the following data about the deposits for different years:

year	deposits
0	76
1	54
2	36

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t . Employ that function to determine the minimum funds available in the investment account .

- 1) The minimum for the depositis in the account was 4 .
- 2) The minimum for the depositis in the account was 12 .
- 3) The minimum for the depositis in the account was 6 .
- 4) The minimum for the depositis in the account was 17 .
- 5) The minimum for the depositis in the account was 16 .

Exercise 6

The funds of a public institution alternate periods of deficit and surplus.

We have the following information for several years (in millions of euros):

year	funds
2	4
6	56
8	106

Employ an interpolation polynomial to build a function that

yields the funds for each year t . We know that due to the legislation the funds of such an institution have to be kept between 56 and 79

- . Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from $t=2$ to $t=8$).

- 1) The funds are inside the limits for the interval: $[-\frac{11}{2}, 8]$.
- 2) The funds are inside the limits for the interval: $[0, 6]$.
- 3) The funds are inside the limits for the interval: $[6, 8]$.
- 4) The funds are inside the limits for the interval: $[-\frac{11}{2}, 0]$.
- 5) The funds are inside the limits for the interval: $[-\frac{11}{2}, -\frac{9}{2}]$.
- 6) The funds are inside the limits for the intervals: $[-\frac{11}{2}, -\frac{9}{2}]$ y $[7, 8]$.
- 7) The funds are inside the limits for the interval: $[6, 7]$.
- 8) The funds are inside the limits for the interval: $[-\frac{11}{2}, 6]$.

Exercise 7

The population of certain type of rodents is analyzed in a region between years $t=2$ and $t=10$. Along that period the population is given by the function $P(t) = 2 + 864t - 102t^2 + 4t^3$ (thousands of rodents). Determine the intervals of years during which the number of rodents is between 768 and 1784.

- 1) Along the intervals of years: $[4.40084, 5.]$ and $[6., 8.34151]$.
- 2) Along the interval of years: $[6.49725, 9.]$.
- 3) Along the interval of years: $[2, 3]$.
- 4) Along the intervals of years: $[2., 4.]$ and $[6.11583, 10.7094]$.
- 5) Along the interval of years: $[3., 9.]$.
- 6) Along the interval of years: $[4.75091, 10.004]$.
- 7) Along the intervals of years: $[2, 2]$ and $[3, 10]$.
- 8) Along the intervals of years: $[2.02043, 4.]$ and $[6., 8.]$.

Exercise 8

Compute the limit: $\lim_{x \rightarrow \infty} \left(\frac{-3 + 3x - 2x^2}{7 - 9x - 2x^2} \right)^{-5+2x}$

- 1) ∞
- 2) $\frac{1}{e^5}$
- 3) 0
- 4) $\frac{1}{e^{12}}$
- 5) $\frac{1}{e^4}$
- 6) $-\infty$
- 7) 1

Exercise 9

From an initial deposit 13000, the interest rate varies every year in such a way that the total amount of money in the account is given by the function $C(t) =$

$13000 \left(\frac{1 + 3t + 9t^2}{3 + 7t + 9t^2} \right)^{-2-2t+4t^2}$. Determine the future tendency for the

deposits that we will have after a large number of years.

- 1) $\frac{13000}{e^4}$
- 2) 0
- 3) $\frac{13000}{e^3}$
- 4) $-\infty$
- 5) 13000
- 6) $\frac{13000}{e^5}$
- 7) ∞

Exercise 10

The population in certain turistic area

increases exponentially and is given by the function $P(t) = 86\,000 e^{t/100}$ that indicates the number of resident citizens for every year t . At the same time, depending on the season, the city receives a variable number of

tourists given by the trigonometric function $I(t) = 2000 + 1000 \sin\left[\frac{t}{2\pi}\right]$

that yields the amount of visitors in the area for every moment t (t in years).

Determine how many years are necessary until the total number of habitants is 120000. (the solution can be found for t between 31 and 36).

- 1) $t = **.*$
- 2) $t = **.*$
- 3) $t = **.*$
- 4) $t = **.*$
- 5) $t = **.*$

Exercise 11

Study the continuity of the function $f(x) = \begin{cases} 2e^{x-3} - 2\sin(3-x) & x \leq 3 \\ 2 & 3 < x < 4 \\ -3\log(x-3) - 2 & 4 \leq x \end{cases}$

- 1) The functions is continuous for all points.
- 2) The functions is not continuous at any point.
- 3) The function is continuous for all the points except for $x=3$.
- 4) The function is continuous for all the points except for $x=4$.
- 5) The function is continuous for all the points except for $x=3$ and $x=4$.

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01-Functions for serial number: 83

Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a continuous compound rate of 10% and in the bank B we are paid a periodic compound interest rate of 4% in 8 periods (compounding frequency). We initially deposit 1000 euros in the bank A and 8000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **0.***** years.
- 2) In **4.***** years.
- 3) In **3.***** years.
- 4) In **1.***** years.
- 5) In **2.***** years.

Exercise 2

Certain parcel of land is devalued from an initial value of 305000 euros until a final value of 200000 euros along 9 years. Determine the rate of periodic compound interest in 11 periods for that devaluation.

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) The interest rate is **0.***** %.
- 2) The interest rate is **4.***** %.
- 3) The interest rate is **2.***** %.
- 4) The interest rate is **6.***** %.
- 5) The interest rate is **7.***** %.

Exercise 3

We have a bank account that initially offers a periodic compound interest rate of 7% in 7 periods (compounding frequency), and after 1 year the conditions are modified and then we obtain a periodic compound interest rate of 6% in 2 periods (compounding frequency). The initial deposit is 8000 euros. Compute the amount of money in the account after 8 years from the moment of the first deposit.

- 1) We will have ****6.***** euros.
- 2) We will have ****3.***** euros.
- 3) We will have ****0.***** euros.
- 4) We will have ****1.***** euros.
- 5) We will have ****2.***** euros.

Exercise 4

A firm sells Q tons of certain product. The price received per ton is given by the formula $P=130000-15Q$. On the other hand, the production cost per ton is $C=70000+Q$. In addition, the transportation cost is 58528 per ton. Compute the maximum profit that can be obtained selling this product.

- 1) Profit = 54441 .
- 2) Profit = 33856 .
- 3) Profit = 47720 .
- 4) Profit = 49154 .
- 5) Profit = 43479 .

Exercise 5

Deposits in certain investment account vary from year to year alternating gains and losses periods. We have the following data about the deposits for different years:

year	deposits
0	6
2	42
4	70

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t . Employ that function to determine the maximum funds available in the investment account .

- 1) The maximum for the depositis in the account was 106 .
- 2) The maximum for the depositis in the account was 97 .
- 3) The maximum for the depositis in the account was 10 .
- 4) The maximum for the depositis in the account was -2 .
- 5) The maximum for the depositis in the account was -4 .

Exercise 6

The funds of a public institution alternate periods of deficit and surplus.

We have the following information for several years (in millions of euros):

year	funds
2	14
4	42
7	114

Employ an interpolation polynomial to build a function that

yields the funds for each year t . We know that due to the legislation the funds of such an institution have to be kept between 14 and 62

- . Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from $t=2$ to $t=7$).

- 1) The funds are inside the limits for the interval: $[0, 2]$.
- 2) The funds are inside the limits for the interval: $[-6, 7]$.
- 3) The funds are inside the limits for the interval: $[-6, -3]$.
- 4) The funds are inside the limits for the interval: $[-6, 2]$.
- 5) The funds are inside the limits for the interval: $[2, 7]$.
- 6) The funds are inside the limits for the interval: $[-6, 0]$.
- 7) The funds are inside the limits for the intervals: $[-6, -3]$ y $[5, 7]$.
- 8) The funds are inside the limits for the interval: $[2, 5]$.

Exercise 7

The population of certain type of rodents is analyzed in a region between years $t=4$ and $t=10$. Along that period the population is given by the function $P(t) = 6 + 648t - 90t^2 + 4t^3$ (thousands of rodents). Determine the intervals of years during which the number of rodents is between 1478 and 1504.

- 1) Along the interval of years: $[5.4047, 7.79368]$.
- 2) Along the intervals of years: $[5., 6.]$ and $[9.00538, 10.4324]$.
- 3) Along the interval of years: $[4.45308, 7.]$.
- 4) Along the intervals of years: $[4.68826, 5.18826]$, $[7, 8]$ and $[9.81174, 10]$.
- 5) Along the intervals of years: $[4.54772, 5.16702]$ and $[8.15856, 10.]$.
- 6) Along the intervals of years: $[4.13942, 5.57244]$ and $[9.03744, 10.526]$.
- 7) Along the intervals of years: $[5., 6.25702]$ and $[8.30046, 9.]$.
- 8) Along the intervals of years: $[4, 4.68826]$, $[5.18826, 7]$, $[8, 9.81174]$ and $[10, 10]$.

Exercise 8

Compute the limit: $\lim_{x \rightarrow -\infty} \left(\frac{-5 + 9x - 9x^2}{5 - 3x - 9x^2} \right)^{-8+7x+9x^2}$

- 1) $\frac{1}{e^3}$
- 2) $\frac{1}{e^2}$
- 3) 0
- 4) 1
- 5) $-\infty$
- 6) ∞
- 7) $\frac{1}{e^4}$

Exercise 9

From an initial deposit 20000, the interest rate varies every year in such a way that the total amount of money in the account is given by the function $C(t) =$

$$20000 \left(\frac{-5 + 9t - 9t^2}{5 - 3t - 9t^2} \right)^{-8+7t+9t^2}. \text{ Determine the future tendency for the}$$

deposits that we will have after a large number of years.

- 1) $\frac{20000}{e^3}$
- 2) $\frac{20000}{e^2}$
- 3) 20000
- 4) $-\infty$
- 5) ∞
- 6) 0
- 7) $\frac{20000}{e^4}$

Exercise 10

The population in certain turistic area

increases exponentially and is given by the function $P(t) = 75\,000 e^{t/50}$ that indicates the number of resident citizens for every year t . At the same time, depending on the season, the city receives a variable number of

tourists given by the trigonometric function $I(t) = 3000 + 2000 \sin\left[\frac{t}{2\pi}\right]$

that yields the amount of visitors in the area for every moment t (t in years).

Determine how many years are necessary until the total number of habitants is 105000. (the solution can be found for t between 12 and 17).

- 1) $t = \dots 0 \dots$
- 2) $t = \dots 2 \dots$
- 3) $t = \dots 4 \dots$
- 4) $t = \dots 6 \dots$
- 5) $t = \dots 8 \dots$

Exercise 11

Study the continuity of the function $f(x) = \begin{cases} 2e^x - 2\sin(x) & x \leq 0 \\ 0 & 0 < x < 2 \\ -2\sin(2-x) & 2 \leq x \end{cases}$

- 1) The functions is continuous for all points.
- 2) The functions is not continuous at any point.
- 3) The function is continuous for all the points except for $x=0$.
- 4) The function is continuous for all the points except for $x=2$.
- 5) The function is continuous for all the points except for $x=0$ and $x=2$.

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01-Functions for serial number: 84

Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a compound interest rate of 4% and in the bank B we are paid a compound interest rate of 8%. We initially deposit 6000 euros in the bank A and 1000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **1.***** years.
- 2) In **7.***** years.
- 3) In **8.***** years.
- 4) In **6.***** years.
- 5) In **0.***** years.

Exercise 2

We have one bank account that offers a compound interest rate of 4% where we initially deposit 7000 euros. How long time is it necessary until the amount of money in the account reaches 13000 euros?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **1.***** years.
- 2) In **5.***** years.
- 3) In **7.***** years.
- 4) In **6.***** years.
- 5) In **0.***** years.

Exercise 3

We have a bank account that initially offers a periodic compound interest rate of 7% in 9 periods (compounding frequency), and after 3 years the conditions are modified and then we obtain a periodic compound interest rate of 1% in 7 periods (compounding frequency). The initial deposit is 6000 euros. Compute the amount of money in the account after 4 years from the moment of the first deposit.

- 1) We will have ****1.***** euros.
- 2) We will have ****0.***** euros.
- 3) We will have ****7.***** euros.
- 4) We will have ****6.***** euros.
- 5) We will have ****3.***** euros.

Exercise 4

A firm sells Q tons of certain product. The price received per ton is given by the formula $P=7000-4Q$. On the other hand, the production cost per ton is $C=5000+3Q$. In addition, the transportation cost is 1762 per ton. Compute the maximum profit that can be obtained selling this product.

- 1) Profit = 3201 .
- 2) Profit = 2023 .
- 3) Profit = 630 .
- 4) Profit = 1453 .
- 5) Profit = 1704 .

Exercise 5

Deposits in certain investment account vary from year to year alternating gains and losses periods. We have the following data about the deposits for different years:

year	deposits
2	-4
3	-6
5	-10

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t . Employ that function to forecast the exact amount for year 7 .

- 1) The depositis in the account for year 7 are 19 .
- 2) The depositis in the account for year 7 are -14 .
- 3) The depositis in the account for year 7 are 2 .
- 4) The depositis in the account for year 7 are -16 .
- 5) The depositis in the account for year 7 are -19 .

Exercise 6

The funds of a public institution alternate periods of deficit and surplus.

We have the following information for several years (in millions of euros):

year	funds
0	0
3	21
6	96

Employ an interpolation polynomial to build a function that

yields the funds for each year t . We know that due to the legislation the funds of such an institution have to be kept between 0 and 65

. Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from $t=0$ to $t=6$).

- 1) The funds are inside the limits for the interval: $[-2, 7]$.
- 2) The funds are inside the limits for the interval: $[0, 5]$.
- 3) The funds are inside the limits for the interval: $[0, 6]$.
- 4) The funds are inside the limits for the interval: $[-1, 4]$.
- 5) The funds are inside the limits for the interval: $[6, 6]$.
- 6) The funds are inside the limits for the interval: $[-\frac{13}{3}, 6]$.
- 7) The funds are inside the limits for the interval: $[-2, 5]$.
- 8) The funds are inside the limits for the interval: $[5, 6]$.

Exercise 7

The deposits in certain account between the

months $t=0$ and $t=9$ is given by the function $C(t) = 6 + 96t - 54t^2 + 4t^3$

. Determine the months for which the deposit is between -364 and 14 euros.

- 1) Along the interval of months: $[1., 8.18132]$.
- 2) Along the interval of months: $[2., 7.]$.
- 3) Along the intervals of months: $[0, 0]$, $[0.0876242, 2]$ and $[5, 9]$.
- 4) Along the interval of months: $[-4.45015 \times 10^{-308}, 3.38083]$.
- 5) Along the interval of months: $[3., 7.53338]$.
- 6) Along the interval of months: $[6.72555, 9.14494]$.
- 7) Along the intervals of months: $[0, 0.0876242]$ and $[2, 5]$.
- 8) Along the intervals of months: $[2.66335, 3.12246]$ and $[6., 7.13438]$.

Exercise 8

Compute the limit: $\lim_{x \rightarrow \infty} \left(\frac{-7 - 2x + 7x^2 - 2x^3}{7 + 8x + 3x^2 - 2x^3} \right)^{5+7x}$

- 1) $\frac{1}{e^{14}}$
- 2) $-\infty$
- 3) 1
- 4) $\frac{1}{e^4}$
- 5) $\frac{1}{e^5}$
- 6) ∞
- 7) 0

Exercise 9

The population of certain country (in millions of habitants) is given by the function $P(t) =$

$$40 \left(\frac{-7 - 2t + 7t^2 + 2t^3}{7 + 8t + 3t^2 + 2t^3} \right)^{5+7t}. \text{ Determine the future tendency for this population.}$$

- 1) $40 e^{6999/500}$
- 2) ∞
- 3) 40
- 4) 0
- 5) $\frac{40}{e^5}$
- 6) $-\infty$
- 7) $40 e^{14}$

Exercise 10

We deposit 6000 euros in a bank account with a periodic compound interest rate of 10% in 8 periods (compounding frequency). At the same time every year we also add in a safe-deposit box (therefore with no interest rate) 4000 euros. How long time is it necessary until the total amount of money (jointly in the bank account and safe-deposit box) is 33000 euros? (the solution can be found for t between 3 and 8).

- 1) $t = **.0****$
- 2) $t = **.2****$
- 3) $t = **.4****$
- 4) $t = **.6****$
- 5) $t = **.8****$

Exercise 11

Study the continuity of the function $f(x) = \begin{cases} \cos(x+2) - 2\sin(x+2) & x \leq -2 \\ 2e^{x+2} + \sin(x+2) - 1 & -2 < x < -1 \\ 3\sin(x+1) + \cos(x+1) & -1 \leq x \end{cases}$

- 1) The functions is continuous for all points.
- 2) The functions is not continuous at any point.
- 3) The function is continuous for all the points except for $x = -2$.
- 4) The function is continuous for all the points except for $x = -1$.
- 5) The function is continuous for all the points except for $x = -2$ and $x = -1$.

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01-Functions for serial number: 85

Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a periodic compound interest rate of 5% in 7 periods (compounding frequency) and in the bank B we are paid a periodic compound interest rate of 2% in 3 periods (compounding frequency). We initially deposit 1000 euros in the bank A and 5000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **8.***** years.
- 2) In **3.***** years.
- 3) In **2.***** years.
- 4) In **6.***** years.
- 5) In **0.***** years.

Exercise 2

We have one bank account that offers a continuous compound rate of 3% where we initially deposit 5000 euros. How long time is it necessary until the amount of money in the account reaches 7000 euros?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **8.***** years.
- 2) In **4.***** years.
- 3) In **1.***** years.
- 4) In **0.***** years.
- 5) In **5.***** years.

Exercise 3

We have a bank account that initially offers a compound interest rate of 3%, and after 2 years the conditions are modified and then we obtain a periodic compound interest rate of 4% in 10 periods (compounding frequency). The initial deposit is 5000 euros. Compute the amount of money in the account after 3 years from the moment of the first deposit.

- 1) We will have ****8.***** euros.
- 2) We will have ****9.***** euros.
- 3) We will have ****0.***** euros.
- 4) We will have ****3.***** euros.
- 5) We will have ****5.***** euros.

Exercise 4

A firm sells Q tons of certain product. The price received per ton is given by the formula $P=8000-2Q$. On the other hand, the production cost per ton is $C=5000+12Q$. In addition, the transportation cost is 2496 per ton. Compute the maximum profit that can be obtained selling this product.

- 1) Profit = 2139 .
- 2) Profit = 4363 .
- 3) Profit = 4536 .
- 4) Profit = 5403 .
- 5) Profit = 4596 .

Exercise 5

Deposits in certain investment account vary from year to year alternating gains and losses periods. We have the following data about the deposits for different years:

year	deposits
0	0
2	-14
3	-27

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t . Employ that function to forecast the exact amount for year 4 .

- 1) The depositis in the account for year 4 are -12 .
- 2) The depositis in the account for year 4 are -44 .
- 3) The depositis in the account for year 4 are 2 .
- 4) The depositis in the account for year 4 are 1 .
- 5) The depositis in the account for year 4 are -65 .

Exercise 6

The funds of a public institution alternate periods of deficit and surplus.

We have the following information for several years (in millions of euros):

year	funds
0	1
2	1
4	9

Employ an interpolation polynomial to build a function that

yields the funds for each year t . We know that due to the legislation the funds of such an institution have to be kept between 1 and 4

. Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from $t=0$ to $t=4$).

- 1) The funds are inside the limits for the interval: $[-1, 0]$.
- 2) The funds are inside the limits for the interval: $[-2, 3]$.
- 3) The funds are inside the limits for the interval: $[-1, 4]$.
- 4) The funds are inside the limits for the intervals: $[0, 0]$ y $[2, 3]$.
- 5) The funds are inside the limits for the interval: $[2, 4]$.
- 6) The funds are inside the limits for the interval: $[0, 2]$.
- 7) The funds are inside the limits for the interval: $[-1, 2]$.
- 8) The funds are inside the limits for the intervals: $[-1, 0]$ y $[3, 4]$.

Exercise 7

The population of certain type of rodents is analyzed in a region between years $t=0$ and $t=7$. Along that period the population is given by the function $P(t) = 4 + 72t - 30t^2 + 4t^3$ (thousands of rodents). Determine the intervals of years during which the number of rodents is between -102 and 4.

- 1) Along the interval of years: $[0.755822, 5.46455]$.
- 2) Along the interval of years: $[3.37772, 4.77706]$.
- 3) Along the intervals of years: $[1., 2.]$ and $[5., 6.01052]$.
- 4) Along the interval of years: $[4., 7.51139]$.
- 5) That number of mice is reach for no interval of years.
- 6) Along the interval of years: $[0, 0]$.
- 7) Along the interval of years: $[0, 7]$.
- 8) Along the interval of years: $[3.46644, 6.]$.

Exercise 8

Compute the limit: $\lim_{x \rightarrow \infty} \left(\frac{-3 + 7x + 9x^2}{-5 - 6x + 9x^2} \right)^{3-8x+8x^2}$

1) $-\infty$

2) $\frac{1}{e^5}$

3) $\frac{1}{e^4}$

4) $\frac{1}{e^2}$

5) ∞

6) 1

7) 0

Exercise 9

The population of certain country (in millions of habitants) is given by the function $P(t) =$

$9 \left(\frac{-9 - 7t + 7t^2}{-5 - 6t + 7t^2} \right)^{3-8t+8t^2}$. Determine the future tendency for this population.

1) ∞

2) $\frac{9}{e^5}$

3) $\frac{9}{e^4}$

4) $\frac{9}{e^2}$

5) 0

6) $-\infty$

7) 9

Exercise 10

We deposit 1000 euros in a bank account with a continuous compound rate of 9%. At the same time every year we also add in a safe-deposit box (therefore with no interest rate) 3000 euros. How long time is it necessary until the total ammount of money (jointly in the bank account and safe-depsit box) is 29000 euros? (the solution can be found for t between 4 and 9).

1) $t = \dots 1 \dots$

2) $t = \dots 3 \dots$

3) $t = \dots 5 \dots$

4) $t = \dots 7 \dots$

5) $t = \dots 9 \dots$

Exercise 11

Study the continuity of the function $f(x) = \begin{cases} -3 \sin(x+3) - \cos(x+3) & x \leq -3 \\ 5x + 14 & -3 < x < -2 \\ 2e^{x+2} - \sin(x+2) & -2 \leq x \end{cases}$

- 1) The functions is continuous for all points.
- 2) The functions is not continuous at any point.
- 3) The function is continuous for all the points except for $x = -3$.
- 4) The function is continuous for all the points except for $x = -2$.
- 5) The function is continuous for all the points except for $x = -3$ and $x = -2$.

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01-Functions for serial number: 86

Exercise 1

We have two bank accounts, the first in the

bank A and the second in the bank B. In the bank A we obtain a continuous compound rate of 6% and in the bank B we are paid a continuous compound rate of 2%. We initially deposit 2000 euros in the bank A and 6000

in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **0.***** years.
- 2) In **4.***** years.
- 3) In **6.***** years.
- 4) In **8.***** years.
- 5) In **7.***** years.

Exercise 2

We have one bank account that offers a

continuous compound rate of 4% where we initially deposit 7000

euros. How long time is it necessary until the amount of money in the account reaches 10000 euros?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **4.***** years.
- 2) In **6.***** years.
- 3) In **0.***** years.
- 4) In **8.***** years.
- 5) In **2.***** years.

Exercise 3

We have a bank account that initially offers a compound interest rate of 4%, and after 4 years the conditions are modified and then we obtain a compound interest rate of 4%. The initial deposit is 6000 euros. Compute the amount of money in the account after 7 years from the moment of the first deposit.

- 1) We will have ****4.***** euros.
- 2) We will have ****9.***** euros.
- 3) We will have ****6.***** euros.
- 4) We will have ****5.***** euros.
- 5) We will have ****2.***** euros.

Exercise 4

A firm sells Q tons of certain product. The price received per ton is given by the formula $P=1100-4Q$. On the other hand, the production cost per ton is $C=600+8Q$. In addition, the transportation cost is 428 per ton. Compute the maximum profit that can be obtained selling this product.

- 1) Profit = 57 .
- 2) Profit = 51 .
- 3) Profit = 108 .
- 4) Profit = 149 .
- 5) Profit = 144 .

Exercise 5

Deposits in certain investment account vary from year to year alternating gains and losses periods. We have the following data about the deposits for different years:

year	deposits
1	-2
3	-22
4	-38

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t . Employ that function to forecast the exact amount for year 6 .

- 1) The depositis in the account for year 6 are 2 .
- 2) The depositis in the account for year 6 are -6 .
- 3) The depositis in the account for year 6 are -82 .
- 4) The depositis in the account for year 6 are 4 .
- 5) The depositis in the account for year 6 are -110 .

Exercise 6

The funds of a public institution alternate periods of deficit and surplus.

We have the following information for several years (in millions of euros):

year	funds
0	12
3	3
5	27

Employ an interpolation polynomial to build a function that

yields the funds for each year t . We know that due to the legislation the funds of such an institution have to be kept between 3 and 12

- . Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from $t=0$ to $t=5$).

- 1) The funds are inside the limits for the interval: $[3, 5]$.
- 2) The funds are inside the limits for the intervals: $[0, 1]$ y $[4, 5]$.
- 3) The funds are inside the limits for the interval: $[0, 3]$.
- 4) The funds are inside the limits for the intervals: $[0, 1]$ y $[3, 4]$.
- 5) The funds are inside the limits for the interval: $[-2, 5]$.
- 6) The funds are inside the limits for the interval: $[0, 1]$.
- 7) The funds are inside the limits for the interval: $[0, 0]$.
- 8) The funds are inside the limits for the interval: $[0, 5]$.

Exercise 7

The population of a city is studied between years $t=0$ and $t=9$. In that period the population is given by the function $P(t) = 6 + 420t - 72t^2 + 4t^3$

- . Determine the intervals of years when the population is between 358 and 870.

- 1) Along the interval of years: $[0.514746, 3.]$.
- 2) Along the interval of years: $[1, 9]$.
- 3) Along the intervals of years: $[0, 1]$ and $[9, 9]$.
- 4) Along the intervals of years: $[3., 4.]$ and $[5.73025, 9.]$.
- 5) Along the intervals of years: $[-4.45015 \times 10^{-308}, 2.24446]$ and $[7., 8.70521]$.
- 6) Along the interval of years: $[1., 3.]$.
- 7) Along the intervals of years: $[1.67158, 5.]$ and $[7.35989, 9.]$.
- 8) Along the intervals of years: $[1., 3.25232]$ and $[6.79176, 9.7472]$.

Exercise 8

Compute the limit: $\lim_{x \rightarrow -\infty} \left(\frac{-6 - 9x + x^2 + 4x^3}{-9 + 2x - 9x^2 + 4x^3} \right)^{7+2x}$

- 1) ∞
- 2) $-\infty$
- 3) e^5
- 4) $\frac{1}{e^3}$
- 5) $\frac{1}{e}$
- 6) 0
- 7) 1

Exercise 9

The population of certain country (in millions of habitants) is given by the function $P(t) =$

$31 \left(\frac{-6 - 9t + t^2 - 5t^3}{-9 + 2t - 9t^2 - 5t^3} \right)^{7+2t}$. Determine the future tendency for this population.

- 1) $\frac{31}{e}$
- 2) 0
- 3) $\frac{31}{e^3}$
- 4) ∞
- 5) 31
- 6) $-\infty$
- 7) $\frac{31}{e^4}$

Exercise 10

We deposit 5000 euros in a bank account with a periodic compound interest rate of 5% in 9 periods (compounding frequency). At the same time every year we also add in a safe-deposit box (therefore with no interest rate) 2000 euros. How long time is it necessary until the total amount of money (jointly in the bank account and safe-deposit box) is 36000 euros? (the solution can be found for t between 9 and 14).

- 1) $t = ** .1****$
- 2) $t = ** .3****$
- 3) $t = ** .5****$
- 4) $t = ** .7****$
- 5) $t = ** .9****$

Exercise 11

Study the continuity of the function $f(x) = \begin{cases} \sin(x+2) - \cos(x+2) & x \leq -2 \\ -\sin(x+2) + \cos(x+2) + \sin(2) - \cos(2) & -2 < x < 0 \\ -3 \sin(x) & 0 \leq x \end{cases}$

- 1) The functions is continuous for all points.
- 2) The functions is not continuous at any point.
- 3) The function is continuous for all the points except for $x = -2$.
- 4) The function is continuous for all the points except for $x = 0$.
- 5) The function is continuous for all the points except for $x = -2$ and $x = 0$.

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01-Functions for serial number: 87

Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a compound interest rate of 4% and in the bank B we are paid a periodic compound interest rate of 8% in 2 periods (compounding frequency). We initially deposit 10000 euros in the bank A and 4000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **3.***** years.
- 2) In **4.***** years.
- 3) In **0.***** years.
- 4) In **9.***** years.
- 5) In **5.***** years.

Exercise 2

We have one bank account that offers a continuous compound rate of 5% where we initially deposit 15000 euros. How long time is it necessary until the amount of money in the account reaches 23000 euros?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **8.***** years.
- 2) In **4.***** years.
- 3) In **0.***** years.
- 4) In **9.***** years.
- 5) In **5.***** years.

Exercise 3

We have a bank account that initially offers a continuous compound rate of 8%, and after 2 years the conditions are modified and then we obtain a compound interest rate of 7%. The initial deposit is 10000 euros. Compute the amount of money in the account after 4 years from the moment of the first deposit.

- 1) We will have ****2.***** euros.
- 2) We will have ****9.***** euros.
- 3) We will have ****1.***** euros.
- 4) We will have ****5.***** euros.
- 5) We will have ****0.***** euros.

Exercise 4

A firm sells Q tons of certain product. The price received per ton is given by the formula $P=400-12Q$. On the other hand, the production cost per ton is $C=100-11Q$. In addition, the transportation cost is 246 per ton. Compute the maximum profit that can be obtained selling this product.

- 1) Profit = 729 .
- 2) Profit = 601 .
- 3) Profit = 976 .
- 4) Profit = 511 .
- 5) Profit = 219 .

Exercise 5

Deposits in certain investment account vary from year to year alternating gains and losses periods. We have the following data about the deposits for different years:

year	deposits
0	3
2	7
4	11

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t . Employ that function to forecast the exact amount for year 5 .

- 1) The depositis in the account for year 5 are 11 .
- 2) The depositis in the account for year 5 are 13 .
- 3) The depositis in the account for year 5 are -11 .
- 4) The depositis in the account for year 5 are 1 .
- 5) The depositis in the account for year 5 are 15 .

Exercise 6

The funds of a public institution alternate periods of deficit and surplus.

We have the following information for several years (in millions of euros):

year	funds
1	10
4	-11
7	-14

Employ an interpolation polynomial to build a function that

yields the funds for each year t . We know that due to the legislation the funds of such an institution have to be kept between -33 and -6

- . Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from $t=1$ to $t=7$).

- 1) The funds are inside the limits for the interval: $[0, 3]$.
- 2) The funds are inside the limits for the interval: $[7, 7]$.
- 3) The funds are inside the limits for the interval: $[0, 7]$.
- 4) The funds are inside the limits for the interval: $[-2, 8]$.
- 5) The funds are inside the limits for the interval: $[7, 9]$.
- 6) The funds are inside the limits for the interval: $[0, 9]$.
- 7) The funds are inside the limits for the interval: $[3, 7]$.
- 8) The funds are inside the limits for the interval: $[-2, 3]$.

Exercise 7

The population of a city is studied between years $t=2$ and $t=9$. In that period the population is given by the function $P(t) = 3 + 144t - 42t^2 + 4t^3$

- . Determine the intervals of years when the population is between 165 and 173.

- 1) Along the interval of years: $[4.5, 5]$.
- 2) Along the intervals of years: $[4.18514, 5.28776]$ and $[6.08238, 7.]$.
- 3) Along the intervals of years: $[2, 4.5]$ and $[5, 9]$.
- 4) Along the intervals of years: $[4., 6.07647]$ and $[7.71817, 8.]$.
- 5) Along the interval of years: $[2., 5.]$.
- 6) Along the intervals of years: $[3, 3]$ and $[4.5, 5]$.
- 7) Along the intervals of years: $[2., 4.70133]$ and $[8., 9.68937]$.
- 8) Along the interval of years: $[5.37554, 8.]$.

Exercise 8

Compute the limit: $\lim_{x \rightarrow -\infty} \left(\frac{6 + 5x - 8x^2 - 3x^3}{9 + 3x + 2x^2 - 3x^3} \right)^{8+7x+2x^2}$

- 1) e
- 2) $-\infty$
- 3) 0
- 4) 1
- 5) $\frac{1}{e^5}$
- 6) ∞
- 7) e^2

Exercise 9

A factory produces certain type of devices. The marginal cost (cost of producing one unit) decreases when we produce a large amount

of units and it is given by the function $C(x) = \frac{1 + 6x + 6x^2}{1 + 8x + 7x^2 + 2x^3 + 3x^4}$

. Determine the expected cost per unit when a large amount of units is produced.

- 1) -1
- 2) 20000
- 3) 0
- 4) $-\frac{3}{2}$
- 5) ∞
- 6) $-\frac{2}{3}$
- 7) $-\infty$

Exercise 10

We deposit 6000 euros in a bank account with a continuous compound rate of 10%. At the same time every year we also add in a safe-deposit box (therefore with no interest rate) 4000 euros. How long time is it necessary until the total ammount of money (jointly in the bank account and safe-depsit box) is 56000 euros? (the solution can be found for t between 9 and 14).

- 1) $t = ** .1****$
- 2) $t = ** .3****$
- 3) $t = ** .5****$
- 4) $t = ** .7****$
- 5) $t = ** .9****$

Exercise 11

Study the continuity of the function $f(x) = \begin{cases} \cos(2-x) - 3 \sin(2-x) & x \leq 2 \\ 1 - \log(x-1) & 2 < x < 5 \\ -\sin(5-x) & 5 \leq x \end{cases}$

- 1) The functions is continuous for all points.
- 2) The functions is not continuous at any point.
- 3) The function is continuous for all the points except for $x=2$.
- 4) The function is continuous for all the points except for $x=5$.
- 5) The function is continuous for all the points except for $x=2$ and $x=5$.

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01-Functions for serial number: 88

Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a periodic compound interest rate of 3% in 4 periods (compounding frequency) and in the bank B we are paid a continuous compound rate of 9%. We initially deposit 13000 euros in the bank A and 7000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **8.***** years.
- 2) In **9.***** years.
- 3) In **7.***** years.
- 4) In **0.***** years.
- 5) In **1.***** years.

Exercise 2

Certain parcel of land is devalued from an initial value of 453000 euros until a final value of 343000 euros along 6 years. Determine the rate of continuous compound interest for that devaluation.

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) The interest rate is **4.***** %.
- 2) The interest rate is **1.***** %.
- 3) The interest rate is **3.***** %.
- 4) The interest rate is **0.***** %.
- 5) The interest rate is **5.***** %.

Exercise 3

We have a bank account that initially offers a periodic compound interest rate of 5% in 9 periods (compounding frequency), and after 2 years the conditions are modified and then we obtain a compound interest rate of 5%. The initial deposit is 13000 euros. Compute the amount of money in the account after 7 years from the moment of the first deposit.

- 1) We will have ****1.***** euros.
- 2) We will have ****7.***** euros.
- 3) We will have ****8.***** euros.
- 4) We will have ****0.***** euros.
- 5) We will have ****9.***** euros.

Exercise 4

A firm sells Q tons of certain product. The price received per ton is given by the formula $P=150000-3Q$. On the other hand, the production cost per ton is $C=30000+14Q$. In addition, the transportation cost is 118402 per ton. Compute the maximum profit that can be obtained selling this product.

- 1) Profit = 61807 .
- 2) Profit = 19779 .
- 3) Profit = 37553 .
- 4) Profit = 45840 .
- 5) Profit = 43084 .

Exercise 5

Deposits in certain investment account vary from year to year alternating gains and losses periods. We have the following data about the deposits for different years:

year	deposits
1	141
3	97
4	78

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t . Employ that function to determine the minimum funds available in the investment account .

- 1) The minimum for the depositis in the account was -3 .
- 2) The minimum for the depositis in the account was 33 .
- 3) The minimum for the depositis in the account was -4 .
- 4) The minimum for the depositis in the account was 5 .
- 5) The minimum for the depositis in the account was 13 .

Exercise 6

The funds of a public institution alternate periods of deficit and surplus.

We have the following information for several years (in millions of euros):

year	funds
1	-2
5	-26
7	-2

Employ an interpolation polynomial to build a function that

yields the funds for each year t . We know that due to the legislation the funds of such an institution have to be kept between -17 and -2

. Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from $t=1$ to $t=7$).

- 1) The funds are inside the limits for the intervals: $[0, 2]$ y $[6, 7]$.
- 2) The funds are inside the limits for the interval: $[6, 7]$.
- 3) The funds are inside the limits for the interval: $[1, 7]$.
- 4) The funds are inside the limits for the interval: $[0, 6]$.
- 5) The funds are inside the limits for the interval: $[1, 6]$.
- 6) The funds are inside the limits for the interval: $[1, 2]$.
- 7) The funds are inside the limits for the interval: $[0, 1]$.
- 8) The funds are inside the limits for the intervals: $[1, 2]$ y $[6, 7]$.

Exercise 7

The deposits in certain account between the

months $t=0$ and $t=9$ is given by the function $C(t) = 6 + 192t - 60t^2 + 4t^3$

. Determine the months for which the deposit is between -138 and -34 euros.

- 1) Along the intervals of months: $[3., 6.]$ and $[7.31717, 9.]$.
- 2) Along the intervals of months: $[2., 3.59994]$ and $[5.26095, 6.]$.
- 3) Along the intervals of months: $[0, 5]$ and $[6, 9]$.
- 4) Along the interval of months: $[5, 6]$.
- 5) Along the intervals of months: $[1.76929, 6.35914]$ and $[7., 9.]$.
- 6) Along the intervals of months: $[2., 5.]$ and $[6., 7.]$.
- 7) Along the intervals of months: $[6., 7.48158]$ and $[8.49842, 9.68433]$.
- 8) Along the interval of months: $[5.75177, 9.78229]$.

Exercise 8

Compute the limit: $\lim_{x \rightarrow \infty} \left(\frac{8 - 9x + 9x^2}{8 + 8x + 9x^2} \right)^{8+8x}$

- 1) 1
- 2) e^2
- 3) e
- 4) $-\infty$
- 5) ∞
- 6) $\frac{1}{e^{136/9}}$
- 7) 0

Exercise 9

A factory produces certain type of devices. The marginal cost (cost of producing one unit) decreases when we produce a large amount of units and it is given by the function $C(x) = \frac{7 + x + 7x^2 + 3x^3}{7 + 6x + 4x^2 + 6x^3}$. Determine the expected cost per unit when a large amount of units is produced.

- 1) 0
- 2) $-\frac{3}{7}$
- 3) $-\infty$
- 4) $\frac{1}{2}$
- 5) ∞
- 6) 10 000
- 7) $\frac{53}{100}$

Exercise 10

The population in certain turistic area

increases exponentially and is given by the function $P(t) = 94\,000 e^{t/100}$ that indicates the number of resident citizens for every year t . At the same time, depending on the season, the city receives a variable number of

tourists given by the trigonometric function $I(t) = 3000 + 1000 \sin\left[\frac{t}{2\pi}\right]$

that yields the amount of visitors in the area for every moment t (t in years).

Determine how many years are necessary until the total number of habitants is 130000. (the solution can be found for t between 27 and 32).

- 1) $t = **.*0****$
- 2) $t = **.*2****$
- 3) $t = **.*4****$
- 4) $t = **.*6****$
- 5) $t = **.*8****$

Exercise 11

Study the continuity of the function $f(x) = \begin{cases} -e^{x-2} - \sin(2-x) & x \leq 2 \\ 3 \log(x-1) - 1 & 2 < x < 4 \\ \cos(4-x) - 2 \sin(4-x) & 4 \leq x \end{cases}$

- 1) The functions is continuous for all points.
- 2) The functions is not continuous at any point.
- 3) The function is continuous for all the points except for $x=2$.
- 4) The function is continuous for all the points except for $x=4$.
- 5) The function is continuous for all the points except for $x=2$ and $x=4$.

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01-Functions for serial number: 89

Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a periodic compound interest rate of 10% in 5 periods (compounding frequency) and in the bank B we are paid a continuous compound rate of 4%. We initially deposit 4000 euros in the bank A and 8000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **1.***** years.
- 2) In **3.***** years.
- 3) In **6.***** years.
- 4) In **0.***** years.
- 5) In **8.***** years.

Exercise 2

We have one bank account that offers a continuous compound rate of 5% where we initially deposit 11000 euros. How long time is it necessary until the amount of money in the account reaches 20000 euros?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **0.***** years.
- 2) In **6.***** years.
- 3) In **3.***** years.
- 4) In **1.***** years.
- 5) In **4.***** years.

Exercise 3

We have a bank account that initially offers a compound interest rate of 8%, and after 4 years the conditions are modified and then we obtain a continuous compound rate of 4%. The initial deposit is 8000 euros. Compute the amount of money in the account after 10 years from the moment of the first deposit.

- 1) We will have ****2.***** euros.
- 2) We will have ****4.***** euros.
- 3) We will have ****3.***** euros.
- 4) We will have ****1.***** euros.
- 5) We will have ****6.***** euros.

Exercise 4

A firm sells Q tons of certain product. The price received per ton is given by the formula $P=700-8Q$. On the other hand, the production cost per ton is $C=500-6Q$. In addition, the transportation cost is 180 per ton. Compute the maximum profit that can be obtained selling this product.

- 1) Profit = 47 .
- 2) Profit = 85 .
- 3) Profit = 46 .
- 4) Profit = 50 .
- 5) Profit = 33 .

Exercise 5

Deposits in certain investment account vary from year to year alternating gains and losses periods. We have the following data about the deposits for different years:

year	deposits
2	3
3	3
5	3

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t . Employ that function to forecast the exact amount for year 7 .

- 1) The depositis in the account for year 7 are -7 .
- 2) The depositis in the account for year 7 are 3 .
- 3) The depositis in the account for year 7 are -4 .
- 4) The depositis in the account for year 7 are 8 .
- 5) The depositis in the account for year 7 are 15 .

Exercise 6

The funds of a public institution alternate periods of deficit and surplus.

We have the following information for several years (in millions of euros):

year	funds
0	0
3	21
5	55

Employ an interpolation polynomial to build a function that

yields the funds for each year t . We know that due to the legislation the funds of such an institution have to be kept between 10 and 36

- . Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from $t=0$ to $t=5$).

- 1) The funds are inside the limits for the interval: $[-\frac{9}{2}, -\frac{5}{2}]$.
- 2) The funds are inside the limits for the interval: $[-\frac{9}{2}, 2]$.
- 3) The funds are inside the limits for the interval: $[-\frac{9}{2}, 5]$.
- 4) The funds are inside the limits for the interval: $[-\frac{9}{2}, 0]$.
- 5) The funds are inside the limits for the interval: $[2, 5]$.
- 6) The funds are inside the limits for the interval: $[0, 2]$.
- 7) The funds are inside the limits for the intervals: $[-\frac{9}{2}, -\frac{5}{2}]$ y $[4, 5]$.
- 8) The funds are inside the limits for the interval: $[2, 4]$.

Exercise 7

The population of a city is studied between years $t=1$ and $t=9$. In that period the population is given by the function $P(t) = 7 + 252t - 60t^2 + 4t^3$

. Determine the intervals of years when the population is between 223 and 311.

- 1) Along the interval of years: $[6., 7.54584]$.
- 2) Along the interval of years: $[1.39154, 3.44983]$.
- 3) Along the interval of years: $[1., 2.]$.
- 4) Along the intervals of years: $[1, 1.1459]$, $[2.1459, 4]$, $[6, 7.8541]$ and $[8.8541, 9]$.
- 5) Along the interval of years: $[8., 9.62841]$.
- 6) Along the intervals of years: $[1.18187, 3.51284]$ and $[4.71349, 9.]$.
- 7) Along the intervals of years: $[1.1459, 2.1459]$, $[4, 6]$ and $[7.8541, 8.8541]$.
- 8) Along the intervals of years: $[3., 4.]$ and $[5., 6.24814]$.

Exercise 8

Compute the limit: $\lim_{x \rightarrow -\infty} \left(\frac{5 - 5x + 9x^2}{5 + 7x + 9x^2} \right)^{-3+9x}$

- 1) $\frac{1}{e^3}$
- 2) 1
- 3) $\frac{1}{e^{12}}$
- 4) $-\infty$
- 5) 0
- 6) $\frac{1}{e^5}$
- 7) ∞

Exercise 9

From an initial deposit 16000, the interest rate varies every year in such a way that the total amount of money in the account is given by the function $C(t) =$

$$16000 \left(\frac{5 - 5t - 9t^2}{5 + 7t - 9t^2} \right)^{-3+9t}. \text{ Determine the future tendency for the}$$

deposits that we will have after a large number of years.

- 1) $\frac{16000}{e^5}$
- 2) ∞
- 3) $\frac{16000}{e^3}$
- 4) $16000 e^{12}$
- 5) 16000
- 6) 0
- 7) $-\infty$

Exercise 10

We deposit 14000 euros in a bank account with a compound interest rate of 3%. At the same time every year we also add in a safe-deposit box (therefore with no interest rate) 2000 euros. How long time is it necessary until the total amount of money (jointly in the bank account and safe-deposit box) is 38000 euros? (the solution can be found for t between 9 and 14).

- 1) $t = \dots 0 \dots$
- 2) $t = \dots 2 \dots$
- 3) $t = \dots 4 \dots$
- 4) $t = \dots 6 \dots$
- 5) $t = \dots 8 \dots$

Exercise 11

Study the continuity of the function $f(x) = \begin{cases} 3 \sin(x) + \cos(x) & x \leq 0 \\ 1 - \frac{2x}{3} & 0 < x < 3 \\ \sin(3-x) - e^{x-3} & 3 \leq x \end{cases}$

- 1) The functions is continuous for all points.
- 2) The functions is not continuous at any point.
- 3) The function is continuous for all the points except for $x=0$.
- 4) The function is continuous for all the points except for $x=3$.
- 5) The function is continuous for all the points except for $x=0$ and $x=3$.

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01-Functions for serial number: 90

Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a compound interest rate of 9% and in the bank B we are paid a continuous compound rate of 6%. We initially deposit 10000 euros in the bank A and 6000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **3.***** years.
- 2) In **8.***** years.
- 3) In **6.***** years.
- 4) In **0.***** years.
- 5) In **4.***** years.

Exercise 2

We have one bank account that offers a compound interest rate of 3% where we initially deposit 8000 euros. How long time is it necessary until the amount of money in the account reaches 12000 euros?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **7.***** years.
- 2) In **3.***** years.
- 3) In **4.***** years.
- 4) In **5.***** years.
- 5) In **0.***** years.

Exercise 3

We have a bank account that initially offers a periodic compound interest rate of 5% in 8 periods (compounding frequency), and after 3 years the conditions are modified and then we obtain a periodic compound interest rate of 6% in 10 periods (compounding frequency). The initial deposit is 6000 euros. Compute the amount of money in the account after 10 years from the moment of the first deposit.

- 1) We will have ****3.***** euros.
- 2) We will have ****1.***** euros.
- 3) We will have ****5.***** euros.
- 4) We will have ****6.***** euros.
- 5) We will have ****0.***** euros.

Exercise 4

A firm sells Q tons of certain product. The price received per ton is given by the formula $P=3000-5Q$. On the other hand, the production cost per ton is $C=2000+11Q$. In addition, the transportation cost is 744 per ton. Compute the maximum profit that can be obtained selling this product.

- 1) Profit = 1024 .
- 2) Profit = 953 .
- 3) Profit = 1134 .
- 4) Profit = 575 .
- 5) Profit = 614 .

Exercise 5

Deposits in certain investment account vary from year to year alternating gains and losses periods. We have the following data about the deposits for different years:

year	deposits
2	4
3	12
4	24

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t . Employ that function to forecast the exact amount for year 6 .

- 1) The depositis in the account for year 6 are 60 .
- 2) The depositis in the account for year 6 are -20 .
- 3) The depositis in the account for year 6 are 84 .
- 4) The depositis in the account for year 6 are 4 .
- 5) The depositis in the account for year 6 are 10 .

Exercise 6

The funds of a public institution alternate periods of deficit and surplus.

We have the following information for several years (in millions of euros):

year	funds
0	3
3	24
7	108

Employ an interpolation polynomial to build a function that

yields the funds for each year t . We know that due to the legislation the funds of such an institution have to be kept between 6 and 58

. Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from $t=0$ to $t=7$).

- 1) The funds are inside the limits for the interval: $[1, 7]$.
- 2) The funds are inside the limits for the intervals: $[-\frac{11}{2}, -\frac{3}{2}]$ y $[5, 7]$.
- 3) The funds are inside the limits for the interval: $[1, 5]$.
- 4) The funds are inside the limits for the interval: $[-\frac{11}{2}, -\frac{3}{2}]$.
- 5) The funds are inside the limits for the interval: $[-\frac{11}{2}, 7]$.
- 6) The funds are inside the limits for the interval: $[-\frac{11}{2}, 0]$.
- 7) The funds are inside the limits for the interval: $[0, 1]$.
- 8) The funds are inside the limits for the interval: $[-\frac{11}{2}, 1]$.

Exercise 7

The deposits in certain account between the

months $t=0$ and $t=10$ is given by the function $C(t) = 4 + 48t - 30t^2 + 4t^3$

. Determine the months for which the deposit is between -14 and 12 euros.

- 1) Along the intervals of months: $[-4.45015 \times 10^{-308}, 4.]$ and $[7., 9.]$.
- 2) Along the intervals of months: $[0, 0]$, $[0.188262, 2]$, $[3, 4.81174]$ and $[5.31174, 10]$.
- 3) Along the intervals of months: $[3., 4.]$ and $[5., 10.]$.
- 4) Along the intervals of months: $[0.618736, 2.]$ and $[4., 6.]$.
- 5) Along the intervals of months: $[2., 4.]$ and $[7., 8.27672]$.
- 6) Along the intervals of months: $[0, 0.188262]$, $[2, 3]$ and $[4.81174, 5.31174]$.
- 7) Along the intervals of months: $[2., 3.06763]$ and $[4., 10.]$.
- 8) Along the intervals of months: $[0.233562, 1.]$ and $[5.07766, 9.]$.

Exercise 8

Compute the limit: $\lim_{x \rightarrow -\infty} \left(\frac{-8 - 3x + 2x^2 - 4x^3}{-1 + x - 3x^2 - 4x^3} \right)^{6+2x}$

- 1) $\frac{1}{e^3}$
- 2) ∞
- 3) $\frac{1}{e^5}$
- 4) 1
- 5) $-\infty$
- 6) $\frac{1}{e^{5/2}}$
- 7) 0

Exercise 9

The population of certain country (in millions of habitants) is given by the function $P(t) =$

$$40 \left(\frac{-8 - 3t + 2t^2 - t^3}{-1 + t - 3t^2 - t^3} \right)^{6+2t}. \text{ Determine the future tendency for this population.}$$

- 1) ∞
- 2) 40
- 3) $\frac{40}{e^3}$
- 4) $\frac{40}{e^{10}}$
- 5) 0
- 6) $\frac{40}{e^5}$
- 7) $-\infty$

Exercise 10

We deposit 7000 euros in a bank account with a periodic compound interest rate of 10% in 12 periods (compounding frequency). At the same time every year we also add in a safe-deposit box (therefore with no interest rate) 1000 euros. How long time is it necessary until the total ammount of money (jointly in the bank account and safe-depsit box) is 56000 euros? (the solution can be found for t between 13 and 18).

- 1) $t = \dots 1 \dots$
- 2) $t = \dots 3 \dots$
- 3) $t = \dots 5 \dots$
- 4) $t = \dots 7 \dots$
- 5) $t = \dots 9 \dots$

Exercise 11

Study the continuity of the function $f(x) = \begin{cases} -3 \sin(x+2) - \cos(x+2) & x \leq -2 \\ -x - 3 & -2 < x < -1 \\ 3 \log(x+2) - 2 & -1 \leq x \end{cases}$

- 1) The functions is continuous for all points.
- 2) The functions is not continuous at any point.
- 3) The function is continuous for all the points except for $x = -2$.
- 4) The function is continuous for all the points except for $x = -1$.
- 5) The function is continuous for all the points except for $x = -2$ and $x = -1$.

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01-Functions for serial number: 91

Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a periodic compound interest rate of 3% in 7 periods (compounding frequency) and in the bank B we are paid a compound interest rate of 10%. We initially deposit 7000 euros in the bank A and 1000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **8.***** years.
- 2) In **4.***** years.
- 3) In **0.***** years.
- 4) In **7.***** years.
- 5) In **9.***** years.

Exercise 2

Certain parcel of land is devalued from an initial value of 250000 euros until a final value of 116000 euros along 7 years. Determine the rate of compound interest for that devaluation.

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) The interest rate is **4.***** %.
- 2) The interest rate is **0.***** %.
- 3) The interest rate is **6.***** %.
- 4) The interest rate is **8.***** %.
- 5) The interest rate is **1.***** %.

Exercise 3

We have a bank account that initially offers a continuous compound rate of 9%, and after 1 year the conditions are modified and then we obtain a periodic compound interest rate of 2% in 2 periods (compounding frequency). The initial deposit is 7000 euros. Compute the amount of money in the account after 10 years from the moment of the first deposit.

- 1) We will have ****7.***** euros.
- 2) We will have ****5.***** euros.
- 3) We will have ****8.***** euros.
- 4) We will have ****0.***** euros.
- 5) We will have ****1.***** euros.

Exercise 4

A firm sells Q tons of certain product. The price received per ton is given by the formula $P=40000-11Q$. On the other hand, the production cost per ton is $C=30000+8Q$. In addition, the transportation cost is 8670 per ton. Compute the maximum profit that can be obtained selling this product.

- 1) Profit = 23 275 .
- 2) Profit = 37 967 .
- 3) Profit = 23 911 .
- 4) Profit = 30 761 .
- 5) Profit = 14 549 .

Exercise 5

Deposits in certain investment account vary from year to year alternating gains and losses periods. We have the following data about the deposits for different years:

year	deposits
1	396
3	292
4	246

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t . Employ that function to determine the minimum funds available in the investment account .

- 1) The minimum for the depositis in the account was -9 .
- 2) The minimum for the depositis in the account was -7 .
- 3) The minimum for the depositis in the account was 166 .
- 4) The minimum for the depositis in the account was 15 .
- 5) The minimum for the depositis in the account was 4 .

Exercise 6

The funds of a public institution alternate periods of deficit and surplus.

We have the following information for several years (in millions of euros):

year	funds
1	8
3	8
7	32

Employ an interpolation polynomial to build a function that

yields the funds for each year t . We know that due to the legislation the funds of such an institution have to be kept between 8 and 16

- . Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from $t=1$ to $t=7$).

- 1) The funds are inside the limits for the interval: $[-1, 1]$.
- 2) The funds are inside the limits for the interval: $[0, 3]$.
- 3) The funds are inside the limits for the interval: $[3, 7]$.
- 4) The funds are inside the limits for the intervals: $[1, 1]$ y $[3, 5]$.
- 5) The funds are inside the limits for the interval: $[-1, 7]$.
- 6) The funds are inside the limits for the interval: $[-1, 0]$.
- 7) The funds are inside the limits for the interval: $[-1, 3]$.
- 8) The funds are inside the limits for the intervals: $[-1, 1]$ y $[5, 7]$.

Exercise 7

The population of certain type of rodents is analyzed in a region between years $t=1$ and $t=8$. Along that period the population is given by the function $P(t) = 9 + 96t - 36t^2 + 4t^3$ (thousands of rodents). Determine the intervals of years during which the number of rodents is between 73 and 289.

- 1) Along the intervals of years: $[1., 3.]$ and $[4., 8.42979]$.
- 2) Along the intervals of years: $[1, 1]$, $[4, 4]$ and $[7, 8]$.
- 3) Along the interval of years: $[1, 7]$.
- 4) Along the interval of years: $[7., 8.]$.
- 5) Along the interval of years: $[3.39942, 4.]$.
- 6) Along the interval of years: $[4.59327, 7.]$.
- 7) Along the interval of years: $[1., 3.46315]$.
- 8) Along the intervals of years: $[1., 2.]$ and $[3., 4.]$.

Exercise 8

Compute the limit: $\lim_{x \rightarrow -\infty} \left(\frac{-7 + 7x - x^2 - 9x^3}{1 - 9x - 5x^2 - 9x^3} \right)^{-2+9x}$

- 1) 1
- 2) $\frac{1}{e^5}$
- 3) ∞
- 4) $\frac{1}{e^4}$
- 5) $-\infty$
- 6) 0
- 7) $\frac{1}{e^3}$

Exercise 9

A factory produces certain type of devices. The marginal cost (cost of producing one unit) decreases when we produce a large amount of units and it is given by the function $C(x) = \frac{3 + 2x + 2x^2}{7 + 9x + x^2 + 5x^3 + x^4}$. Determine the expected cost per unit when a large amount of units is produced.

- 1) $-\frac{3}{4}$
- 2) ∞
- 3) 19000
- 4) $-\frac{1}{3}$
- 5) $-\infty$
- 6) 0
- 7) $\frac{1}{5}$

Exercise 10

The population in certain turistic area

increases exponentially and is given by the function $P(t) = 72\,000 e^{t/100}$ that indicates the number of resident citizens for every year t . At the same time, depending on the season, the city receives a variable number of

tourists given by the trigonometric function $I(t) = 4000 + 1000 \sin\left[\frac{t}{2\pi}\right]$

that yields the amount of visitors in the area for every moment t (t in years).

Determine how many years are necessary until the total number of habitants is 113000. (the solution can be found for t between 39 and 44).

- 1) $t = ** .0****$
- 2) $t = ** .2****$
- 3) $t = ** .4****$
- 4) $t = ** .6****$
- 5) $t = ** .8****$

Exercise 11

Study the continuity of the function $f(x) = \begin{cases} -\sin(x+1) & x \leq -1 \\ -3\sin(x+1) - \cos(x+1) + 1 & -1 < x < 2 \\ \sin(2-x) - \cos(2-x) & 2 \leq x \end{cases}$

- 1) The functions is continuous for all points.
- 2) The functions is not continuous at any point.
- 3) The function is continuous for all the points except for $x = -1$.
- 4) The function is continuous for all the points except for $x = 2$.
- 5) The function is continuous for all the points except for $x = -1$ and $x = 2$.

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01-Functions for serial number: 92

Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a compound interest rate of 6% and in the bank B we are paid a periodic compound interest rate of 9% in 2 periods (compounding frequency). We initially deposit 6000 euros in the bank A and 2000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **5.***** years.
- 2) In **1.***** years.
- 3) In **6.***** years.
- 4) In **4.***** years.
- 5) In **0.***** years.

Exercise 2

We have one bank account that offers a compound interest rate of 4% where we initially deposit 8000 euros. How long time is it necessary until the amount of money in the account reaches 13000 euros?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **5.***** years.
- 2) In **6.***** years.
- 3) In **4.***** years.
- 4) In **0.***** years.
- 5) In **2.***** years.

Exercise 3

We have a bank account that initially offers a periodic compound interest rate of 7% in 12 periods (compounding frequency), and after 1 year the conditions are modified and then we obtain a continuous compound rate of 7%. The initial deposit is 6000 euros. Compute the amount of money in the account after 10 years from the moment of the first deposit.

- 1) We will have ****4.***** euros.
- 2) We will have ****1.***** euros.
- 3) We will have ****0.***** euros.
- 4) We will have ****7.***** euros.
- 5) We will have ****5.***** euros.

Exercise 4

A firm sells Q tons of certain product. The price received per ton is given by the formula $P=10000-5Q$. On the other hand, the production cost per ton is $C=9000+7Q$. In addition, the transportation cost is 64 per ton. Compute the maximum profit that can be obtained selling this product.

- 1) Profit = 23 361 .
- 2) Profit = 18 252 .
- 3) Profit = 15 782 .
- 4) Profit = 28 495 .
- 5) Profit = 14 545 .

Exercise 5

Deposits in certain investment account vary from year to year alternating gains and losses periods. We have the following data about the deposits for different years:

year	deposits
0	2
2	6
4	26

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t . Employ that function to forecast the exact amount for year 5 .

- 1) The depositis in the account for year 5 are 62 .
- 2) The depositis in the account for year 5 are 6 .
- 3) The depositis in the account for year 5 are -16 .
- 4) The depositis in the account for year 5 are 42 .
- 5) The depositis in the account for year 5 are 3 .

Exercise 6

The funds of a public institution alternate periods of deficit and surplus.

We have the following information for several years (in millions of euros):

year	funds
0	17
3	-1
7	31

Employ an interpolation polynomial to build a function that

yields the funds for each year t . We know that due to the legislation the funds of such an institution have to be kept between -9 and 1

- . Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from $t=0$ to $t=7$).

- 1) The funds are inside the limits for the interval: $[-2, 8]$.
- 2) The funds are inside the limits for the interval: $[0, 4]$.
- 3) The funds are inside the limits for the interval: $[0, 7]$.
- 4) The funds are inside the limits for the interval: $[4, 7]$.
- 5) The funds are inside the limits for the interval: $[7, 7]$.
- 6) The funds are inside the limits for the interval: $[-2, 5]$.
- 7) The funds are inside the limits for the interval: $[2, 4]$.
- 8) The funds are inside the limits for the interval: $[2, 7]$.

Exercise 7

The deposits in certain account between the

months $t=0$ and $t=10$ is given by the function $C(t) = 6 + 60t - 36t^2 + 4t^3$

- . Determine the months for which the deposit is between -30 and 14 euros.

- 1) Along the interval of months: $[0.739778, 6.]$.
- 2) Along the intervals of months: $[0, 0.145898]$, $[2, 3]$ and $[6.4641, 6.8541]$.
- 3) Along the interval of months: $[6.50317, 9.15293]$.
- 4) Along the intervals of months: $[-4.45015 \times 10^{-308}, 4.34329]$ and $[6., 8.]$.
- 5) Along the intervals of months: $[0.473148, 6.01461]$ and $[8.76485, 9.60702]$.
- 6) Along the interval of months: $[3., 8.05883]$.
- 7) Along the intervals of months: $[0, 0]$, $[0.145898, 2]$, $[3, 6.4641]$ and $[6.8541, 10]$.
- 8) Along the intervals of months: $[2.33464, 5.]$ and $[7., 9.07249]$.

Exercise 8

Compute the limit: $\lim_{x \rightarrow \infty} \left(\frac{8 + 2x - 2x^2}{3 - 6x - 2x^2} \right)^{9-9x+8x^2}$

- 1) $\frac{1}{e^5}$
- 2) ∞
- 3) $\frac{1}{e}$
- 4) 1
- 5) $\frac{1}{e^2}$
- 6) 0
- 7) $-\infty$

Exercise 9

The population of certain country (in millions of habitants) is given by the function $P(t) =$

$$22 \left(\frac{-6 + 2t + 3t^2 + t^3}{-6 + 6t - 3t^2 + t^3} \right)^{-2+2t}. \text{ Determine the future tendency for this population.}$$

- 1) $\frac{22}{e^5}$
- 2) ∞
- 3) $\frac{22}{e^4}$
- 4) 0
- 5) $-\infty$
- 6) $22e^{12}$
- 7) 22

Exercise 10

We deposit 7000 euros in a bank account with a continuous compound rate of 10%. At the same time every year we also add in a safe-deposit box (therefore with no interest rate) 1000 euros. How long time is it necessary until the total ammount of money (jointly in the bank account and safe-depsit box) is 47000 euros? (the solution can be found for t between 13 and 18).

- 1) $t = *.1****$
- 2) $t = *.3****$
- 3) $t = *.5****$
- 4) $t = *.7****$
- 5) $t = *.9****$

Exercise 11

Study the continuity of the function $f(x) = \begin{cases} 3 \sin(x+2) + 2 \cos(x+2) & x \leq -2 \\ -e^{x+2} + 3 \sin(x+2) + e + 2 - 3 \sin(1) & -2 < x < -1 \\ \log(x+2) + 2 & -1 \leq x \end{cases}$

- 1) The functions is continuous for all points.
- 2) The functions is not continuous at any point.
- 3) The function is continuous for all the points except for $x = -2$.
- 4) The function is continuous for all the points except for $x = -1$.
- 5) The function is continuous for all the points except for $x = -2$ and $x = -1$.

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01-Functions for serial number: 93

Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a continuous compound rate of 7% and in the bank B we are paid a continuous compound rate of 3%. We initially deposit 7000 euros in the bank A and 13000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **4.***** years.
- 2) In **6.***** years.
- 3) In **3.***** years.
- 4) In **0.***** years.
- 5) In **5.***** years.

Exercise 2

Certain parcel of land is revalued from an initial value of 120000 euros until a final value of 379000 euros along 10 years. Determine the rate of continuous compound interest for that revaluation.

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) The interest rate is **5.***** %.
- 2) The interest rate is **9.***** %.
- 3) The interest rate is **2.***** %.
- 4) The interest rate is **3.***** %.
- 5) The interest rate is **1.***** %.

Exercise 3

We have a bank account that initially offers a compound interest rate of 6%, and after 3 years the conditions are modified and then we obtain a continuous compound rate of 7%. The initial deposit is 13000 euros. Compute the amount of money in the account after 3 years from the moment of the first deposit.

- 1) We will have ****4.***** euros.
- 2) We will have ****5.***** euros.
- 3) We will have ****0.***** euros.
- 4) We will have ****1.***** euros.
- 5) We will have ****3.***** euros.

Exercise 4

A firm sells Q tons of certain product. The price received per ton is given by the formula $P=7000-18Q$. On the other hand, the production cost per ton is $C=6000-8Q$. In addition, the transportation cost is 60 per ton. Compute the maximum profit that can be obtained selling this product.

- 1) Profit = 30607 .
- 2) Profit = 22090 .
- 3) Profit = 30995 .
- 4) Profit = 9218 .
- 5) Profit = 21842 .

Exercise 5

Deposits in certain investment account vary from year to year alternating gains and losses periods. We have the following data about the deposits for different years:

year	deposits
1	14
3	22
4	20

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t . Employ that function to determine the maximum funds available in the investment account .

- 1) The maximum for the depositis in the account was 22 .
- 2) The maximum for the depositis in the account was -9 .
- 3) The maximum for the depositis in the account was 3 .
- 4) The maximum for the depositis in the account was 20 .
- 5) The maximum for the depositis in the account was -10 .

Exercise 6

The funds of a public institution alternate periods of deficit and surplus.

We have the following information for several years (in millions of euros):

year	funds
2	37
4	37
7	-8

Employ an interpolation polynomial to build a function that

yields the funds for each year t . We know that due to the legislation the funds of such an institution have to be kept between 13 and 28

- . Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from $t=2$ to $t=7$).

- 1) The funds are inside the limits for the interval: $[0, 1]$.
- 2) The funds are inside the limits for the interval: $[0, 6]$.
- 3) The funds are inside the limits for the interval: $[1, 7]$.
- 4) The funds are inside the limits for the intervals: $[0, 1]$ y $[5, 7]$.
- 5) The funds are inside the limits for the interval: $[6, 7]$.
- 6) The funds are inside the limits for the intervals: $[0, 0]$ y $[5, 6]$.
- 7) The funds are inside the limits for the interval: $[1, 6]$.
- 8) The funds are inside the limits for the interval: $[5, 6]$.

Exercise 7

The population of a city is studied between years $t=4$ and $t=7$. In that period the population is given by the function $P(t) = 10 + 360t - 66t^2 + 4t^3$

- . Determine the intervals of years when the population is between 604 and 714.

- 1) Along the interval of years: $[4.16838, 5.25761]$.
- 2) Along the interval of years: $[4.48604, 7.]$.
- 3) Along the intervals of years: $[4, 4]$ and $[7, 7]$.
- 4) Along the intervals of years: $[4.40946, 5.42625]$ and $[6., 7.]$.
- 5) Along the interval of years: $[4, 7]$.
- 6) Along the interval of years: $[6.08569, 7.06511]$.
- 7) Along the intervals of years: $[4.64347, 5.30373]$ and $[6., 7.]$.
- 8) Along the interval of years: $[4.56967, 7.69899]$.

Exercise 8

Compute the limit: $\lim_{x \rightarrow -\infty} \left(\frac{7 + 8x + 4x^2 - 5x^3}{2 - 6x + 4x^2 - 5x^3} \right)^{2+4x}$

1) ∞

2) $\frac{1}{e^4}$

3) 1

4) $\frac{1}{e^5}$

5) $-\infty$

6) $\frac{1}{e}$

7) 0

Exercise 9

The population of certain country (in millions of habitants) is given by the function $P(t) =$

$15 \left(\frac{8 + 6t - 2t^2}{4 + 2t - 2t^2} \right)^{6-2t+3t^2}$. Determine the future tendency for this population.

1) ∞

2) 15

3) $\frac{15}{e^5}$

4) $\frac{15}{e^4}$

5) $-\infty$

6) $\frac{15}{e}$

7) 0

Exercise 10

The population in certain turistic area

increases exponentially and is given by the function $P(t) = 52\,000 e^{t/50}$ that indicates the number of resident citizens for every year t . At the same time, depending on the season, the city receives a variable number of

tourists given by the trigonometric function $I(t) = 2000 + 1000 \sin\left[\frac{t}{2\pi}\right]$

that yields the amount of visitors in the area for every moment t (t in years).

Determine how many years are necessary until the total number of habitants is 96000.

(the solution can be found for t between 29 and 34).

- 1) $t = **.*$
- 2) $t = **.*$
- 3) $t = **.*$
- 4) $t = **.*$
- 5) $t = **.*$

Exercise 11

Study the continuity of the function $f(x) = \begin{cases} 2e^{x+3} - \sin(x+3) & x \leq -3 \\ \frac{x}{2} + \frac{7}{2} & -3 < x < -1 \\ \log(x+2) + 1 & -1 \leq x \end{cases}$

- 1) The functions is continuous for all points.
- 2) The functions is not continuous at any point.
- 3) The function is continuous for all the points except for $x = -3$.
- 4) The function is continuous for all the points except for $x = -1$.
- 5) The function is continuous for all the points except for $x = -3$ and $x = -1$.

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01-Functions for serial number: 94

Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a compound interest rate of 9% and in the bank B we are paid a continuous compound rate of 3%. We initially deposit 10000 euros in the bank A and 14000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **7.***** years.
- 2) In **6.***** years.
- 3) In **1.***** years.
- 4) In **4.***** years.
- 5) In **0.***** years.

Exercise 2

Certain parcel of land is revalued from an initial value of 185000 euros until a final value of 476000 euros along 5 years. Determine the rate of compound interest for that revaluation.

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) The interest rate is **8.***** %.
- 2) The interest rate is **3.***** %.
- 3) The interest rate is **2.***** %.
- 4) The interest rate is **6.***** %.
- 5) The interest rate is **0.***** %.

Exercise 3

We have a bank account that initially offers a periodic compound interest rate of 6% in 2 periods (compounding frequency), and after 1 year the conditions are modified and then we obtain a continuous compound rate of 5%. The initial deposit is 14000 euros. Compute the amount of money in the account after 10 years from the moment of the first deposit.

- 1) We will have ****7.***** euros.
- 2) We will have ****5.***** euros.
- 3) We will have ****3.***** euros.
- 4) We will have ****4.***** euros.
- 5) We will have ****1.***** euros.

Exercise 4

A firm sells Q tons of certain product. The price received per ton is given by the formula $P=150000-20Q$. On the other hand, the production cost per ton is $C=50000+19Q$. In addition, the transportation cost is 98596 per ton. Compute the maximum profit that can be obtained selling this product.

- 1) Profit = 12 636 .
- 2) Profit = 14 078 .
- 3) Profit = 17 201 .
- 4) Profit = 16 625 .
- 5) Profit = 20 543 .

Exercise 5

Deposits in certain investment account vary from year to year alternating gains and losses periods. We have the following data about the deposits for different years:

year	deposits
0	5
1	47
2	85

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t . Employ that function to determine the maximum funds available in the investment account .

- 1) The maximum for the depositis in the account was 247 .
- 2) The maximum for the depositis in the account was 149 .
- 3) The maximum for the depositis in the account was 13 .
- 4) The maximum for the depositis in the account was 7 .
- 5) The maximum for the depositis in the account was 11 .

Exercise 6

The funds of a public institution alternate periods of deficit and surplus.

We have the following information for several years (in millions of euros):

year	funds
2	8
5	-1
8	8

Employ an interpolation polynomial to build a function that

yields the funds for each year t . We know that due to the legislation the funds of such an institution have to be kept between -7 and 0

- . Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from $t=2$ to $t=8$).

- 1) The funds are inside the limits for the interval: $[0, 6]$.
- 2) The funds are inside the limits for the interval: $[0, 8]$.
- 3) The funds are inside the limits for the interval: $[4, 6]$.
- 4) The funds are inside the limits for the interval: $[6, 8]$.
- 5) The funds are inside the limits for the interval: $[-2, 9]$.
- 6) The funds are inside the limits for the interval: $[8, 8]$.
- 7) The funds are inside the limits for the interval: $[-2, 3]$.
- 8) The funds are inside the limits for the interval: $[4, 8]$.

Exercise 7

The population of a city is studied between years $t=4$ and $t=9$. In that

period the population is given by the function $P(t) = 10 + 480t - 78t^2 + 4t^3$

- . Determine the intervals of years when the population is between 920 and 946.

- 1) Along the intervals of years: $[6.76498, 7.]$ and $[8.55388, 9.]$.
- 2) Along the intervals of years: $[4, 4]$, $[4.18826, 6]$, $[7, 8.81174]$ and $[9, 9]$.
- 3) Along the interval of years: $[8., 9.]$.
- 4) Along the intervals of years: $[5.52202, 7.37545]$ and $[8., 9.22828]$.
- 5) Along the interval of years: $[4., 9.58943]$.
- 6) Along the intervals of years: $[4, 4.18826]$, $[6, 7]$ and $[8.81174, 9]$.
- 7) Along the intervals of years: $[4., 6.]$ and $[8.1026, 9.]$.
- 8) Along the interval of years: $[7., 8.]$.

Exercise 8

Compute the limit: $\lim_{x \rightarrow -\infty} \left(\frac{-6 + 2x + 8x^2}{-8 + x + 8x^2} \right)^{6-8x+8x^2}$

- 1) 1
- 2) $\frac{1}{e^2}$
- 3) 0
- 4) $\frac{1}{e}$
- 5) ∞
- 6) e^2
- 7) $-\infty$

Exercise 9

The population of certain country (in millions of habitants) is given by the function $P(t) =$

$$37 \left(\frac{-2 + 2t - 8t^2 - 8t^3}{1 - 8t + 6t^2 - 8t^3} \right)^{6+4t+2t^2}. \text{ Determine the future tendency for this population.}$$

- 1) $\frac{37}{e^5}$
- 2) 37
- 3) $\frac{37}{e^3}$
- 4) $\frac{37}{e^4}$
- 5) ∞
- 6) $-\infty$
- 7) 0

Exercise 10

The population in certain turistic area

increases exponentially and is given by the function $P(t) = 60\,000 e^{t/50}$ that indicates the number of resident citizens for every year t . At the same time, depending on the season, the city receives a variable number of

tourists given by the trigonometric function $I(t) = 3000 + 1000 \sin\left[\frac{t}{2\pi}\right]$

that yields the amount of visitors in the area for every moment t (t in years).

Determine how many years are necessary until the total number of habitants is 83000. (the solution can be found for t between 10 and 15).

- 1) $t = **.*0****$
- 2) $t = **.*2****$
- 3) $t = **.*4****$
- 4) $t = **.*6****$
- 5) $t = **.*8****$

Exercise 11

Study the continuity of the function $f(x) = \begin{cases} -2e^{x+2} - \sin(x+2) & x \leq -2 \\ 2\log(x+3) - 2 & -2 < x < 0 \\ -2\sin(x) & 0 \leq x \end{cases}$

- 1) The functions is continuous for all points.
- 2) The functions is not continuous at any point.
- 3) The function is continuous for all the points except for $x = -2$.
- 4) The function is continuous for all the points except for $x = 0$.
- 5) The function is continuous for all the points except for $x = -2$ and $x = 0$.

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01-Functions for serial number: 95

Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a compound interest rate of 1% and in the bank B we are paid a continuous compound rate of 9%. We initially deposit 12000 euros in the bank A and 8000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **5.***** years.
- 2) In **9.***** years.
- 3) In **8.***** years.
- 4) In **6.***** years.
- 5) In **0.***** years.

Exercise 2

We have one bank account that offers a continuous compound rate of 2% where we initially deposit 8000 euros. How long time is it necessary until the amount of money in the account reaches 11000 euros?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **5.***** years.
- 2) In **9.***** years.
- 3) In **1.***** years.
- 4) In **6.***** years.
- 5) In **0.***** years.

Exercise 3

We have a bank account that initially offers a continuous compound rate of 2%, and after 4 years the conditions are modified and then we obtain a compound interest rate of 6%. The initial deposit is 12000 euros. Compute the amount of money in the account after 5 years from the moment of the first deposit.

- 1) We will have ****5.***** euros.
- 2) We will have ****6.***** euros.
- 3) We will have ****2.***** euros.
- 4) We will have ****4.***** euros.
- 5) We will have ****9.***** euros.

Exercise 4

A firm sells Q tons of certain product. The price received per ton is given by the formula $P=110000-16Q$. On the other hand, the production cost per ton is $C=30000+5Q$. In addition, the transportation cost is 78782 per ton. Compute the maximum profit that can be obtained selling this product.

- 1) Profit = 28801 .
- 2) Profit = 20894 .
- 3) Profit = 17661 .
- 4) Profit = 17303 .
- 5) Profit = 16530 .

Exercise 5

Deposits in certain investment account vary from year to year alternating gains and losses periods. We have the following data about the deposits for different years:

year	deposits
0	3
2	5
3	12

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t . Employ that function to forecast the exact amount for year 4 .

- 1) The depositis in the account for year 4 are 23 .
- 2) The depositis in the account for year 4 are 5 .
- 3) The depositis in the account for year 4 are 38 .
- 4) The depositis in the account for year 4 are 18 .
- 5) The depositis in the account for year 4 are 8 .

Exercise 6

The funds of a public institution alternate periods of deficit and surplus.

We have the following information for several years (in millions of euros):

year	funds
1	23
3	35
6	38

Employ an interpolation polynomial to build a function that

yields the funds for each year t . We know that due to the legislation the funds of such an institution have to be kept between 38 and 47

- . Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from $t=1$ to $t=6$).

- 1) The funds are inside the limits for the interval: $[0, 3]$.
- 2) The funds are inside the limits for the interval: $[4, 6]$.
- 3) The funds are inside the limits for the interval: $[0, 4]$.
- 4) The funds are inside the limits for the interval: $[-2, 4]$.
- 5) The funds are inside the limits for the interval: $[-2, 5]$.
- 6) The funds are inside the limits for the interval: $[-2, 6]$.
- 7) The funds are inside the limits for the interval: $[0, 6]$.
- 8) The funds are inside the limits for the interval: $[6, 6]$.

Exercise 7

The population of certain type of rodents is analyzed in a region between years $t=3$ and $t=9$. Along that period the population is given by the function $P(t) = 3 + 420t - 72t^2 + 4t^3$ (thousands of rodents). Determine the intervals of years during which the number of rodents is between 787 and 1003.

- 1) Along the intervals of years: $[4., 5.]$ and $[8.28439, 9.3436]$.
- 2) Along the intervals of years: $[3.75987, 5.]$ and $[7.19989, 8.]$.
- 3) Along the interval of years: $[4, 9]$.
- 4) Along the interval of years: $[5.74656, 9.3285]$.
- 5) Along the intervals of years: $[3, 4]$, $[7, 7]$ and $[9, 9]$.
- 6) Along the intervals of years: $[3.70842, 7.]$ and $[8., 9.]$.
- 7) Along the intervals of years: $[4.1544, 5.]$ and $[6., 8.35799]$.
- 8) Along the intervals of years: $[4.37566, 5.64301]$ and $[7.07025, 9.1303]$.

Exercise 8

Compute the limit: $\lim_{x \rightarrow \infty} \left(\frac{-7 - 6x + 3x^2 + 7x^3}{-7 - 2x - 6x^2 + 7x^3} \right)^{-7+3x+x^2}$

- 1) 0
- 2) $\frac{1}{e^4}$
- 3) $\frac{1}{e^2}$
- 4) $-\infty$
- 5) ∞
- 6) $\frac{1}{e^5}$
- 7) 1

Exercise 9

A factory produces certain type of devices. The marginal cost (cost of producing one unit) decreases when we produce a large amount of units and it is given by the function $C(x) = \frac{6 + 7x + 6x^2 + 5x^3}{7 + 9x + 2x^2 + 2x^3}$.

. Determine the expected cost per unit when a large amount of units is produced.

- 1) $\frac{127}{50}$
- 2) $\frac{5}{2}$
- 3) $-\frac{3}{2}$
- 4) ∞
- 5) 0
- 6) 8000
- 7) $-\infty$

Exercise 10

We deposit 16000 euros in a bank account with a continuous compound rate of 8%. At the same time every year we also add in a safe-deposit box (therefore with no interest rate) 2000 euros. How long time is it necessary until the total ammount of money (jointly in the bank account and safe-depsit box) is 45000 euros? (the solution can be found for t between 6 and 11).

- 1) $t = \dots 0 \dots$
- 2) $t = \dots 2 \dots$
- 3) $t = \dots 4 \dots$
- 4) $t = \dots 6 \dots$
- 5) $t = \dots 8 \dots$

Exercise 11

Study the continuity of the function $f(x) = \begin{cases} 0 & x \leq -3 \\ 2 \log(x+4) - 1 - 2 \log(3) & -3 < x < -1 \\ -2 \sin(x+1) - \cos(x+1) & -1 \leq x \end{cases}$

- 1) The functions is continuous for all points.
- 2) The functions is not continuous at any point.
- 3) The function is continuous for all the points except for $x = -3$.
- 4) The function is continuous for all the points except for $x = -1$.
- 5) The function is continuous for all the points except for $x = -3$ and $x = -1$.

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01-Functions for serial number: 96

Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a compound interest rate of 10% and in the bank B we are paid a compound interest rate of 6%. We initially deposit 1000 euros in the bank A and 8000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **1.***** years.
- 2) In **3.***** years.
- 3) In **6.***** years.
- 4) In **4.***** years.
- 5) In **0.***** years.

Exercise 2

Certain parcel of land is revalued from an initial value of 233000 euros until a final value of 490000 euros along 6 years. Determine the rate of periodic compound interest in 6 periods for that revaluation.

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) The interest rate is **0.***** %.
- 2) The interest rate is **2.***** %.
- 3) The interest rate is **8.***** %.
- 4) The interest rate is **1.***** %.
- 5) The interest rate is **3.***** %.

Exercise 3

We have a bank account that initially offers a continuous compound rate of 5%, and after 1 year the conditions are modified and then we obtain a compound interest rate of 10%. The initial deposit is 8000 euros. Compute the amount of money in the account after 7 years from the moment of the first deposit.

- 1) We will have ****9.***** euros.
- 2) We will have ****1.***** euros.
- 3) We will have ****8.***** euros.
- 4) We will have ****2.***** euros.
- 5) We will have ****3.***** euros.

Exercise 4

A firm sells Q tons of certain product. The price received per ton is given by the formula $P=5000-14Q$. On the other hand, the production cost per ton is $C=3000+2Q$. In addition, the transportation cost is 1808 per ton. Compute the maximum profit that can be obtained selling this product.

- 1) Profit = 576 .
- 2) Profit = 783 .
- 3) Profit = 715 .
- 4) Profit = 515 .
- 5) Profit = 707 .

Exercise 5

Deposits in certain investment account vary from year to year alternating gains and losses periods. We have the following data about the deposits for different years:

year	deposits
2	36
4	12
5	6

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t . Employ that function to determine the minimum funds available in the investment account .

- 1) The minimum for the depositis in the account was 12 .
- 2) The minimum for the depositis in the account was 6 .
- 3) The minimum for the depositis in the account was 2 .
- 4) The minimum for the depositis in the account was 14 .
- 5) The minimum for the depositis in the account was 4 .

Exercise 6

The funds of a public institution alternate periods of deficit and surplus.

We have the following information for several years (in millions of euros):

year	funds
2	22
6	30
8	46

Employ an interpolation polynomial to build a function that

yields the funds for each year t . We know that due to the legislation the funds of such an institution have to be kept between 18 and 30

- . Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from $t=2$ to $t=8$).

- 1) The funds are inside the limits for the interval: $[-2, 8]$.
- 2) The funds are inside the limits for the interval: $[8, 8]$.
- 3) The funds are inside the limits for the interval: $[6, 8]$.
- 4) The funds are inside the limits for the interval: $[0, 8]$.
- 5) The funds are inside the limits for the interval: $[0, 6]$.
- 6) The funds are inside the limits for the interval: $[-1, 5]$.
- 7) The funds are inside the limits for the interval: $[2, 6]$.
- 8) The funds are inside the limits for the interval: $[-2, 5]$.

Exercise 7

The population of a city is studied between years $t=2$ and $t=10$. In that period the population is given by the function $P(t) = 3 + 324t - 72t^2 + 4t^3$

- . Determine the intervals of years when the population is between 323 and 403.

- 1) Along the interval of years: $[5., 10.]$.
- 2) Along the interval of years: $[3.179, 8.]$.
- 3) Along the intervals of years: $[2., 3.59865]$ and $[4., 8.]$.
- 4) Along the intervals of years: $[2, 2]$, $[2.10102, 4]$ and $[5, 10]$.
- 5) Along the interval of years: $[2., 3.38416]$.
- 6) Along the intervals of years: $[4., 5.]$ and $[7.09737, 9.20799]$.
- 7) Along the intervals of years: $[4., 5.10627]$ and $[6., 8.62976]$.
- 8) Along the intervals of years: $[2, 2.10102]$ and $[4, 5]$.

Exercise 8

Compute the limit: $\lim_{x \rightarrow -\infty} \left(\frac{2 - 7x - 7x^2 - 5x^3}{-7 + 6x + 5x^2 - 5x^3} \right)^{1+2x}$

- 1) $-\infty$
- 2) ∞
- 3) $\frac{1}{e^2}$
- 4) 0
- 5) $\frac{1}{e^4}$
- 6) $e^{24/5}$
- 7) 1

Exercise 9

From an initial deposit 13000, the interest rate varies every year in such a way that the total amount of money in the account is given by the function $C(t) =$

$$13000 \left(\frac{2 + 2t - 4t^2}{-7 - 7t - 4t^2} \right)^{6+6t+4t^2}. \text{ Determine the future tendency for the}$$

deposits that we will have after a large number of years.

- 1) $\frac{13000}{e^4}$
- 2) $-\infty$
- 3) $\frac{13000}{e^5}$
- 4) 13000
- 5) 0
- 6) $\frac{13000}{e^2}$
- 7) ∞

Exercise 10

The population in certain turistic area

increases exponentially and is given by the function $P(t) = 89\,000 e^{t/50}$ that indicates the number of resident citizens for every year t . At the same time, depending on the season, the city receives a variable number of

tourists given by the trigonometric function $I(t) = 3000 + 1000 \sin\left[\frac{t}{2\pi}\right]$

that yields the amount of visitors in the area for every moment t (t in years).

Determine how many years are necessary until the total number of habitants is 130000. (the solution can be found for t between 17 and 22).

- 1) $t = ** .0****$
- 2) $t = ** .2****$
- 3) $t = ** .4****$
- 4) $t = ** .6****$
- 5) $t = ** .8****$

Exercise 11

Study the continuity of the function $f(x) = \begin{cases} 2e^{x-3} - 2\sin(3-x) & x \leq 3 \\ 8 - 2x & 3 < x < 5 \\ 2\sin(5-x) - 2e^{x-5} & 5 \leq x \end{cases}$

- 1) The functions is continuous for all points.
- 2) The functions is not continuous at any point.
- 3) The function is continuous for all the points except for $x = 3$.
- 4) The function is continuous for all the points except for $x = 5$.
- 5) The function is continuous for all the points except for $x = 3$ and $x = 5$.

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01-Functions for serial number: 97

Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a continuous compound rate of 6% and in the bank B we are paid a periodic compound interest rate of 10% in 5 periods (compounding frequency). We initially deposit 5000 euros in the bank A and 1000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **9.***** years.
- 2) In **8.***** years.
- 3) In **6.***** years.
- 4) In **1.***** years.
- 5) In **0.***** years.

Exercise 2

Certain parcel of land is devalued from an initial value of 407000 euros until a final value of 214000 euros along 10 years. Determine the rate of continuous compound interest for that devaluation.

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) The interest rate is **6.***** %.
- 2) The interest rate is **8.***** %.
- 3) The interest rate is **5.***** %.
- 4) The interest rate is **7.***** %.
- 5) The interest rate is **3.***** %.

Exercise 3

We have a bank account that initially offers a compound interest rate of 4%, and after 4 years the conditions are modified and then we obtain a continuous compound rate of 10%. The initial deposit is 5000 euros. Compute the amount of money in the account after 8 years from the moment of the first deposit.

- 1) We will have ****3.***** euros.
- 2) We will have ****7.***** euros.
- 3) We will have ****9.***** euros.
- 4) We will have ****2.***** euros.
- 5) We will have ****6.***** euros.

Exercise 4

A firm sells Q tons of certain product. The price received per ton is given by the formula $P=130000-4Q$. On the other hand, the production cost per ton is $C=80000+14Q$. In addition, the transportation cost is 48920 per ton. Compute the maximum profit that can be obtained selling this product.

- 1) Profit = 19 063 .
- 2) Profit = 18 299 .
- 3) Profit = 16 200 .
- 4) Profit = 23 095 .
- 5) Profit = 17 187 .

Exercise 5

Deposits in certain investment account vary from year to year alternating gains and losses periods. We have the following data about the deposits for different years:

year	deposits
1	128
3	72
5	32

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t . Employ that function to determine the minimum funds available in the investment account .

- 1) The minimum for the depositis in the account was -5 .
- 2) The minimum for the depositis in the account was 9 .
- 3) The minimum for the depositis in the account was -3 .
- 4) The minimum for the depositis in the account was 2 .
- 5) The minimum for the depositis in the account was 0 .

Exercise 6

The funds of a public institution alternate periods of deficit and surplus.

We have the following information for several years (in millions of euros):

year	funds
0	24
2	72
6	96

Employ an interpolation polynomial to build a function that

yields the funds for each year t . We know that due to the legislation the funds of such an institution have to be kept between 16 and 96

- . Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from $t=0$ to $t=6$).

- 1) The funds are inside the limits for the interval: $[-2, 5]$.
- 2) The funds are inside the limits for the interval: $[-2, 4]$.
- 3) The funds are inside the limits for the interval: $[4, 6]$.
- 4) The funds are inside the limits for the interval: $[0, 4]$.
- 5) The funds are inside the limits for the intervals: $[0, 4]$ y $[6, 6]$.
- 6) The funds are inside the limits for the interval: $[6, 6]$.
- 7) The funds are inside the limits for the interval: $[-1, 4]$.
- 8) The funds are inside the limits for the interval: $[0, 6]$.

Exercise 7

The population of certain type of rodents is analyzed in a region between years $t=4$ and $t=7$. Along that period the population is given by the function $P(t) = 3 + 360t - 66t^2 + 4t^3$ (thousands of rodents). Determine the intervals of years during which the number of rodents is between 643 and 651.

- 1) Along the intervals of years: $[4.50083, 5.23636]$ and $[6., 7.76905]$.
- 2) Along the intervals of years: $[4, 4]$ and $[4.5, 7]$.
- 3) Along the interval of years: $[5.28775, 7.12016]$.
- 4) Along the intervals of years: $[4.38911, 5.42498]$ and $[6.33518, 7.56103]$.
- 5) Along the interval of years: $[4, 4.5]$.
- 6) Along the intervals of years: $[4., 5.56653]$ and $[6.56666, 7.]$.
- 7) Along the intervals of years: $[4, 4.5]$ and $[6, 6]$.
- 8) Along the interval of years: $[5.12414, 7.14028]$.

Exercise 8

Compute the limit: $\lim_{x \rightarrow -\infty} \left(\frac{-7 - x + 3x^2 + 7x^3}{1 - 7x - 2x^2 + 7x^3} \right)^{-2+4x}$

- 1) 1
- 2) 0
- 3) $-\infty$
- 4) $e^{20/7}$
- 5) $\frac{1}{e^5}$
- 6) $\frac{1}{e^4}$
- 7) ∞

Exercise 9

A factory produces certain type of devices. The marginal cost (cost of producing one unit) decreases when we produce a large amount of units and it is given by the function $C(x) = \frac{6 + 9x + 7x^2}{1 + 8x + 5x^2}$. Determine the expected cost per unit when a large amount of units is produced.

- 1) $-\infty$
- 2) 3000
- 3) ∞
- 4) $\frac{7}{5}$
- 5) $\frac{29}{20}$
- 6) 0
- 7) $-\frac{1}{2}$

Exercise 10

The population in certain turistic area

increases exponentially and is given by the function $P(t) = 73\,000 e^{t/100}$ that indicates the number of resident citizens for every year t . At the same time, depending on the season, the city receives a variable number of

tourists given by the trigonometric function $I(t) = 5000 + 4000 \sin\left[\frac{t}{2\pi}\right]$

that yields the amount of visitors in the area for every moment t (t in years).

Determine how many years are necessary until the total number of habitants is 107000. (the solution can be found for t between 31 and 36).

- 1) $t = \dots 0 \dots$
- 2) $t = \dots 2 \dots$
- 3) $t = \dots 4 \dots$
- 4) $t = \dots 6 \dots$
- 5) $t = \dots 8 \dots$

Exercise 11

Study the continuity of the function $f(x) = \begin{cases} e^{x+3} - \sin(x+3) & x \leq -3 \\ e^{x+3} + 3 \sin(x+3) - e + 1 - 3 \sin(1) & -3 < x < -2 \\ e^{x+2} + 3 \sin(x+2) & -2 \leq x \end{cases}$

- 1) The functions is continuous for all points.
- 2) The functions is not continuous at any point.
- 3) The function is continuous for all the points except for $x = -3$.
- 4) The function is continuous for all the points except for $x = -2$.
- 5) The function is continuous for all the points except for $x = -3$ and $x = -2$.

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01-Functions for serial number: 98

Exercise 1

We have two bank accounts, the first in the

bank A and the second in the bank B. In the bank A we obtain a continuous compound rate of 6% and in the bank B we are paid a compound interest rate of 9%. We initially deposit 7000 euros in the bank A and 2000

in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **1.***** years.
- 2) In **7.***** years.
- 3) In **3.***** years.
- 4) In **5.***** years.
- 5) In **0.***** years.

Exercise 2

We have one bank account that offers a

periodic compound interest rate of 4% in 2 periods (compounding frequency) where we initially deposit 10000

euros. How long time is it necessary until the amount of money in the account reaches 17000 euros?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **3.***** years.
- 2) In **7.***** years.
- 3) In **0.***** years.
- 4) In **6.***** years.
- 5) In **5.***** years.

Exercise 3

We have a bank account that initially offers a compound interest rate of 9%, and after 4 years the conditions are modified and then we obtain a compound interest rate of 3%. The initial deposit is 7000 euros. Compute the amount of money in the account after 9 years from the moment of the first deposit.

- 1) We will have ****4.***** euros.
- 2) We will have ****5.***** euros.
- 3) We will have ****0.***** euros.
- 4) We will have ****2.***** euros.
- 5) We will have ****3.***** euros.

Exercise 4

A firm sells Q tons of certain product. The price received per ton is given by the formula $P=50000-7Q$. On the other hand, the production cost per ton is $C=30000+6Q$. In addition, the transportation cost is 18934 per ton. Compute the maximum profit that can be obtained selling this product.

- 1) Profit = 11308 .
- 2) Profit = 19928 .
- 3) Profit = 26580 .
- 4) Profit = 21853 .
- 5) Profit = 30356 .

Exercise 5

Deposits in certain investment account vary from year to year alternating gains and losses periods. We have the following data about the deposits for different years:

year	deposits
1	4
2	9
4	31

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t . Employ that function to forecast the exact amount for year 5 .

- 1) The depositis in the account for year 5 are 3 .
- 2) The depositis in the account for year 5 are 11 .
- 3) The depositis in the account for year 5 are 48 .
- 4) The depositis in the account for year 5 are 6 .
- 5) The depositis in the account for year 5 are 69 .

Exercise 6

The funds of a public institution alternate periods of deficit and surplus.

We have the following information for several years (in millions of euros):

year	funds
0	24
4	0
8	8

Employ an interpolation polynomial to build a function that

yields the funds for each year t . We know that due to the legislation the funds of such an institution have to be kept between 8 and 15

- . Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from $t=0$ to $t=8$).

- 1) The funds are inside the limits for the interval: $[0, 8]$.
- 2) The funds are inside the limits for the intervals: $[0, 2]$ y $[8, 9]$.
- 3) The funds are inside the limits for the interval: $[0, 1]$.
- 4) The funds are inside the limits for the intervals: $[1, 2]$ y $[8, 8]$.
- 5) The funds are inside the limits for the interval: $[1, 8]$.
- 6) The funds are inside the limits for the intervals: $[1, 2]$ y $[8, 9]$.
- 7) The funds are inside the limits for the interval: $[1, 2]$.
- 8) The funds are inside the limits for the interval: $[8, 8]$.

Exercise 7

The population of a city is studied between years $t=1$ and $t=8$. In that period the population is given by the function $P(t) = 7 + 240t - 54t^2 + 4t^3$

- . Determine the intervals of years when the population is between 7 and 349.

- 1) Along the intervals of years: $[5.35254, 6.25452]$ and $[7.63218, 8.]$.
- 2) Along the interval of years: $[1, 3]$.
- 3) Along the interval of years: $[3., 7.]$.
- 4) Along the interval of years: $[4.51163, 6.]$.
- 5) Along the intervals of years: $[1., 3.16111]$ and $[4., 6.54009]$.
- 6) Along the intervals of years: $[1, 1]$ and $[3, 8]$.
- 7) Along the intervals of years: $[2.36012, 3.]$ and $[5., 7.66822]$.
- 8) Along the interval of years: $[1.46436, 2.43934]$.

Exercise 8

Compute the limit: $\lim_{x \rightarrow \infty} \left(\frac{9 - 7x + 8x^2}{2 - 6x + 8x^2} \right)^{-7-x+8x^2}$

1) $-\infty$

2) $\frac{1}{e^4}$

3) $\frac{1}{e^3}$

4) $\frac{1}{e^2}$

5) 0

6) 1

7) ∞

Exercise 9

From an initial deposit 12000, the interest rate varies every year in such a way that the total amount of money in the account is given by the function $C(t) =$

$12000 \left(\frac{7 + 9t - 7t^2 + 8t^3}{2 - 6t + 5t^2 + 8t^3} \right)^{-1+7t}$. Determine the future tendency for the

deposits that we will have after a large number of years.

1) $\frac{12000}{e^{21/2}}$

2) ∞

3) 0

4) $\frac{12000}{e^{5251/500}}$

5) $\frac{12000}{e^4}$

6) $-\infty$

7) 12000

Exercise 10

We deposit 11000 euros in a bank account with a continuous compound rate of 1%. At the same time every year we also add in a safe-deposit box (therefore with no interest rate) 3000 euros. How long time is it necessary until the total ammount of money (jointly in the bank account and safe-depsit box) is 62000 euros? (the solution can be found for t between 16 and 21).

- 1) $t = \dots 1 \dots$
- 2) $t = \dots 3 \dots$
- 3) $t = \dots 5 \dots$
- 4) $t = \dots 7 \dots$
- 5) $t = \dots 9 \dots$

Exercise 11

Study the continuity of the function $f(x) = \begin{cases} -2 \sin(x+1) - 2 \cos(x+1) & x \leq -1 \\ \sin(x+1) - 2 \cos(x+1) & -1 < x < 1 \\ e^{x-1} - 3 \sin(1-x) & 1 \leq x \end{cases}$

- 1) The functions is continuous for all points.
- 2) The functions is not continuous at any point.
- 3) The function is continuous for all the points except for $x = -1$.
- 4) The function is continuous for all the points except for $x = 1$.
- 5) The function is continuous for all the points except for $x = -1$ and $x = 1$.

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01-Functions for serial number: 99

Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a periodic compound interest rate of 10% in 12 periods (compounding frequency) and in the bank B we are paid a periodic compound interest rate of 6% in 6 periods (compounding frequency). We initially deposit 1000 euros in the bank A and 6000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **5.***** years.
- 2) In **6.***** years.
- 3) In **4.***** years.
- 4) In **9.***** years.
- 5) In **0.***** years.

Exercise 2

We have one bank account that offers a periodic compound interest rate of 3% in 3 periods (compounding frequency) where we initially deposit 8000 euros. How long time is it necessary until the amount of money in the account reaches 15000 euros?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **5.***** years.
- 2) In **9.***** years.
- 3) In **1.***** years.
- 4) In **0.***** years.
- 5) In **6.***** years.

Exercise 3

We have a bank account that initially offers a continuous compound rate of 9%, and after 3 years the conditions are modified and then we obtain a compound interest rate of 10%. The initial deposit is 6000 euros. Compute the amount of money in the account after 10 years from the moment of the first deposit.

- 1) We will have ****1.***** euros.
- 2) We will have ****9.***** euros.
- 3) We will have ****5.***** euros.
- 4) We will have ****7.***** euros.
- 5) We will have ****6.***** euros.

Exercise 4

A firm sells Q tons of certain product. The price received per ton is given by the formula $P=120000-5Q$. On the other hand, the production cost per ton is $C=10000+10Q$. In addition, the transportation cost is 108770 per ton. Compute the maximum profit that can be obtained selling this product.

- 1) Profit = 31471 .
- 2) Profit = 34398 .
- 3) Profit = 11080 .
- 4) Profit = 25215 .
- 5) Profit = 30515 .

Exercise 5

Deposits in certain investment account vary from year to year alternating gains and losses periods. We have the following data about the deposits for different years:

year	deposits
1	1
2	5
4	25

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t . Employ that function to forecast the exact amount for year 5.

- 1) The depositis in the account for year 5 are 17 .
- 2) The depositis in the account for year 5 are 7 .
- 3) The depositis in the account for year 5 are 41 .
- 4) The depositis in the account for year 5 are 61 .
- 5) The depositis in the account for year 5 are 5 .

Exercise 6

The funds of a public institution alternate periods of deficit and surplus.

We have the following information for several years (in millions of euros):

year	funds
0	30
3	-33
7	-33

Employ an interpolation polynomial to build a function that

yields the funds for each year t . We know that due to the legislation the funds of such an institution have to be kept between -18 and 3

. Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from $t=0$ to $t=7$).

- 1) The funds are inside the limits for the interval: $[1, 8]$.
- 2) The funds are inside the limits for the intervals: $[0, 2]$ y $[8, 9]$.
- 3) The funds are inside the limits for the interval: $[0, 1]$.
- 4) The funds are inside the limits for the interval: $[1, 2]$.
- 5) The funds are inside the limits for the interval: $[0, 8]$.
- 6) The funds are inside the limits for the interval: $[7, 8]$.
- 7) The funds are inside the limits for the intervals: $[1, 2]$ y $[7, 9]$.
- 8) The funds are inside the limits for the interval: $[1, 7]$.

Exercise 7

The population of a city is studied between years $t=0$ and $t=10$. In that period the population is given by the function $P(t) = 5 + 504t - 78t^2 + 4t^3$

. Determine the intervals of years when the population is between 5 and 1093.

- 1) Along the intervals of years: $[5., 6.]$ and $[8., 9.]$.
- 2) Along the interval of years: $[0, 8]$.
- 3) Along the interval of years: $[4.08053, 8.24876]$.
- 4) Along the interval of years: $[5.60099, 9.]$.
- 5) Along the interval of years: $[5., 10.2528]$.
- 6) Along the interval of years: $[-4.45015 \times 10^{-308}, 2.5425]$.
- 7) Along the intervals of years: $[0, 0]$ and $[8, 10]$.
- 8) Along the intervals of years: $[0.717429, 2.]$ and $[3.70796, 6.]$.

Exercise 8

Compute the limit: $\lim_{x \rightarrow \infty} \left(\frac{2 + 6x + 5x^2 - 7x^3}{-2 + 6x + 9x^2 - 7x^3} \right)^{-3+5x}$

- 1) $\frac{1}{e^4}$
- 2) $-\infty$
- 3) 1
- 4) $\frac{1}{e^5}$
- 5) 0
- 6) ∞
- 7) $e^{20/7}$

Exercise 9

The population of certain country (in millions of habitants) is given by the function $P(t) =$

$25 \left(\frac{2 + 6t + 5t^2 + 7t^3}{-2 + 6t + 9t^2 + 7t^3} \right)^{-3+5t}$. Determine the future tendency for this population.

- 1) $\frac{25}{e^{2859/1000}}$
- 2) 0
- 3) 25
- 4) $-\infty$
- 5) $\frac{25}{e^5}$
- 6) $\frac{25}{e^{20/7}}$
- 7) ∞

Exercise 10

We deposit 7000 euros in a bank account with a continuous compound rate of 4%. At the same time every year we also add in a safe-deposit box (therefore with no interest rate) 3000 euros. How long time is it necessary until the total ammount of money (jointly in the bank account and safe-depsit box) is 31000 euros? (the solution can be found for t between 5 and 10).

- 1) $t = **.0****$
- 2) $t = **.2****$
- 3) $t = **.4****$
- 4) $t = **.6****$
- 5) $t = **.8****$

Exercise 11

Study the continuity of the function $f(x) =$

$$\begin{cases} 2 \sin(x+2) & x \leq -2 \\ -3 \sin(x+2) + \cos(x+2) - 2 + 3 \sin(2) - \cos(2) & -2 < x < 0 \\ -2 \sin(x) - 2 \cos(x) & 0 \leq x \end{cases}$$

- 1) The functions is continuous for all points.
- 2) The functions is not continuous at any point.
- 3) The function is continuous for all the points except for $x = -2$.
- 4) The function is continuous for all the points except for $x = 0$.
- 5) The function is continuous for all the points except for $x = -2$ and $x = 0$.

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01-Functions for serial number: 100

Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a periodic compound interest rate of 9% in 11 periods (compounding frequency) and in the bank B we are paid a compound interest rate of 3% . We initially deposit 7000 euros in the bank A and 15000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) In **0.***** years.
- 2) In **8.***** years.
- 3) In **7.***** years.
- 4) In **3.***** years.
- 5) In **2.***** years.

Exercise 2

Certain parcel of land is devalued from an initial value of 333000 euros until a final value of 171000 euros along 8 years. Determine the rate of compound interest for that devaluation .

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

- 1) The interest rate is **8.***** %.
- 2) The interest rate is **5.***** %.
- 3) The interest rate is **3.***** %.
- 4) The interest rate is **7.***** %.
- 5) The interest rate is **0.***** %.

Exercise 3

We have a bank account that initially offers a continuous compound rate of 6% , and after 2 years the conditions are modified and then we obtain a compound interest rate of 2% . The initial deposit is 15000 euros. Compute the amount of money in the account after 8 years from the moment of the first deposit.

- 1) We will have ****1.***** euros.
- 2) We will have ****2.***** euros.
- 3) We will have ****9.***** euros.
- 4) We will have ****5.***** euros.
- 5) We will have ****6.***** euros.

Exercise 4

A firm sells Q tons of certain product. The price received per ton is given by the formula $P=110000-11Q$. On the other hand, the production cost per ton is $C=40000+8Q$. In addition, the transportation cost is 68252 per ton. Compute the maximum profit that can be obtained selling this product.

- 1) Profit = 48 237 .
- 2) Profit = 62 053 .
- 3) Profit = 41 300 .
- 4) Profit = 40 204 .
- 5) Profit = 14 296 .

Exercise 5

Deposits in certain investment account vary from year to year alternating gains and losses periods. We have the following data about the deposits for different years:

year	deposits
0	-3
2	49
3	72

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t . Employ that function to determine the maximum funds available in the investment account .

- 1) The maximum for the depositis in the account was 129 .
- 2) The maximum for the depositis in the account was 14 .
- 3) The maximum for the depositis in the account was 193 .
- 4) The maximum for the depositis in the account was -2 .
- 5) The maximum for the depositis in the account was 8 .

Exercise 6

The funds of a public institution alternate periods of deficit and surplus.

We have the following information for several years (in millions of euros):

year	funds
2	1
6	-23
10	-15

Employ an interpolation polynomial to build a function that

yields the funds for each year t . We know that due to the legislation the funds of such an institution have to be kept between -8 and 1

. Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from $t=2$ to $t=10$).

- 1) The funds are inside the limits for the intervals: $[2, 3]$ y $[10, 12]$.
- 2) The funds are inside the limits for the interval: $[2, 3]$.
- 3) The funds are inside the limits for the interval: $[0, 2]$.
- 4) The funds are inside the limits for the interval: $[2, 10]$.
- 5) The funds are inside the limits for the interval: $[2, 11]$.
- 6) The funds are inside the limits for the interval: $[0, 11]$.
- 7) The funds are inside the limits for the interval: $[10, 11]$.
- 8) The funds are inside the limits for the intervals: $[0, 3]$ y $[11, 12]$.

Exercise 7

The population of a city is studied between years $t=4$ and $t=9$. In that period the population is given by the function $P(t) = 6 + 576t - 84t^2 + 4t^3$

. Determine the intervals of years when the population is between 1222 and 1302.

- 1) Along the intervals of years: $[4.45806, 5.50137]$ and $[6., 7.]$.
- 2) Along the intervals of years: $[5.16146, 6.19336]$ and $[7., 8.47389]$.
- 3) Along the intervals of years: $[4, 4]$, $[6, 6]$ and $[9, 9]$.
- 4) Along the interval of years: $[4, 9]$.
- 5) Along the interval of years: $[6., 7.51015]$.
- 6) Along the intervals of years: $[4., 5.41917]$ and $[6., 8.]$.
- 7) Along the intervals of years: $[4.67463, 6.12179]$ and $[7.4149, 8.37585]$.
- 8) Along the interval of years: $[6.50358, 7.21037]$.

Exercise 8

Compute the limit: $\lim_{x \rightarrow \infty} \left(\frac{-8 + 2x - 9x^2}{-1 - 3x - 9x^2} \right)^{7-4x+8x^2}$

- 1) 1
- 2) ∞
- 3) 0
- 4) $\frac{1}{e^3}$
- 5) $\frac{1}{e}$
- 6) $\frac{1}{e^5}$
- 7) $-\infty$

Exercise 9

From an initial deposit 12000, the interest rate varies every year in such a way that the total amount of money in the account is given by the function $C(t) =$

$12000 \left(\frac{-9 + 2t + 3t^2}{-1 - 3t + 3t^2} \right)^{7-4t+8t^2}$. Determine the future tendency for the

deposits that we will have after a large number of years.

- 1) 0
- 2) $-\infty$
- 3) ∞
- 4) $\frac{12000}{e^3}$
- 5) $\frac{12000}{e}$
- 6) $\frac{12000}{e^5}$
- 7) 12000

Exercise 10

The population in certain turistic area

increases exponentially and is given by the function $P(t) = 79\,000 e^{t/100}$ that indicates the number of resident citizens for every year t . At the same time, depending on the season, the city receives a variable number of

tourists given by the trigonometric function $I(t) = 3000 + 1000 \sin\left[\frac{t}{2\pi}\right]$

that yields the amount of visitors in the area for every moment t (t in years).

Determine how many years are necessary until the total number of habitants is 127000. (the solution can be found for t between 41 and 46).

- 1) $t = ** .1****$
- 2) $t = ** .3****$
- 3) $t = ** .5****$
- 4) $t = ** .7****$
- 5) $t = ** .9****$

Exercise 11

Study the continuity of the function $f(x) = \begin{cases} 2 \sin(x) - e^x & x \leq 0 \\ -2 \log(x+1) - 1 & 0 < x < 3 \\ e^{x-3} + \sin(3-x) & 3 \leq x \end{cases}$

- 1) The functions is continuous for all points.
- 2) The functions is not continuous at any point.
- 3) The function is continuous for all the points except for $x=0$.
- 4) The function is continuous for all the points except for $x=3$.
- 5) The function is continuous for all the points except for $x=0$ and $x=3$.