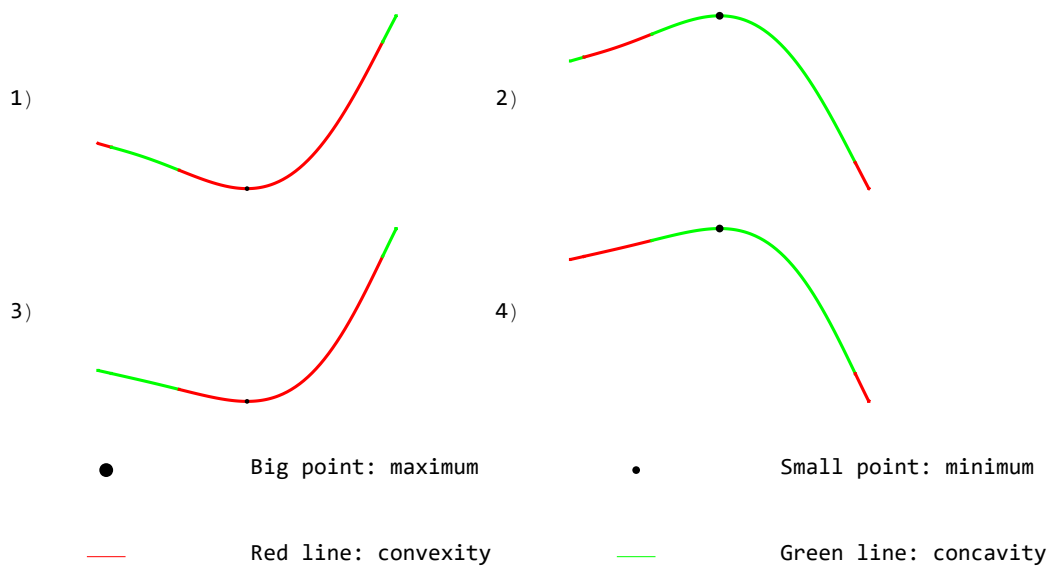


Mathematics 1 - ADE - English - 2026/2027

02-Derivatives for serial number: 1

Exercise 1

Study the shape properties of $f(x) = 4 - 24x^2 - 8x^3 + x^4 + \frac{3x^5}{5}$ to decide which amongst the following ones is the representation of the function.



Indication: To solve this exercise it is necessary to determine the concavity and convexity interval. To find the inflexion points separating the concavity and convexity intervals, check (by means of Ruffini) with the points $-2, -1, 0, 1, 2$.

Exercise 2

Determine the derivative of the function $f(t) = \sin(t) + \log(t+1) (\log(t+1) - 2\sin(t))$ and compute its value at the point $t=0$.

- 1) $f'(0) = 2$ 2) $f'(0) = -2$ 3) $f'(0) = 1$ 4) $f'(0) = 4$

Exercise 3

Compute the limit: $\lim_{x \rightarrow 0} \frac{-1 + e^x - x}{x^2}$

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

Exercise 4

Compute the limit: $\lim_{x \rightarrow -2} \frac{4 + 8x + 5x^2 + x^3}{4x + 4x^2 + x^3}$

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

Exercise 5

Between the months $t=2$ and $t=7$

, the true value of the shares of a company (in euros) are given by the function $C(t) = 42 + 48t - 18t^2 + 2t^3$.

Determine the interval within the value oscillates between months $t=2$ and $t=7$.

- 1) It oscillates between 78 and 175.
- 2) It oscillates between 74 and 82.
- 3) It oscillates between 71 and 175.
- 4) It oscillates between 74 and 182.
- 5) It oscillates between 72 and 186.

Exercise 6

In a fish farm, data of precedings years reveal that, if the initial number of fish is x (x in thousands), after one month they reproduce until a number of $f(x) = \frac{49x}{9 + 13x}$ fishes.

What number of fish leads to the largest increase in the number of animals, $f(x) - x$?

- 1) $\frac{18}{19}$
- 2) $\frac{12}{13}$
- 3) $\frac{11}{5}$
- 4) $\frac{3}{5}$
- 5) $\frac{22}{15}$

Exercise 7

The yield of a tree plantation is given by $f(x) =$

$$\frac{-12 + 8x + 48x^2}{43x^7}, \text{ where } x \text{ is the distance in meters between two trees.}$$

What is the distance x that leads to the largest yield.

- 1) $\frac{35}{18}$
- 2) $\frac{1}{2}$
- 3) $\frac{19}{6}$
- 4) $\frac{11}{8}$
- 5) $\frac{37}{13}$

Exercise 8

A plastic firm receives an order to manufacture 39270 special plastic foam boards for swimming training. The firm has 19 machines but each of them will be able to participate in the manufacturing of this special type of tables only after an adaptation so that each adapted machine is capable of manufacturing 33 boards per hour; on the other hand, the non adapted ones cannot be used for this special order. The cost to adapt each machine is 425 monetary units. Moreover, these adapted machines are automated and only need staff to supervise the production whose salary is 70 monetary units per hour. Taking into account the number of hours that will be necessary to produce the ordered tables, the cost in salaries for those hours, and the adaptation costs, how many of the machines that the company has should be adapted to place the order at the lowest possible cost?

- 1) 13
- 2) None of the other options is correct.
- 3) 16
- 4) 14
- 5) 12

Exercise 9

Study the differentiability of the function $f(x) =$

$$\begin{cases} 2e^{x-2} + 3\sin(2)\sin(x) + 3\cos(2)\cos(x) + 5 & x \leq 2 \\ -2(x-7) & 2 < x < 5 \\ 2\sin(5-x) - 3\cos(5-x) + 7 & 5 \leq x \end{cases}$$

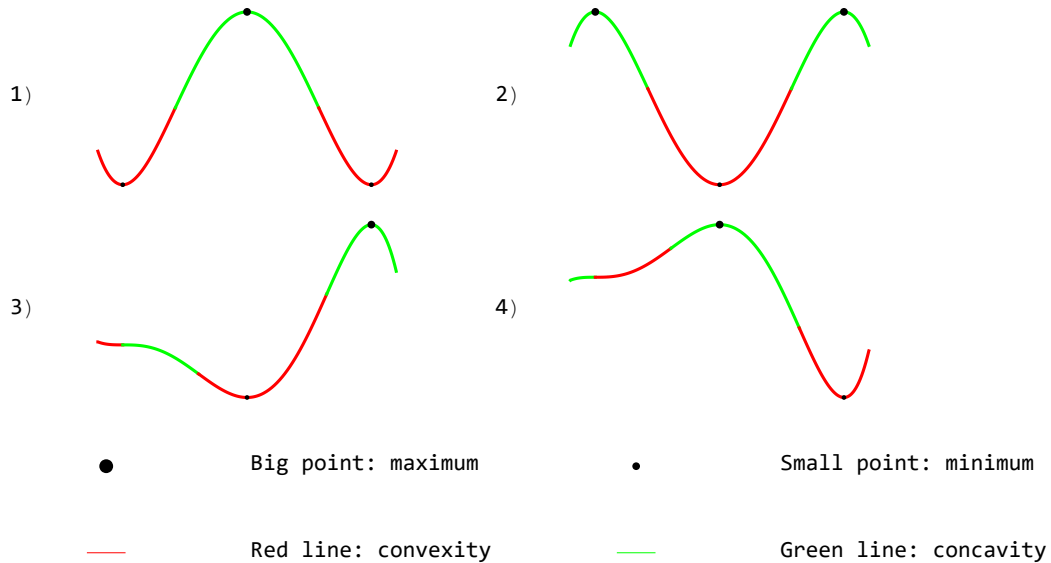
- 1) The function is differentiable for all points.
- 2) The function is not differentiable at any point.
- 3) The function is differentiable for all points except for $x=2$.
- 4) The function is differentiable for all points except for $x=5$.
- 5) The function is differentiable for all points except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

Mathematics 1 - ADE - English - 2026/2027

02-Derivatives for serial number: 2

Exercise 1

Study the shape properties of the $f(x) = 5 - 30x^2 - 20x^3 + 15x^4 + 12x^5$ to decide which amongst the following ones is the representation of the function.



Indication: To find the maximum and minimum points of the function, try (with Ruffini) the points $-2, -1, 0, 1, 2$. To solve this exercise it is necessary to determine the increasing and decreasing intervals.

Exercise 2

Determine the derivative of the function $f(t) = e^t - 2 \sin(\cos(t)) + 1$ and compute its value at the point $t=0$.

- 1) $f'(0) = 3$ 2) $f'(0) = 2$ 3) $f'(0) = 1$ 4) $f'(0) = -4$

Exercise 3

Compute the limit: $\lim_{x \rightarrow 0} \frac{-x^2 + \sin[x^2]}{x^5}$

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

Exercise 4

Compute the limit: $\lim_{x \rightarrow -2} \frac{4x + 4x^2 + x^3}{2 + 3x + x^2}$

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

Exercise 5

Between the months $t=1$ and $t=6$

, the funds in certain account (in millions of euros) are given by the function $F(t) = -17 + 12t - 9t^2 + 2t^3$.

Determine the interval within the funds oscillates between months $t=2$ and $t=3$.

- 1) It oscillates between -13 and 163 .
- 2) It oscillates between -21 and -9 .
- 3) It oscillates between -13 and -12 .
- 4) It oscillates between -13 and -8 .
- 5) It oscillates between -7 and -14 .

Exercise 6

In a fish farm, data of precedings years reveal that, if the initial number of fish is x (x in thousands), after one month they reproduce until a number of $f(x) = \frac{25x}{1 + 25x}$ fishes.

What number of fish leads to the largest increase in the number of animals, $f(x) - x$?

- 1) $\frac{38}{11}$
- 2) 4
- 3) $\frac{37}{7}$
- 4) $\frac{4}{25}$
- 5) $\frac{9}{2}$

Exercise 7

The yield of a tree plantation is given by $f(x) =$

$$\frac{-32 + 27x + 13x^2}{21x^2}, \text{ where } x \text{ is the distance in meters between two trees.}$$

What is the distance x that leads to the largest yield.

- 1) $\frac{7}{11}$
- 2) $\frac{21}{17}$
- 3) $\frac{5}{2}$
- 4) $\frac{17}{10}$
- 5) $\frac{64}{27}$

Exercise 8

A plastic firm receives an order to manufacture 300 special plastic foam boards for swimming training. The firm has 14 machines but each of them will be able to participate in the manufacturing of this special type of tables only after an adaptation so that each adapted machine is capable of manufacturing 50 boards per hour; on the other hand, the non adapted ones cannot be used for this special order. The cost to adapt each machine is 15 monetary units. Moreover, these adapted machines are automated and only need staff to supervise the production whose salary is 90 monetary units per hour. Taking into account the number of hours that will be necessary to produce the ordered tables, the cost in salaries for those hours, and the adaptation costs, how many of the machines that the company has should be adapted to place the order at the lowest possible cost?

- 1) 8
- 2) None of the other options is correct.
- 3) 7
- 4) 17
- 5) 6

Exercise 9

Study the differentiability of the function $f(x) =$

$$\begin{cases} -e^{x+2} + \cos(x+2) - 5 & x \leq -2 \\ -(x(5 + \log(64))) + 3(x+3)\log(x+3) - 13 - 2\log(64) & -2 < x < 1 \\ -2x\log(x) - 17 + \log(64) & 1 \leq x \end{cases}$$

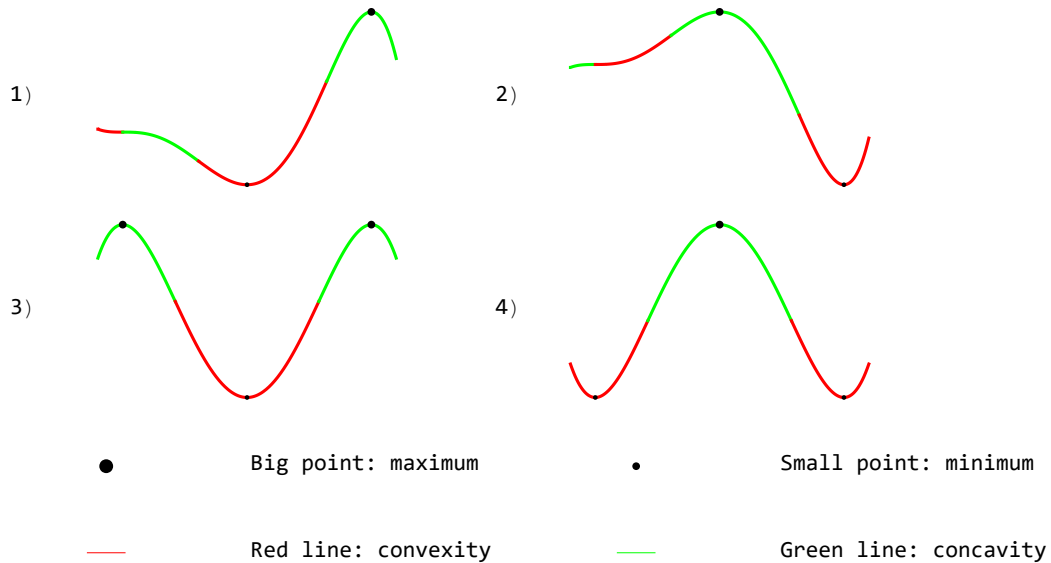
- 1) The function is differentiable for all points.
- 2) The function is not differentiable at any point.
- 3) The function is differentiable for all points except for $x = -2$.
- 4) The function is differentiable for all points except for $x = 1$.
- 5) The function is differentiable for all points except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

Mathematics 1 - ADE - English - 2026/2027

02-Derivatives for serial number: 3

Exercise 1

Study the shape properties of the $f(x) = 2 + 40x^3 - 45x^4 + 12x^5$ to decide which amongst the following ones is the representation of the function.



Indication: To find the maximum and minimum points of the function, try (with Ruffini) the points $-2, -1, 0, 1, 2$. To solve this exercise it is necessary to determine the increasing and decreasing intervals.

Exercise 2

Determine the derivative of the function $f(t) = t + 2(t+1) + 3$ and compute its value at the point $t=0$.

- 1) $f'(0) = 4$ 2) $f'(0) = 1$ 3) $f'(0) = 2$ 4) $f'(0) = 3$

Exercise 3

Compute the limit: $\lim_{x \rightarrow 0} \frac{-1 + e^{x^2} - x^2}{x^3}$

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

Exercise 4

Compute the limit: $\lim_{x \rightarrow 2} \frac{-16 + 16x - 4x^3 + x^4}{4x - 4x^2 + x^3}$

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

Exercise 5

Between the months $t=4$ and $t=10$

, the funds in certain account (in millions of euros) are given by the function $F(t) = -16 + 300t - 45t^2 + 2t^3$.

Determine the interval within the funds oscillates between months $t=7$ and $t=10$.

- 1) It oscillates between 484 and 609.
- 2) It oscillates between 488 and 572.
- 3) It oscillates between 494 and 575.
- 4) It oscillates between 484 and 609.
- 5) It oscillates between 484 and 565.

Exercise 6

In a fish farm, data of precedings years reveal that, if the initial number of fish is x (x in thousands), after one month they reproduce until a number of $f(x) = \frac{49x}{16 + 33x}$ fishes.

What number of fish leads to the largest increase in the number of animals, $f(x) - x$?

- 1) $\frac{4}{11}$
- 2) $\frac{29}{14}$
- 3) $\frac{18}{7}$
- 4) $\frac{14}{3}$
- 5) $\frac{7}{4}$

Exercise 7

The yield of a tree plantation is given by $f(x) =$

$$\frac{-46 + 34x + 23x^2}{29x^2}, \text{ where } x \text{ is the distance in meters between two trees.}$$

What is the distance x that leads to the largest yield.

- 1) $\frac{46}{17}$
- 2) $\frac{7}{4}$
- 3) $\frac{33}{20}$
- 4) $\frac{13}{14}$
- 5) $\frac{23}{18}$

Exercise 8

A plastic firm receives an order to manufacture 28812 special plastic foam boards for swimming training. The firm has 18 machines but each of them will be able to participate in the manufacturing of this special type of tables only after an adaptation so that each adapted machine is capable of manufacturing 49 boards per hour; on the other hand, the non adapted ones cannot be used for this special order. The cost to adapt each machine is 147 monetary units. Moreover, these adapted machines are automated and only need staff to supervise the production whose salary is 49 monetary units per hour. Taking into account the number of hours that will be necessary to produce the ordered tables, the cost in salaries for those hours, and the adaptation costs, how many of the machines that the company has should be adapted to place the order at the lowest possible cost?

- 1) None of the other options is correct.
- 2) 28
- 3) 18
- 4) 14
- 5) 2

Exercise 9

Study the differentiability of the function $f(x) = \begin{cases} -\sin(1-x) - 3 \cos(1-x) - 5 & x \leq 1 \\ -\frac{1}{6}(x-20)x - \frac{67}{6} & 1 < x < 4 \\ -2 \sin(4-x) - 3 \cos(4-x) + \frac{5}{2} & 4 \leq x \end{cases}$

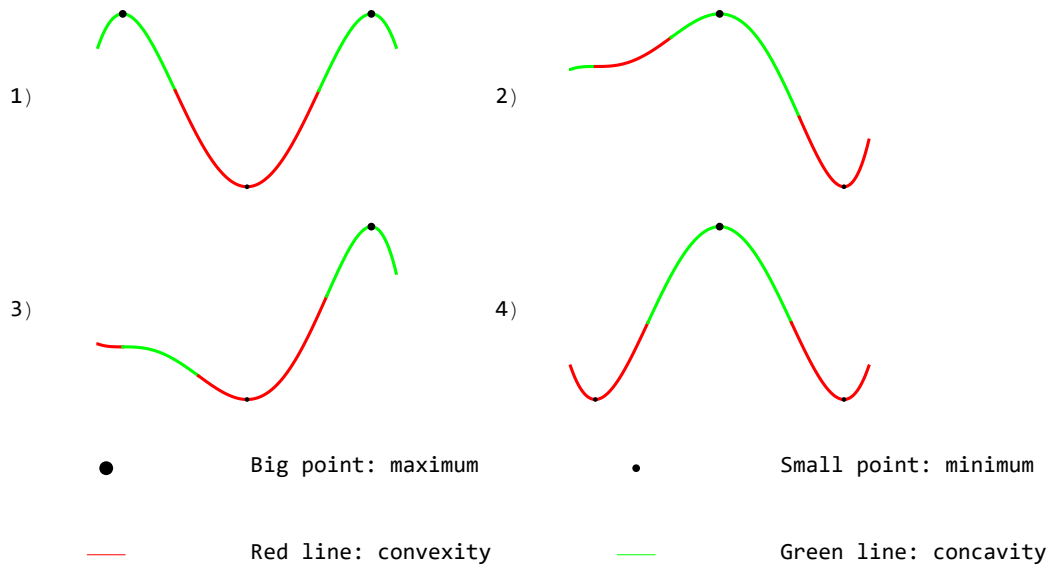
- 1) The function is differentiable for all points.
- 2) The function is not differentiable at any point.
- 3) The function is differentiable for all points except for $x=1$.
- 4) The function is differentiable for all points except for $x=4$.
- 5) The function is differentiable for all points except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

Mathematics 1 - ADE - English - 2026/2027

02-Derivatives for serial number: 4

Exercise 1

Study the shape properties of the $f(x) = 3 + 12x^2 + 12x^3 + 3x^4$ to decide which amongst the following ones is the representation of the function.



Indication: To find the maximum and minimum points of the function, try (with Ruffini) the points $-2, -1, 0, 1, 2$. To solve this exercise it is necessary to determine the increasing and decreasing intervals.

Exercise 2

Determine the derivative of the function $f(t) = 2 \log(\log(t+1) + 1) \sin(\cos(\log(t+1)))$ and compute its value at the point $t=0$.

- 1) $f'(0) = 1$ 2) $f'(0) = 2 \sin[1]$ 3) $f'(0) = -2$ 4) $f'(0) = -3$

Exercise 3

Compute the limit: $\lim_{x \rightarrow 0} \frac{-1 + e^{x^2} - x^2}{x^4}$

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

Exercise 4

Compute the limit: $\lim_{x \rightarrow -2} \frac{4x + 4x^2 + x^3}{12 + 16x + 7x^2 + x^3}$

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

Exercise 5

Between the months $t=0$ and $t=5$

, the funds in certain account (in millions of euros) are given by the function $F(t) = -12 + 48t - 18t^2 + 2t^3$.

Determine the interval within the funds oscillates between months $t=0$ and $t=1$.

- 1) It oscillates between 20 and 28.
- 2) It oscillates between -4 and 22.
- 3) It oscillates between -2 and 29.
- 4) It oscillates between -12 and 28.
- 5) It oscillates between -12 and 20.

Exercise 6

In a fish farm, data of precedings years reveal that, if the initial number of fish is x (x in thousands), after one month they reproduce until a number of $f(x) = \frac{27x}{12 + 43x}$ fishes.

What number of fish leads to the largest increase in the number of animals, $f(x) - x$?

- 1) $\frac{23}{2}$
- 2) $\frac{10}{7}$
- 3) $\frac{6}{43}$
- 4) 8
- 5) $\frac{7}{6}$

Exercise 7

The yield of a tree plantation is given by $f(x) =$

$$\frac{-25 + 39x + 18x^2}{40x^2}, \text{ where } x \text{ is the distance in meters between two trees.}$$

What is the distance x that leads to the largest yield.

- 1) $\frac{34}{7}$
- 2) $\frac{29}{4}$
- 3) $\frac{3}{5}$
- 4) 4
- 5) $\frac{50}{39}$

Exercise 8

A plastic firm receives an order to manufacture 7735 special plastic foam boards for swimming training. The firm has 8 machines but each of them will be able to participate in the manufacturing of this special type of tables only after an adaptation so that each adapted machine is capable of manufacturing 1105 boards per hour; on the other hand, the non adapted ones cannot be used for this special order. The cost to adapt each machine is 10 monetary units. Moreover, these adapted machines are automated and only need staff to supervise the production whose salary is 70 monetary units per hour. Taking into account the number of hours that will be necessary to produce the ordered tables, the cost in salaries for those hours, and the adaptation costs, how many of the machines that the company has should be adapted to place the order at the lowest possible cost?

- 1) 8
- 2) 13
- 3) 18
- 4) 22
- 5) None of the other options is correct.

Exercise 9

Study the differentiability of the function $f(x) = \begin{cases} -2(e^{x+1} + 1) - \cos(x+1) & x \leq -1 \\ \frac{3x^2}{2} + x - \frac{11}{2} & -1 < x < 0 \\ e^x - 3\cos(x) - \frac{7}{2} & 0 \leq x \end{cases}$

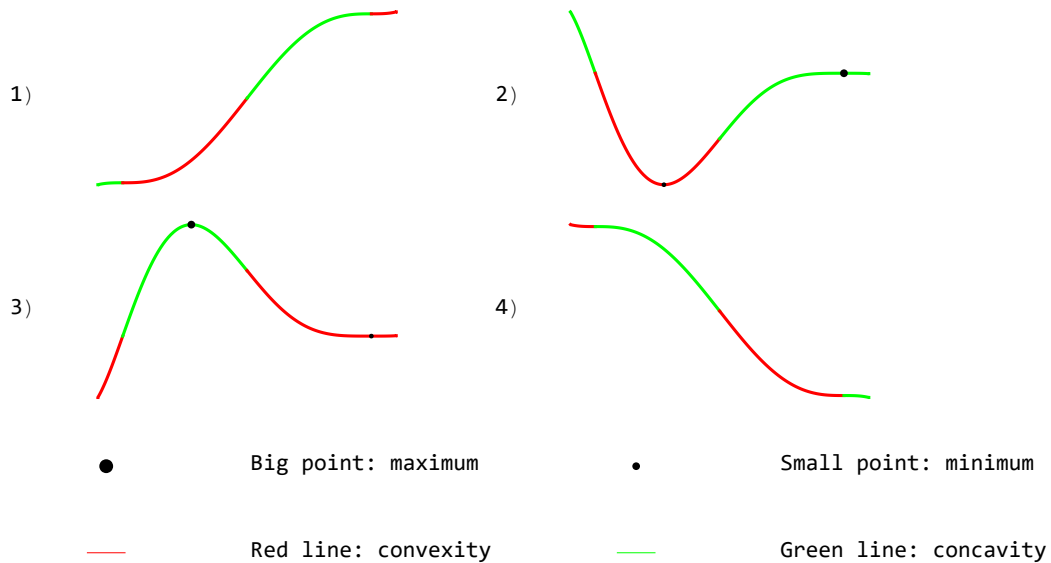
- 1) The function is differentiable for all points.
- 2) The function is not differentiable at any point.
- 3) The function is differentiable for all points except for $x = -1$.
- 4) The function is differentiable for all points except for $x = 0$.
- 5) The function is differentiable for all points except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

Mathematics 1 - ADE - English - 2026/2027

02-Derivatives for serial number: 5

Exercise 1

Study the shape properties of $f(x) = 5 + 10x^4 + 9x^5 + 2x^6$ to decide which amongst the following ones is the representation of the function.



Indication: To solve this exercise it is necessary to determine the concavity and convexity interval. To find the inflexion points separating the concavity and convexity intervals, check (by means of Ruffini) with the points $-2, -1, 0, 1, 2$.

Exercise 2

Determine the derivative of the function $f(t) = 2e^{e^t} + \log(t+1) + 2$ and compute its value at the point $t=0$.

- 1) $f'(0) = 1 + 2e$ 2) $f'(0) = 4$ 3) $f'(0) = 0$ 4) $f'(0) = 3$

Exercise 3

Compute the limit: $\lim_{x \rightarrow 0} \frac{-x^2 + \sin[x^2]}{x^4}$

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

Exercise 4

Compute the limit: $\lim_{x \rightarrow 2} \frac{-8 + 4x + 6x^2 - 5x^3 + x^4}{8 - 4x - 2x^2 + x^3}$

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

Exercise 5

Between the months $t=3$ and $t=7$

, the true value of the shares of a company (in euros) are given by the function $C(t) = 214 + 120t - 27t^2 + 2t^3$.

Determine the interval within the value oscillates between months $t=4$ and $t=7$.

- 1) It oscillates between 385 and 417.
- 2) It oscillates between 397 and 407.
- 3) It oscillates between 389 and 390.
- 4) It oscillates between 389 and 417.
- 5) It oscillates between 390 and 419.

Exercise 6

In a fish farm, data of precedings years reveal that, if the initial number of fish is x (x in thousands), after one month they reproduce until a number of $f(x) = \frac{45x}{20 + 13x}$ fishes.

What number of fish leads to the largest increase in the number of animals, $f(x) - x$?

- 1) $\frac{10}{13}$
- 2) $\frac{7}{4}$
- 3) $\frac{11}{20}$
- 4) $\frac{7}{4}$
- 5) 4

Exercise 7

The yield of a tree plantation is given by $f(x) =$

$$\frac{-13 + 22x + 43x^2}{30x^8}, \text{ where } x \text{ is the distance in meters between two trees.}$$

What is the distance x that leads to the largest yield.

- 1) $\frac{52}{129}$
- 2) $\frac{3}{2}$
- 3) $\frac{19}{9}$
- 4) $\frac{7}{4}$
- 5) $\frac{35}{16}$

Exercise 8

A plastic firm receives an order to manufacture 34391 special plastic foam boards for swimming training. The firm has 10 machines but each of them will be able to participate in the manufacturing of this special type of tables only after an adaptation so that each adapted machine is capable of manufacturing 119 boards per hour; on the other hand, the non adapted ones cannot be used for this special order. The cost to adapt each machine is 4913 monetary units. Moreover, these adapted machines are automated and only need staff to supervise the production whose salary is 833 monetary units per hour. Taking into account the number of hours that will be necessary to produce the ordered tables, the cost in salaries for those hours, and the adaptation costs, how many of the machines that the company has should be adapted to place the order at the lowest possible cost?

- 1) 7
- 2) 10
- 3) None of the other options is correct.
- 4) 19
- 5) 9

Exercise 9

Study the differentiability of the function $f(x) =$

$$\begin{cases} -2 \sin(2-x) - \cos(2-x) + 5 & x \leq 2 \\ 2x + \cos(2-x) - 1 & 2 < x < 4 \\ -2x + (x-3) \log(x-3) + 15 + \cos(2) & 4 \leq x \end{cases}$$

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

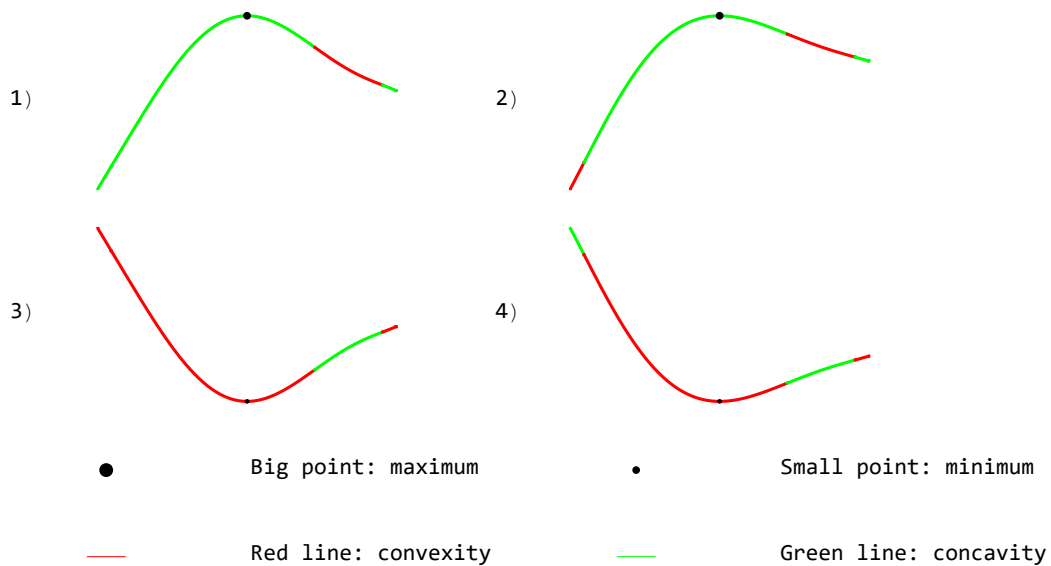
Mathematics 1 - ADE - English - 2026/2027

02-Derivatives for serial number: 6

Exercise 1

Study the shape properties of $f(x) = 1 + 24x^2 - 8x^3 - x^4 + \frac{3x^5}{5}$

to decide which amongst the following ones is the representation of the function.



Indication: To solve this exercise it is necessary to determine the concavity and convexity interval. To find the inflexion points separating the concavity and convexity intervals, check (by means of Ruffini) with the points $-2, -1, 0, 1, 2$.

Exercise 2

Determine the derivative of the function $f(t) = t^2 (\cos(t) + \cos(\cos(t)))$ and compute its value at the point $t=0$.

- 1) $f'(0) = -3$ 2) $f'(0) = 3$ 3) $f'(0) = 0$ 4) $f'(0) = 2$

Exercise 3

Compute the limit: $\lim_{x \rightarrow 1} \frac{\frac{11}{6} - 3x + \frac{3x^2}{2} - \frac{x^3}{3} + \text{Log}[x]}{1 - 4x + 6x^2 - 4x^3 + x^4}$

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

Exercise 4

Compute the limit: $\lim_{x \rightarrow -1} \frac{3 + 7x + 5x^2 + x^3}{x + 2x^2 + x^3}$

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

Exercise 5

Between the months $t=0$ and $t=6$

, the true value of the shares of a company (in euros) are given by the function $C(t) = 220 - 18t^2 + 2t^3$.

Determine the interval within the value oscillates between months $t=3$ and $t=4$.

- 1) It oscillates between 60 and 113.
- 2) It oscillates between 57 and 105.
- 3) It oscillates between 4 and 220.
- 4) It oscillates between 4 and 220.
- 5) It oscillates between 60 and 112.

Exercise 6

In a fish farm, data of precedings years reveal that, if the initial number of fish is x (x in thousands), after one month they reproduce until a number of $f(x) = \frac{32x}{18 + 8x}$ fishes.

What number of fish leads to the largest increase in the number of animals, $f(x) - x$?

1) 26

2) $\frac{3}{4}$

3) 3

4) $\frac{18}{5}$

5) 1

Exercise 7

The yield of a tree plantation is given by $f(x) =$

$$\frac{-12 + 30x + 21x^2}{8x^9}, \text{ where } x \text{ is the distance in meters between two trees.}$$

What is the distance x that leads to the largest yield.

1) $\frac{7}{19}$

2) 5

3) $\frac{7}{8}$

4) $\frac{18}{49}$

5) $\frac{29}{3}$

Exercise 8

A plastic firm receives an order to manufacture 1445 special plastic foam boards for swimming training. The firm has 19 machines but each of them will be able to participate in the manufacturing of this special type of tables only after an adaptation so that each adapted machine is capable of manufacturing 4 boards per hour; on the other hand, the non adapted ones cannot be used for this special order. The cost to adapt each machine is 20 monetary units. Moreover, these adapted machines are automated and only need staff to supervise the production whose salary is 16 monetary units per hour. Taking into account the number of hours that will be necessary to produce the ordered tables, the cost in salaries for those hours, and the adaptation costs, how many of the machines that the company has should be adapted to place the order at the lowest possible cost?

- 1) 17
- 2) 12
- 3) 16
- 4) None of the other options is correct.
- 5) 32

Exercise 9

Study the differentiability of the function $f(x) =$

$$\begin{cases} -\cos(x+3) - 2 & x \leq -3 \\ -(x(3 + \log(4))) + 2(x+4)\log(x+4) - 3(4 + \log(4)) & -3 < x < -2 \\ -e^{x+2} - 5 + \log(4) & -2 \leq x \end{cases}$$

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

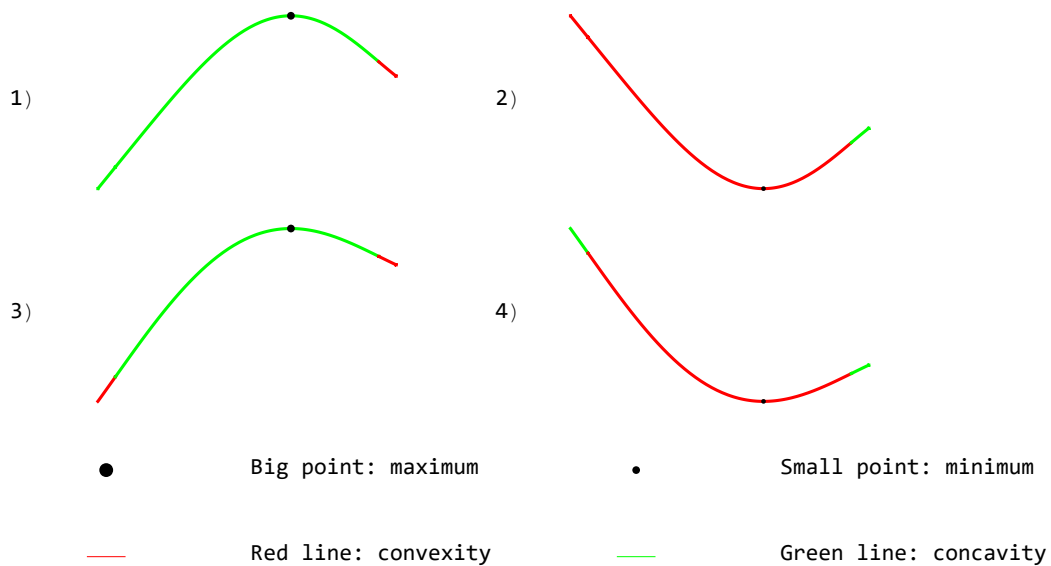
Mathematics 1 - ADE - English - 2026/2027

02-Derivatives for serial number: 7

Exercise 1

Study the shape properties of $f(x) = 2 - 24x^2 + 3x^4 + \frac{3x^5}{5}$

to decide which amongst the following ones is the representation of the function.



Indication: To solve this exercise it is necessary to determine the concavity and convexity interval. To find the inflexion points separating the concavity and convexity intervals, check (by means of Ruffini) with the points $-2, -1, 0, 1, 2$.

Exercise 2

Determine the derivative of the function $f(t) = -3 \sin(e^t) \sin^2(t)$ and compute its value at the point $t=0$.

- 1) $f'(0) = 0$ 2) $f'(0) = -2$ 3) $f'(0) = 3$ 4) $f'(0) = 2$

Exercise 3

Compute the limit: $\lim_{x \rightarrow 0} \frac{-1 + \cos[x^3]}{x^5}$

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

Exercise 4

Compute the limit: $\lim_{x \rightarrow -3} \frac{3x + x^2}{-3 + 2x + x^2}$

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

Exercise 5

Between the months $t=3$ and $t=8$

, the true value of the shares of a company (in euros) are given by the function $C(t) = 188 + 120t - 27t^2 + 2t^3$.

Determine the interval within the value oscillates between months $t=3$ and $t=4$.

- 1) It oscillates between 359 and 364.
- 2) It oscillates between 368 and 354.
- 3) It oscillates between 363 and 364.
- 4) It oscillates between 355 and 359.
- 5) It oscillates between 359 and 444.

Exercise 6

In a fish farm, data of precedings years reveal that, if the initial number of fish is x (x in thousands), after one month they reproduce until a number of $f(x) = \frac{9x}{1+32x}$ fishes.

What number of fish leads to the largest increase in the number of animals, $f(x) - x$?

- 1) $\frac{10}{17}$
- 2) $\frac{39}{14}$
- 3) $\frac{1}{16}$
- 4) $\frac{29}{6}$
- 5) $\frac{11}{14}$

Exercise 7

The yield of a tree plantation is given by $f(x) =$

$$\frac{-15 + 26x + 42x^2}{7x^4}, \text{ where } x \text{ is the distance in meters between two trees.}$$

What is the distance x that leads to the largest yield.

- 1) $\frac{31}{17}$
- 2) $\frac{39}{19}$
- 3) $\frac{29}{13}$
- 4) $\frac{1}{2}$
- 5) $\frac{39}{19}$

Exercise 8

A plastic firm receives an order to manufacture 3332 special plastic foam boards for swimming training. The firm has 13 machines but each of them will be able to participate in the manufacturing of this special type of tables only after an adaptation so that each adapted machine is capable of manufacturing 35 boards per hour; on the other hand, the non adapted ones cannot be used for this special order. The cost to adapt each machine is 935 monetary units. Moreover, these adapted machines are automated and only need staff to supervise the production whose salary is 1925 monetary units per hour. Taking into account the number of hours that will be necessary to produce the ordered tables, the cost in salaries for those hours, and the adaptation costs, how many of the machines that the company has should be adapted to place the order at the lowest possible cost?

- 1) 13
- 2) None of the other options is correct.
- 3) 9
- 4) 2
- 5) 14

Exercise 9

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

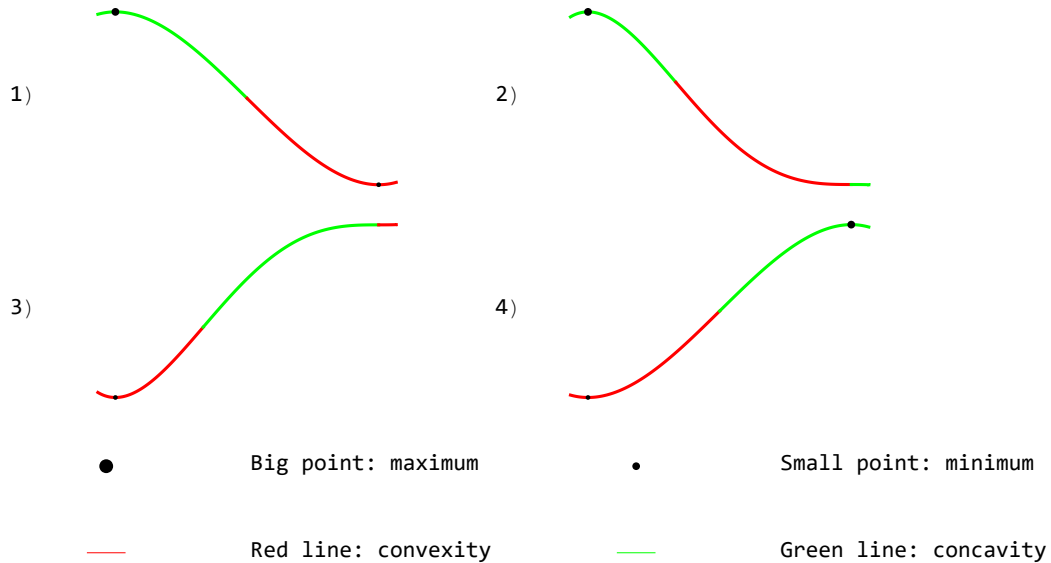
- 1) The function is differentiable for all points.
- 2) The function is not differentiable at any point.
- 3) The function is differentiable for all points except for $x=1$.
- 4) The function is differentiable for all points except for $x=2$.
- 5) The function is differentiable for all points except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

Mathematics 1 - ADE - English - 2026/2027

02-Derivatives for serial number: 8

Exercise 1

Study the shape properties of the $f(x) = 5 + 24x - 18x^2 + 3x^4$ to decide which amongst the following ones is the representation of the function.



Indication: To find the maximum and minimum points of the function, try (with Ruffini) the points $-2, -1, 0, 1, 2$. To solve this exercise it is necessary to determine the increasing and decreasing intervals.

Exercise 2

Determine the derivative of the function $f(t) = \sin(\log(\sin(t) + 1)) \cos(\log(\sin(t) + 1))$ and compute its value at the point $t=0$.

- 1) $f'(0) = -1$ 2) $f'(0) = 2$ 3) $f'(0) = -4$ 4) $f'(0) = 1$

Exercise 3

Compute the limit: $\lim_{x \rightarrow 0} \frac{-x + \sin[x]}{x^3}$

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

Exercise 4

Compute the limit: $\lim_{x \rightarrow -1} \frac{-3 - 8x - 6x^2 + x^4}{2 + 5x + 4x^2 + x^3}$

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

Exercise 5

Between the months $t=1$ and $t=5$

, the funds in certain account (in millions of euros) are given by the function $F(t) = 14 + 72t - 21t^2 + 2t^3$.

Determine the interval within the funds oscillates between months $t=1$ and $t=4$.

- 1) It oscillates between 67 and 99.
- 2) It oscillates between 72 and 99.
- 3) It oscillates between 94 and 95.
- 4) It oscillates between 67 and 95.
- 5) It oscillates between 70 and 90.

Exercise 6

In a fish farm, data of precedings years reveal that, if the initial number of fish is x (x in thousands), after one month they reproduce until a number of $f(x) = \frac{50x}{32 + 12x}$ fishes.

What number of fish leads to the largest increase in the number of animals, $f(x) - x$?

- 1) 8
- 2) $\frac{8}{3}$
- 3) $\frac{2}{3}$
- 4) $\frac{19}{2}$
- 5) $\frac{2}{7}$

Exercise 7

The yield of a tree plantation is given by $f(x) =$

$$\frac{-2 + 35x + 27x^2}{41x^2}, \text{ where } x \text{ is the distance in meters between two trees.}$$

What is the distance x that leads to the largest yield.

- 1) $\frac{3}{5}$
- 2) 1
- 3) $\frac{4}{35}$
- 4) $\frac{3}{2}$
- 5) $\frac{3}{13}$

Exercise 8

A plastic firm receives an order to manufacture 2601 special plastic foam boards for swimming training. The firm has 19 machines but each of them will be able to participate in the manufacturing of this special type of tables only after an adaptation so that each adapted machine is capable of manufacturing 26 boards per hour; on the other hand, the non adapted ones cannot be used for this special order. The cost to adapt each machine is 99 monetary units. Moreover, these adapted machines are automated and only need staff to supervise the production whose salary is 286 monetary units per hour. Taking into account the number of hours that will be necessary to produce the ordered tables, the cost in salaries for those hours, and the adaptation costs, how many of the machines that the company has should be adapted to place the order at the lowest possible cost?

- 1) 19
- 2) 11
- 3) 32
- 4) None of the other options is correct.
- 5) 7

Exercise 9

Study the differentiability of the function $f(x) =$

$$f(x) = \begin{cases} e^{x-1} + 3 & x \leq 1 \\ -2 \sin(1-x) + 3 \cos(1-x) + x(2 + 3 \sin(1) - 2 \cos(1)) - 1 - 3 \sin(1) + 2 \cos(1) & 1 < x < 2 \\ 2e^{x-2} - 3 \cos(2-x) + 4 + 5 \sin(1) + \cos(1) & 2 \leq x \end{cases}$$

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

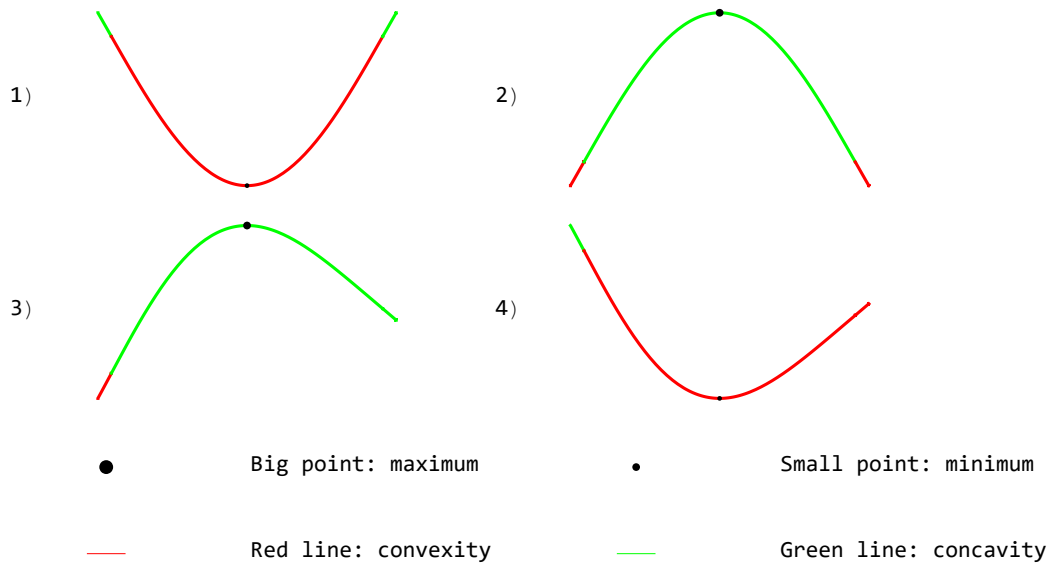
Mathematics 1 - ADE - English - 2026/2027

02-Derivatives for serial number: 9

Exercise 1

Study the shape properties of $f(x) = 1 + 48x^2 - 8x^3 - 2x^4 + \frac{3x^5}{5}$

to decide which amongst the following ones is the representation of the function.



Indication: To solve this exercise it is necessary to determine the concavity and convexity interval. To find the inflexion points separating the concavity and convexity intervals, check (by means of Ruffini) with the points $-2, -1, 0, 1, 2$.

Exercise 2

Determine the derivative of the function $f(t) =$

$3 \sin^2(t) \log(\sin(t) + 1) \cos(\sin(t))$ and compute its value at the point $t=0$.

- 1) $f'(0) = -3$ 2) $f'(0) = 1$ 3) $f'(0) = 0$ 4) $f'(0) = -4$

Exercise 3

Compute the limit: $\lim_{x \rightarrow 1} \frac{\frac{25}{4} - 12x + 9x^2 - 4x^3 + \frac{3x^4}{4} + \text{Log}[x^3]}{-1 + 5x - 10x^2 + 10x^3 - 5x^4 + x^5}$

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

Exercise 4

Compute the limit: $\lim_{x \rightarrow 3} \frac{27 - 9x - 3x^2 + x^3}{-18 + 21x - 8x^2 + x^3}$

- 1) 0
- 2) $-\infty$
- 3) 6
- 4) ∞
- 5) -1
- 6) 1
- 7) -2

Exercise 5

Between the months $t=0$ and $t=5$

, the true value of the shares of a company (in euros) are given by the function $C(t) = 7 + 72t - 21t^2 + 2t^3$.

Determine the interval within the value oscillates between months $t=3$ and $t=4$.

- 1) It oscillates between 77 and 90.
- 2) It oscillates between 89 and 93.
- 3) It oscillates between 87 and 88.
- 4) It oscillates between 82 and 85.
- 5) It oscillates between 7 and 92.

Exercise 6

In a fish farm, data of precedings years reveal that, if the initial number of fish is x (x in thousands), after one month they reproduce until a number of $f(x) = \frac{18x}{2+x}$ fishes.

What number of fish leads to the largest increase in the number of animals, $f(x) - x$?

- 1) 4
- 2) 2
- 3) $\frac{35}{12}$
- 4) $\frac{17}{7}$
- 5) $\frac{2}{9}$

Exercise 7

The yield of a tree plantation is given by $f(x) =$

$$\frac{-22 + 12x + 18x^2}{38x^6}, \text{ where } x \text{ is the distance in meters between two trees.}$$

What is the distance x that leads to the largest yield.

- 1) $\frac{1}{9}$
- 2) 1
- 3) $\frac{17}{13}$
- 4) $\frac{29}{6}$
- 5) $\frac{19}{15}$

Exercise 8

A plastic firm receives an order to manufacture 7098 special plastic foam boards for swimming training. The firm has 9 machines but each of them will be able to participate in the manufacturing of this special type of tables only after an adaptation so that each adapted machine is capable of manufacturing 13 boards per hour; on the other hand, the non adapted ones cannot be used for this special order. The cost to adapt each machine is 2366 monetary units. Moreover, these adapted machines are automated and only need staff to supervise the production whose salary is 156 monetary units per hour. Taking into account the number of hours that will be necessary to produce the ordered tables, the cost in salaries for those hours, and the adaptation costs, how many of the machines that the company has should be adapted to place the order at the lowest possible cost?

- 1) None of the other options is correct.
- 2) 9
- 3) 9
- 4) 8
- 5) 16

Exercise 9

Study the differentiability of the function $f(x) = \begin{cases} -2e^{x+2} + 2\cos(x+2) + 5 & x \leq -2 \\ \frac{1}{3}((x-2)x+7) & -2 < x < 1 \\ 9 - 3\cos(1-x) & 1 \leq x \end{cases}$

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

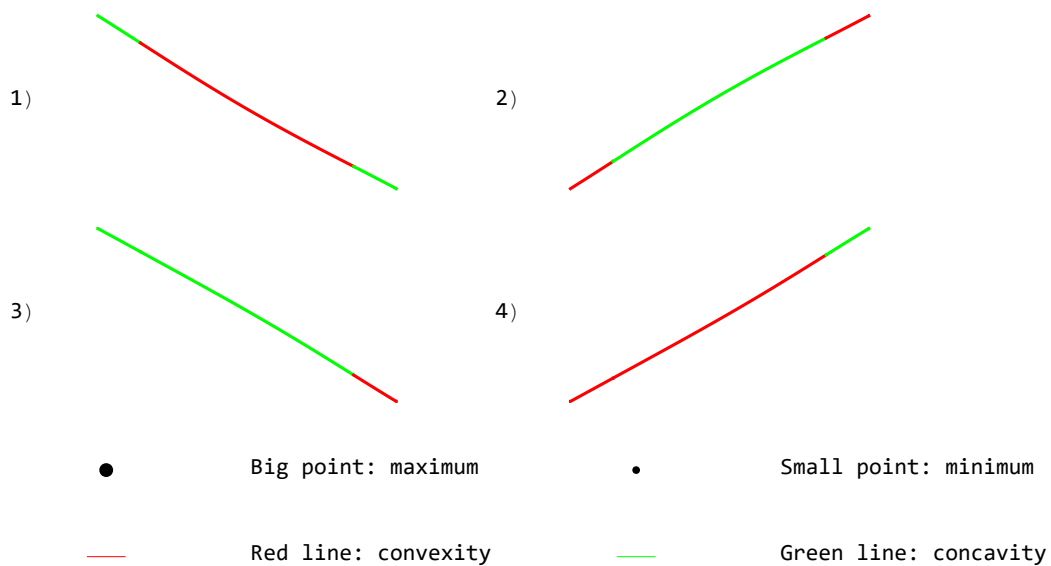
Mathematics 1 - ADE - English - 2026/2027

02-Derivatives for serial number: 10

Exercise 1

Study the shape properties of $f(x) = 5 + 6x^2 - 3x^3 + \frac{x^4}{2}$

to decide which amongst the following ones is the representation of the function.



Indication: To solve this exercise it is necessary to determine the concavity and convexity interval. To find the inflexion points separating the concavity and convexity intervals, check (by means of Ruffini) with the points -2, -1, 0, 1, 2.

Exercise 2

Determine the derivative of the function $f(t) = 3 \log(t+1)$ and compute its value at the point $t=0$.

- 1) $f'(0) = -2$ 2) $f'(0) = -3$ 3) $f'(0) = -1$ 4) $f'(0) = 3$

Exercise 3

Compute the limit: $\lim_{x \rightarrow 0} \frac{-1 + e^{x^3} - x^3}{x^4}$

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

Exercise 4

Compute the limit: $\lim_{x \rightarrow 3} \frac{-27 + 18x^2 - 8x^3 + x^4}{-9 + 15x - 7x^2 + x^3}$

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

Exercise 5

Between the months $t=4$ and $t=11$

, the true value of the shares of a company (in euros) are given by the function $C(t) = 459 + 330t - 48t^2 + 2t^3$.

Determine the interval within the value oscillates between months $t=8$ and $t=9$.

- 1) It oscillates between 943 and 1159.
- 2) It oscillates between 999 and 1051.
- 3) It oscillates between 1002 and 1059.
- 4) It oscillates between 943 and 1159.
- 5) It oscillates between 990 and 1045.

Exercise 6

In a fish farm, data of precedings years reveal that, if the initial number of fish is x (x in thousands), after one month they reproduce until a number of $f(x) = \frac{48x}{27 + 6x}$ fishes.

What number of fish leads to the largest increase in the number of animals, $f(x) - x$?

- 1) $\frac{39}{10}$
- 2) 1
- 3) $\frac{3}{2}$
- 4) 4
- 5) $\frac{17}{13}$

Exercise 7

The yield of a tree plantation is given by $f(x) =$

$$\frac{-34 + 12x + 36x^2}{30x^6}, \text{ where } x \text{ is the distance in meters between two trees.}$$

What is the distance x that leads to the largest yield.

- 1) $\frac{5}{4}$
- 2) 1
- 3) $\frac{37}{10}$
- 4) $\frac{23}{10}$
- 5) $\frac{11}{13}$

Exercise 8

A plastic firm receives an order to manufacture 65637 special plastic foam boards for swimming training. The firm has 12 machines but each of them will be able to participate in the manufacturing of this special type of tables only after an adaptation so that each adapted machine is capable of manufacturing 11 boards per hour; on the other hand, the non adapted ones cannot be used for this special order. The cost to adapt each machine is 63869 monetary units. Moreover, these adapted machines are automated and only need staff to supervise the production whose salary is 867 monetary units per hour. Taking into account the number of hours that will be necessary to produce the ordered tables, the cost in salaries for those hours, and the adaptation costs, how many of the machines that the company has should be adapted to place the order at the lowest possible cost?

- 1) 9
- 2) 4
- 3) None of the other options is correct.
- 4) 12
- 5) 24

Exercise 9

Study the differentiability of the function $f(x) = \begin{cases} 2 \sin(1-x) - 3 \cos(1-x) - 4 & x \leq 1 \\ -3(x+2) + e^{x-1} + \cos(1-x) & 1 < x < 2 \\ \sin(2-x) + e - 12 + \cos(1) & 2 \leq x \end{cases}$

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

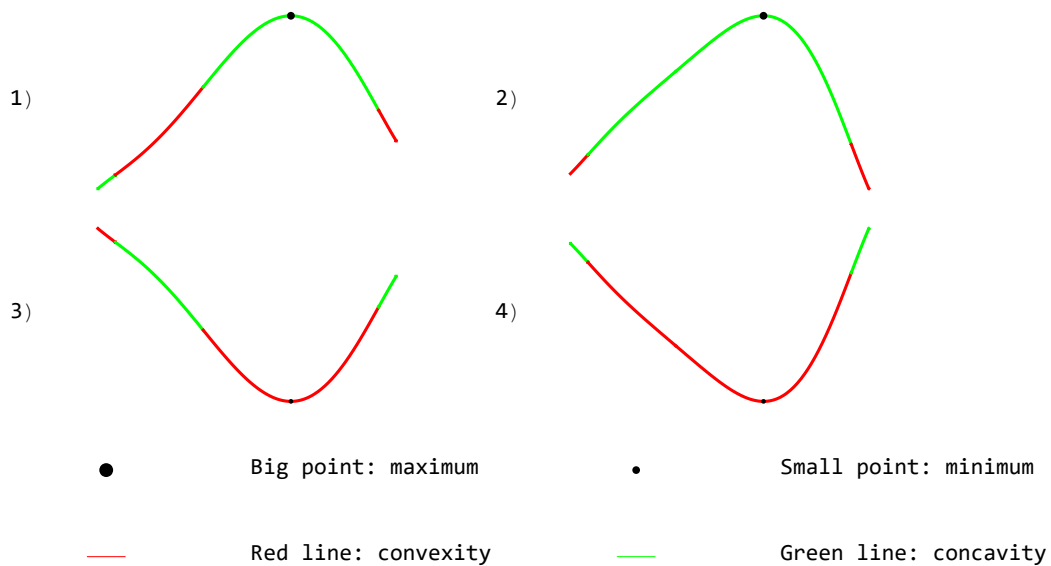
Mathematics 1 - ADE - English - 2026/2027

02-Derivatives for serial number: 11

Exercise 1

Study the shape properties of $f(x) = 2 - 12x^2 - 2x^3 + 2x^4 + \frac{3x^5}{5}$

to decide which amongst the following ones is the representation of the function.



Indication: To solve this exercise it is necessary to determine the concavity and convexity interval. To find the inflexion points separating the concavity and convexity intervals, check (by means of Ruffini) with the points $-2, -1, 0, 1, 2$.

Exercise 2

Determine the derivative of the function $f(t) = -\sin(\cos(t))$ and compute its value at the point $t=0$.

- 1) $f'(0) = 2$ 2) $f'(0) = 0$ 3) $f'(0) = 4$ 4) $f'(0) = -3$

Exercise 3

Compute the limit: $\lim_{x \rightarrow 0} \frac{-1 + \cos[x]}{x^2}$

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

Exercise 4

Compute the limit: $\lim_{x \rightarrow 1} \frac{-3 + 2x + x^2}{2 - 3x + x^2}$

- 1) 0
- 2) -2
- 3) -4
- 4) 1
- 5) $-\infty$
- 6) ∞
- 7) -1

Exercise 5

Between the months $t=1$ and $t=7$

, the true value of the shares of a company (in euros) are given by the function $C(t) = 26 + 24t - 15t^2 + 2t^3$.

Determine the interval within the value oscillates between months $t=3$ and $t=5$.

- 1) It oscillates between 10 and 21.
- 2) It oscillates between 10 and 37.
- 3) It oscillates between 12 and 13.
- 4) It oscillates between 10 and 145.
- 5) It oscillates between 16 and 27.

Exercise 6

In a fish farm, data of precedings years reveal that, if the initial number of fish is x (x in thousands), after one month they reproduce until a number of $f(x) = \frac{50x}{8+4x}$ fishes.

What number of fish leads to the largest increase in the number of animals, $f(x) - x$?

- 1) $\frac{11}{12}$
- 2) 3
- 3) $\frac{2}{3}$
- 4) $\frac{25}{16}$
- 5) $\frac{19}{8}$

Exercise 7

The yield of a tree plantation is given by $f(x) =$

$$\frac{-10 + 5x + 8x^2}{31x^7}, \text{ where } x \text{ is the distance in meters between two trees.}$$

What is the distance x that leads to the largest yield.

- 1) 1
- 2) $\frac{11}{6}$
- 3) 2
- 4) $\frac{25}{7}$
- 5) $\frac{38}{7}$

Exercise 8

A plastic firm receives and order to manufacture 54978 special plastic foam boards for swimming training. The firm have 11 machines but each of them will be able to participate in the manufacturing of this special type of tables only after an adaptation so that each adapted machine is capable of manufacturing 51 boards per hour; on the other hand, the non adapted ones cannot be used for this special order. The cost to adapt each machine is 374 monetary units. Moreover, these adapted machines are automated and only need staff to supervise the production whose salary is 68 monetary units per hour. Taking into account the number of hours that will be necessary to produce the ordered tables, the cost in salaries for those hours, and the adaptation costs, how many of the machines that the company has should be adapted to place the order at the lowest possible cost?

- 1) None of the other options is correct.
- 2) 29
- 3) 23
- 4) 25
- 5) 11

Exercise 9

Study the differentiability of the function $f(x) =$

$$\begin{cases} 2 \sin(3-x) - 3 \cos(3-x) + 1 & x \leq 3 \\ x \log\left(\frac{x-2}{3}\right) - 2 \log(x-2) - 2 + \log(27) & 3 < x < 5 \\ e^{x-5} - \cos(5-x) - 2 + \log(3) & 5 \leq x \end{cases}$$

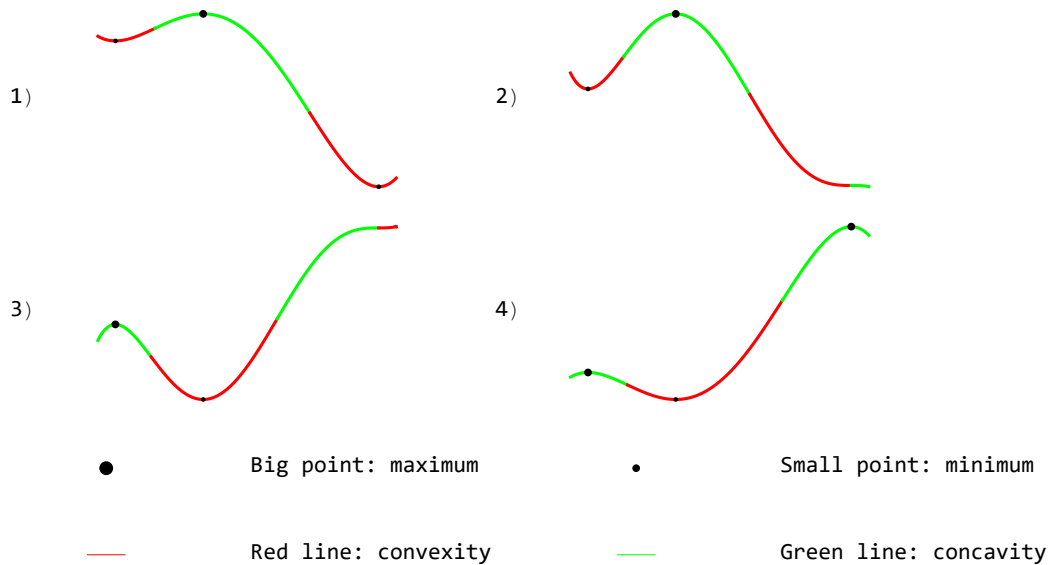
- 1) The function is differentiable for all points.
- 2) The function is not differentiable at any point.
- 3) The function is differentiable for all points except for $x=3$.
- 4) The function is differentiable for all points except for $x=5$.
- 5) The function is differentiable for all points except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

Mathematics 1 - ADE - English - 2026/2027

02-Derivatives for serial number: 12

Exercise 1

Study the shape properties of the $f(x) = 5 + 120x - 30x^2 - 60x^3 + 15x^4 + 12x^5$ to decide which amongst the following ones is the representation of the function.



Indication: To find the maximum and minimum points of the function, try (with Ruffini) the points $-2, -1, 0, 1, 2$. To solve this exercise it is necessary to determine the increasing and decreasing intervals.

Exercise 2

Determine the derivative of the function $f(t) = 2e^t \sin(t)$ and compute its value at the point $t=0$.

- 1) $f'(0) = 2$ 2) $f'(0) = -2$ 3) $f'(0) = 1$ 4) $f'(0) = -3$

Exercise 3

Compute the limit: $\lim_{x \rightarrow 0} \frac{-x^2 + \sin[x^2]}{x^4}$

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

Exercise 4

Compute the limit: $\lim_{x \rightarrow 2} \frac{-12 + 16x - 7x^2 + x^3}{8 - 4x - 2x^2 + x^3}$

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

Exercise 5

Between the months $t=4$ and $t=11$

, the funds in certain account (in millions of euros) are given by the function $F(t) = -19 + 480t - 54t^2 + 2t^3$.

Determine the interval within the funds oscillates between months $t=4$ and $t=5$.

- 1) It oscillates between 1172 and 1275.
- 2) It oscillates between 1165 and 1389.
- 3) It oscillates between 1381 and 1389.
- 4) It oscillates between 1165 and 1281.
- 5) It oscillates between 1155 and 1272.

Exercise 6

In a fish farm, data of precedings years reveal that, if the initial number of fish is x (x in thousands), after one month they reproduce until a number of $f(x) = \frac{9x}{1+40x}$ fishes.

What number of fish leads to the largest increase in the number of animals, $f(x)-x$?

- 1) $\frac{13}{4}$
- 2) $\frac{5}{3}$
- 3) $\frac{1}{7}$
- 4) $\frac{1}{3}$
- 5) $\frac{1}{20}$

Exercise 7

The yield of a tree plantation is given by $f(x) =$

$$\frac{-10 + 46x + 38x^2}{28x^2}, \text{ where } x \text{ is the distance in meters between two trees.}$$

What is the distance x that leads to the largest yield.

- 1) $\frac{5}{17}$
- 2) $\frac{10}{23}$
- 3) $\frac{39}{20}$
- 4) $\frac{31}{17}$
- 5) $\frac{1}{14}$

Exercise 8

A plastic firm receives an order to manufacture 1080

special plastic foam boards for swimming training. The firm has

13 machines but each of them will be able to participate

in the manufacturing of this special type of tables only after an

adaptation so that each adapted machine is capable of manufacturing

18 boards per hour; on the other hand, the non adapted ones cannot be

used for this special order. The cost to adapt each machine is

35 monetary units. Moreover, these adapted machines are automated and

only need staff to supervise the production whose salary is 21

monetary units per hour. Taking into account the number of hours that will be

necessary to produce the ordered tables, the cost in salaries for those

hours, and the adaptation costs, how many of the machines that the company

has should be adapted to place the order at the lowest possible cost?

- 1) 8
- 2) 12
- 3) 13
- 4) None of the other options is correct.
- 5) 21

Exercise 9

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

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

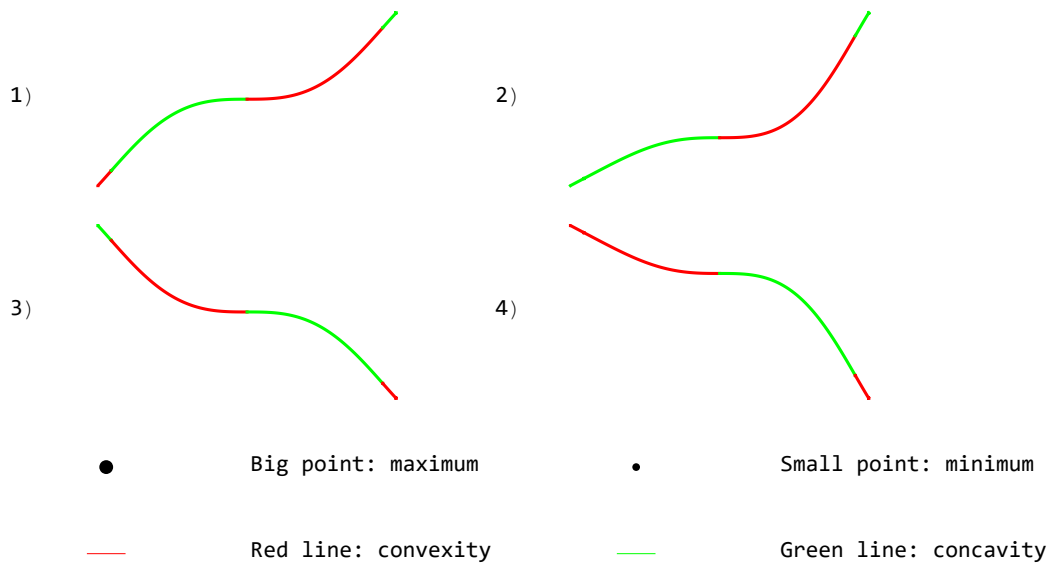
Mathematics 1 - ADE - English - 2026/2027

02-Derivatives for serial number: 13

Exercise 1

Study the shape properties of $f(x) = 2 - 8x^3 + \frac{3x^5}{5}$

to decide which amongst the following ones is the representation of the function.



Indication: To solve this exercise it is necessary to determine the concavity and convexity interval. To find the inflexion points separating the concavity and convexity intervals, check (by means of Ruffini) with the points $-2, -1, 0, 1, 2$.

Exercise 2

Determine the derivative of the function $f(t) = 3e^{t^2} + 2\sin(t^2)$ and compute its value at the point $t=0$.

- 1) $f'(0) = -1$ 2) $f'(0) = 0$ 3) $f'(0) = 4$ 4) $f'(0) = 2$

Exercise 3

Compute the limit: $\lim_{x \rightarrow 0} \frac{-1 + e^{x^2} - x^2 - \frac{x^4}{2}}{x^5}$

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

Exercise 4

Compute the limit: $\lim_{x \rightarrow 2} \frac{-8 + 4x + 6x^2 - 5x^3 + x^4}{-4 + 8x - 5x^2 + x^3}$

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

Exercise 5

Between the months $t=0$ and $t=6$

, the true value of the shares of a company (in euros) are given by the function $C(t) = 134 - 15t^2 + 2t^3$.

Determine the interval within the value oscillates between months $t=0$ and $t=1$.

- 1) It oscillates between 9 and 134.
- 2) It oscillates between 116 and 125.
- 3) It oscillates between 121 and 134.
- 4) It oscillates between 9 and 134.
- 5) It oscillates between 123 and 126.

Exercise 6

In a fish farm, data of precedings years reveal that, if the initial number of fish is x (x in thousands), after one month they reproduce until a number of $f(x) = \frac{49x}{36+x}$ fishes.

What number of fish leads to the largest increase in the number of animals, $f(x) - x$?

- 1) 6
- 2) $\frac{27}{17}$
- 3) $\frac{29}{9}$
- 4) $\frac{5}{8}$
- 5) $\frac{11}{5}$

Exercise 7

The yield of a tree plantation is given by $f(x) =$

$$\frac{-10 + 12x + 24x^2}{30x^9}, \text{ where } x \text{ is the distance in meters between two trees.}$$

What is the distance x that leads to the largest yield.

- 1) $\frac{34}{11}$
- 2) $\frac{1}{2}$
- 3) $\frac{9}{16}$
- 4) $\frac{40}{9}$
- 5) $\frac{27}{2}$

Exercise 8

A plastic firm receives an order to manufacture 18200 special plastic foam boards for swimming training. The firm has 25 machines but each of them will be able to participate in the manufacturing of this special type of tables only after an adaptation so that each adapted machine is capable of manufacturing 455 boards per hour; on the other hand, the non adapted ones cannot be used for this special order. The cost to adapt each machine is 22 monetary units. Moreover, these adapted machines are automated and only need staff to supervise the production whose salary is 55 monetary units per hour. Taking into account the number of hours that will be necessary to produce the ordered tables, the cost in salaries for those hours, and the adaptation costs, how many of the machines that the company has should be adapted to place the order at the lowest possible cost?

- 1) 2
- 2) 10
- 3) 15
- 4) 25
- 5) None of the other options is correct.

Exercise 9

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

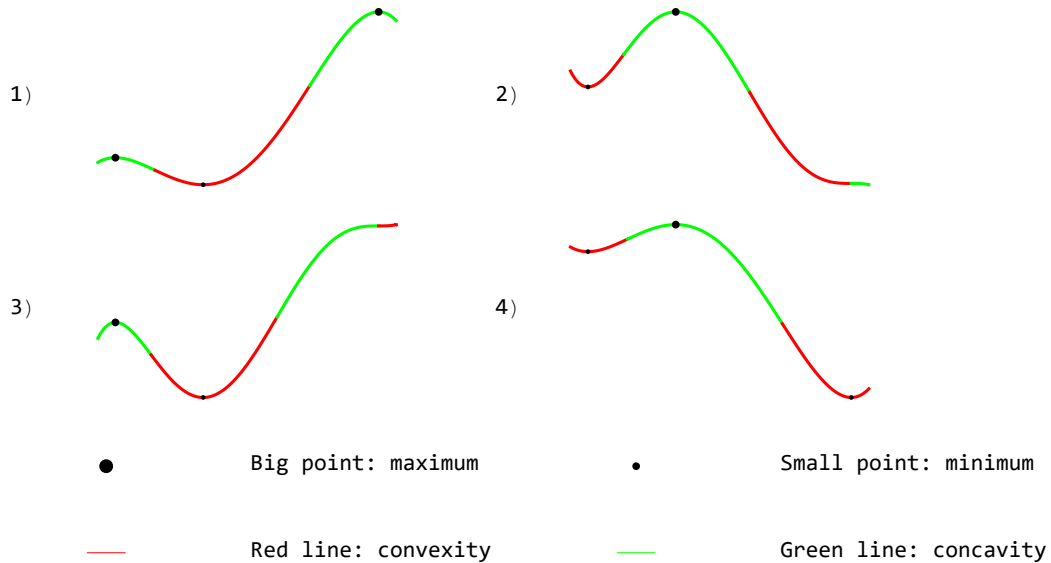
- 1) The function is differentiable for all points.
- 2) The function is not differentiable at any point.
- 3) The function is differentiable for all points except for $x = -3$.
- 4) The function is differentiable for all points except for $x = 0$.
- 5) The function is differentiable for all points except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

Mathematics 1 - ADE - English - 2026/2027

02-Derivatives for serial number: 14

Exercise 1

Study the shape properties of the $f(x) = 5 - 24x - 6x^2 + 8x^3 + 3x^4$ to decide which amongst the following ones is the representation of the function.



Indication: To find the maximum and minimum points of the function, try (with Ruffini) the points $-2, -1, 0, 1, 2$. To solve this exercise it is necessary to determine the increasing and decreasing intervals.

Exercise 2

Determine the derivative of the function $f(t) = \cos^2(t) + e^{\cos(t)} - 2\sin(\cos(t))$ and compute its value at the point $t=0$.

- 1) $f'(0) = 4$ 2) $f'(0) = 2$ 3) $f'(0) = 0$ 4) $f'(0) = 3$

Exercise 3

Compute the limit: $\lim_{x \rightarrow 0} \frac{-1 + e^{x^2} - x^2 - \frac{x^4}{2}}{x^5}$

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

Exercise 4

Compute the limit: $\lim_{x \rightarrow -2} \frac{-12 - 8x + x^2 + x^3}{-4 + x^2}$

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

Exercise 5

Between the months $t=4$ and $t=10$

, the funds in certain account (in millions of euros) are given by the function $F(t) = 4 + 120t - 27t^2 + 2t^3$.

Determine the interval within the funds oscillates between months $t=5$ and $t=6$.

- 1) It oscillates between 185 and 191.
- 2) It oscillates between 179 and 180.
- 3) It oscillates between 173 and 184.
- 4) It oscillates between 179 and 504.
- 5) It oscillates between 179 and 184.

Exercise 6

In a fish farm, data of precedings years reveal that, if the initial number of fish is x (x in thousands), after one month they reproduce until a number of $f(x) = \frac{45x}{20 + 11x}$ fishes.

What number of fish leads to the largest increase in the number of animals, $f(x) - x$?

- 1) $\frac{3}{2}$
- 2) $\frac{10}{11}$
- 3) 4
- 4) $\frac{34}{3}$
- 5) $\frac{7}{6}$

Exercise 7

The yield of a tree plantation is given by $f(x) =$

$$\frac{-29 + 43x + 34x^2}{14x^2}, \text{ where } x \text{ is the distance in meters between two trees.}$$

What is the distance x that leads to the largest yield.

- 1) $\frac{5}{8}$
- 2) $\frac{58}{43}$
- 3) $\frac{7}{3}$
- 4) $\frac{1}{3}$
- 5) $\frac{22}{5}$

Exercise 8

A plastic firm receives an order to manufacture 30855 special plastic foam boards for swimming training. The firm has 14 machines but each of them will be able to participate in the manufacturing of this special type of tables only after an adaptation so that each adapted machine is capable of manufacturing 5 boards per hour; on the other hand, the non adapted ones cannot be used for this special order. The cost to adapt each machine is 1815 monetary units. Moreover, these adapted machines are automated and only need staff to supervise the production whose salary is 85 monetary units per hour. Taking into account the number of hours that will be necessary to produce the ordered tables, the cost in salaries for those hours, and the adaptation costs, how many of the machines that the company has should be adapted to place the order at the lowest possible cost?

- 1) 17
- 2) None of the other options is correct.
- 3) 2
- 4) 2
- 5) 14

Exercise 9

Study the differentiability of the function $f(x) =$

$$\begin{cases} -2e^x + 2\cos(x) + 3 & x \leq 0 \\ -3x + \sin(x) - 2\cos(x) + 5 & 0 < x < 3 \\ e^{x-3} + \cos(3-x) - 6 + \sin(3) - 2\cos(3) & 3 \leq x \end{cases}$$

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

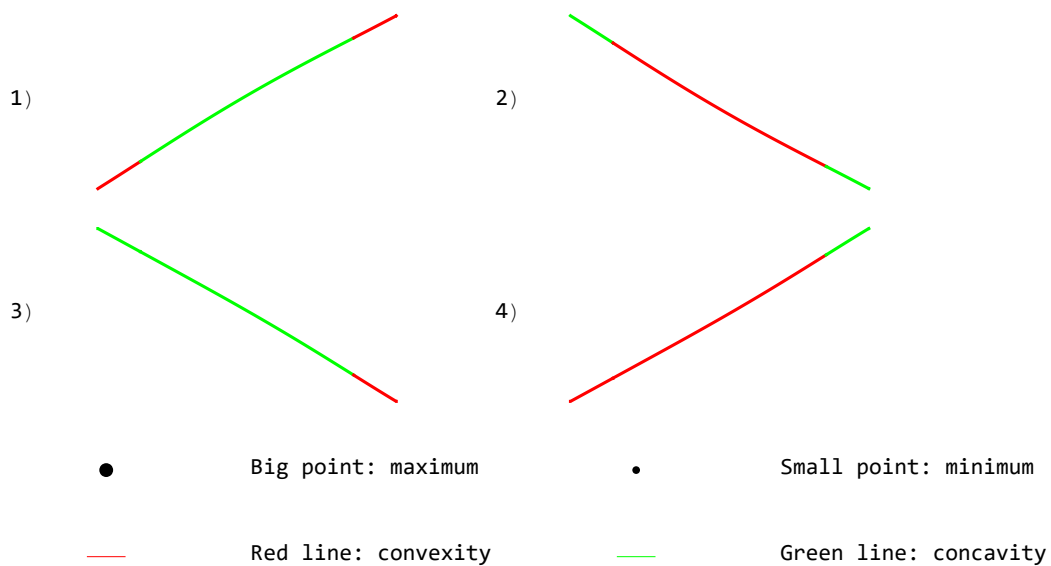
Mathematics 1 - ADE - English - 2026/2027

02-Derivatives for serial number: 15

Exercise 1

Study the shape properties of $f(x) = 4 - 12x^2 + 10x^3 - 4x^4 + \frac{3x^5}{5}$

to decide which amongst the following ones is the representation of the function.



Indication: To solve this exercise it is necessary to determine the concavity and convexity interval. To find the inflexion points separating the concavity and convexity intervals, check (by means of Ruffini) with the points $-2, -1, 0, 1, 2$.

Exercise 2

Determine the derivative of the function $f(t) = \sin(t) (\cos(t) - 2\sin(t))$ and compute its value at the point $t=0$.

- 1) $f'(0) = 0$ 2) $f'(0) = 2$ 3) $f'(0) = -4$ 4) $f'(0) = 1$

Exercise 3

Compute the limit: $\lim_{x \rightarrow 0} \frac{-x^3 + \sin[x^3]}{x^6}$

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

Exercise 4

Compute the limit: $\lim_{x \rightarrow -3} \frac{9 + 15x + 7x^2 + x^3}{-6 + x + x^2}$

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

Exercise 5

Between the months $t=4$ and $t=11$

, the true value of the shares of a company (in euros) are given by the function $C(t) = 166 + 240t - 42t^2 + 2t^3$.

Determine the interval within the value oscillates between months $t=4$ and $t=10$.

- 1) It oscillates between 373 and 576.
- 2) It oscillates between 366 and 582.
- 3) It oscillates between 376 and 578.
- 4) It oscillates between 368 and 588.
- 5) It oscillates between 360 and 591.

Exercise 6

In a fish farm, data of precedings years reveal that, if the initial number of fish is x (x in thousands), after one month they reproduce until a number of $f(x) = \frac{25x}{4 + 42x}$ fishes.

What number of fish leads to the largest increase in the number of animals, $f(x) - x$?

- 1) $\frac{10}{9}$
- 2) $\frac{40}{13}$
- 3) $\frac{1}{7}$
- 4) 32
- 5) $\frac{27}{2}$

Exercise 7

The yield of a tree plantation is given by $f(x) =$

$$\frac{-9 + 9x + 14x^2}{26x^4}, \text{ where } x \text{ is the distance in meters between two trees.}$$

What is the distance x that leads to the largest yield.

- 1) $\frac{13}{16}$
- 2) $\frac{20}{9}$
- 3) $\frac{33}{10}$
- 4) $\frac{35}{2}$
- 5) $\frac{3}{4}$

Exercise 8

A plastic firm receives an order to manufacture 1815 special plastic foam boards for swimming training. The firm has 19 machines but each of them will be able to participate in the manufacturing of this special type of tables only after an adaptation so that each adapted machine is capable of manufacturing 363 boards per hour; on the other hand, the non adapted ones cannot be used for this special order. The cost to adapt each machine is 187 monetary units. Moreover, these adapted machines are automated and only need staff to supervise the production whose salary is 935 monetary units per hour. Taking into account the number of hours that will be necessary to produce the ordered tables, the cost in salaries for those hours, and the adaptation costs, how many of the machines that the company has should be adapted to place the order at the lowest possible cost?

- 1) None of the other options is correct.
- 2) 4
- 3) 19
- 4) 3
- 5) 5

Exercise 9

Study the differentiability of the function $f(x) =$

$$f(x) = \begin{cases} \cos(x+3) + 5 & x \leq -3 \\ -2(-x + \sin(x+3)) + \cos(x+3) - 8 & -3 < x < -2 \\ 2\sin(x+2) - 3\cos(x+2) + 3 - 2(-6 + \sin(1) + \cos(1)) & -2 \leq x \end{cases}$$

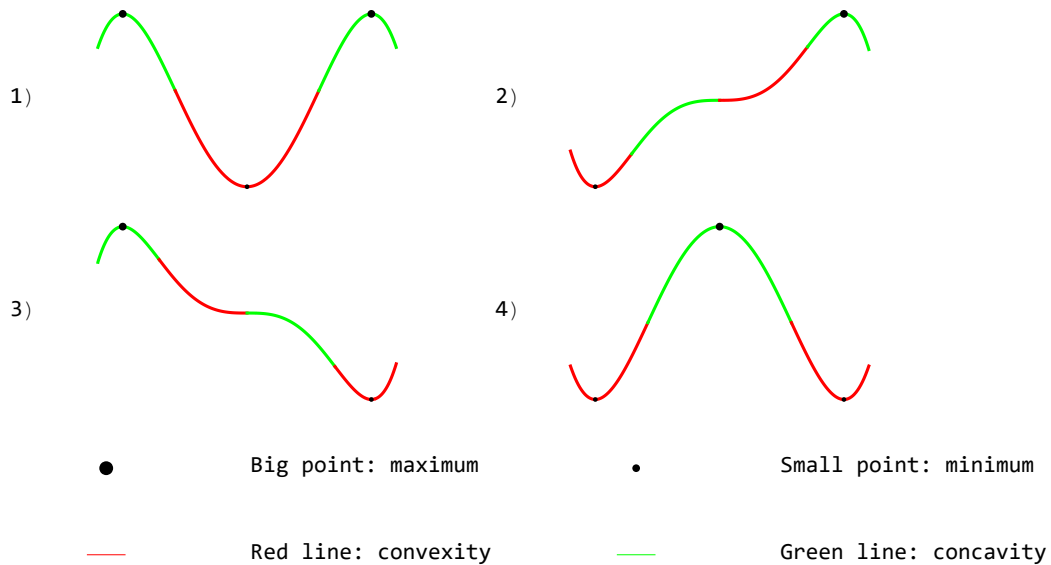
- 1) The function is differentiable for all points.
- 2) The function is not differentiable at any point.
- 3) The function is differentiable for all points except for $x = -3$.
- 4) The function is differentiable for all points except for $x = -2$.
- 5) The function is differentiable for all points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

Mathematics 1 - ADE - English - 2026/2027

02-Derivatives for serial number: 16

Exercise 1

Study the shape properties of the $f(x) = 3 - 20x^3 + 12x^5$ to decide which amongst the following ones is the representation of the function.



Indication: To find the maximum and minimum points of the function, try (with Ruffini) the points $-2, -1, 0, 1, 2$. To solve this exercise it is necessary to determine the increasing and decreasing intervals.

Exercise 2

Determine the derivative of the function $f(t) = e^t + 2 \sin(t)$ and compute its value at the point $t=0$.

- 1) $f'(0) = 3$ 2) $f'(0) = -2$ 3) $f'(0) = 0$ 4) $f'(0) = 1$

Exercise 3

Compute the limit: $\lim_{x \rightarrow 1} \frac{\frac{25}{6} - 8x + 6x^2 - \frac{8x^3}{3} + \frac{x^4}{2} + \text{Log}[x^2]}{-1 + 5x - 10x^2 + 10x^3 - 5x^4 + x^5}$

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

Exercise 4

Compute the limit: $\lim_{x \rightarrow -2} \frac{-4 + 3x^2 + x^3}{-8 - 4x + 2x^2 + x^3}$

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

Exercise 5

Between the months $t=4$ and $t=11$

, the funds in certain account (in millions of euros) are given by the function $F(t) = -6 + 378t - 48t^2 + 2t^3$.

Determine the interval within the funds oscillates between months $t=8$ and $t=10$.

- 1) It oscillates between 971 and 966.
- 2) It oscillates between 974 and 975.
- 3) It oscillates between 866 and 1006.
- 4) It oscillates between 966 and 974.
- 5) It oscillates between 967 and 974.

Exercise 6

In a fish farm, data of precedings years reveal that, if the initial number of fish is x (x in thousands), after one month they reproduce until a number of $f(x) = \frac{45x}{5 + 35x}$ fishes.

What number of fish leads to the largest increase in the number of animals, $f(x) - x$?

- 1) 10
- 2) $\frac{7}{3}$
- 3) $\frac{30}{17}$
- 4) 2
- 5) $\frac{2}{7}$

Exercise 7

The yield of a tree plantation is given by $f(x) =$

$$\frac{-41 + 23x + 28x^2}{19x^2}, \text{ where } x \text{ is the distance in meters between two trees.}$$

What is the distance x that leads to the largest yield.

- 1) $\frac{2}{5}$
- 2) $\frac{11}{7}$
- 3) $\frac{7}{5}$
- 4) $\frac{4}{7}$
- 5) $\frac{82}{23}$

Exercise 8

A plastic firm receives an order to manufacture 2275 special plastic foam boards for swimming training. The firm has 9 machines but each of them will be able to participate in the manufacturing of this special type of tables only after an adaptation so that each adapted machine is capable of manufacturing 1547 boards per hour; on the other hand, the non adapted ones cannot be used for this special order. The cost to adapt each machine is 55 monetary units. Moreover, these adapted machines are automated and only need staff to supervise the production whose salary is 935 monetary units per hour. Taking into account the number of hours that will be necessary to produce the ordered tables, the cost in salaries for those hours, and the adaptation costs, how many of the machines that the company has should be adapted to place the order at the lowest possible cost?

- 1) 19
- 2) 9
- 3) 17
- 4) 1
- 5) None of the other options is correct.

Exercise 9

Study the differentiability of the function $f(x) = \begin{cases} e^x - \cos(x) + 5 & x \leq 0 \\ \frac{x^2}{4} + x + 5 & 0 < x < 2 \\ -2 \sin(2-x) - \cos(2-x) + 9 & 2 \leq x \end{cases}$

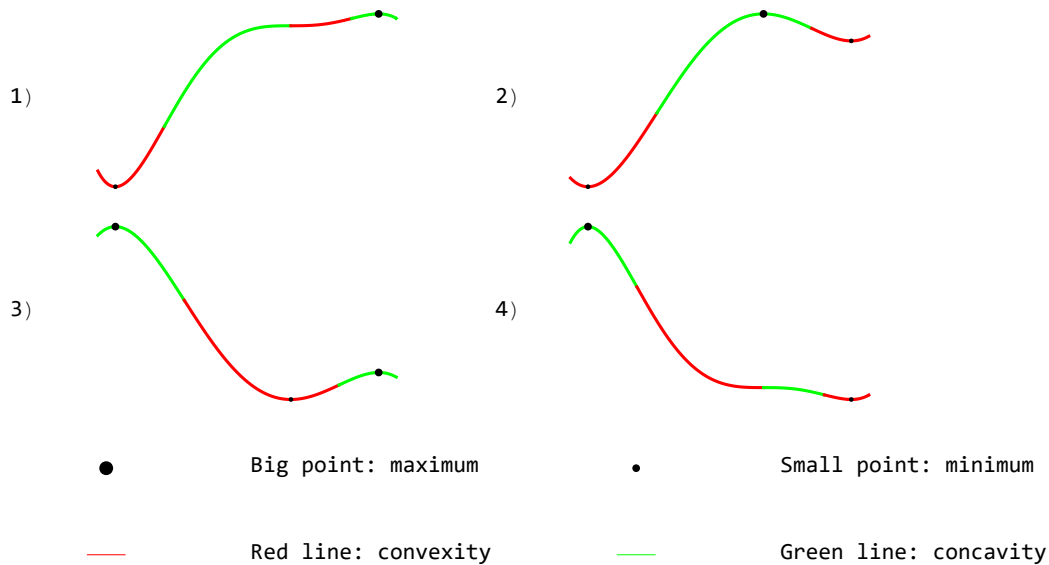
- 1) The function is differentiable for all points.
- 2) The function is not differentiable at any point.
- 3) The function is differentiable for all points except for $x=0$.
- 4) The function is differentiable for all points except for $x=2$.
- 5) The function is differentiable for all points except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

Mathematics 1 - ADE - English - 2026/2027

02-Derivatives for serial number: 17

Exercise 1

Study the shape properties of the $f(x) = 5 + 24x - 6x^2 - 8x^3 + 3x^4$ to decide which amongst the following ones is the representation of the function.



Indication: To find the maximum and minimum points of the function, try (with Ruffini) the points $-2, -1, 0, 1, 2$. To solve this exercise it is necessary to determine the increasing and decreasing intervals.

Exercise 2

Determine the derivative of the function $f(t) = 2 \log^2(t+1)$ and compute its value at the point $t=0$.

- 1) $f'(0) = 2$ 2) $f'(0) = 0$ 3) $f'(0) = -1$ 4) $f'(0) = -4$

Exercise 3

Compute the limit: $\lim_{x \rightarrow 1} \frac{3 - 4x + x^2 + \log[x^2]}{-1 + 3x - 3x^2 + x^3}$

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

Exercise 4

Compute the limit: $\lim_{x \rightarrow 2} \frac{-8 + 4x + 6x^2 - 5x^3 + x^4}{-12 + 16x - 7x^2 + x^3}$

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

Exercise 5

Between the months $t=1$ and $t=7$

, the funds in certain account (in millions of euros) are given by the function $F(t) = 7 + 90t - 24t^2 + 2t^3$.

Determine the interval within the funds oscillates between months $t=5$ and $t=6$.

- 1) It oscillates between 111 and 124.
- 2) It oscillates between 75 and 147.
- 3) It oscillates between 107 and 115.
- 4) It oscillates between 101 and 124.
- 5) It oscillates between 112 and 114.

Exercise 6

In a fish farm, data of precedings years reveal that, if the initial number of fish is x (x in thousands), after one month they reproduce until a number of $f(x) = \frac{9x}{4 + 11x}$ fishes.

What number of fish leads to the largest increase in the number of animals, $f(x) - x$?

- 1) $\frac{31}{17}$
- 2) $\frac{2}{11}$
- 3) 3
- 4) $\frac{39}{19}$
- 5) $\frac{13}{8}$

Exercise 7

The yield of a tree plantation is given by $f(x) =$

$$\frac{-13 + 15x + 25x^2}{20x^2}, \text{ where } x \text{ is the distance in meters between two trees.}$$

What is the distance x that leads to the largest yield.

- 1) $\frac{12}{17}$
- 2) $\frac{26}{15}$
- 3) $\frac{39}{20}$
- 4) $\frac{40}{7}$
- 5) $\frac{13}{8}$

Exercise 8

A plastic firm receives an order to manufacture 36400 special plastic foam boards for swimming training. The firm has 13 machines but each of them will be able to participate in the manufacturing of this special type of tables only after an adaptation so that each adapted machine is capable of manufacturing 325 boards per hour; on the other hand, the non adapted ones cannot be used for this special order. The cost to adapt each machine is 49 monetary units. Moreover, these adapted machines are automated and only need staff to supervise the production whose salary is 63 monetary units per hour. Taking into account the number of hours that will be necessary to produce the ordered tables, the cost in salaries for those hours, and the adaptation costs, how many of the machines that the company has should be adapted to place the order at the lowest possible cost?

- 1) 13
- 2) 8
- 3) 1
- 4) 19
- 5) None of the other options is correct.

Exercise 9

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

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

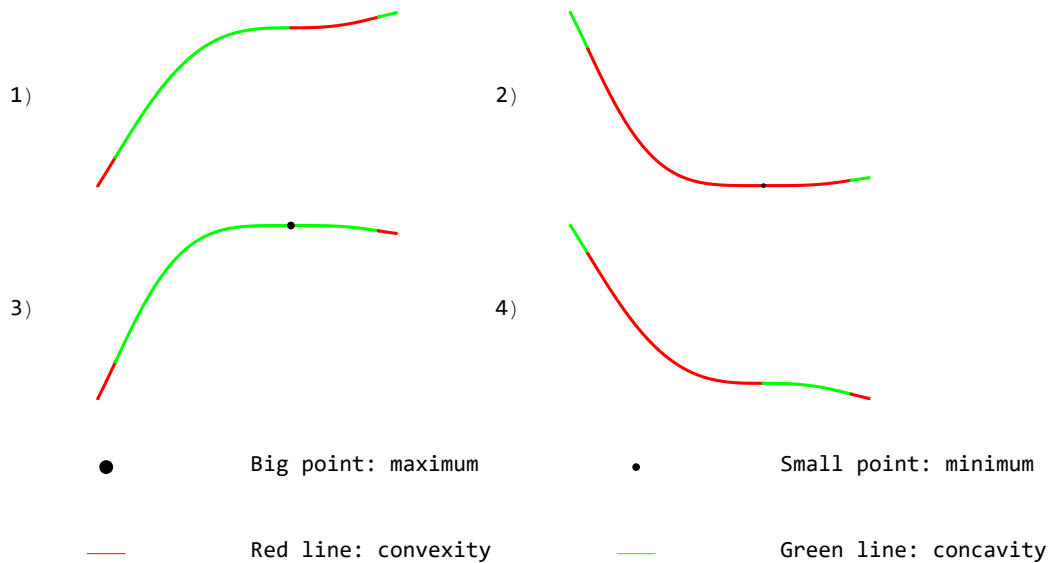
Mathematics 1 - ADE - English - 2026/2027

02-Derivatives for serial number: 18

Exercise 1

Study the shape properties of $f(x) = 1 - 4x^3 + x^4 + \frac{3x^5}{5}$

to decide which amongst the following ones is the representation of the function.



Indication: To solve this exercise it is necessary to determine the concavity and convexity interval. To find the inflexion points separating the concavity and convexity intervals, check (by means of Ruffini) with the points $-2, -1, 0, 1, 2$.

Exercise 2

Determine the derivative of the function $f(t) =$

$3 \log(t+1) e^{\sin(\cos(t))}$ and compute its value at the point $t=0$.

- 1) $f'(0) = -4$ 2) $f'(0) = 3 e^{\sin[1]}$ 3) $f'(0) = 0$ 4) $f'(0) = 1$

Exercise 3

Compute the limit: $\lim_{x \rightarrow 0} \frac{-1 + e^{x^3} - x^3}{x^6}$

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

Exercise 4

Compute the limit: $\lim_{x \rightarrow -2} \frac{-8 - 4x + 6x^2 + 5x^3 + x^4}{-8 - 4x + 2x^2 + x^3}$

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

Exercise 5

Between the months $t=2$ and $t=6$

, the true value of the shares of a company (in euros) are given by the function $C(t) = 35 + 60t - 21t^2 + 2t^3$.

Determine the interval within the value oscillates between months $t=4$ and $t=5$.

- 1) It oscillates between 60 and 87.
- 2) It oscillates between 60 and 67.
- 3) It oscillates between 66 and 73.
- 4) It oscillates between 60 and 87.
- 5) It oscillates between 51 and 74.

Exercise 6

In a fish farm, data of precedings years reveal that, if the initial number of fish is x (x in thousands), after one month they reproduce until a number of $f(x) = \frac{8x}{2 + 35x}$ fishes.

What number of fish leads to the largest increase in the number of animals, $f(x) - x$?

- 1) $\frac{8}{3}$
- 2) $\frac{1}{8}$
- 3) 18
- 4) $\frac{19}{5}$
- 5) $\frac{2}{35}$

Exercise 7

The yield of a tree plantation is given by $f(x) =$

$$\frac{-37 + 29x + 3x^2}{40x^9}, \text{ where } x \text{ is the distance in meters between two trees.}$$

What is the distance x that leads to the largest yield.

- 1) $\frac{11}{10}$
- 2) $\frac{5}{8}$
- 3) $\frac{9}{2}$
- 4) $\frac{9}{7}$
- 5) $\frac{2}{3}$

Exercise 8

A plastic firm receives an order to manufacture 53900 special plastic foam boards for swimming training. The firm has 22 machines but each of them will be able to participate in the manufacturing of this special type of tables only after an adaptation so that each adapted machine is capable of manufacturing 35 boards per hour; on the other hand, the non adapted ones cannot be used for this special order. The cost to adapt each machine is 154 monetary units. Moreover, these adapted machines are automated and only need staff to supervise the production whose salary is 10 monetary units per hour. Taking into account the number of hours that will be necessary to produce the ordered tables, the cost in salaries for those hours, and the adaptation costs, how many of the machines that the company has should be adapted to place the order at the lowest possible cost?

- 1) 14
- 2) 23
- 3) 22
- 4) 10
- 5) None of the other options is correct.

Exercise 9

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

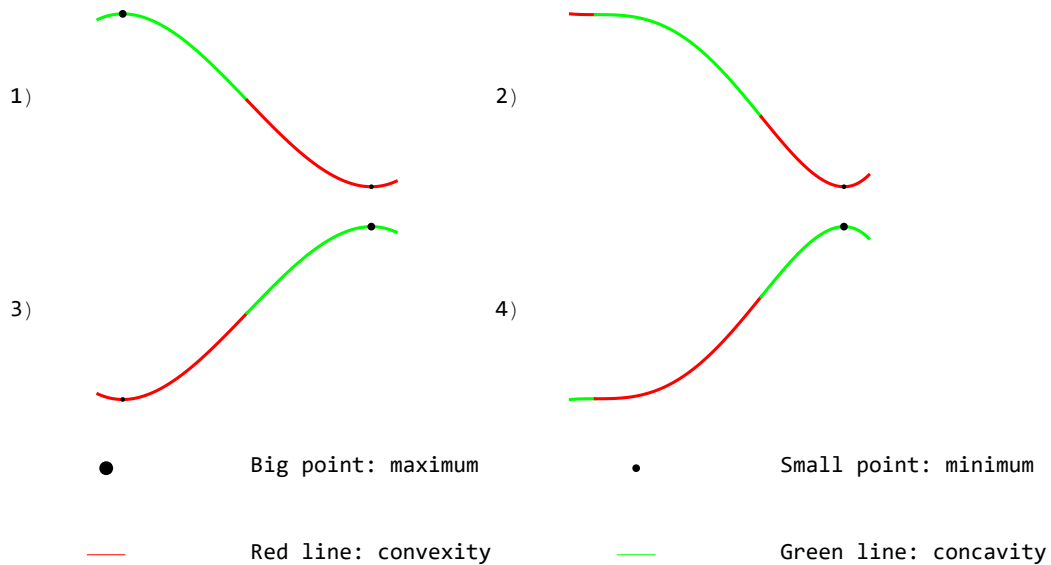
- 1) The function is differentiable for all points.
- 2) The function is not differentiable at any point.
- 3) The function is differentiable for all points except for $x = -1$.
- 4) The function is differentiable for all points except for $x = 1$.
- 5) The function is differentiable for all points except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

Mathematics 1 - ADE - English - 2026/2027

02-Derivatives for serial number: 19

Exercise 1

Study the shape properties of the $f(x) = 5 - 6x + 2x^3$ to decide which amongst the following ones is the representation of the function.



Indication: To find the maximum and minimum points of the function, try (with Ruffini) the points $-2, -1, 0, 1, 2$. To solve this exercise it is necessary to determine the increasing and decreasing intervals.

Exercise 2

Determine the derivative of the function $f(t) = e^t (\sin(t) - t^2 \cos(t))$ and compute its value at the point $t=0$.

- 1) $f'(0) = 2$ 2) $f'(0) = 1$ 3) $f'(0) = -2$ 4) $f'(0) = -3$

Exercise 3

Compute the limit: $\lim_{x \rightarrow 0} \frac{-1 + \cos[x]}{x^2}$

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

Exercise 4

Compute the limit: $\lim_{x \rightarrow -1} \frac{-3 - 5x - x^2 + x^3}{-1 + x^2}$

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

Exercise 5

Between the months $t=3$ and $t=8$, the funds in certain account (in millions of euros) are given by the function $F(t) = -10 + 336t - 45t^2 + 2t^3$.

Determine the interval within the funds oscillates between months $t=6$ and $t=7$.

- 1) It oscillates between 818 and 823.
- 2) It oscillates between 810 and 826.
- 3) It oscillates between 826 and 815.
- 4) It oscillates between 647 and 823.
- 5) It oscillates between 822 and 823.

Exercise 6

In a fish farm, data of precedings years reveal that, if the initial number of fish is x (x in thousands), after one month they reproduce until a number of $f(x) = \frac{32x}{8 + 17x}$ fishes.

What number of fish leads to the largest increase in the number of animals, $f(x) - x$?

- 1) $\frac{11}{7}$
- 2) $\frac{7}{8}$
- 3) $\frac{24}{11}$
- 4) $\frac{8}{17}$
- 5) $\frac{4}{13}$

Exercise 7

The yield of a tree plantation is given by $f(x) =$

$$\frac{-33 + 21x + 6x^2}{23x^2}, \text{ where } x \text{ is the distance in meters between two trees.}$$

What is the distance x that leads to the largest yield.

- 1) $\frac{27}{7}$
- 2) $\frac{7}{8}$
- 3) $\frac{24}{11}$
- 4) $\frac{22}{7}$
- 5) $\frac{7}{6}$

Exercise 8

A plastic firm receives an order to manufacture 637

special plastic foam boards for swimming training. The firm has

20 machines but each of them will be able to participate

in the manufacturing of this special type of tables only after an

adaptation so that each adapted machine is capable of manufacturing

182 boards per hour; on the other hand, the non adapted ones cannot be

used for this special order. The cost to adapt each machine is

21 monetary units. Moreover, these adapted machines are automated and

only need staff to supervise the production whose salary is 150

monetary units per hour. Taking into account the number of hours that will be

necessary to produce the ordered tables, the cost in salaries for those

hours, and the adaptation costs, how many of the machines that the company

has should be adapted to place the order at the lowest possible cost?

- 1) 17
- 2) 20
- 3) 7
- 4) 5
- 5) None of the other options is correct.

Exercise 9

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

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

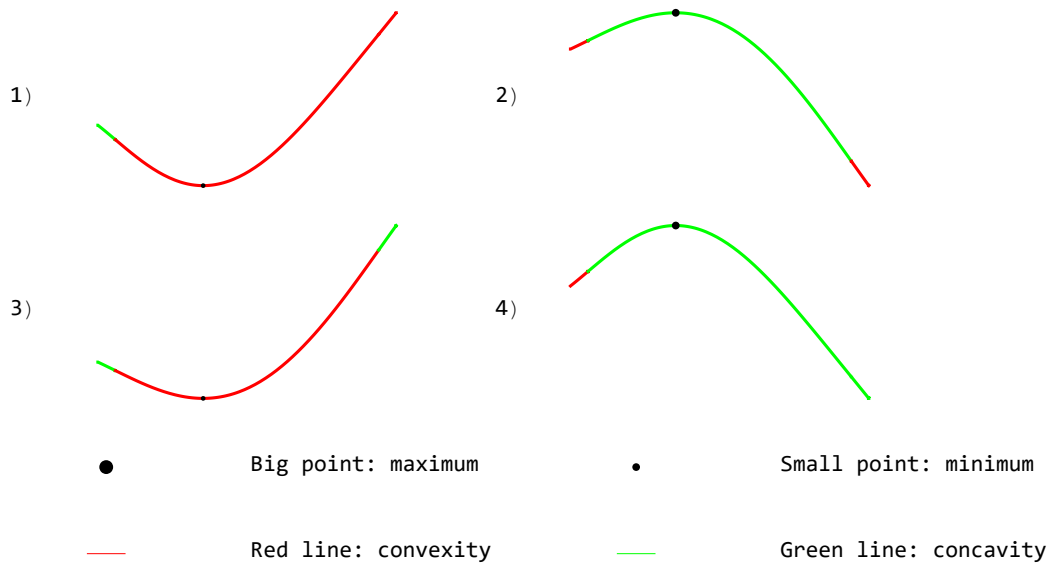
Mathematics 1 - ADE - English - 2026/2027

02-Derivatives for serial number: 20

Exercise 1

Study the shape properties of $f(x) = 5 + 24x^2 - 3x^4 + \frac{3x^5}{5}$

to decide which amongst the following ones is the representation of the function.



Indication: To solve this exercise it is necessary to determine the concavity and convexity interval. To find the inflexion points separating the concavity and convexity intervals, check (by means of Ruffini) with the points $-2, -1, 0, 1, 2$.

Exercise 2

Determine the derivative of the function $f(t) =$

$\log(t+1) (1 - 2 \cos(\log(t+1)))$ and compute its value at the point $t=0$.

- 1) $f'(0) = 0$ 2) $f'(0) = -3$ 3) $f'(0) = 4$ 4) $f'(0) = -1$

Exercise 3

Compute the limit: $\lim_{x \rightarrow 0} \frac{-1 + \cos[x^3]}{x^4}$

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

Exercise 4

Compute the limit: $\lim_{x \rightarrow 3} \frac{3 - 4x + x^2}{-9 + x^2}$

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

Exercise 5

Between the months $t=0$ and $t=7$

, the true value of the shares of a company (in euros) are given by the function $C(t) = 8 + 12t - 9t^2 + 2t^3$.

Determine the interval within the value oscillates between months $t=2$ and $t=4$.

- 1) It oscillates between 12 and 40.
- 2) It oscillates between 12 and 13.
- 3) It oscillates between 7 and 47.
- 4) It oscillates between 12 and 36.
- 5) It oscillates between 8 and 337.

Exercise 6

In a fish farm, data of precedings years reveal that, if the initial number of fish is x (x in thousands), after one month they reproduce until a number of $f(x) = \frac{50x}{18 + 19x}$ fishes.

What number of fish leads to the largest increase in the number of animals, $f(x) - x$?

- 1) 4
- 2) 1
- 3) $\frac{12}{19}$
- 4) $\frac{28}{9}$
- 5) 2

Exercise 7

The yield of a tree plantation is given by $f(x) =$

$$\frac{-36 + 17x + 8x^2}{12x^5}, \text{ where } x \text{ is the distance in meters between two trees.}$$

What is the distance x that leads to the largest yield.

- 1) $\frac{14}{3}$
- 2) $\frac{37}{12}$
- 3) $\frac{27}{4}$
- 4) $\frac{34}{7}$
- 5) $\frac{5}{3}$

Exercise 8

A plastic firm receives an order to manufacture 4875 special plastic foam boards for swimming training. The firm has 10 machines but each of them will be able to participate in the manufacturing of this special type of tables only after an adaptation so that each adapted machine is capable of manufacturing 22 boards per hour; on the other hand, the non adapted ones cannot be used for this special order. The cost to adapt each machine is 1105 monetary units. Moreover, these adapted machines are automated and only need staff to supervise the production whose salary is 1122 monetary units per hour. Taking into account the number of hours that will be necessary to produce the ordered tables, the cost in salaries for those hours, and the adaptation costs, how many of the machines that the company has should be adapted to place the order at the lowest possible cost?

- 1) 24
- 2) 10
- 3) 6
- 4) 12
- 5) None of the other options is correct.

Exercise 9

Study the differentiability of the function $f(x) = \begin{cases} e^{x+3} + 2 \cos(x+3) - 3 & x \leq -3 \\ \frac{1}{4}(x(x+10) + 21) & -3 < x < -1 \\ 2 \sin(x+1) + 3 \cos(x+1) & -1 \leq x \end{cases}$

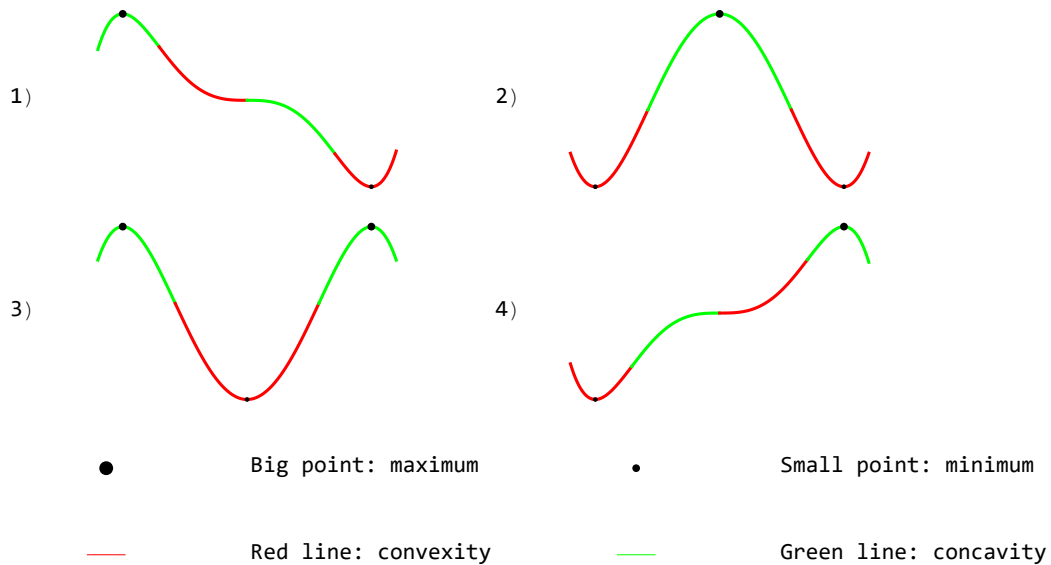
- 1) The function is differentiable for all points.
- 2) The function is not differentiable at any point.
- 3) The function is differentiable for all points except for $x = -3$.
- 4) The function is differentiable for all points except for $x = -1$.
- 5) The function is differentiable for all points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

Mathematics 1 - ADE - English - 2026/2027

02-Derivatives for serial number: 21

Exercise 1

Study the shape properties of the $f(x) = 1 - 60x^2 + 100x^3 - 60x^4 + 12x^5$ to decide which amongst the following ones is the representation of the function.



Indication: To find the maximum and minimum points of the function, try (with Ruffini) the points $-2, -1, 0, 1, 2$. To solve this exercise it is necessary to determine the increasing and decreasing intervals.

Exercise 2

Determine the derivative of the function $f(t) = -2t \log(\cos(\cos(t)) + 1)$ and compute its value at the point $t=0$.

- 1) $f'(0) = 2$ 2) $f'(0) = -4$ 3) $f'(0) = -2 \log[1 + \cos[1]]$ 4) $f'(0) = -2$

Exercise 3

Compute the limit: $\lim_{x \rightarrow 0} \frac{-1 + \cos[x^2]}{x^3}$

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

Exercise 4

Compute the limit: $\lim_{x \rightarrow 2} \frac{2 - 3x + x^2}{-6 + x + x^2}$

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

Exercise 5

Between the months $t=1$ and $t=5$, the funds in certain account (in millions of euros) are given by the function $F(t) = 3 + 24t - 15t^2 + 2t^3$.

Determine the interval within the funds oscillates between months $t=1$ and $t=3$.

- 1) It oscillates between -6 and 14 .
- 2) It oscillates between -13 and 14 .
- 3) It oscillates between 2 and 13 .
- 4) It oscillates between 2 and 19 .
- 5) It oscillates between -13 and 14 .

Exercise 6

In a fish farm, data of precedings years reveal that, if the initial number of fish is x (x in thousands), after one month they reproduce until a number of $f(x) = \frac{44x}{11 + 19x}$ fishes.

What number of fish leads to the largest increase in the number of animals, $f(x) - x$?

- 1) $\frac{31}{3}$
- 2) $\frac{25}{16}$
- 3) $\frac{2}{3}$
- 4) $\frac{13}{2}$
- 5) $\frac{11}{19}$

Exercise 7

The yield of a tree plantation is given by $f(x) = \frac{-41 + 45x}{27x^2}$, where x is the distance in meters between two trees.

What is the distance x that leads to the largest yield.

- 1) $\frac{33}{14}$
- 2) $\frac{3}{4}$
- 3) 18
- 4) $\frac{82}{45}$
- 5) $\frac{9}{8}$

Exercise 8

A plastic firm receives an order to manufacture 1870 special plastic foam boards for swimming training. The firm has 14 machines but each of them will be able to participate in the manufacturing of this special type of tables only after an adaptation so that each adapted machine is capable of manufacturing 28 boards per hour; on the other hand, the non adapted ones cannot be used for this special order. The cost to adapt each machine is 187 monetary units. Moreover, these adapted machines are automated and only need staff to supervise the production whose salary is 1120 monetary units per hour. Taking into account the number of hours that will be necessary to produce the ordered tables, the cost in salaries for those hours, and the adaptation costs, how many of the machines that the company has should be adapted to place the order at the lowest possible cost?

- 1) 22
- 2) 2
- 3) None of the other options is correct.
- 4) 16
- 5) 18

Exercise 9

Study the differentiability of the function $f(x) = \begin{cases} \cos(x+1) - 2(\sin(x+1) + 2) & x \leq -1 \\ -2x - 5 & -1 < x < 1 \\ 2(\sin(1-x) + \cos(1-x)) - 9 & 1 \leq x \end{cases}$

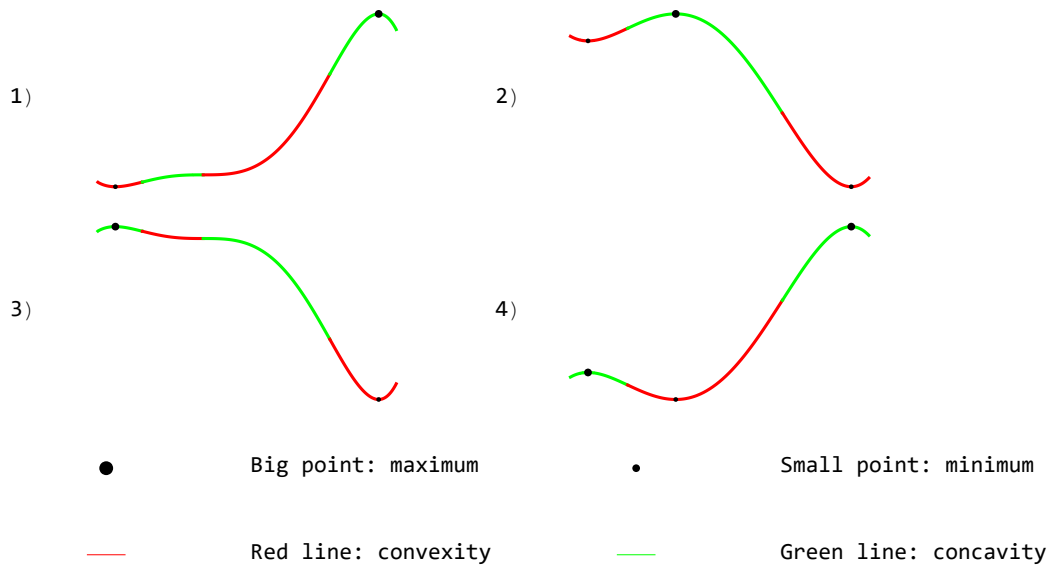
- 1) The function is differentiable for all points.
- 2) The function is not differentiable at any point.
- 3) The function is differentiable for all points except for $x = -1$.
- 4) The function is differentiable for all points except for $x = 1$.
- 5) The function is differentiable for all points except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

Mathematics 1 - ADE - English - 2026/2027

02-Derivatives for serial number: 22

Exercise 1

Study the shape properties of the $f(x) = 4 - 12x^2 - 4x^3 + 3x^4$ to decide which amongst the following ones is the representation of the function.



Indication: To find the maximum and minimum points of the function, try (with Ruffini) the points $-2, -1, 0, 1, 2$. To solve this exercise it is necessary to determine the increasing and decreasing intervals.

Exercise 2

Determine the derivative of the function $f(t) = \cos^2(t) - \log(\cos(t) + 1)$ and compute its value at the point $t=0$.

- 1) $f'(0) = -4$ 2) $f'(0) = -3$ 3) $f'(0) = 0$ 4) $f'(0) = 1$

Exercise 3

Compute the limit: $\lim_{x \rightarrow 1} \frac{3 - 4x + x^2 + \text{Log}[x^2]}{-1 + 3x - 3x^2 + x^3}$

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

Exercise 4

Compute the limit: $\lim_{x \rightarrow 2} \frac{12 - 8x - x^2 + x^3}{-4 + x^2}$

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

Exercise 5

Between the months $t=3$ and $t=10$

, the funds in certain account (in millions of euros) are given by the function $F(t) = 14 + 144t - 33t^2 + 2t^3$.

Determine the interval within the funds oscillates between months $t=7$ and $t=8$.

- 1) It oscillates between 72 and 83.
- 2) It oscillates between 70 and 91.
- 3) It oscillates between 78 and 91.
- 4) It oscillates between 78 and 203.
- 5) It oscillates between 78 and 203.

Exercise 6

In a fish farm, data of precedings years reveal that, if the initial number of fish is x (x in thousands), after one month they reproduce until a number of $f(x) = \frac{9x}{1+49x}$ fishes.

What number of fish leads to the largest increase in the number of animals, $f(x) - x$?

- 1) 5
- 2) $\frac{1}{3}$
- 3) 4
- 4) $\frac{2}{49}$
- 5) $\frac{3}{2}$

Exercise 7

The yield of a tree plantation is given by $f(x) =$

$$\frac{-2 + 25x + 44x^2}{42x^2}, \text{ where } x \text{ is the distance in meters between two trees.}$$

What is the distance x that leads to the largest yield.

- 1) $\frac{11}{9}$
- 2) $\frac{13}{7}$
- 3) $\frac{32}{9}$
- 4) $\frac{4}{25}$
- 5) $\frac{35}{2}$

Exercise 8

A plastic firm receives an order to manufacture 20020

special plastic foam boards for swimming training. The firm has

17 machines but each of them will be able to participate

in the manufacturing of this special type of tables only after an

adaptation so that each adapted machine is capable of manufacturing

182 boards per hour; on the other hand, the non adapted ones cannot be

used for this special order. The cost to adapt each machine is

33 monetary units. Moreover, these adapted machines are automated and

only need staff to supervise the production whose salary is 30

monetary units per hour. Taking into account the number of hours that will be

necessary to produce the ordered tables, the cost in salaries for those

hours, and the adaptation costs, how many of the machines that the company

has should be adapted to place the order at the lowest possible cost?

- 1) 10
- 2) 4
- 3) 7
- 4) None of the other options is correct.
- 5) 7

Exercise 9

Study the differentiability of the function $f(x) =$

$$\begin{cases} 2e^{x-2} + 3\sin(2)\sin(x) + 3\cos(2)\cos(x) + 4 & x \leq 2 \\ 2e^{x-2} + 2\cos(2-x) + 5 & 2 < x < 4 \\ 2e^{x-4} + 3 + 2e^2 + 2\cos(2) & 4 \leq x \end{cases}$$

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

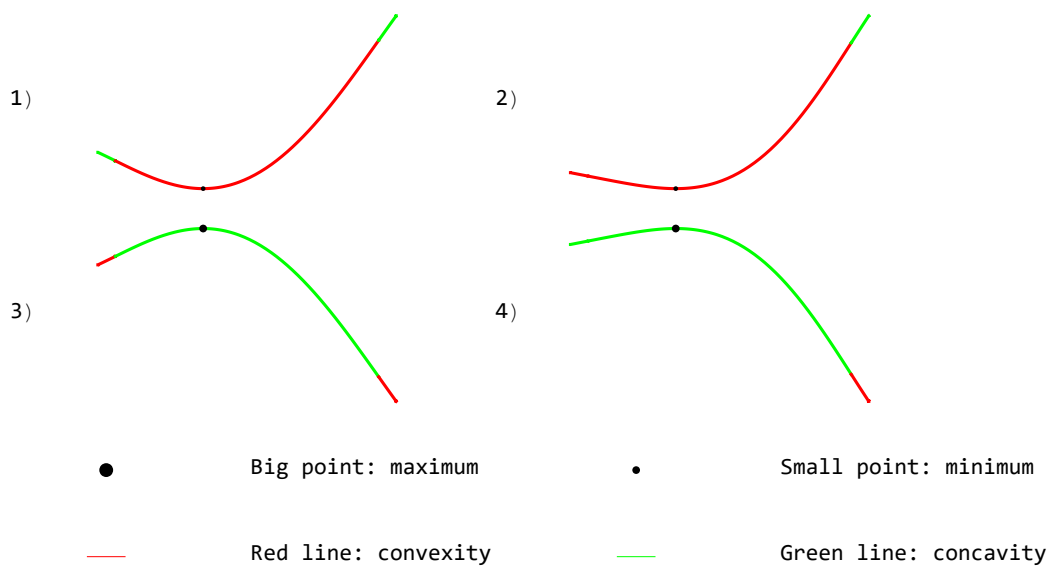
Mathematics 1 - ADE - English - 2026/2027

02-Derivatives for serial number: 23

Exercise 1

Study the shape properties of $f(x) = 5 - 6x^2 - x^3 + \frac{x^4}{2}$

to decide which amongst the following ones is the representation of the function.



Indication: To solve this exercise it is necessary to determine the concavity and convexity interval. To find the inflexion points separating the concavity and convexity intervals, check (by means of Ruffini) with the points $-2, -1, 0, 1, 2$.

Exercise 2

Determine the derivative of the function $f(t) =$

$t^3 + 3(t+1)\cos(\log(t+1))$ and compute its value at the point $t=0$.

- 1) $f'(0) = 2$ 2) $f'(0) = -2$ 3) $f'(0) = 3$ 4) $f'(0) = -1$

Exercise 3

Compute the limit: $\lim_{x \rightarrow 0} \frac{-1 + e^{x^3} - x^3}{x^6}$

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

Exercise 4

Compute the limit: $\lim_{x \rightarrow 3} \frac{9 + 3x - 5x^2 + x^3}{9x - 6x^2 + x^3}$

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

Exercise 5

Between the months $t=3$ and $t=8$

, the true value of the shares of a company (in euros) are given by the function $C(t) = 134 + 126t - 30t^2 + 2t^3$.

Determine the interval within the value oscillates between months $t=4$ and $t=7$.

- 1) It oscillates between 233 and 293.
- 2) It oscillates between 232 and 296.
- 3) It oscillates between 236 and 281.
- 4) It oscillates between 232 and 286.
- 5) It oscillates between 232 and 296.

Exercise 6

In a fish farm, data of precedings years reveal that, if the initial number of fish is x (x in thousands), after one month they reproduce until a number of $f(x) = \frac{50x}{8 + 22x}$ fishes.

What number of fish leads to the largest increase in the number of animals, $f(x) - x$?

- 1) $\frac{37}{15}$
- 2) 3
- 3) $\frac{40}{19}$
- 4) $\frac{6}{11}$
- 5) $\frac{1}{2}$

Exercise 7

The yield of a tree plantation is given by $f(x) =$

$$\frac{-26 + 29x + 16x^2}{32x^5}, \text{ where } x \text{ is the distance in meters between two trees.}$$

What is the distance x that leads to the largest yield.

- 1) $\frac{1}{2}$
- 2) $\frac{1}{2}$
- 3) $\frac{13}{5}$
- 4) $\frac{19}{6}$
- 5) $\frac{5}{6}$

Exercise 8

A plastic firm receives an order to manufacture 1815 special plastic foam boards for swimming training. The firm has 18 machines but each of them will be able to participate in the manufacturing of this special type of tables only after an adaptation so that each adapted machine is capable of manufacturing 21 boards per hour; on the other hand, the non adapted ones cannot be used for this special order. The cost to adapt each machine is 195 monetary units. Moreover, these adapted machines are automated and only need staff to supervise the production whose salary is 273 monetary units per hour. Taking into account the number of hours that will be necessary to produce the ordered tables, the cost in salaries for those hours, and the adaptation costs, how many of the machines that the company has should be adapted to place the order at the lowest possible cost?

- 1) 8
- 2) 5
- 3) 12
- 4) None of the other options is correct.
- 5) 17

Exercise 9

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

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

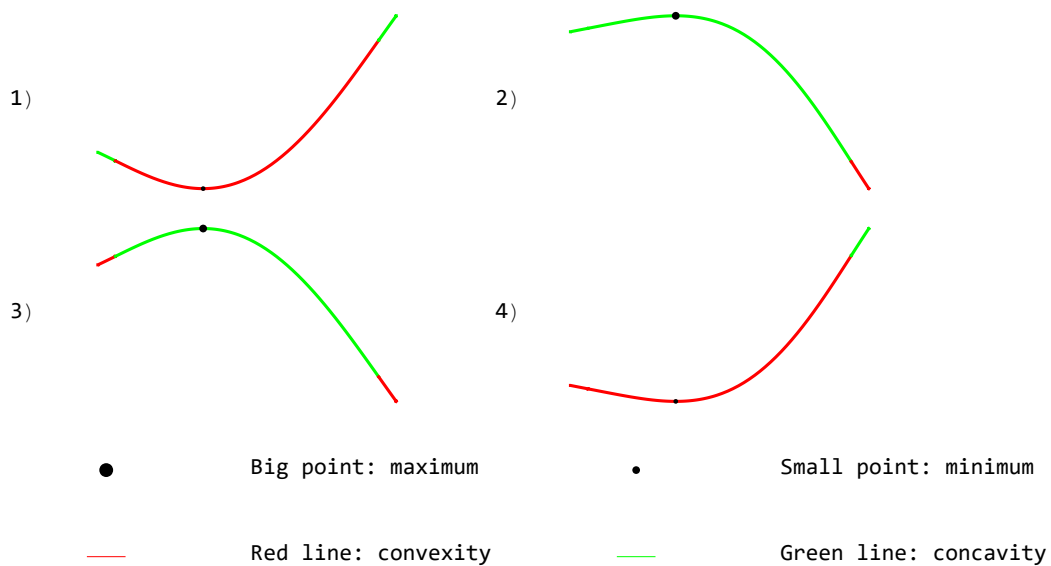
Mathematics 1 - ADE - English - 2026/2027

02-Derivatives for serial number: 24

Exercise 1

Study the shape properties of $f(x) = 1 - 12x^2 - 6x^3 + \frac{3x^5}{5}$

to decide which amongst the following ones is the representation of the function.



Indication: To solve this exercise it is necessary to determine the concavity and convexity interval. To find the inflexion points separating the concavity and convexity intervals, check (by means of Ruffini) with the points $-2, -1, 0, 1, 2$.

Exercise 2

Determine the derivative of the function $f(t) =$

$e^t t (\sin(t) + 3 \cos(t))$ and compute its value at the point $t=0$.

- 1) $f'(0) = 0$ 2) $f'(0) = -4$ 3) $f'(0) = 3$ 4) $f'(0) = -1$

Exercise 3

Compute the limit: $\lim_{x \rightarrow 1} \frac{\frac{11}{2} - 9x + \frac{9x^2}{2} - x^3 + \text{Log}[x^3]}{1 - 4x + 6x^2 - 4x^3 + x^4}$

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

Exercise 4

Compute the limit: $\lim_{x \rightarrow -3} \frac{18 + 21x + 8x^2 + x^3}{-9 + 3x + 5x^2 + x^3}$

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

Exercise 5

Between the months $t=3$ and $t=10$

, the true value of the shares of a company (in euros) are given by the function $C(t) = 128 + 108t - 27t^2 + 2t^3$.

Determine the interval within the value oscillates between months $t=5$ and $t=7$.

- 1) It oscillates between 233 and 251.
- 2) It oscillates between 236 and 247.
- 3) It oscillates between 236 and 508.
- 4) It oscillates between 230 and 251.
- 5) It oscillates between 236 and 263.

Exercise 6

In a fish farm, data of precedings years reveal that, if the initial number of fish is x (x in thousands), after one month they reproduce until a number of $f(x) = \frac{27x}{12 + 39x}$ fishes.

What number of fish leads to the largest increase in the number of animals, $f(x) - x$?

- 1) $\frac{10}{19}$
- 2) $\frac{2}{13}$
- 3) $\frac{12}{5}$
- 4) $\frac{34}{7}$
- 5) $\frac{40}{19}$

Exercise 7

The yield of a tree plantation is given by $f(x) =$

$$\frac{-20 + 49x + 18x^2}{44x^3}, \text{ where } x \text{ is the distance in meters between two trees.}$$

What is the distance x that leads to the largest yield.

- 1) $\frac{15}{7}$
- 2) $\frac{5}{9}$
- 3) $\frac{20}{3}$
- 4) $\frac{10}{9}$
- 5) $\frac{27}{11}$

Exercise 8

A plastic firm receives an order to manufacture 13860 special plastic foam boards for swimming training. The firm has 20 machines but each of them will be able to participate in the manufacturing of this special type of tables only after an adaptation so that each adapted machine is capable of manufacturing 5 boards per hour; on the other hand, the non adapted ones cannot be used for this special order. The cost to adapt each machine is 2618 monetary units. Moreover, these adapted machines are automated and only need staff to supervise the production whose salary is 306 monetary units per hour. Taking into account the number of hours that will be necessary to produce the ordered tables, the cost in salaries for those hours, and the adaptation costs, how many of the machines that the company has should be adapted to place the order at the lowest possible cost?

- 1) None of the other options is correct.
- 2) 24
- 3) 20
- 4) 7
- 5) 11

Exercise 9

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

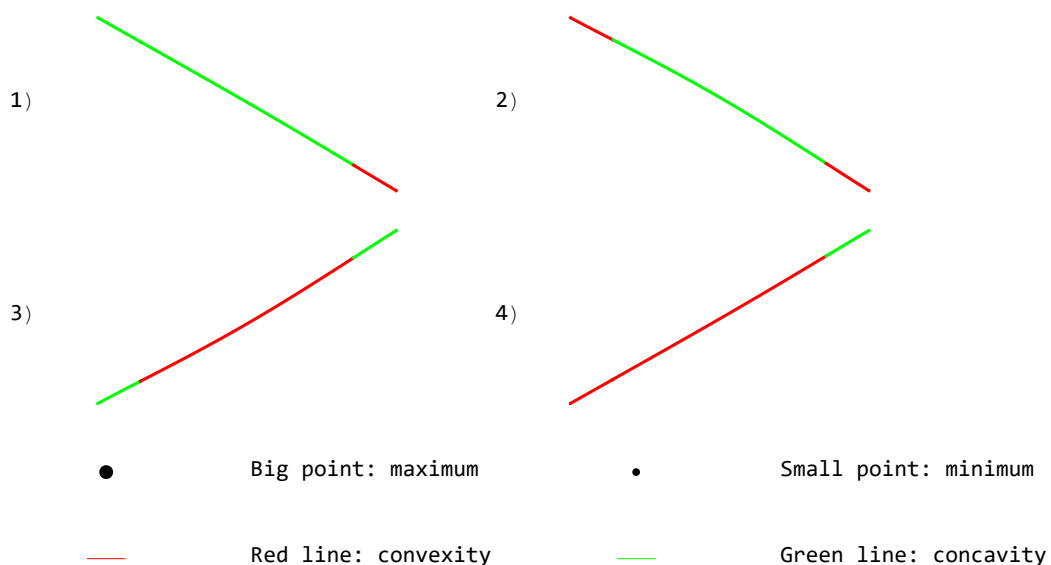
- 1) The function is differentiable for all points.
- 2) The function is not differentiable at any point.
- 3) The function is differentiable for all points except for $x = -3$.
- 4) The function is differentiable for all points except for $x = -2$.
- 5) The function is differentiable for all points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

Mathematics 1 - ADE - English - 2026/2027

02-Derivatives for serial number: 25

Exercise 1

Study the shape properties of $f(x) = 3 + 24x^2 + 16x^3 + 5x^4 + \frac{3x^5}{5}$ to decide which amongst the following ones is the representation of the function.



Indication: To solve this exercise it is necessary to determine the concavity and convexity interval. To find the inflexion points separating the concavity and convexity intervals, check (by means of Ruffini) with the points $-2, -1, 0, 1, 2$.

Exercise 2

Determine the derivative of the function $f(t) = e^t (\log(t+1) - 3 \log(\cos(t) + 1))$ and compute its value at the point $t=0$.

- 1) $f'(0) = 1 - 3 \log[2]$ 2) $f'(0) = 1$ 3) $f'(0) = -4$ 4) $f'(0) = 4$

Exercise 3

Compute the limit: $\lim_{x \rightarrow 0} \frac{-1 + \cos[x^3]}{x^4}$

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

Exercise 4

Compute the limit: $\lim_{x \rightarrow 3} \frac{6 - 5x + x^2}{-9 + x^2}$

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

Exercise 5

Between the months $t=0$ and $t=4$

, the true value of the shares of a company (in euros) are given by the function $C(t) = 28 + 12t - 9t^2 + 2t^3$.

Determine the interval within the value oscillates between months $t=2$ and $t=3$.

- 1) It oscillates between 28 and 39.
- 2) It oscillates between 32 and 37.
- 3) It oscillates between 28 and 60.
- 4) It oscillates between 24 and 34.
- 5) It oscillates between 32 and 33.

Exercise 6

In a fish farm, data of precedings years reveal that, if the initial number of fish is x (x in thousands), after one month they reproduce until a number of $f(x) = \frac{18x}{8 + 40x}$ fishes.

What number of fish leads to the largest increase in the number of animals, $f(x) - x$?

- 1) $\frac{1}{10}$
- 2) $\frac{18}{11}$
- 3) $\frac{1}{19}$
- 4) $\frac{8}{9}$
- 5) $\frac{17}{9}$

Exercise 7

The yield of a tree plantation is given by $f(x) =$

$$\frac{-35 + 22x + 5x^2}{30x^6}, \text{ where } x \text{ is the distance in meters between two trees.}$$

What is the distance x that leads to the largest yield.

- 1) $\frac{15}{7}$
- 2) $\frac{3}{2}$
- 3) $\frac{23}{12}$
- 4) $\frac{11}{6}$
- 5) $\frac{33}{5}$

Exercise 8

A plastic firm receives and order to manufacture 73216 special plastic foam boards for swimming training. The firm have 13 machines but each of them will be able to participate in the manufacturing of this special type of tables only after an adaptation so that each adapted machine is capable of manufacturing 2 boards per hour; on the other hand, the non adapted ones cannot be used for this special order. The cost to adapt each machine is 4862 monetary units. Moreover, these adapted machines are automated and only need staff to supervise the production whose salary is 34 monetary units per hour. Taking into account the number of hours that will be necessary to produce the ordered tables, the cost in salaries for those hours, and the adaptation costs, how many of the machines that the company has should be adapted to place the order at the lowest possible cost?

- 1) 4
- 2) 30
- 3) 26
- 4) 20
- 5) None of the other options is correct.

Exercise 9

Study the differentiability of the function $f(x) =$

$$\begin{cases} -2 \sin(x+2) - 2 \cos(x+2) - 3 & x \leq -2 \\ \cos(x+2) - 2(\sin(x+2) + 3) & -2 < x < -1 \\ 2 \sin(x+1) - 3 \cos(x+1) - 3 - 2 \sin(1) + \cos(1) & -1 \leq x \end{cases}$$

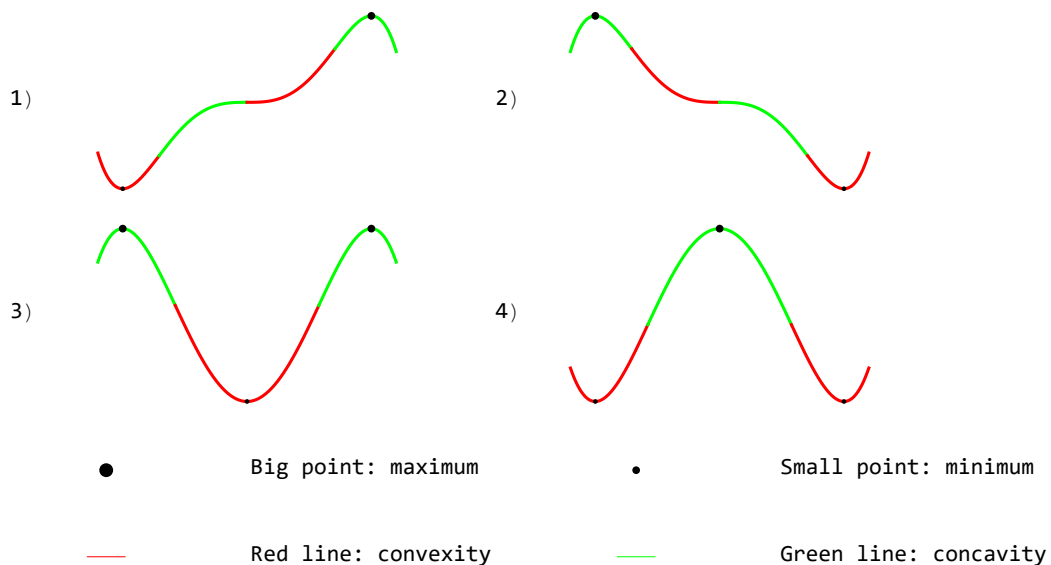
- 1) The function is differentiable for all points.
- 2) The function is not differentiable at any point.
- 3) The function is differentiable for all points except for $x = -2$.
- 4) The function is differentiable for all points except for $x = -1$.
- 5) The function is differentiable for all points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

Mathematics 1 - ADE - English - 2026/2027

02-Derivatives for serial number: 26

Exercise 1

Study the shape properties of the $f(x) = 3 + 60x^2 + 100x^3 + 60x^4 + 12x^5$ to decide which amongst the following ones is the representation of the function.



Indication: To find the maximum and minimum points of the function, try (with Ruffini) the points $-2, -1, 0, 1, 2$. To solve this exercise it is necessary to determine the increasing and decreasing intervals.

Exercise 2

Determine the derivative of the function $f(t) = e^{\sin(t)} \cos^2(\sin(t))$ and compute its value at the point $t=0$.

- 1) $f'(0) = 4$ 2) $f'(0) = 2$ 3) $f'(0) = 1$ 4) $f'(0) = -4$

Exercise 3

Compute the limit: $\lim_{x \rightarrow 0} \frac{-1 + e^{x^2} - x^2}{x^3}$

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

Exercise 4

Compute the limit: $\lim_{x \rightarrow -2} \frac{8 + 20x + 18x^2 + 7x^3 + x^4}{-4 + 3x^2 + x^3}$

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

Exercise 5

Between the months $t=3$ and $t=7$

, the funds in certain account (in millions of euros) are given by the function $F(t) = 8 + 168t - 33t^2 + 2t^3$.

Determine the interval within the funds oscillates between months $t=3$ and $t=5$.

- 1) It oscillates between 253 and 280.
- 2) It oscillates between 269 and 280.
- 3) It oscillates between 263 and 272.
- 4) It oscillates between 253 and 280.
- 5) It oscillates between 273 and 272.

Exercise 6

In a fish farm, data of precedings years reveal that, if the initial number of fish is x (x in thousands), after one month they reproduce until a number of $f(x) = \frac{25x}{16 + 30x}$ fishes.

What number of fish leads to the largest increase in the number of animals, $f(x) - x$?

- 1) $\frac{36}{5}$
- 2) $\frac{20}{7}$
- 3) $\frac{2}{15}$
- 4) $\frac{12}{13}$
- 5) 8

Exercise 7

The yield of a tree plantation is given by $f(x) =$

$$\frac{-37 + 27x + 16x^2}{2x^2}, \text{ where } x \text{ is the distance in meters between two trees.}$$

What is the distance x that leads to the largest yield.

- 1) $\frac{13}{20}$
- 2) $\frac{39}{14}$
- 3) $\frac{31}{12}$
- 4) 11
- 5) $\frac{74}{27}$

Exercise 8

A plastic firm receives and order to manufacture 2023 special plastic foam boards for swimming training. The firm have 21 machines but each of them will be able to participate in the manufacturing of this special type of tables only after an adaptation so that each adapted machine is capable of manufacturing 7 boards per hour; on the other hand, the non adapted ones cannot be used for this special order. The cost to adapt each machine is 1365 monetary units. Moreover, these adapted machines are automated and only need staff to supervise the production whose salary is 1365 monetary units per hour. Taking into account the number of hours that will be necessary to produce the ordered tables, the cost in salaries for those hours, and the adaptation costs, how many of the machines that the company has should be adapted to place the order at the lowest possible cost?

- 1) 21
- 2) None of the other options is correct.
- 3) 23
- 4) 17
- 5) 20

Exercise 9

Study the differentiability of the function $f(x) =$

$$\begin{cases} 2 \sin(1-x) & x \leq 1 \\ 2 \sin(1-x) + \cos(1-x) + x(-1 + \sin(2) + 2 \cos(2)) - \sin(2) - 2 \cos(2) & 1 < x < 3 \\ -4x + 3(x-2) \log(x-2) + 14 + 5 \cos(2) & 3 \leq x \end{cases}$$

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

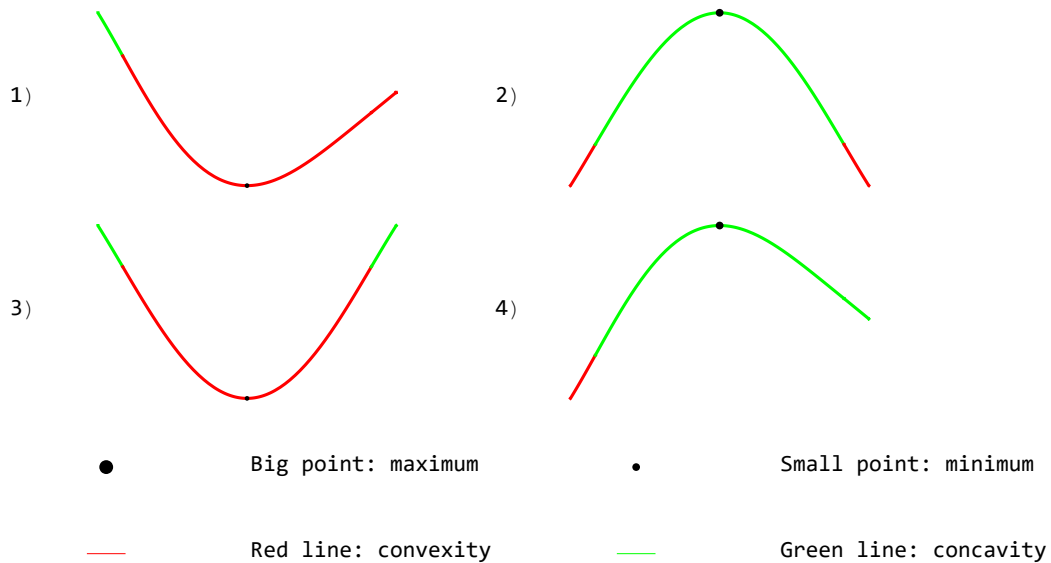
Mathematics 1 - ADE - English - 2026/2027

02-Derivatives for serial number: 27

Exercise 1

Study the shape properties of $f(x) = 2 - 3x^2 + \frac{x^4}{2}$

to decide which amongst the following ones is the representation of the function.



Indication: To solve this exercise it is necessary to determine the concavity and convexity interval. To find the inflexion points separating the concavity and convexity intervals, check (by means of Ruffini) with the points $-2, -1, 0, 1, 2$.

Exercise 2

Determine the derivative of the function $f(t) =$

$\log(t+1) \cos(t) (\cos(t) - 3 \log(t+1))$ and compute its value at the point $t=0$.

- 1) $f'(0) = 4$ 2) $f'(0) = 0$ 3) $f'(0) = 1$ 4) $f'(0) = -2$

Exercise 3

Compute the limit: $\lim_{x \rightarrow 0} \frac{-x^3 + \sin[x^3]}{x^4}$

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

Exercise 4

Compute the limit: $\lim_{x \rightarrow 3} \frac{-9 + x^2}{-6 - x + x^2}$

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

Exercise 5

Between the months $t=1$ and $t=7$

, the true value of the shares of a company (in euros) are given by the function $C(t) = 9 + 18t - 12t^2 + 2t^3$.

Determine the interval within the value oscillates between months $t=5$ and $t=7$.

- 1) It oscillates between 9 and 233.
- 2) It oscillates between 49 and 233.
- 3) It oscillates between 58 and 236.
- 4) It oscillates between 9 and 17.
- 5) It oscillates between 40 and 239.

Exercise 6

In a fish farm, data of precedings years reveal that, if the initial number of fish is x (x in thousands), after one month they reproduce until a number of $f(x) = \frac{9x}{1+x}$ fishes.

What number of fish leads to the largest increase in the number of animals, $f(x) - x$?

- 1) $\frac{13}{5}$
- 2) $\frac{14}{11}$
- 3) $\frac{34}{7}$
- 4) $\frac{3}{14}$
- 5) 2

Exercise 7

The yield of a tree plantation is given by $f(x) =$

$$\frac{-25 + 43x + 10x^2}{44x^6}, \text{ where } x \text{ is the distance in meters between two trees.}$$

What is the distance x that leads to the largest yield.

- 1) $\frac{28}{5}$
- 2) $\frac{5}{8}$
- 3) 2
- 4) $\frac{29}{6}$
- 5) 27

Exercise 8

A plastic firm receives an order to manufacture 5850 special plastic foam boards for swimming training. The firm has 14 machines but each of them will be able to participate in the manufacturing of this special type of tables only after an adaptation so that each adapted machine is capable of manufacturing 2 boards per hour; on the other hand, the non adapted ones cannot be used for this special order. The cost to adapt each machine is 8619 monetary units. Moreover, these adapted machines are automated and only need staff to supervise the production whose salary is 663 monetary units per hour. Taking into account the number of hours that will be necessary to produce the ordered tables, the cost in salaries for those hours, and the adaptation costs, how many of the machines that the company has should be adapted to place the order at the lowest possible cost?

- 1) 15
- 2) 14
- 3) 22
- 4) 11
- 5) None of the other options is correct.

Exercise 9

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

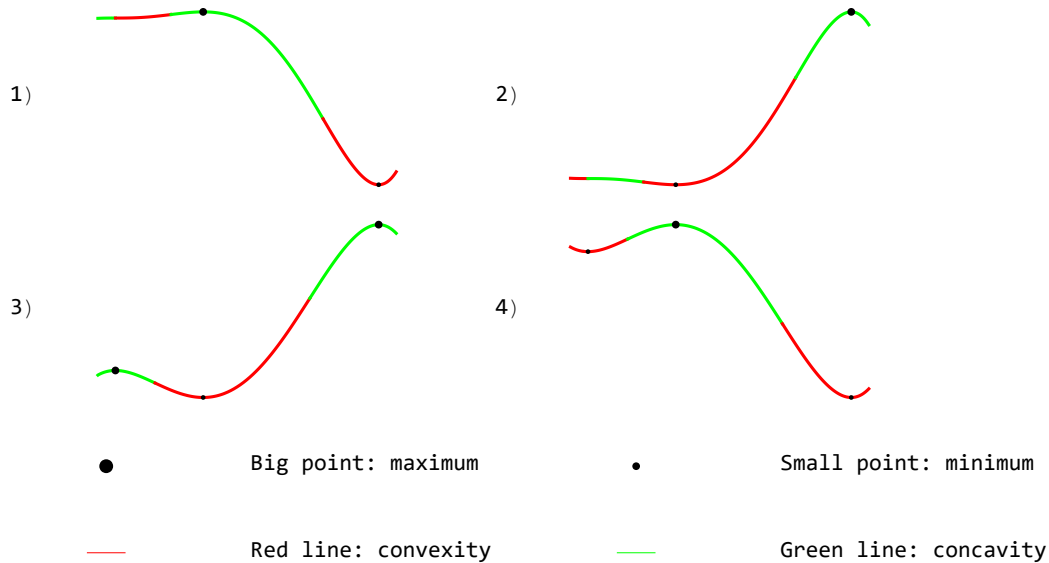
- 1) The function is differentiable for all points.
- 2) The function is not differentiable at any point.
- 3) The function is differentiable for all points except for $x = -3$.
- 4) The function is differentiable for all points except for $x = -1$.
- 5) The function is differentiable for all points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

Mathematics 1 - ADE - English - 2026/2027

02-Derivatives for serial number: 28

Exercise 1

Study the shape properties of the $f(x) = 5 - 240x - 120x^2 + 60x^3 + 60x^4 + 12x^5$ to decide which amongst the following ones is the representation of the function.



Indication: To find the maximum and minimum points of the function, try (with Ruffini) the points $-2, -1, 0, 1, 2$. To solve this exercise it is necessary to determine the increasing and decreasing intervals.

Exercise 2

Determine the derivative of the function $f(t) = 2e^{2t} \sin(t) + 3$ and compute its value at the point $t=0$.

- 1) $f'(0) = 3$ 2) $f'(0) = -3$ 3) $f'(0) = 2$ 4) $f'(0) = -1$

Exercise 3

Compute the limit: $\lim_{x \rightarrow 0} \frac{-1 + \cos[x^2]}{x^4}$

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

Exercise 4

Compute the limit: $\lim_{x \rightarrow 2} \frac{-12 + 16x - 7x^2 + x^3}{8 - 4x - 2x^2 + x^3}$

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

Exercise 5

Between the months $t=4$ and $t=10$

, the funds in certain account (in millions of euros) are given by the function $F(t) = 20 + 432t - 51t^2 + 2t^3$.

Determine the interval within the funds oscillates between months $t=5$ and $t=9$.

- 1) It oscillates between 1155 and 1236.
- 2) It oscillates between 1163 and 1233.
- 3) It oscillates between 1235 and 1236.
- 4) It oscillates between 1060 and 1240.
- 5) It oscillates between 1147 and 1242.

Exercise 6

In a fish farm, data of precedings years reveal that, if the initial number of fish is x (x in thousands), after one month they reproduce until a number of $f(x) = \frac{16x}{4 + 31x}$ fishes.

What number of fish leads to the largest increase in the number of animals, $f(x) - x$?

- 1) $\frac{26}{11}$
- 2) $\frac{4}{31}$
- 3) $\frac{13}{3}$
- 4) $\frac{1}{2}$
- 5) $\frac{3}{2}$

Exercise 7

The yield of a tree plantation is given by $f(x) =$

$$\frac{-5 + 19x + 48x^2}{22x^2}, \text{ where } x \text{ is the distance in meters between two trees.}$$

What is the distance x that leads to the largest yield.

- 1) $\frac{1}{13}$
- 2) $\frac{35}{18}$
- 3) $\frac{15}{17}$
- 4) $\frac{10}{19}$
- 5) $\frac{11}{10}$

Exercise 8

A plastic firm receives an order to manufacture 3780 special plastic foam boards for swimming training. The firm has 14 machines but each of them will be able to participate in the manufacturing of this special type of tables only after an adaptation so that each adapted machine is capable of manufacturing 45 boards per hour; on the other hand, the non adapted ones cannot be used for this special order. The cost to adapt each machine is 119 monetary units. Moreover, these adapted machines are automated and only need staff to supervise the production whose salary is 204 monetary units per hour. Taking into account the number of hours that will be necessary to produce the ordered tables, the cost in salaries for those hours, and the adaptation costs, how many of the machines that the company has should be adapted to place the order at the lowest possible cost?

- 1) 8
- 2) 27
- 3) None of the other options is correct.
- 4) 9
- 5) 19

Exercise 9

Study the differentiability of the function $f(x) =$

$$\begin{cases} e^{x+2} - 2 \cos(x+2) + 2 & x \leq -2 \\ x(\log(4) - 1) - (x+3) \log(x+3) - 1 + \log(16) & -2 < x < 1 \\ -2e^{x-1} - 3 \cos(1-x) + 3 - \log(4) & 1 \leq x \end{cases}$$

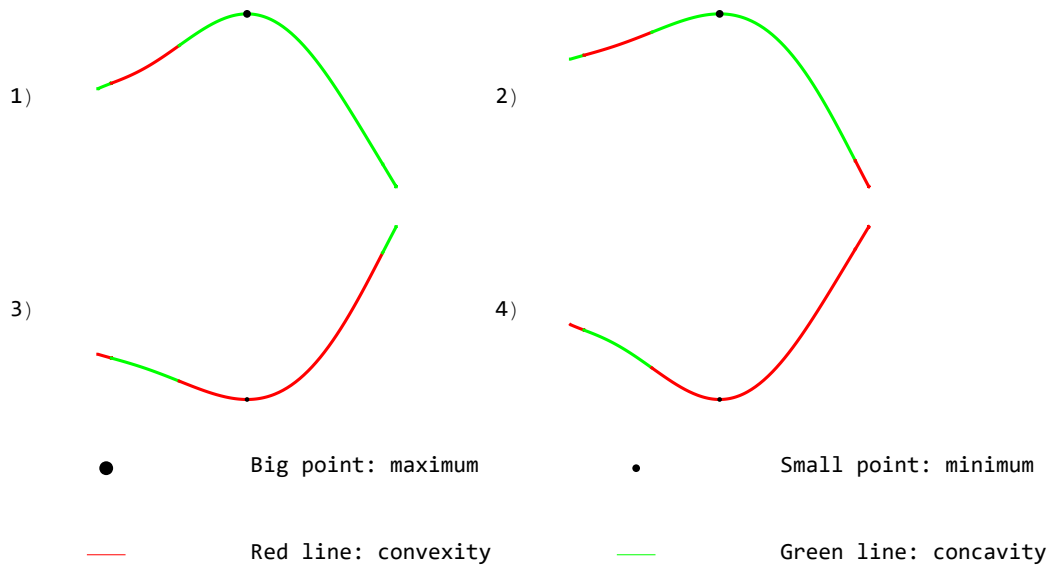
- 1) The function is differentiable for all points.
- 2) The function is not differentiable at any point.
- 3) The function is differentiable for all points except for $x = -2$.
- 4) The function is differentiable for all points except for $x = 1$.
- 5) The function is differentiable for all points except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

Mathematics 1 - ADE - English - 2026/2027

02-Derivatives for serial number: 29

Exercise 1

Study the shape properties of $f(x) = 1 + 240x^2 + 40x^3 - 30x^4 - 3x^5 + 2x^6$ to decide which amongst the following ones is the representation of the function.



Indication: To solve this exercise it is necessary to determine the concavity and convexity interval. To find the inflexion points separating the concavity and convexity intervals, check (by means of Ruffini) with the points $-2, -1, 0, 1, 2$.

Exercise 2

Determine the derivative of the function $f(t) = t^3 \log(t^3 + 1) \sin(t^3)$ and compute its value at the point $t=0$.

- 1) $f'(0) = -4$ 2) $f'(0) = -3$ 3) $f'(0) = 1$ 4) $f'(0) = 0$

Exercise 3

Compute the limit: $\lim_{x \rightarrow 0} \frac{-1 + e^x - x - \frac{x^2}{2}}{x^3}$

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

Exercise 4

Compute the limit: $\lim_{x \rightarrow -3} \frac{-54 - 27x + 9x^2 + 7x^3 + x^4}{-9 + 3x + 5x^2 + x^3}$

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

Exercise 5

Between the months $t=3$ and $t=10$

, the true value of the shares of a company (in euros) are given by the function $C(t) = 4 + 162t - 36t^2 + 2t^3$.

Determine the interval within the value oscillates between months $t=7$ and $t=10$.

- 1) It oscillates between 4 and 220.
- 2) It oscillates between 8 and 55.
- 3) It oscillates between 4 and 60.
- 4) It oscillates between 4 and 220.
- 5) It oscillates between -1 and 64.

Exercise 6

In a fish farm, data of precedings years reveal that, if the initial number of fish is x (x in thousands), after one month they reproduce until a number of $f(x) = \frac{40x}{10 + 20x}$ fishes.

What number of fish leads to the largest increase in the number of animals, $f(x) - x$?

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

2) $\frac{11}{18}$

3) $\frac{31}{8}$

4) $\frac{29}{16}$

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

Exercise 7

The yield of a tree plantation is given by $f(x) =$

$$\frac{-44 + 23x + 45x^2}{44x^4}, \text{ where } x \text{ is the distance in meters between two trees.}$$

What is the distance x that leads to the largest yield.

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

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

3) $\frac{19}{11}$

4) $\frac{16}{15}$

5) $\frac{9}{4}$

Exercise 8

A plastic firm receives an order to manufacture 11011 special plastic foam boards for swimming training. The firm has 22 machines but each of them will be able to participate in the manufacturing of this special type of tables only after an adaptation so that each adapted machine is capable of manufacturing 13 boards per hour; on the other hand, the non adapted ones cannot be used for this special order. The cost to adapt each machine is 5929 monetary units. Moreover, these adapted machines are automated and only need staff to supervise the production whose salary is 1183 monetary units per hour. Taking into account the number of hours that will be necessary to produce the ordered tables, the cost in salaries for those hours, and the adaptation costs, how many of the machines that the company has should be adapted to place the order at the lowest possible cost?

- 1) 22
- 2) 25
- 3) None of the other options is correct.
- 4) 13
- 5) 22

Exercise 9

Study the differentiability of the function $f(x) = \begin{cases} \sin(3-x) - 3\cos(3-x) + 4 & x \leq 3 \\ \frac{1}{2}((x-8)x + 17) & 3 < x < 4 \\ 2\cos(4-x) - \frac{3}{2} & 4 \leq x \end{cases}$

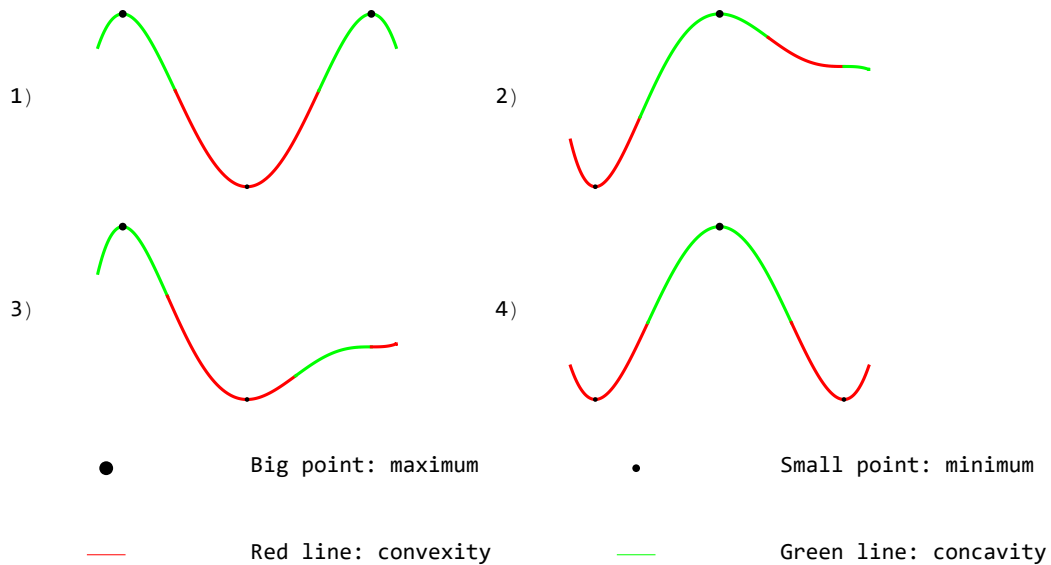
- 1) The function is differentiable for all points.
- 2) The function is not differentiable at any point.
- 3) The function is differentiable for all points except for $x=3$.
- 4) The function is differentiable for all points except for $x=4$.
- 5) The function is differentiable for all points except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

Mathematics 1 - ADE - English - 2026/2027

02-Derivatives for serial number: 30

Exercise 1

Study the shape properties of the $f(x) = 5 + 30x^2 - 20x^3 - 15x^4 + 12x^5$ to decide which amongst the following ones is the representation of the function.



Indication: To find the maximum and minimum points of the function, try (with Ruffini) the points $-2, -1, 0, 1, 2$. To solve this exercise it is necessary to determine the increasing and decreasing intervals.

Exercise 2

Determine the derivative of the function $f(t) = t^2 (e^t + 2 \sin(t) + 2)$ and compute its value at the point $t=0$.

- 1) $f'(0) = 4$ 2) $f'(0) = 0$ 3) $f'(0) = 3$ 4) $f'(0) = -1$

Exercise 3

Compute the limit: $\lim_{x \rightarrow 1} \frac{\frac{25}{6} - 8x + 6x^2 - \frac{8x^3}{3} + \frac{x^4}{2} + \text{Log}[x^2]}{-1 + 5x - 10x^2 + 10x^3 - 5x^4 + x^5}$

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

Exercise 4

Compute the limit: $\lim_{x \rightarrow -2} \frac{4x + 4x^2 + x^3}{12 + 16x + 7x^2 + x^3}$

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

Exercise 5

Between the months $t=0$ and $t=7$

, the funds in certain account (in millions of euros) are given by the function $F(t) = -4 + 12t - 9t^2 + 2t^3$.

Determine the interval within the funds oscillates between months $t=4$ and $t=6$.

- 1) It oscillates between 38 and 180.
- 2) It oscillates between 0 and 1.
- 3) It oscillates between -4 and 325.
- 4) It oscillates between 28 and 176.
- 5) It oscillates between 24 and 178.

Exercise 6

In a fish farm, data of precedings years reveal that, if the initial number of fish is x (x in thousands), after one month they reproduce until a number of $f(x) = \frac{12x}{3 + 37x}$ fishes.

What number of fish leads to the largest increase in the number of animals, $f(x) - x$?

- 1) 6
- 2) $\frac{18}{11}$
- 3) $\frac{11}{16}$
- 4) 1
- 5) $\frac{3}{37}$

Exercise 7

The yield of a tree plantation is given by $f(x) =$

$$\frac{-35 + 19x + 28x^2}{33x^2}, \text{ where } x \text{ is the distance in meters between two trees.}$$

What is the distance x that leads to the largest yield.

- 1) $\frac{28}{3}$
- 2) 1
- 3) $\frac{35}{9}$
- 4) $\frac{17}{20}$
- 5) $\frac{70}{19}$

Exercise 8

A plastic firm receives and order to manufacture 1870 special plastic foam boards for swimming training. The firm have 18 machines but each of them will be able to participate in the manufacturing of this special type of tables only after an adaptation so that each adapted machine is capable of manufacturing 170 boards per hour; on the other hand, the non adapted ones cannot be used for this special order. The cost to adapt each machine is 65 monetary units. Moreover, these adapted machines are automated and only need staff to supervise the production whose salary is 715 monetary units per hour. Taking into account the number of hours that will be necessary to produce the ordered tables, the cost in salaries for those hours, and the adaptation costs, how many of the machines that the company has should be adapted to place the order at the lowest possible cost?

- 1) 11
- 2) 26
- 3) None of the other options is correct.
- 4) 19
- 5) 12

Exercise 9

Study the differentiability of the function $f(x) =$

$$\begin{cases} e^{x-1} + \sin(1) \sin(x) + \cos(1) \cos(x) + 2 & x \leq 1 \\ x + 3 & 1 < x < 4 \vee 4 \leq x \end{cases}$$

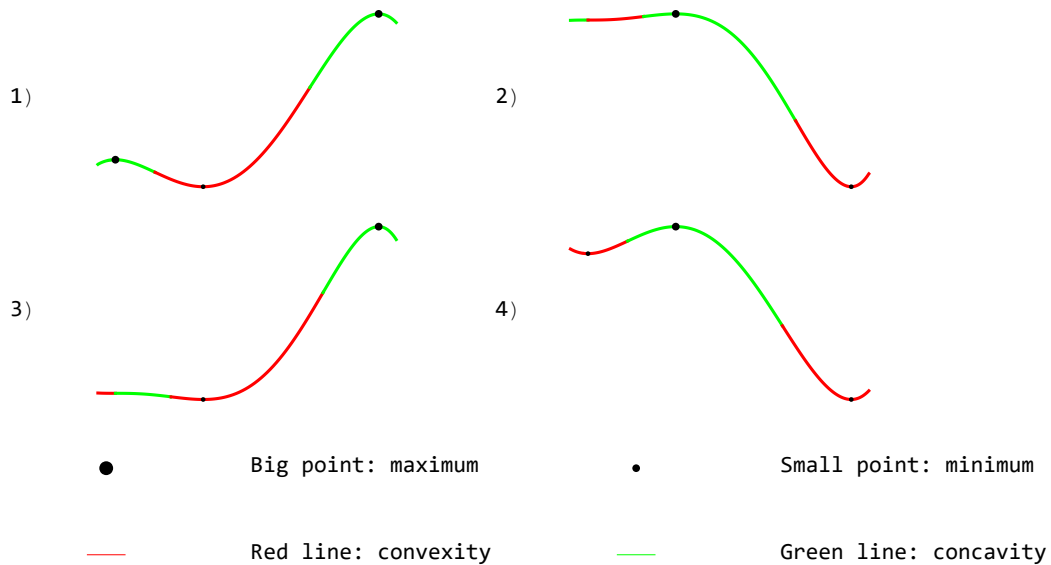
- 1) The function is differentiable for all points.
- 2) The function is not differentiable at any point.
- 3) The function is differentiable for all points except for $x=1$.
- 4) The function is differentiable for all points except for $x=4$.
- 5) The function is differentiable for all points except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

Mathematics 1 - ADE - English - 2026/2027

02-Derivatives for serial number: 31

Exercise 1

Study the shape properties of the $f(x) = 2 - 60x^2 - 60x^3 + 12x^5$ to decide which amongst the following ones is the representation of the function.



Indication: To find the maximum and minimum points of the function, try (with Ruffini) the points $-2, -1, 0, 1, 2$. To solve this exercise it is necessary to determine the increasing and decreasing intervals.

Exercise 2

Determine the derivative of the function $f(t) = 2 \log(\log(t^3 + 1) + 1) \cos(\log(t^3 + 1))$ and compute its value at the point $t=0$.

- 1) $f'(0) = -4$ 2) $f'(0) = 4$ 3) $f'(0) = 0$ 4) $f'(0) = 3$

Exercise 3

Compute the limit: $\lim_{x \rightarrow 1} \frac{3 - 4x + x^2 + \text{Log}[x^2]}{-1 + 3x - 3x^2 + x^3}$

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

Exercise 4

Compute the limit: $\lim_{x \rightarrow 2} \frac{12 - 8x - x^2 + x^3}{-12 + 16x - 7x^2 + x^3}$

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

Exercise 5

Between the months $t=3$ and $t=8$

, the funds in certain account (in millions of euros) are given by the function $F(t) = 5 + 120t - 27t^2 + 2t^3$.

Determine the interval within the funds oscillates between months $t=6$ and $t=8$.

- 1) It oscillates between 177 and 258.
- 2) It oscillates between 185 and 261.
- 3) It oscillates between 183 and 268.
- 4) It oscillates between 180 and 181.
- 5) It oscillates between 176 and 261.

Exercise 6

In a fish farm, data of precedings years reveal that, if the initial number of fish is x (x in thousands), after one month they reproduce until a number of $f(x) = \frac{24x}{6 + 17x}$ fishes.

What number of fish leads to the largest increase in the number of animals, $f(x) - x$?

- 1) 2
- 2) $\frac{40}{13}$
- 3) $\frac{15}{11}$
- 4) $\frac{6}{17}$
- 5) 8

Exercise 7

The yield of a tree plantation is given by $f(x) =$

$$\frac{-41 + 43x + 24x^2}{41x^2}, \text{ where } x \text{ is the distance in meters between two trees.}$$

What is the distance x that leads to the largest yield.

- 1) $\frac{29}{12}$
- 2) $\frac{82}{43}$
- 3) $\frac{7}{9}$
- 4) $\frac{7}{2}$
- 5) $\frac{13}{6}$

Exercise 8

A plastic firm receives and order to manufacture 42959 special plastic foam boards for swimming training. The firm have 27 machines but each of them will be able to participate in the manufacturing of this special type of tables only after an adaptation so that each adapted machine is capable of manufacturing 182 boards per hour; on the other hand, the non adapted ones cannot be used for this special order. The cost to adapt each machine is 289 monetary units. Moreover, these adapted machines are automated and only need staff to supervise the production whose salary is 442 monetary units per hour. Taking into account the number of hours that will be necessary to produce the ordered tables, the cost in salaries for those hours, and the adaptation costs, how many of the machines that the company has should be adapted to place the order at the lowest possible cost?

- 1) 19
- 2) 34
- 3) 7
- 4) None of the other options is correct.
- 5) 27

Exercise 9

Study the differentiability of the function $f(x) =$

$$f(x) = \begin{cases} \sin(2-x) + \cos(2-x) + 5 & x \leq 2 \\ 2x + 3x \sin(1) - \sin(2-x) - x \cos(1) + 3 \cos(2-x) - 1 - 6 \sin(1) + 2 \cos(1) & 2 < x < 3 \\ 5x - 3(x-2) \log(x-2) + 2(-5 + 2 \sin(1) + \cos(1)) & 3 \leq x \end{cases}$$

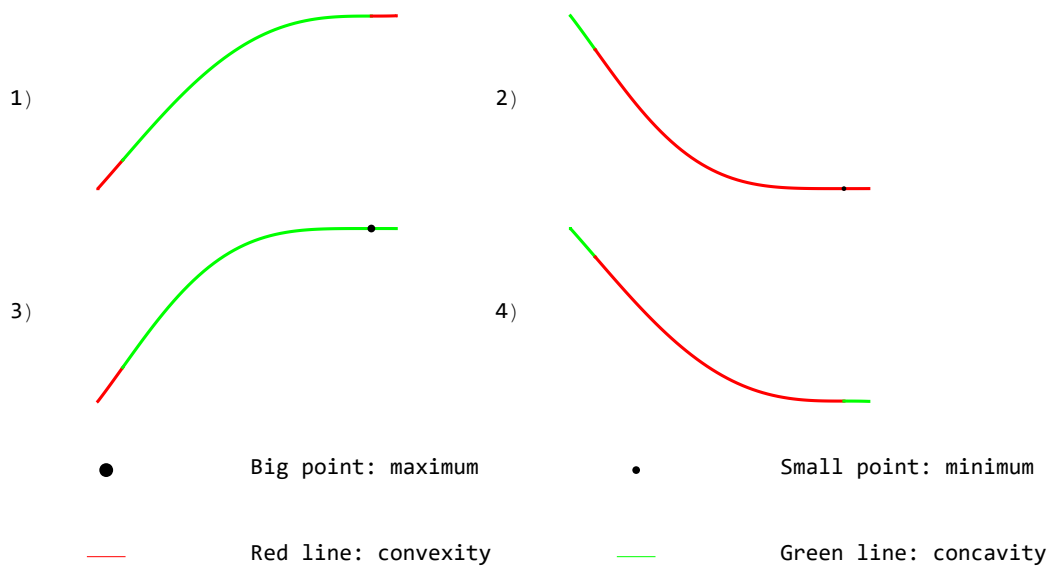
- 1) The function is differentiable for all points.
- 2) The function is not differentiable at any point.
- 3) The function is differentiable for all points except for $x=2$.
- 4) The function is differentiable for all points except for $x=3$.
- 5) The function is differentiable for all points except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

Mathematics 1 - ADE - English - 2026/2027

02-Derivatives for serial number: 32

Exercise 1

Study the shape properties of $f(x) = 3 + 2x^4 + \frac{3x^5}{5}$ to decide which amongst the following ones is the representation of the function.



Indication: To solve this exercise it is necessary to determine the concavity and convexity interval. To find the inflexion points separating the concavity and convexity intervals, check (by means of Ruffini) with the points $-2, -1, 0, 1, 2$.

Exercise 2

Determine the derivative of the function $f(t) = \sin(t) (t + \log(t+1) - 3 \sin(t))$ and compute its value at the point $t=0$.

- 1) $f'(0) = 1$ 2) $f'(0) = 4$ 3) $f'(0) = 0$ 4) $f'(0) = -1$

Exercise 3

Compute the limit: $\lim_{x \rightarrow 0} \frac{-x^3 + \sin[x^3]}{x^4}$

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

Exercise 4

Compute the limit: $\lim_{x \rightarrow -3} \frac{3x + x^2}{-6 + x + x^2}$

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

Exercise 5

Between the months $t=4$ and $t=9$

, the true value of the shares of a company (in euros) are given by the function $C(t) = 363 + 210t - 36t^2 + 2t^3$.

Determine the interval within the value oscillates between months $t=6$ and $t=7$.

- 1) It oscillates between 755 and 795.
- 2) It oscillates between 755 and 759.
- 3) It oscillates between 754 and 767.
- 4) It oscillates between 763 and 760.
- 5) It oscillates between 755 and 763.

Exercise 6

In a fish farm, data of precedings years reveal that, if the initial number of fish is x (x in thousands), after one month they reproduce until a number of $f(x) = \frac{28x}{7 + 30x}$ fishes.

What number of fish leads to the largest increase in the number of animals, $f(x) - x$?

- 1) $\frac{15}{7}$
- 2) $\frac{7}{30}$
- 3) $\frac{37}{12}$
- 4) $\frac{32}{17}$
- 5) $\frac{9}{14}$

Exercise 7

The yield of a tree plantation is given by $f(x) =$

$$\frac{-40 + 32x + 17x^2}{44x^4}, \text{ where } x \text{ is the distance in meters between two trees.}$$

What is the distance x that leads to the largest yield.

- 1) $\frac{22}{7}$
- 2) $\frac{20}{17}$
- 3) $\frac{6}{19}$
- 4) $\frac{32}{17}$
- 5) $\frac{7}{20}$

Exercise 8

A plastic firm receives an order to manufacture 1650 special plastic foam boards for swimming training. The firm has 11 machines but each of them will be able to participate in the manufacturing of this special type of tables only after an adaptation so that each adapted machine is capable of manufacturing 55 boards per hour; on the other hand, the non adapted ones cannot be used for this special order. The cost to adapt each machine is 935 monetary units. Moreover, these adapted machines are automated and only need staff to supervise the production whose salary is 1122 monetary units per hour. Taking into account the number of hours that will be necessary to produce the ordered tables, the cost in salaries for those hours, and the adaptation costs, how many of the machines that the company has should be adapted to place the order at the lowest possible cost?

- 1) 2
- 2) 9
- 3) 21
- 4) None of the other options is correct.
- 5) 15

Exercise 9

Study the differentiability of the function $f(x) = \begin{cases} 2e^{x+2} + 3\cos(x+2) + 4 & x \leq -2 \\ -2(x+3)\log\left(\frac{x+3}{3}\right) + 12 - \log(9) & -2 < x < 0 \\ -2e^x - \cos(x) + 15 - \log(9) & 0 \leq x \end{cases}$

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

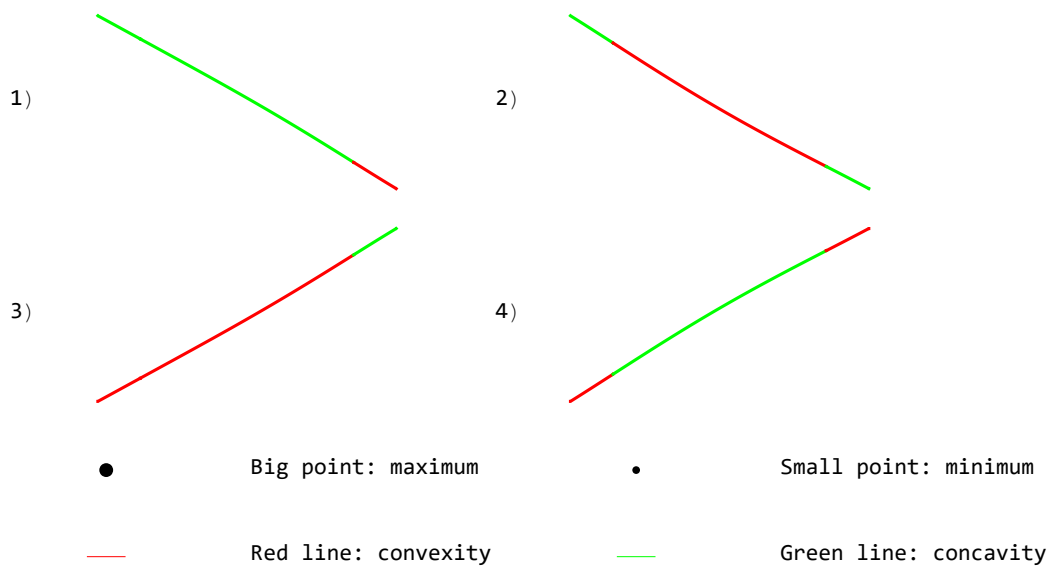
Mathematics 1 - ADE - English - 2026/2027

02-Derivatives for serial number: 33

Exercise 1

Study the shape properties of $f(x) = 3 - 12x^2 + 10x^3 - 4x^4 + \frac{3x^5}{5}$

to decide which amongst the following ones is the representation of the function.



Indication: To solve this exercise it is necessary to determine the concavity and convexity interval. To find the inflexion points separating the concavity and convexity intervals, check (by means of Ruffini) with the points $-2, -1, 0, 1, 2$.

Exercise 2

Determine the derivative of the function $f(t) = 6 \sin(\cos(e^t))$ and compute its value at the point $t=0$.

- 1) $f'(0) = 3$ 2) $f'(0) = -1$ 3) $f'(0) = 4$ 4) $f'(0) = -6 \cos[\cos[1]] \sin[1]$

Exercise 3

Compute the limit: $\lim_{x \rightarrow 0} \frac{-1 + \cos[x^3]}{x^6}$

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

Exercise 4

Compute the limit: $\lim_{x \rightarrow 3} \frac{9 + 3x - 5x^2 + x^3}{9x - 6x^2 + x^3}$

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

Exercise 5

Between the months $t=3$ and $t=10$

, the true value of the shares of a company (in euros) are given by the function $C(t) = 463 + 240t - 39t^2 + 2t^3$.

Determine the interval within the value oscillates between months $t=4$ and $t=9$.

- 1) It oscillates between 915 and 933.
- 2) It oscillates between 911 and 938.
- 3) It oscillates between 903 and 928.
- 4) It oscillates between 901 and 942.
- 5) It oscillates between 886 and 963.

Exercise 6

In a fish farm, data of precedings years reveal that, if the initial number of fish is x (x in thousands), after one month they reproduce until a number of $f(x) = \frac{45x}{20 + 21x}$ fishes.

What number of fish leads to the largest increase in the number of animals, $f(x) - x$?

- 1) $\frac{10}{21}$
- 2) $\frac{14}{9}$
- 3) $\frac{11}{2}$
- 4) $\frac{6}{11}$
- 5) $\frac{11}{7}$

Exercise 7

The yield of a tree plantation is given by $f(x) =$

$$\frac{-33 + 16x + 28x^2}{10x^5}, \text{ where } x \text{ is the distance in meters between two trees.}$$

What is the distance x that leads to the largest yield.

- 1) $\frac{15}{14}$
- 2) 6
- 3) $\frac{21}{2}$
- 4) $\frac{6}{11}$
- 5) $\frac{11}{7}$

Exercise 8

A plastic firm receives an order to manufacture 21840 special plastic foam boards for swimming training. The firm has 22 machines but each of them will be able to participate in the manufacturing of this special type of tables only after an adaptation so that each adapted machine is capable of manufacturing 455 boards per hour; on the other hand, the non adapted ones cannot be used for this special order. The cost to adapt each machine is 91 monetary units. Moreover, these adapted machines are automated and only need staff to supervise the production whose salary is 273 monetary units per hour. Taking into account the number of hours that will be necessary to produce the ordered tables, the cost in salaries for those hours, and the adaptation costs, how many of the machines that the company has should be adapted to place the order at the lowest possible cost?

- 1) 20
- 2) 2
- 3) 23
- 4) 12
- 5) None of the other options is correct.

Exercise 9

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

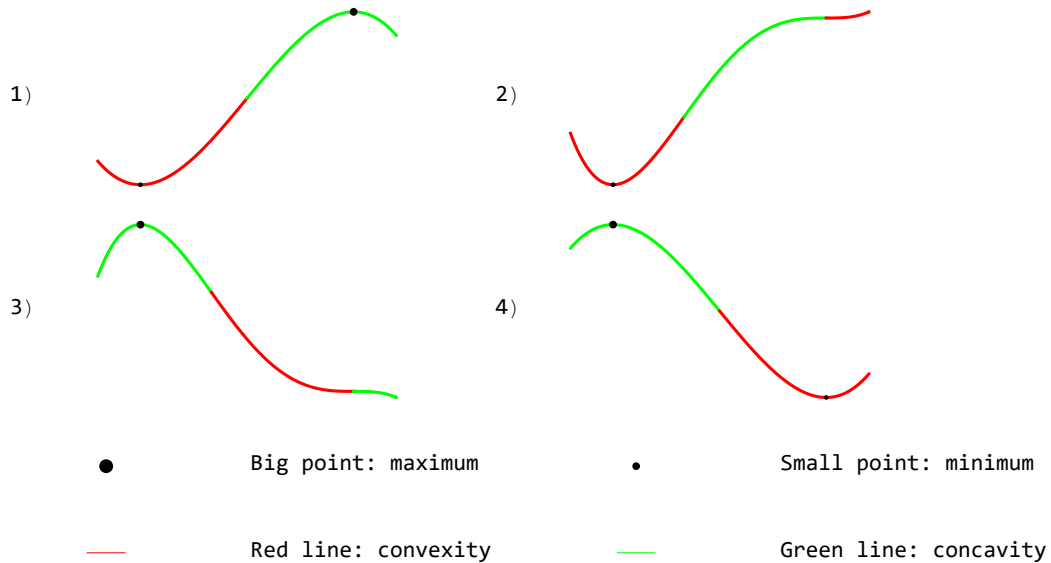
- 1) The function is differentiable for all points.
- 2) The function is not differentiable at any point.
- 3) The function is differentiable for all points except for $x=1$.
- 4) The function is differentiable for all points except for $x=3$.
- 5) The function is differentiable for all points except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

Mathematics 1 - ADE - English - 2026/2027

02-Derivatives for serial number: 34

Exercise 1

Study the shape properties of the $f(x) = 5 + 6x^2 - 8x^3 + 3x^4$ to decide which amongst the following ones is the representation of the function.



Indication: To find the maximum and minimum points of the function, try (with Ruffini) the points $-2, -1, 0, 1, 2$. To solve this exercise it is necessary to determine the increasing and decreasing intervals.

Exercise 2

Determine the derivative of the function $f(t) = \sin(\cos(t)) (\log(\cos(t) + 1) + \sin(\cos(t)))$ and compute its value at the point $t=0$.

- 1) $f'(0) = 2$ 2) $f'(0) = 1$ 3) $f'(0) = 0$ 4) $f'(0) = 3$

Exercise 3

Compute the limit: $\lim_{x \rightarrow 1} \frac{1 - x + \log[x]}{1 - 2x + x^2}$

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

Exercise 4

Compute the limit: $\lim_{x \rightarrow 1} \frac{-2 + 5x - 3x^2 - x^3 + x^4}{-2 + 5x - 4x^2 + x^3}$

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

Exercise 5

Between the months $t=4$ and $t=8$, the funds in certain account (in millions of euros) are given by the function $F(t) = -17 + 180t - 33t^2 + 2t^3$.

Determine the interval within the funds oscillates between months $t=4$ and $t=5$.

- 1) It oscillates between 307 and 311.
- 2) It oscillates between 303 and 335.
- 3) It oscillates between 307 and 308.
- 4) It oscillates between 294 and 311.
- 5) It oscillates between 303 and 308.

Exercise 6

In a fish farm, data of precedings years reveal that, if the initial number of fish is x (x in thousands), after one month they reproduce until a number of $f(x) = \frac{12x}{3 + 37x}$ fishes.

What number of fish leads to the largest increase in the number of animals, $f(x) - x$?

- 1) $\frac{13}{6}$
- 2) $\frac{5}{9}$
- 3) $\frac{5}{11}$
- 4) $\frac{13}{4}$
- 5) $\frac{3}{37}$

Exercise 7

The yield of a tree plantation is given by $f(x) =$

$$\frac{-39 + 22x + 25x^2}{21x^2}, \text{ where } x \text{ is the distance in meters between two trees.}$$

What is the distance x that leads to the largest yield.

- 1) 7
- 2) $\frac{7}{2}$
- 3) $\frac{25}{8}$
- 4) $\frac{39}{11}$
- 5) $\frac{25}{11}$

Exercise 8

A plastic firm receives an order to manufacture 825 special plastic foam boards for swimming training. The firm has 14 machines but each of them will be able to participate in the manufacturing of this special type of tables only after an adaptation so that each adapted machine is capable of manufacturing 385 boards per hour; on the other hand, the non adapted ones cannot be used for this special order. The cost to adapt each machine is 9 monetary units. Moreover, these adapted machines are automated and only need staff to supervise the production whose salary is 105 monetary units per hour. Taking into account the number of hours that will be necessary to produce the ordered tables, the cost in salaries for those hours, and the adaptation costs, how many of the machines that the company has should be adapted to place the order at the lowest possible cost?

- 1) 5
- 2) 14
- 3) 3
- 4) 4
- 5) None of the other options is correct.

Exercise 9

Study the differentiability of the function $f(x) = \begin{cases} -2e^{x+2} + 2\cos(x+2) + 5 & x \leq -2 \\ 2x(x+3) + 9 & -2 < x < -1 \\ 2(e^{x+1} + \cos(x+1)) + 1 & -1 \leq x \end{cases}$

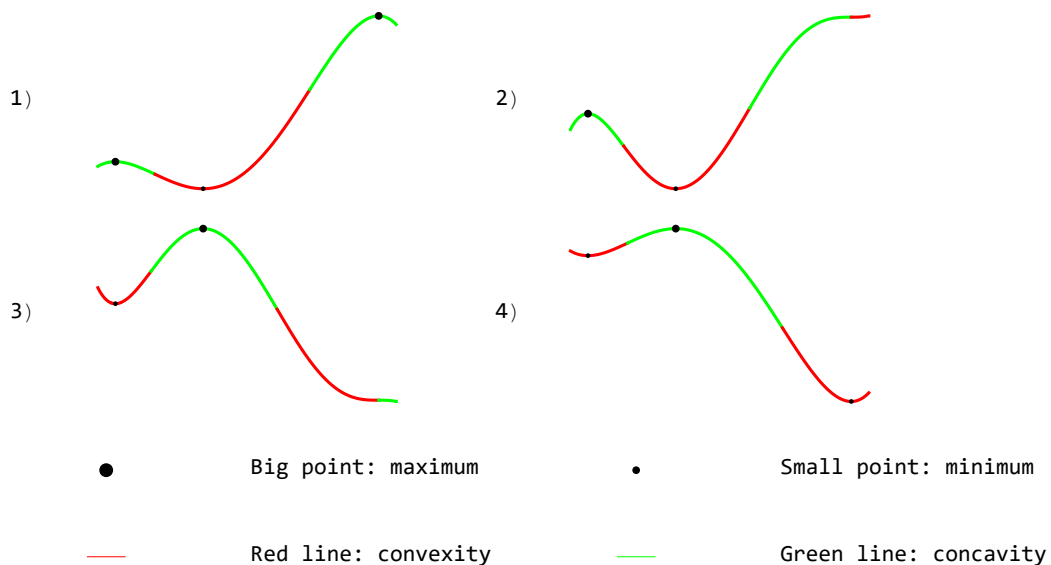
- 1) The function is differentiable for all points.
- 2) The function is not differentiable at any point.
- 3) The function is differentiable for all points except for $x = -2$.
- 4) The function is differentiable for all points except for $x = -1$.
- 5) The function is differentiable for all points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

Mathematics 1 - ADE - English - 2026/2027

02-Derivatives for serial number: 35

Exercise 1

Study the shape properties of the $f(x) = 3 + 120x^2 - 45x^4 + 12x^5$ to decide which amongst the following ones is the representation of the function.



Indication: To find the maximum and minimum points of the function, try (with Ruffini) the points $-2, -1, 0, 1, 2$. To solve this exercise it is necessary to determine the increasing and decreasing intervals.

Exercise 2

Determine the derivative of the function $f(t) = 4t \log(t+1) \cos(t)$ and compute its value at the point $t=0$.

- 1) $f'(0) = -2$ 2) $f'(0) = 4$ 3) $f'(0) = 2$ 4) $f'(0) = 0$

Exercise 3

Compute the limit: $\lim_{x \rightarrow 1} \frac{3 - 4x + x^2 + \text{Log}[x^2]}{-1 + 3x - 3x^2 + x^3}$

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

Exercise 4

Compute the limit: $\lim_{x \rightarrow 2} \frac{4 - 3x^2 + x^3}{-12 + 16x - 7x^2 + x^3}$

- 1) $-\infty$
- 2) ∞
- 3) -3
- 4) 0
- 5) -1
- 6) 1
- 7) -2

Exercise 5

Between the months $t=3$ and $t=10$

, the funds in certain account (in millions of euros) are given by the function $F(t) = -18 + 108t - 27t^2 + 2t^3$.

Determine the interval within the funds oscillates between months $t=6$ and $t=7$.

- 1) It oscillates between 90 and 102.
- 2) It oscillates between 90 and 101.
- 3) It oscillates between 88 and 97.
- 4) It oscillates between 90 and 362.
- 5) It oscillates between 90 and 117.

Exercise 6

In a fish farm, data of precedings years reveal that, if the initial number of fish is x (x in thousands), after one month they reproduce until a number of $f(x) = \frac{27x}{12 + 8x}$ fishes.

What number of fish leads to the largest increase in the number of animals, $f(x) - x$?

- 1) $\frac{3}{2}$
- 2) 4
- 3) $\frac{30}{7}$
- 4) $\frac{14}{9}$
- 5) $\frac{3}{4}$

Exercise 7

The yield of a tree plantation is given by $f(x) =$

$$\frac{-42 + 24x + 47x^2}{4x^2}, \text{ where } x \text{ is the distance in meters between two trees.}$$

What is the distance x that leads to the largest yield.

- 1) $\frac{9}{2}$
- 2) $\frac{18}{11}$
- 3) $\frac{7}{2}$
- 4) $\frac{16}{7}$
- 5) 2

Exercise 8

A plastic firm receives an order to manufacture 160160 special plastic foam boards for swimming training. The firm has 21 machines but each of them will be able to participate in the manufacturing of this special type of tables only after an adaptation so that each adapted machine is capable of manufacturing 91 boards per hour; on the other hand, the non adapted ones cannot be used for this special order. The cost to adapt each machine is 715 monetary units. Moreover, these adapted machines are automated and only need staff to supervise the production whose salary is 26 monetary units per hour. Taking into account the number of hours that will be necessary to produce the ordered tables, the cost in salaries for those hours, and the adaptation costs, how many of the machines that the company has should be adapted to place the order at the lowest possible cost?

- 1) 15
- 2) 10
- 3) 21
- 4) None of the other options is correct.
- 5) 22

Exercise 9

Study the differentiability of the function $f(x) = \begin{cases} 2 (\cos(2 - x) + 2) & x \leq 2 \\ \frac{10}{3} - \frac{1}{6} (x - 16) x & 2 < x < 5 \\ 4x - 3(x - 4) \log(x - 4) - \frac{15}{2} & 5 \leq x \end{cases}$

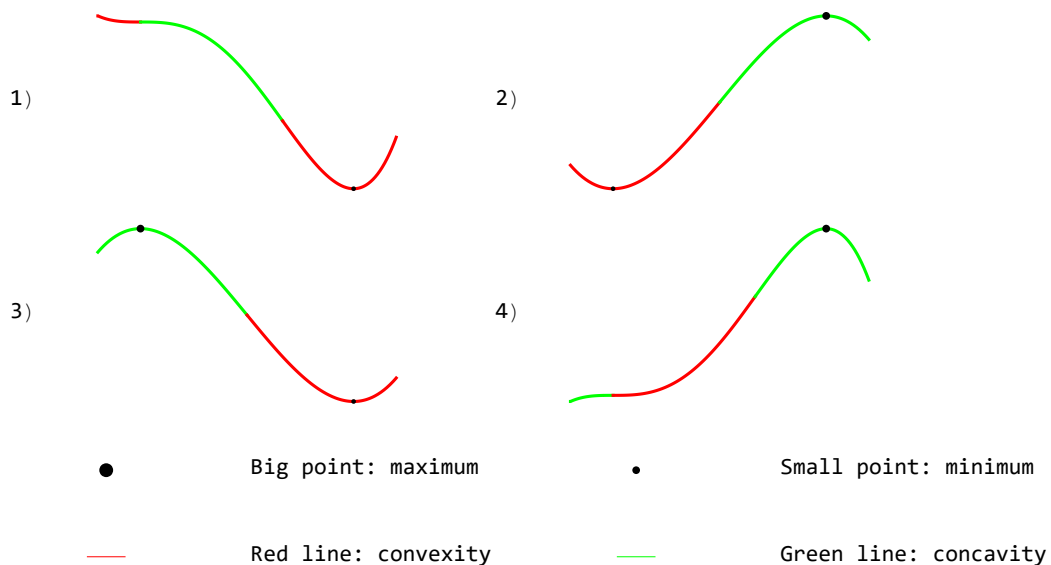
- 1) The function is differentiable for all points.
- 2) The function is not differentiable at any point.
- 3) The function is differentiable for all points except for $x = 2$.
- 4) The function is differentiable for all points except for $x = 5$.
- 5) The function is differentiable for all points except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

Mathematics 1 - ADE - English - 2026/2027

02-Derivatives for serial number: 36

Exercise 1

Study the shape properties of the $f(x) = 2 + 48x + 48x^2 + 20x^3 + 3x^4$ to decide which amongst the following ones is the representation of the function.



Indication: To find the maximum and minimum points of the function, try (with Ruffini) the points $-2, -1, 0, 1, 2$. To solve this exercise it is necessary to determine the increasing and decreasing intervals.

Exercise 2

Determine the derivative of the function $f(t) = -\log(t+1)$ and compute its value at the point $t=0$.

- 1) $f'(0) = -1$ 2) $f'(0) = -2$ 3) $f'(0) = -4$ 4) $f'(0) = 0$

Exercise 3

Compute the limit: $\lim_{x \rightarrow 0} \frac{-1 + \frac{x^2}{2} + \cos[x]}{x^4}$

- 1) 1
- 2) $\frac{1}{24}$
- 3) $-\frac{2}{3}$
- 4) ∞
- 5) 0
- 6) $-\infty$
- 7) $-\frac{1}{2}$

Exercise 4

Compute the limit: $\lim_{x \rightarrow 1} \frac{3 - 5x + x^2 + x^3}{2 - 3x + x^2}$

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

Exercise 5

Between the months $t=4$ and $t=8$

, the funds in certain account (in millions of euros) are given by the function $F(t) = 19 + 252t - 39t^2 + 2t^3$.

Determine the interval within the funds oscillates between months $t=4$ and $t=8$.

- 1) It oscillates between 531 and 563.
- 2) It oscillates between 524 and 553.
- 3) It oscillates between 558 and 559.
- 4) It oscillates between 526 and 553.
- 5) It oscillates between 524 and 563.

Exercise 6

In a fish farm, data of precedings years reveal that, if the initial number of fish is x (x in thousands), after one month they reproduce until a number of $f(x) = \frac{50x}{8 + 33x}$ fishes.

What number of fish leads to the largest increase in the number of animals, $f(x) - x$?

- 1) $\frac{15}{17}$
- 2) $\frac{5}{6}$
- 3) $\frac{4}{5}$
- 4) $\frac{6}{5}$
- 5) $\frac{4}{11}$

Exercise 7

The yield of a tree plantation is given by $f(x) =$

$$\frac{-1 + 8x + 4x^2}{29x^2}, \text{ where } x \text{ is the distance in meters between two trees.}$$

What is the distance x that leads to the largest yield.

- 1) $\frac{1}{4}$
- 2) 31
- 3) $\frac{19}{10}$
- 4) $\frac{8}{5}$
- 5) 30

Exercise 8

A plastic firm receives and order to manufacture 194480 special plastic foam boards for swimming training. The firm have 10 machines but each of them will be able to participate in the manufacturing of this special type of tables only after an adaptation so that each adapted machine is capable of manufacturing 11 boards per hour; on the other hand, the non adapted ones cannot be used for this special order. The cost to adapt each machine is 1326 monetary units. Moreover, these adapted machines are automated and only need staff to supervise the production whose salary is 30 monetary units per hour. Taking into account the number of hours that will be necessary to produce the ordered tables, the cost in salaries for those hours, and the adaptation costs, how many of the machines that the company has should be adapted to place the order at the lowest possible cost?

- 1) 5
- 2) 6
- 3) None of the other options is correct.
- 4) 20
- 5) 12

Exercise 9

Study the differentiability of the function $f(x) =$

$$\begin{cases} e^{x+1} + 2 \cos(x+1) & x \leq -1 \\ 4x - 3(x+2) \log(x+2) + 7 & -1 < x < 0 \\ x - 3(x+1) \log(x+1) + 7 - 6 \log(2) & 0 \leq x \end{cases}$$

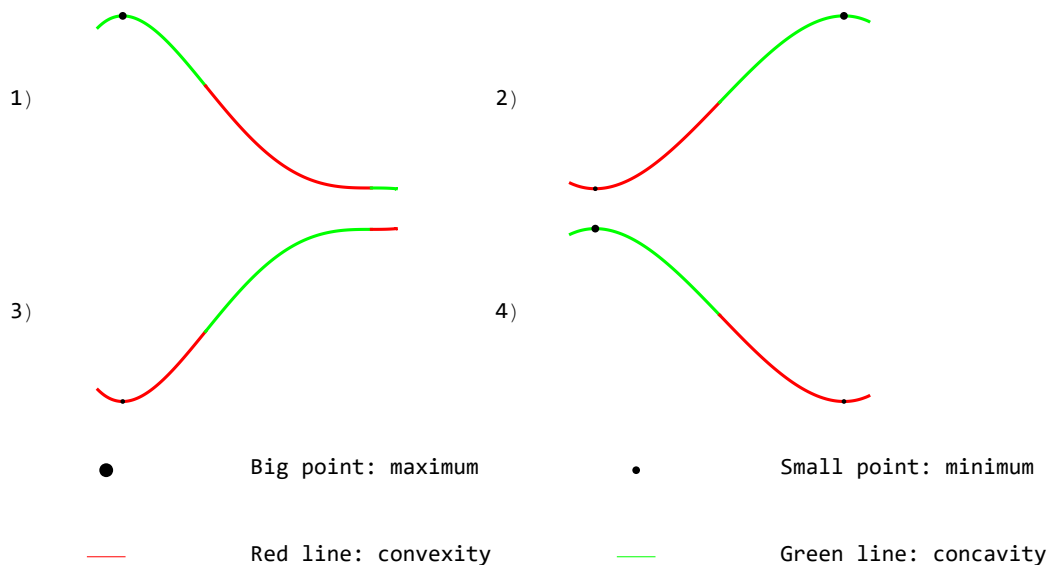
- 1) The function is differentiable for all points.
- 2) The function is not differentiable at any point.
- 3) The function is differentiable for all points except for $x = -1$.
- 4) The function is differentiable for all points except for $x = 0$.
- 5) The function is differentiable for all points except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

Mathematics 1 - ADE - English - 2026/2027

02-Derivatives for serial number: 37

Exercise 1

Study the shape properties of the $f(x) = 1 + 8x^3 + 3x^4$ to decide which amongst the following ones is the representation of the function.



Indication: To find the maximum and minimum points of the function, try (with Ruffini) the points $-2, -1, 0, 1, 2$. To solve this exercise it is necessary to determine the increasing and decreasing intervals.

Exercise 2

Determine the derivative of the function $f(t) = t + \log(\log(t+1) + 1) - \cos(\log(t+1)) + 1$ and compute its value at the point $t=0$.

- 1) $f'(0) = 0$ 2) $f'(0) = -2$ 3) $f'(0) = -1$ 4) $f'(0) = 2$

Exercise 3

Compute the limit: $\lim_{x \rightarrow 0} \frac{-1 + e^x - x - \frac{x^2}{2} - \frac{x^3}{6}}{x^4}$

- 1) 0
- 2) ∞
- 3) -2
- 4) 1
- 5) $\frac{1}{24}$
- 6) -1
- 7) $-\infty$

Exercise 4

Compute the limit: $\lim_{x \rightarrow -1} \frac{-1 + x^2}{3 + 4x + x^2}$

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

Exercise 5

Between the months $t=0$ and $t=7$

, the funds in certain account (in millions of euros) are given by the function $F(t) = 4 - 15t^2 + 2t^3$.

Determine the interval within the funds oscillates between months $t=3$ and $t=5$.

- 1) It oscillates between -121 and 4.
- 2) It oscillates between -131 and -69.
- 3) It oscillates between -121 and -77.
- 4) It oscillates between -121 and 4.
- 5) It oscillates between -129 and -78.

Exercise 6

In a fish farm, data of precedings years reveal that, if the initial number of fish is x (x in thousands), after one month they reproduce until a number of $f(x) = \frac{49x}{25 + 2x}$ fishes.

What number of fish leads to the largest increase in the number of animals, $f(x) - x$?

- 1) $\frac{23}{4}$
- 2) $\frac{19}{4}$
- 3) $\frac{1}{11}$
- 4) 5
- 5) 2

Exercise 7

The yield of a tree plantation is given by $f(x) =$

$$\frac{-50 + 42x + 42x^2}{44x^2}, \text{ where } x \text{ is the distance in meters between two trees.}$$

What is the distance x that leads to the largest yield.

- 1) $\frac{1}{6}$
- 2) $\frac{13}{19}$
- 3) $\frac{4}{15}$
- 4) $\frac{34}{5}$
- 5) $\frac{50}{21}$

Exercise 8

A plastic firm receives an order to manufacture 2040 special plastic foam boards for swimming training. The firm has 19 machines but each of them will be able to participate in the manufacturing of this special type of tables only after an adaptation so that each adapted machine is capable of manufacturing 2 boards per hour; on the other hand, the non adapted ones cannot be used for this special order. The cost to adapt each machine is 714 monetary units. Moreover, these adapted machines are automated and only need staff to supervise the production whose salary is 70 monetary units per hour. Taking into account the number of hours that will be necessary to produce the ordered tables, the cost in salaries for those hours, and the adaptation costs, how many of the machines that the company has should be adapted to place the order at the lowest possible cost?

- 1) None of the other options is correct.
- 2) 15
- 3) 14
- 4) 20
- 5) 12

Exercise 9

Study the differentiability of the function $f(x) = \begin{cases} \sin(x+1) - 5 & x \leq -1 \\ x - 4 & -1 < x < 0 \\ e^x - 2 \cos(x) - 3 & 0 \leq x \end{cases}$

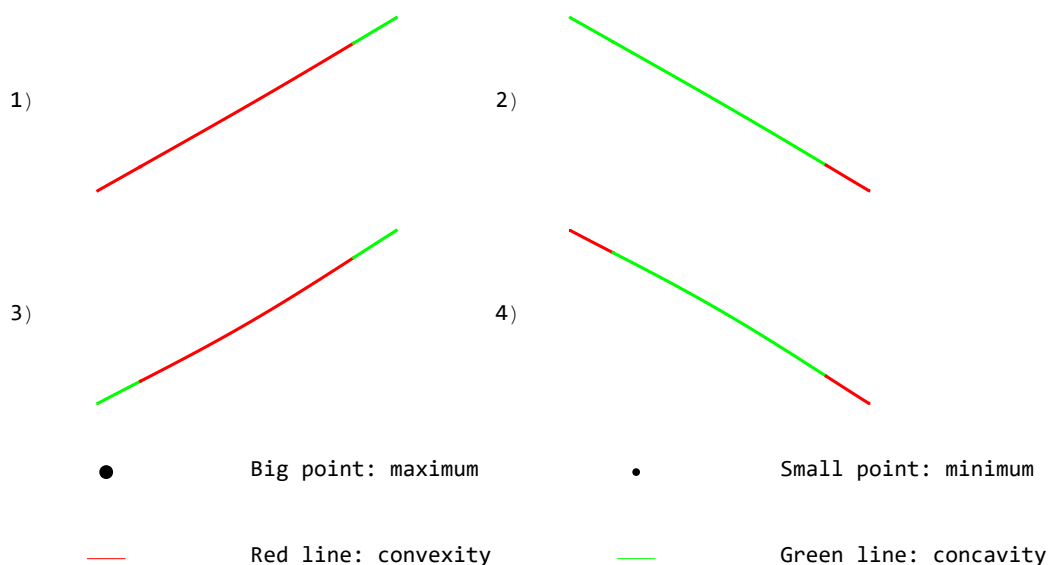
- 1) The function is differentiable for all points.
- 2) The function is not differentiable at any point.
- 3) The function is differentiable for all points except for $x = -1$.
- 4) The function is differentiable for all points except for $x = 0$.
- 5) The function is differentiable for all points except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

Mathematics 1 - ADE - English - 2026/2027

02-Derivatives for serial number: 38

Exercise 1

Study the shape properties of $f(x) = 5 + 24x^2 + 16x^3 + 5x^4 + \frac{3x^5}{5}$ to decide which amongst the following ones is the representation of the function.



Indication: To solve this exercise it is necessary to determine the concavity and convexity interval. To find the inflexion points separating the concavity and convexity intervals, check (by means of Ruffini) with the points $-2, -1, 0, 1, 2$.

Exercise 2

Determine the derivative of the function $f(t) = \cos(t) (e^{t^2} - 3 \cos(t^2))$ and compute its value at the point $t=0$.

- 1) $f'(0) = -1$ 2) $f'(0) = 1$ 3) $f'(0) = 0$ 4) $f'(0) = 4$

Exercise 3

Compute the limit: $\lim_{x \rightarrow 0} \frac{-1 + e^{x^3} - x^3}{x^4}$

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

Exercise 4

Compute the limit: $\lim_{x \rightarrow -3} \frac{-3 + 2x + x^2}{6 + 5x + x^2}$

- 1) -2
- 2) 1
- 3) -1
- 4) 0
- 5) ∞
- 6) $-\infty$
- 7) 4

Exercise 5

Between the months $t=0$ and $t=5$

, the true value of the shares of a company (in euros) are given by the function $C(t) = 12 + 48t - 18t^2 + 2t^3$.

Determine the interval within the value oscillates between months $t=0$ and $t=5$.

- 1) It oscillates between 20 and 51.
- 2) It oscillates between 21 and 56.
- 3) It oscillates between 12 and 52.
- 4) It oscillates between 5 and 50.
- 5) It oscillates between 44 and 52.

Exercise 6

In a fish farm, data of precedings years reveal that, if the initial number of fish is x (x in thousands), after one month they reproduce until a number of $f(x) = \frac{49x}{9 + 28x}$ fishes.

What number of fish leads to the largest increase in the number of animals, $f(x) - x$?

- 1) $\frac{3}{7}$
- 2) $\frac{15}{8}$
- 3) $\frac{24}{17}$
- 4) 20
- 5) $\frac{11}{5}$

Exercise 7

The yield of a tree plantation is given by $f(x) =$

$$\frac{-48 + 29x + 7x^2}{27x^3}, \text{ where } x \text{ is the distance in meters between two trees.}$$

What is the distance x that leads to the largest yield.

- 1) $\frac{17}{2}$
- 2) $\frac{1}{2}$
- 3) 2
- 4) $\frac{1}{2}$
- 5) $\frac{6}{13}$

Exercise 8

A plastic firm receives an order to manufacture 19712 special plastic foam boards for swimming training. The firm has 12 machines but each of them will be able to participate in the manufacturing of this special type of tables only after an adaptation so that each adapted machine is capable of manufacturing 11 boards per hour; on the other hand, the non adapted ones cannot be used for this special order. The cost to adapt each machine is 364 monetary units. Moreover, these adapted machines are automated and only need staff to supervise the production whose salary is 52 monetary units per hour. Taking into account the number of hours that will be necessary to produce the ordered tables, the cost in salaries for those hours, and the adaptation costs, how many of the machines that the company has should be adapted to place the order at the lowest possible cost?

- 1) 5
- 2) 18
- 3) 12
- 4) 11
- 5) None of the other options is correct.

Exercise 9

Study the differentiability of the function $f(x) =$

$$\begin{cases} e^{x-3} + \sin(3) \sin(x) + \cos(3) \cos(x) + 4 & x \leq 3 \\ \frac{1}{2} (-x^2 + 8x - 3) & 3 < x < 6 \\ \frac{9}{2} & 6 \leq x \end{cases}$$

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

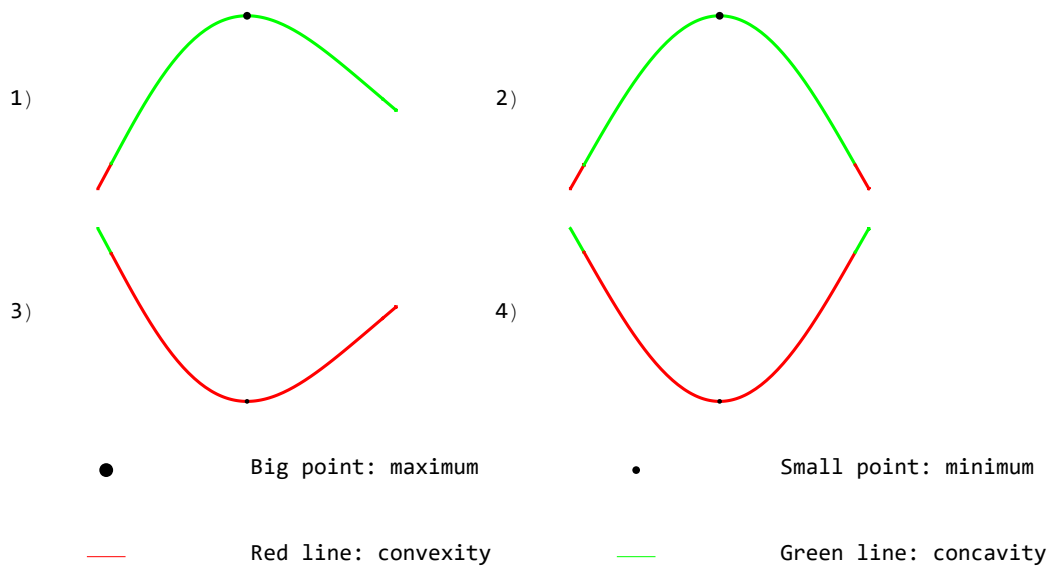
Mathematics 1 - ADE - English - 2026/2027

02-Derivatives for serial number: 39

Exercise 1

Study the shape properties of $f(x) = 3 + 48x^2 - 8x^3 - 2x^4 + \frac{3x^5}{5}$

to decide which amongst the following ones is the representation of the function.



Indication: To solve this exercise it is necessary to determine the concavity and convexity interval. To find the inflexion points separating the concavity and convexity intervals, check (by means of Ruffini) with the points $-2, -1, 0, 1, 2$.

Exercise 2

Determine the derivative of the function $f(t) =$

$e^{\sin(t)} (3e^{\sin(t)} + \log(\sin(t) + 1))$ and compute its value at the point $t=0$.

- 1) $f'(0) = -1$ 2) $f'(0) = -3$ 3) $f'(0) = 3$ 4) $f'(0) = 7$

Exercise 3

Compute the limit: $\lim_{x \rightarrow 0} \frac{-1 + e^{x^3} - x^3}{x^5}$

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

Exercise 4

Compute the limit: $\lim_{x \rightarrow 3} \frac{9 + 3x - 5x^2 + x^3}{27 - 9x - 3x^2 + x^3}$

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

Exercise 5

Between the months $t=0$ and $t=5$

, the true value of the shares of a company (in euros) are given by the function $C(t) = 33 + 18t - 12t^2 + 2t^3$.

Determine the interval within the value oscillates between months $t=2$ and $t=3$.

- 1) It oscillates between 33 and 41.
- 2) It oscillates between 42 and 37.
- 3) It oscillates between 33 and 73.
- 4) It oscillates between 33 and 37.
- 5) It oscillates between 28 and 27.

Exercise 6

In a fish farm, data of precedings years reveal that, if the initial number of fish is x (x in thousands), after one month they reproduce until a number of $f(x) = \frac{24x}{6 + 22x}$ fishes.

What number of fish leads to the largest increase in the number of animals, $f(x) - x$?

- 1) $\frac{3}{7}$
- 2) $\frac{11}{4}$
- 3) 26
- 4) $\frac{3}{11}$
- 5) $\frac{19}{10}$

Exercise 7

The yield of a tree plantation is given by $f(x) =$

$$\frac{-39 + 31x + 44x^2}{19x^5}, \text{ where } x \text{ is the distance in meters between two trees.}$$

What is the distance x that leads to the largest yield.

- 1) $\frac{23}{14}$
- 2) $\frac{5}{4}$
- 3) $\frac{5}{6}$
- 4) $\frac{5}{3}$
- 5) $\frac{3}{2}$

Exercise 8

A plastic firm receives an order to manufacture 25480 special plastic foam boards for swimming training. The firm has 18 machines but each of them will be able to participate in the manufacturing of this special type of tables only after an adaptation so that each adapted machine is capable of manufacturing 10 boards per hour; on the other hand, the non adapted ones cannot be used for this special order. The cost to adapt each machine is 130 monetary units. Moreover, these adapted machines are automated and only need staff to supervise the production whose salary is 10 monetary units per hour. Taking into account the number of hours that will be necessary to produce the ordered tables, the cost in salaries for those hours, and the adaptation costs, how many of the machines that the company has should be adapted to place the order at the lowest possible cost?

- 1) None of the other options is correct.
- 2) 12
- 3) 25
- 4) 14
- 5) 20

Exercise 9

Study the differentiability of the function $f(x) =$

$$\begin{cases} e^{x-3} + \sin(3) \sin(x) + \cos(3) \cos(x) + 5 & x \leq 3 \\ -\frac{x^2}{3} + 3x + 1 & 3 < x < 6 \\ -4x + 3(x-5) \log(x-5) + 31 & 6 \leq x \end{cases}$$

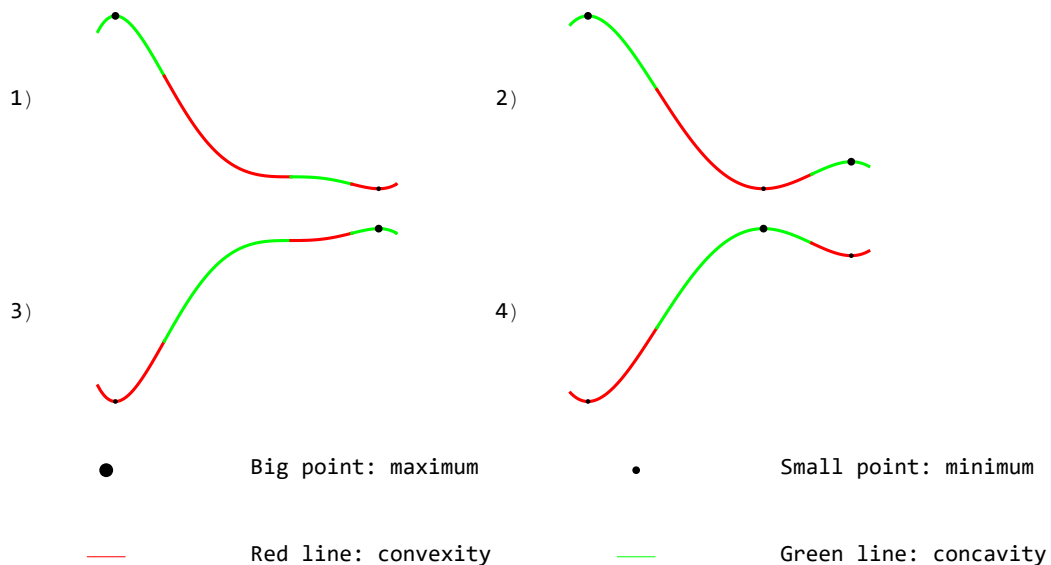
- 1) The function is differentiable for all points.
- 2) The function is not differentiable at any point.
- 3) The function is differentiable for all points except for $x=3$.
- 4) The function is differentiable for all points except for $x=6$.
- 5) The function is differentiable for all points except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

Mathematics 1 - ADE - English - 2026/2027

02-Derivatives for serial number: 40

Exercise 1

Study the shape properties of the $f(x) = 5 - 40x^3 + 15x^4 + 12x^5$ to decide which amongst the following ones is the representation of the function.



Indication: To find the maximum and minimum points of the function, try (with Ruffini) the points $-2, -1, 0, 1, 2$. To solve this exercise it is necessary to determine the increasing and decreasing intervals.

Exercise 2

Determine the derivative of the function $f(t) = 1 - 2e^2 t^2$ and compute its value at the point $t=0$.

- 1) $f'(0) = -2$ 2) $f'(0) = 3$ 3) $f'(0) = 0$ 4) $f'(0) = 2$

Exercise 3

Compute the limit: $\lim_{x \rightarrow 0} \frac{-1 + \frac{x^4}{2} + \cos[x^2]}{x^5}$

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

Exercise 4

Compute the limit: $\lim_{x \rightarrow 2} \frac{-12 + 16x - 7x^2 + x^3}{-2 - x + x^2}$

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

Exercise 5

Between the months $t=2$ and $t=8$

, the funds in certain account (in millions of euros) are given by the function $F(t) = 6 + 252t - 39t^2 + 2t^3$.

Determine the interval within the funds oscillates between months $t=3$ and $t=6$.

- 1) It oscillates between 465 and 546.
- 2) It oscillates between 470 and 548.
- 3) It oscillates between 545 and 546.
- 4) It oscillates between 463 and 553.
- 5) It oscillates between 370 and 550.

Exercise 6

In a fish farm, data of precedings years reveal that, if the initial number of fish is x (x in thousands), after one month they reproduce until a number of $f(x) = \frac{36x}{9 + 11x}$ fishes.

What number of fish leads to the largest increase in the number of animals, $f(x) - x$?

- 1) $\frac{9}{11}$
- 2) $\frac{27}{8}$
- 3) $\frac{27}{13}$
- 4) 6
- 5) $\frac{26}{17}$

Exercise 7

The yield of a tree plantation is given by $f(x) =$

$$\frac{-31 + 42x + 18x^2}{39x^2}, \text{ where } x \text{ is the distance in meters between two trees.}$$

What is the distance x that leads to the largest yield.

- 1) $\frac{31}{21}$
- 2) $\frac{19}{8}$
- 3) $\frac{11}{10}$
- 4) 6
- 5) $\frac{26}{17}$

Exercise 8

A plastic firm receives an order to manufacture 2275 special plastic foam boards for swimming training. The firm has 10 machines but each of them will be able to participate in the manufacturing of this special type of tables only after an adaptation so that each adapted machine is capable of manufacturing 5 boards per hour; on the other hand, the non adapted ones cannot be used for this special order. The cost to adapt each machine is 7735 monetary units. Moreover, these adapted machines are automated and only need staff to supervise the production whose salary is 2057 monetary units per hour. Taking into account the number of hours that will be necessary to produce the ordered tables, the cost in salaries for those hours, and the adaptation costs, how many of the machines that the company has should be adapted to place the order at the lowest possible cost?

- 1) 21
- 2) 14
- 3) 11
- 4) None of the other options is correct.
- 5) 26

Exercise 9

Study the differentiability of the function $f(x) = \begin{cases} -e^{x+2} - 2 \cos(x+2) - 4 & x \leq -2 \\ -x - 9 & -2 < x < 0 \\ -\sin(x) - 2 \cos(x) - 7 & 0 \leq x \end{cases}$

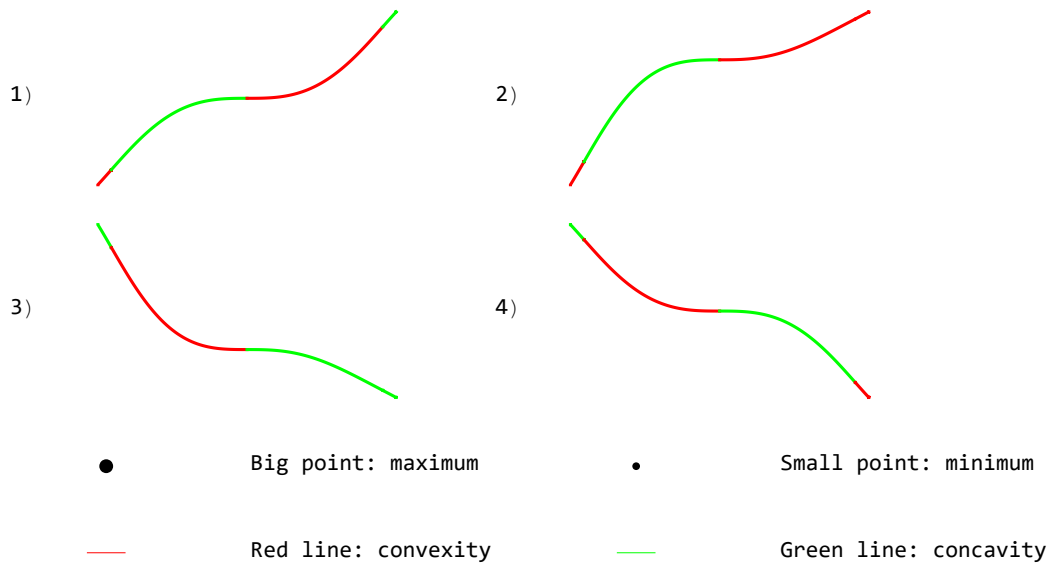
- 1) The function is differentiable for all points.
- 2) The function is not differentiable at any point.
- 3) The function is differentiable for all points except for $x = -2$.
- 4) The function is differentiable for all points except for $x = 0$.
- 5) The function is differentiable for all points except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

Mathematics 1 - ADE - English - 2026/2027

02-Derivatives for serial number: 41

Exercise 1

Study the shape properties of $f(x) = 4 + 80x^3 - 20x^4 - 6x^5 + 2x^6$ to decide which amongst the following ones is the representation of the function.



Indication: To solve this exercise it is necessary to determine the concavity and convexity interval. To find the inflexion points separating the concavity and convexity intervals, check (by means of Ruffini) with the points $-2, -1, 0, 1, 2$.

Exercise 2

Determine the derivative of the function $f(t) = -3(t+1) + \log(t+1) + \cos(t)$ and compute its value at the point $t=0$.

- 1) $f'(0) = -3$ 2) $f'(0) = 4$ 3) $f'(0) = 3$ 4) $f'(0) = -2$

Exercise 3

Compute the limit: $\lim_{x \rightarrow 1} \frac{1 - x + \log[x]}{1 - 2x + x^2}$

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

Exercise 4

Compute the limit: $\lim_{x \rightarrow -2} \frac{-4 + 3x^2 + x^3}{-12 - 8x + x^2 + x^3}$

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

Exercise 5

Between the months $t=2$ and $t=8$

, the true value of the shares of a company (in euros) are given by the function $C(t) = 510 + 336t - 45t^2 + 2t^3$.

Determine the interval within the value oscillates between months $t=5$ and $t=7$.

- 1) It oscillates between 1317 and 1334.
- 2) It oscillates between 1315 and 1343.
- 3) It oscillates between 1342 and 1343.
- 4) It oscillates between 1305 and 1344.
- 5) It oscillates between 1018 and 1343.

Exercise 6

In a fish farm, data of precedings years reveal that, if the initial number of fish is x (x in thousands), after one month they reproduce until a number of $f(x) = \frac{49x}{16 + 4x}$ fishes.

What number of fish leads to the largest increase in the number of animals, $f(x) - x$?

- 1) $\frac{1}{5}$
- 2) $\frac{37}{19}$
- 3) $\frac{7}{4}$
- 4) 24
- 5) 3

Exercise 7

The yield of a tree plantation is given by $f(x) =$

$$\frac{-46 + 12x + 18x^2}{31x^7}, \text{ where } x \text{ is the distance in meters between two trees.}$$

What is the distance x that leads to the largest yield.

- 1) $\frac{23}{15}$
- 2) 3
- 3) $\frac{1}{12}$
- 4) $\frac{15}{7}$
- 5) $\frac{26}{7}$

Exercise 8

A plastic firm receives an order to manufacture 16055 special plastic foam boards for swimming training. The firm has 20 machines but each of them will be able to participate in the manufacturing of this special type of tables only after an adaptation so that each adapted machine is capable of manufacturing 5 boards per hour; on the other hand, the non adapted ones cannot be used for this special order. The cost to adapt each machine is 20111 monetary units. Moreover, these adapted machines are automated and only need staff to supervise the production whose salary is 2261 monetary units per hour. Taking into account the number of hours that will be necessary to produce the ordered tables, the cost in salaries for those hours, and the adaptation costs, how many of the machines that the company has should be adapted to place the order at the lowest possible cost?

- 1) None of the other options is correct.
- 2) 19
- 3) 2
- 4) 25
- 5) 10

Exercise 9

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

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

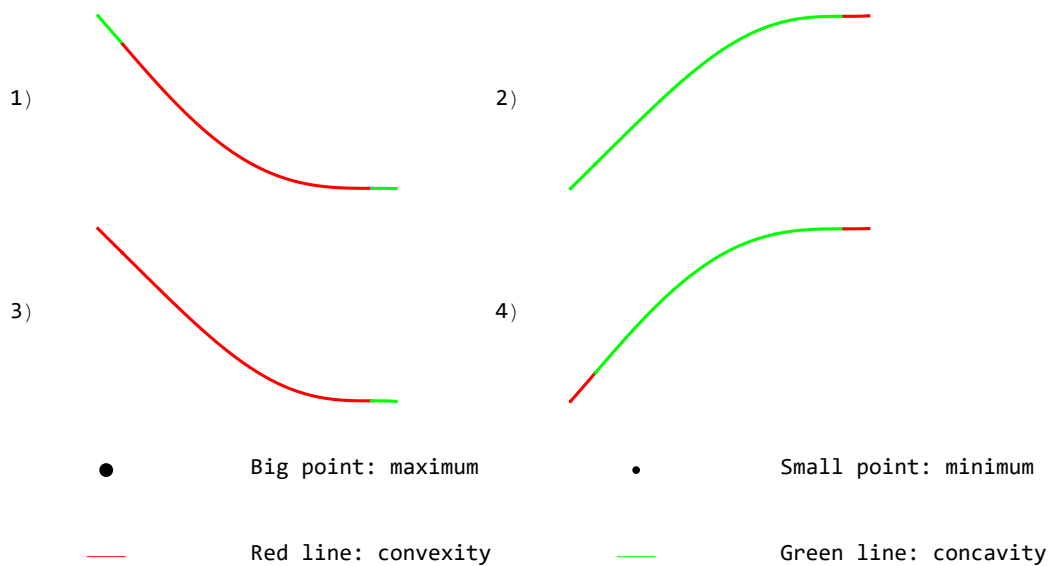
Mathematics 1 - ADE - English - 2026/2027

02-Derivatives for serial number: 42

Exercise 1

Study the shape properties of $f(x) = 4 + 8x^3 + 4x^4 + \frac{3x^5}{5}$

to decide which amongst the following ones is the representation of the function.



Indication: To solve this exercise it is necessary to determine the concavity and convexity interval. To find the inflexion points separating the concavity and convexity intervals, check (by means of Ruffini) with the points $-2, -1, 0, 1, 2$.

Exercise 2

Determine the derivative of the function $f(t) = -2 \log^3(t+1) e^{\sin(\log(t+1))}$ and compute its value at the point $t=0$.

- 1) $f'(0) = 0$ 2) $f'(0) = -3$ 3) $f'(0) = 2$ 4) $f'(0) = -2$

Exercise 3

Compute the limit: $\lim_{x \rightarrow 1} \frac{\frac{11}{2} - 9x + \frac{9x^2}{2} - x^3 + \text{Log}[x^3]}{1 - 4x + 6x^2 - 4x^3 + x^4}$

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

Exercise 4

Compute the limit: $\lim_{x \rightarrow 3} \frac{-9 + 15x - 7x^2 + x^3}{9 + 3x - 5x^2 + x^3}$

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

Exercise 5

Between the months $t=2$ and $t=9$

, the true value of the shares of a company (in euros) are given by the function $C(t) = 48 + 48t - 18t^2 + 2t^3$.

Determine the interval within the value oscillates between months $t=3$ and $t=5$.

- 1) It oscillates between 87 and 81.
- 2) It oscillates between 85 and 80.
- 3) It oscillates between 80 and 88.
- 4) It oscillates between 80 and 98.
- 5) It oscillates between 80 and 480.

Exercise 6

In a fish farm, data of precedings years reveal that, if the initial number of fish is x (x in thousands), after one month they reproduce until a number of $f(x) = \frac{50x}{2 + 18x}$ fishes.

What number of fish leads to the largest increase in the number of animals, $f(x) - x$?

- 1) $\frac{7}{18}$
- 2) $\frac{24}{17}$
- 3) $\frac{2}{3}$
- 4) $\frac{4}{9}$
- 5) $\frac{26}{15}$

Exercise 7

The yield of a tree plantation is given by $f(x) =$

$$\frac{-32 + 40x + 33x^2}{13x^6}, \text{ where } x \text{ is the distance in meters between two trees.}$$

What is the distance x that leads to the largest yield.

- 1) $\frac{8}{3}$
- 2) 19
- 3) $\frac{23}{12}$
- 4) $\frac{2}{13}$
- 5) $\frac{2}{3}$

Exercise 8

A plastic firm receives an order to manufacture 115830 special plastic foam boards for swimming training. The firm has 21 machines but each of them will be able to participate in the manufacturing of this special type of tables only after an adaptation so that each adapted machine is capable of manufacturing 5 boards per hour; on the other hand, the non adapted ones cannot be used for this special order. The cost to adapt each machine is 4862 monetary units. Moreover, these adapted machines are automated and only need staff to supervise the production whose salary is 68 monetary units per hour. Taking into account the number of hours that will be necessary to produce the ordered tables, the cost in salaries for those hours, and the adaptation costs, how many of the machines that the company has should be adapted to place the order at the lowest possible cost?

- 1) 30
- 2) None of the other options is correct.
- 3) 31
- 4) 18
- 5) 27

Exercise 9

Study the differentiability of the function $f(x) =$

$$\begin{cases} e^{x-3} - \sin(3) \sin(x) - \cos(3) \cos(x) - 2 & x \leq 3 \\ -x^2 + 5x - 8 & 3 < x < 4 \\ \sin(4-x) - 2 \cos(4-x) - 2 & 4 \leq x \end{cases}$$

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

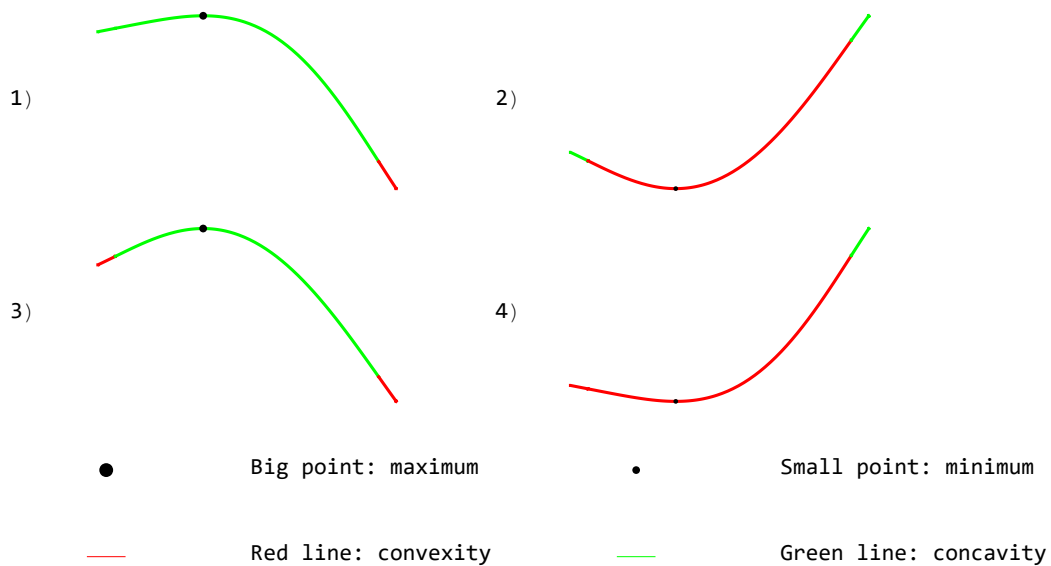
Mathematics 1 - ADE - English - 2026/2027

02-Derivatives for serial number: 43

Exercise 1

Study the shape properties of $f(x) = 4 - 12x^2 - 6x^3 + \frac{3x^5}{5}$

to decide which amongst the following ones is the representation of the function.



Indication: To solve this exercise it is necessary to determine the concavity and convexity interval. To find the inflexion points separating the concavity and convexity intervals, check (by means of Ruffini) with the points $-2, -1, 0, 1, 2$.

Exercise 2

Determine the derivative of the function $f(t) = 2t(e^t + 3\cos(t))$ and compute its value at the point $t=0$.

- 1) $f'(0) = 8$ 2) $f'(0) = 1$ 3) $f'(0) = -3$ 4) $f'(0) = -4$

Exercise 3

Compute the limit: $\lim_{x \rightarrow 0} \frac{-1 + \cos[x^3]}{x^6}$

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

Exercise 4

Compute the limit: $\lim_{x \rightarrow -3} \frac{-18 - 3x + 4x^2 + x^3}{-9 + 3x + 5x^2 + x^3}$

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

Exercise 5

Between the months $t=3$ and $t=10$

, the true value of the shares of a company (in euros) are given by the function $C(t) = 600 + 324t - 45t^2 + 2t^3$.

Determine the interval within the value oscillates between months $t=5$ and $t=7$.

- 1) It oscillates between 1353 and 1354.
- 2) It oscillates between 1345 and 1356.
- 3) It oscillates between 1344 and 1351.
- 4) It oscillates between 1221 and 1356.
- 5) It oscillates between 1329 and 1356.

Exercise 6

In a fish farm, data of precedings years reveal that, if the initial number of fish is x (x in thousands), after one month they reproduce until a number of $f(x) = \frac{50x}{2 + 13x}$ fishes.

What number of fish leads to the largest increase in the number of animals, $f(x) - x$?

- 1) $\frac{8}{13}$
- 2) $\frac{6}{17}$
- 3) $\frac{40}{9}$
- 4) $\frac{18}{7}$
- 5) $\frac{12}{5}$

Exercise 7

The yield of a tree plantation is given by $f(x) =$

$$\frac{-16 + 3x + 15x^2}{27x^3}, \text{ where } x \text{ is the distance in meters between two trees.}$$

What is the distance x that leads to the largest yield.

- 1) $\frac{5}{4}$
- 2) $\frac{10}{3}$
- 3) $\frac{3}{5}$
- 4) $\frac{10}{17}$
- 5) $\frac{8}{5}$

Exercise 8

A plastic firm receives an order to manufacture 10780 special plastic foam boards for swimming training. The firm has 15 machines but each of them will be able to participate in the manufacturing of this special type of tables only after an adaptation so that each adapted machine is capable of manufacturing 7 boards per hour; on the other hand, the non adapted ones cannot be used for this special order. The cost to adapt each machine is 5929 monetary units. Moreover, these adapted machines are automated and only need staff to supervise the production whose salary is 385 monetary units per hour. Taking into account the number of hours that will be necessary to produce the ordered tables, the cost in salaries for those hours, and the adaptation costs, how many of the machines that the company has should be adapted to place the order at the lowest possible cost?

- 1) None of the other options is correct.
- 2) 17
- 3) 1
- 4) 13
- 5) 15

Exercise 9

Study the differentiability of the function $f(x) =$

$$\begin{cases} \sin(3-x) - 5 & x \leq 3 \\ -\sin(3-x) - (x(1+\cos(1))) - 2 + 3\cos(1) & 3 < x < 4 \\ -3x + 2(x-3)\log(x-3) + 6 + \sin(1) - \cos(1) & 4 \leq x \end{cases}$$

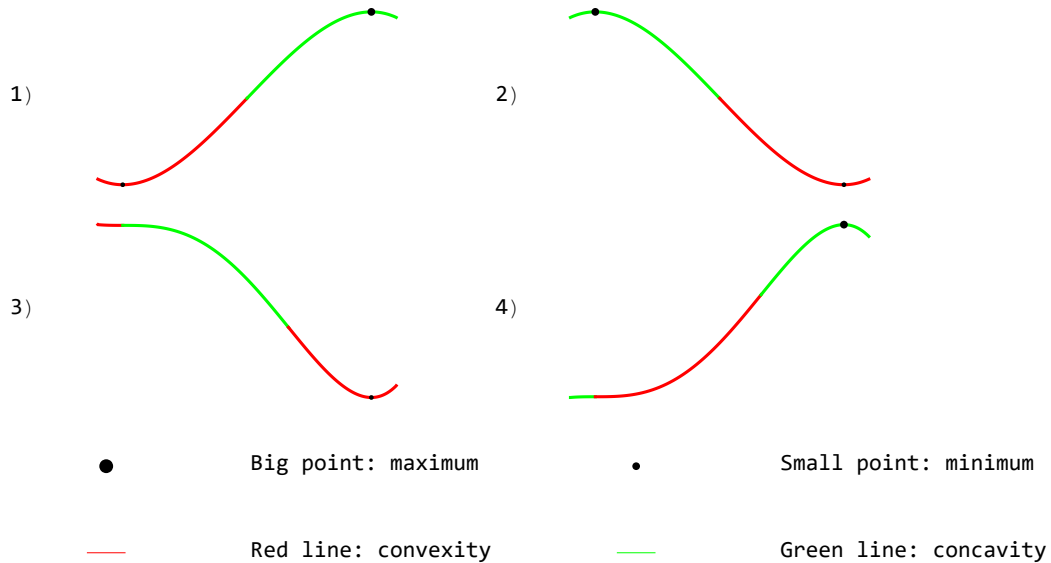
- 1) The function is differentiable for all points.
- 2) The function is not differentiable at any point.
- 3) The function is differentiable for all points except for $x=3$.
- 4) The function is differentiable for all points except for $x=4$.
- 5) The function is differentiable for all points except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

Mathematics 1 - ADE - English - 2026/2027

02-Derivatives for serial number: 44

Exercise 1

Study the shape properties of the $f(x) = 3 - 12x - 6x^2 + 4x^3 + 3x^4$ to decide which amongst the following ones is the representation of the function.



Indication: To find the maximum and minimum points of the function, try (with Ruffini) the points $-2, -1, 0, 1, 2$. To solve this exercise it is necessary to determine the increasing and decreasing intervals.

Exercise 2

Determine the derivative of the function $f(t) = t^9 + 3 \sin(t^3) + 2$ and compute its value at the point $t=0$.

- 1) $f'(0) = 3$ 2) $f'(0) = 1$ 3) $f'(0) = 4$ 4) $f'(0) = 0$

Exercise 3

Compute the limit: $\lim_{x \rightarrow 1} \frac{\frac{3}{2} - 2x + \frac{x^2}{2} + \text{Log}[x]}{-1 + 3x - 3x^2 + x^3}$

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

Exercise 4

Compute the limit: $\lim_{x \rightarrow -1} \frac{3 + 10x + 12x^2 + 6x^3 + x^4}{-3 - 5x - x^2 + x^3}$

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

Exercise 5

Between the months $t=0$ and $t=5$

, the funds in certain account (in millions of euros) are given by the function $F(t) = -11 + 48t - 18t^2 + 2t^3$.

Determine the interval within the funds oscillates between months $t=2$ and $t=4$.

- 1) It oscillates between 26 and 24.
- 2) It oscillates between 14 and 27.
- 3) It oscillates between 18 and 38.
- 4) It oscillates between -11 and 29.
- 5) It oscillates between 21 and 29.

Exercise 6

In a fish farm, data of precedings years reveal that, if the initial number of fish is x (x in thousands), after one month they reproduce until a number of $f(x) = \frac{4x}{1+21x}$ fishes.

What number of fish leads to the largest increase in the number of animals, $f(x) - x$?

- 1) $\frac{7}{4}$
- 2) $\frac{23}{10}$
- 3) $\frac{1}{21}$
- 4) $\frac{7}{11}$
- 5) $\frac{3}{5}$

Exercise 7

The yield of a tree plantation is given by $f(x) =$

$$\frac{-29 + 38x + 27x^2}{21x^2}, \text{ where } x \text{ is the distance in meters between two trees.}$$

What is the distance x that leads to the largest yield.

- 1) $\frac{31}{12}$
- 2) $\frac{10}{11}$
- 3) $\frac{29}{19}$
- 4) $\frac{7}{3}$
- 5) $\frac{5}{3}$

Exercise 8

A plastic firm receives an order to manufacture 11560 special plastic foam boards for swimming training. The firm has 20 machines but each of them will be able to participate in the manufacturing of this special type of tables only after an adaptation so that each adapted machine is capable of manufacturing 2 boards per hour; on the other hand, the non adapted ones cannot be used for this special order. The cost to adapt each machine is 7514 monetary units. Moreover, these adapted machines are automated and only need staff to supervise the production whose salary is 130 monetary units per hour. Taking into account the number of hours that will be necessary to produce the ordered tables, the cost in salaries for those hours, and the adaptation costs, how many of the machines that the company has should be adapted to place the order at the lowest possible cost?

- 1) None of the other options is correct.
- 2) 10
- 3) 20
- 4) 11
- 5) 21

Exercise 9

Study the differentiability of the function $f(x) =$

$$\begin{cases} \sin(x+2) - 3 \cos(x+2) - 4 & x \leq -2 \\ x(\log(2) - 1) - (x+3) \log(x+3) - 9 + \log(4) & -2 < x < -1 \\ -2e^{x+1} + 2 \cos(x+1) - 8 - \log(2) & -1 \leq x \end{cases}$$

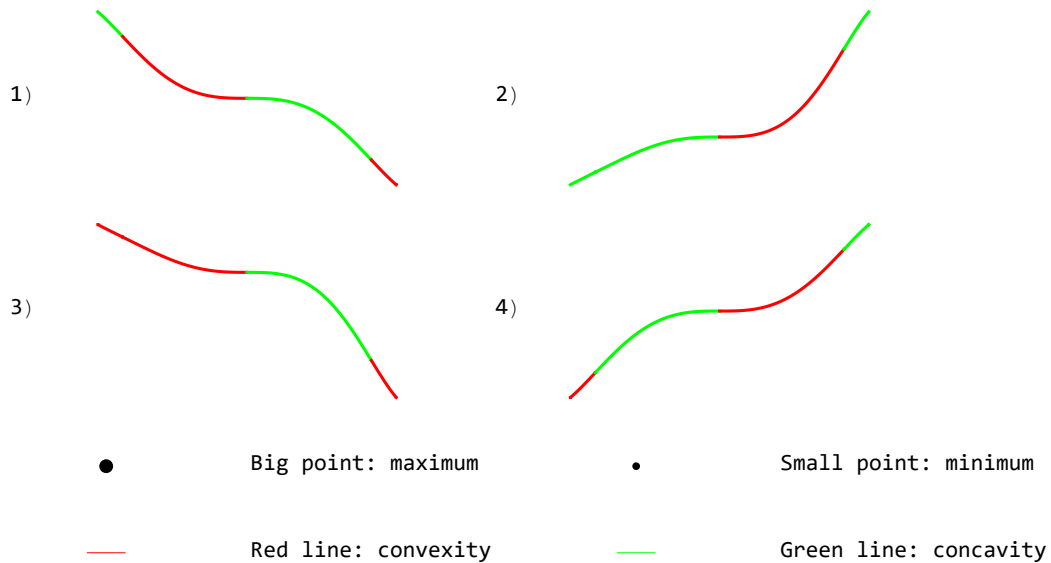
- 1) The function is differentiable for all points.
- 2) The function is not differentiable at any point.
- 3) The function is differentiable for all points except for $x = -2$.
- 4) The function is differentiable for all points except for $x = -1$.
- 5) The function is differentiable for all points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

Mathematics 1 - ADE - English - 2026/2027

02-Derivatives for serial number: 45

Exercise 1

Study the shape properties of $f(x) = 5 - 10x^3 - 5x^4 + 3x^5 + 2x^6$ to decide which amongst the following ones is the representation of the function.



Indication: To solve this exercise it is necessary to determine the concavity and convexity interval. To find the inflexion points separating the concavity and convexity intervals, check (by means of Ruffini) with the points $-2, -1, 0, 1, 2$.

Exercise 2

Determine the derivative of the function $f(t) = -3e^{\log^2(t+1)} \log^4(t+1)$ and compute its value at the point $t=0$.

- 1) $f'(0) = 0$ 2) $f'(0) = -4$ 3) $f'(0) = 3$ 4) $f'(0) = 1$

Exercise 3

Compute the limit: $\lim_{x \rightarrow 0} \frac{-x^3 + \sin[x^3]}{x^5}$

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

Exercise 4

Compute the limit: $\lim_{x \rightarrow -2} \frac{-8 - 4x + 2x^2 + x^3}{2 + 3x + x^2}$

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

Exercise 5

Between the months $t=3$ and $t=8$

, the true value of the shares of a company (in euros) are given by the function $C(t) = 443 + 252t - 39t^2 + 2t^3$.

Determine the interval within the value oscillates between months $t=6$ and $t=7$.

- 1) It oscillates between 902 and 987.
- 2) It oscillates between 981 and 976.
- 3) It oscillates between 985 and 989.
- 4) It oscillates between 982 and 983.
- 5) It oscillates between 987 and 992.

Exercise 6

In a fish farm, data of precedings years reveal that, if the initial number of fish is x (x in thousands), after one month they reproduce until a number of $f(x) = \frac{24x}{6 + 27x}$ fishes.

What number of fish leads to the largest increase in the number of animals, $f(x) - x$?

- 1) $\frac{6}{7}$
- 2) $\frac{1}{15}$
- 3) $\frac{38}{5}$
- 4) $\frac{2}{9}$
- 5) 2

Exercise 7

The yield of a tree plantation is given by $f(x) =$

$$\frac{-12 + 30x + 4x^2}{17x^9}, \text{ where } x \text{ is the distance in meters between two trees.}$$

What is the distance x that leads to the largest yield.

- 1) $\frac{29}{19}$
- 2) $\frac{3}{7}$
- 3) 2
- 4) 23
- 5) $\frac{3}{20}$

Exercise 8

A plastic firm receives an order to manufacture 56355 special plastic foam boards for swimming training. The firm has 12 machines but each of them will be able to participate in the manufacturing of this special type of tables only after an adaptation so that each adapted machine is capable of manufacturing 51 boards per hour; on the other hand, the non adapted ones cannot be used for this special order. The cost to adapt each machine is 1445 monetary units. Moreover, these adapted machines are automated and only need staff to supervise the production whose salary is 221 monetary units per hour. Taking into account the number of hours that will be necessary to produce the ordered tables, the cost in salaries for those hours, and the adaptation costs, how many of the machines that the company has should be adapted to place the order at the lowest possible cost?

- 1) 13
- 2) 12
- 3) None of the other options is correct.
- 4) 1
- 5) 16

Exercise 9

Study the differentiability of the function $f(x) =$

$$\begin{cases} \sin(3-x) + 2\cos(3-x) - 3 & x \leq 3 \\ -3x\sin(3) - 3\cos(3-x) + 2 + 9\sin(3) & 3 < x < 6 \\ 2x - 2(x-5)\log(x-5) - 3(2 + 3\sin(3) + \cos(3)) & 6 \leq x \end{cases}$$

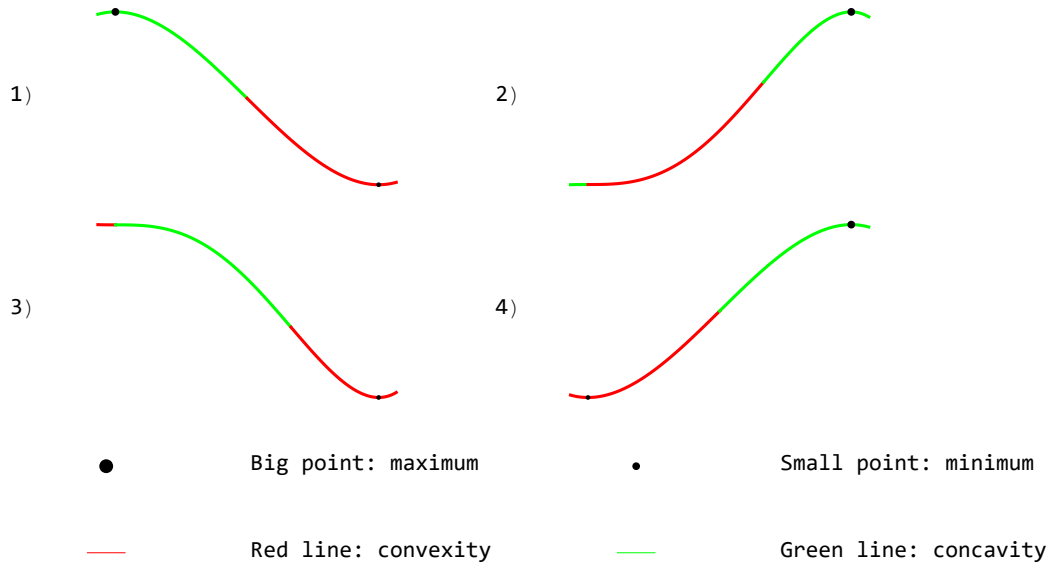
- 1) The function is differentiable for all points.
- 2) The function is not differentiable at any point.
- 3) The function is differentiable for all points except for $x=3$.
- 4) The function is differentiable for all points except for $x=6$.
- 5) The function is differentiable for all points except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

Mathematics 1 - ADE - English - 2026/2027

02-Derivatives for serial number: 46

Exercise 1

Study the shape properties of the $f(x) = 3 - 12x - 3x^2 + 2x^3$ to decide which amongst the following ones is the representation of the function.



Indication: To find the maximum and minimum points of the function, try (with Ruffini) the points $-2, -1, 0, 1, 2$. To solve this exercise it is necessary to determine the increasing and decreasing intervals.

Exercise 2

Determine the derivative of the function $f(t) = t^3 (t^6 - e^{t^3})$ and compute its value at the point $t=0$.

- 1) $f'(0) = 4$ 2) $f'(0) = 1$ 3) $f'(0) = 0$ 4) $f'(0) = -3$

Exercise 3

Compute the limit: $\lim_{x \rightarrow 0} \frac{-1 + \frac{x^2}{2} + \cos[x]}{x^4}$

- 1) $-\frac{2}{3}$
- 2) 1
- 3) 0
- 4) $\frac{1}{24}$
- 5) ∞
- 6) -2
- 7) $-\infty$

Exercise 4

Compute the limit: $\lim_{x \rightarrow 1} \frac{-2 + 5x - 4x^2 + x^3}{-3 + 2x + x^2}$

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

Exercise 5

Between the months $t=0$ and $t=6$, the funds in certain account (in millions of euros) are given by the function $F(t) = -18 + 18t - 12t^2 + 2t^3$.

Determine the interval within the funds oscillates between months $t=4$ and $t=5$.

- 1) It oscillates between -10 and 22.
- 2) It oscillates between -18 and 90.
- 3) It oscillates between -4 and 27.
- 4) It oscillates between -18 and -10.
- 5) It oscillates between -19 and 30.

Exercise 6

In a fish farm, data of precedings years reveal that, if the initial number of fish is x (x in thousands), after one month they reproduce until a number of $f(x) = \frac{18x}{2+x}$ fishes.

What number of fish leads to the largest increase in the number of animals, $f(x) - x$?

- 1) $\frac{1}{2}$
- 2) $\frac{21}{10}$
- 3) $\frac{25}{11}$
- 4) 4
- 5) $\frac{31}{14}$

Exercise 7

The yield of a tree plantation is given by $f(x) =$

$$\frac{-24 + 7x + 5x^2}{46x^2}, \text{ where } x \text{ is the distance in meters between two trees.}$$

What is the distance x that leads to the largest yield.

- 1) $\frac{1}{10}$
- 2) $\frac{48}{7}$
- 3) $\frac{31}{11}$
- 4) 6
- 5) $\frac{9}{4}$

Exercise 8

A plastic firm receives an order to manufacture 561 special plastic foam boards for swimming training. The firm has 14 machines but each of them will be able to participate in the manufacturing of this special type of tables only after an adaptation so that each adapted machine is capable of manufacturing 51 boards per hour; on the other hand, the non adapted ones cannot be used for this special order. The cost to adapt each machine is 110 monetary units. Moreover, these adapted machines are automated and only need staff to supervise the production whose salary is 360 monetary units per hour. Taking into account the number of hours that will be necessary to produce the ordered tables, the cost in salaries for those hours, and the adaptation costs, how many of the machines that the company has should be adapted to place the order at the lowest possible cost?

- 1) 15
- 2) 6
- 3) 7
- 4) 17
- 5) None of the other options is correct.

Exercise 9

Study the differentiability of the function $f(x) =$

$$f(x) = \begin{cases} 2(e^{x+2} + \cos(x+2) - 1) & x \leq -2 \\ (x+2)(2\sin(1) - 1) + 2\cos(x+2) & -2 < x < -1 \\ -2x + (x+2)\log(x+2) - 3 + 2\sin(1) + 2\cos(1) & -1 \leq x \end{cases}$$

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

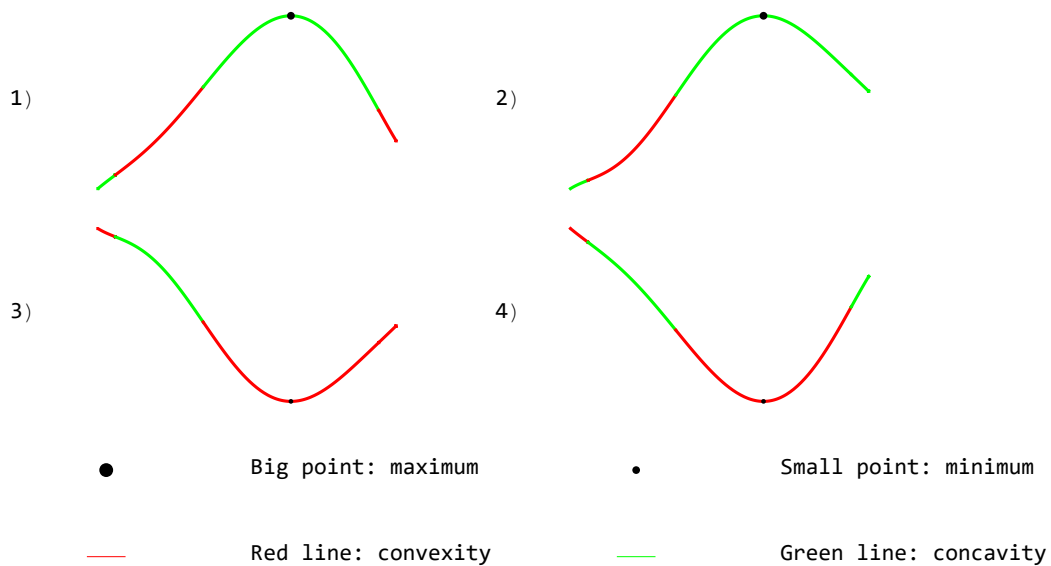
Mathematics 1 - ADE - English - 2026/2027

02-Derivatives for serial number: 47

Exercise 1

Study the shape properties of $f(x) = 3 - 12x^2 - 2x^3 + 2x^4 + \frac{3x^5}{5}$

to decide which amongst the following ones is the representation of the function.



Indication: To solve this exercise it is necessary to determine the concavity and convexity interval. To find the inflexion points separating the concavity and convexity intervals, check (by means of Ruffini) with the points $-2, -1, 0, 1, 2$.

Exercise 2

Determine the derivative of the function $f(t) = e^t - 2e^{2t}t$ and compute its value at the point $t=0$.

- 1) $f'(0) = 3$ 2) $f'(0) = -1$ 3) $f'(0) = -4$ 4) $f'(0) = -3$

Exercise 3

Compute the limit: $\lim_{x \rightarrow 0} \frac{-1 + \frac{x^4}{2} + \cos[x^2]}{x^5}$

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

Exercise 4

Compute the limit: $\lim_{x \rightarrow 2} \frac{4x - 4x^2 + x^3}{-4 + x^2}$

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

Exercise 5

Between the months $t=3$ and $t=9$

, the true value of the shares of a company (in euros) are given by the function $C(t) = 589 + 324t - 45t^2 + 2t^3$.

Determine the interval within the value oscillates between months $t=6$ and $t=9$.

- 1) It oscillates between 1318 and 1345.
- 2) It oscillates between 1210 and 1345.
- 3) It oscillates between 1320 and 1340.
- 4) It oscillates between 1311 and 1343.
- 5) It oscillates between 1317 and 1340.

Exercise 6

In a fish farm, data of precedings years reveal that, if the initial number of fish is x (x in thousands), after one month they reproduce until a number of $f(x) = \frac{36x}{9 + 40x}$ fishes.

What number of fish leads to the largest increase in the number of animals, $f(x) - x$?

- 1) $\frac{9}{5}$
- 2) 6
- 3) 13
- 4) $\frac{5}{16}$
- 5) $\frac{9}{40}$

Exercise 7

The yield of a tree plantation is given by $f(x) =$

$$\frac{-22 + 34x + 8x^2}{43x^9}, \text{ where } x \text{ is the distance in meters between two trees.}$$

What is the distance x that leads to the largest yield.

- 1) 11
- 2) $\frac{9}{14}$
- 3) $\frac{15}{16}$
- 4) 9
- 5) $\frac{39}{7}$

Exercise 8

A plastic firm receives an order to manufacture 28560 special plastic foam boards for swimming training. The firm has 8 machines but each of them will be able to participate in the manufacturing of this special type of tables only after an adaptation so that each adapted machine is capable of manufacturing 7 boards per hour; on the other hand, the non adapted ones cannot be used for this special order. The cost to adapt each machine is 2499 monetary units. Moreover, these adapted machines are automated and only need staff to supervise the production whose salary is 245 monetary units per hour. Taking into account the number of hours that will be necessary to produce the ordered tables, the cost in salaries for those hours, and the adaptation costs, how many of the machines that the company has should be adapted to place the order at the lowest possible cost?

- 1) 1
- 2) None of the other options is correct.
- 3) 20
- 4) 11
- 5) 23

Exercise 9

Study the differentiability of the function $f(x) = \begin{cases} -\sin(3-x) - 4 & x \leq 3 \\ -\frac{x^2}{6} + 2x - \frac{17}{2} & 3 < x < 6 \\ -x + (x-5) \log(x-5) + \frac{7}{2} & 6 \leq x \end{cases}$

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

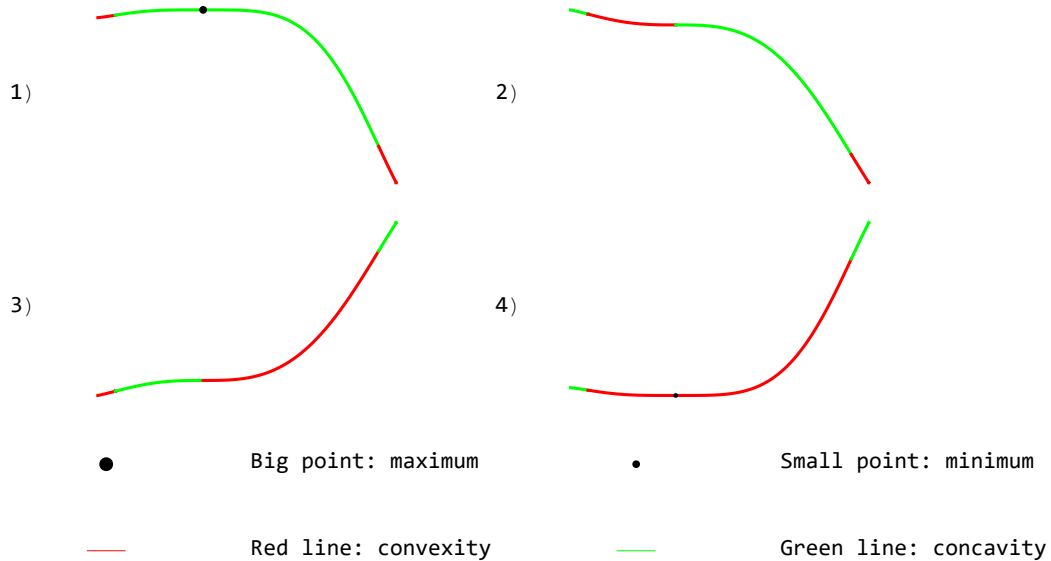
Mathematics 1 - ADE - English - 2026/2027

02-Derivatives for serial number: 48

Exercise 1

Study the shape properties of $f(x) = 4 - 10x^4 - 3x^5 + 2x^6$

to decide which amongst the following ones is the representation of the function.



Indication: To solve this exercise it is necessary to determine the concavity and convexity interval. To find the inflexion points separating the concavity and convexity intervals, check (by means of Ruffini) with the points $-2, -1, 0, 1, 2$.

Exercise 2

Determine the derivative of the function $f(t) =$

$2 \cos(\cos(t)) \cos(t) + \cos(t)$ and compute its value at the point $t=0$.

- 1) $f'(0) = 0$ 2) $f'(0) = -4$ 3) $f'(0) = 1$ 4) $f'(0) = 4$

Exercise 3

Compute the limit: $\lim_{x \rightarrow 0} \frac{-1 + \cos[x^2]}{x^3}$

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

Exercise 4

Compute the limit: $\lim_{x \rightarrow -3} \frac{9 + 15x + 7x^2 + x^3}{-9 + 3x + 5x^2 + x^3}$

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

Exercise 5

Between the months $t=4$ and $t=9$

, the true value of the shares of a company (in euros) are given by the function $C(t) = 581 + 288t - 42t^2 + 2t^3$.

Determine the interval within the value oscillates between months $t=5$ and $t=6$.

- 1) It oscillates between 1221 and 1229.
- 2) It oscillates between 1213 and 1228.
- 3) It oscillates between 1189 and 1229.
- 4) It oscillates between 1230 and 1230.
- 5) It oscillates between 1219 and 1227.

Exercise 6

In a fish farm, data of precedings years reveal that, if the initial number of fish is x (x in thousands), after one month they reproduce until a number of $f(x) = \frac{49x}{9 + 50x}$ fishes.

What number of fish leads to the largest increase in the number of animals, $f(x) - x$?

- 1) $\frac{26}{19}$
- 2) $\frac{6}{25}$
- 3) $\frac{31}{13}$
- 4) 7
- 5) 5

Exercise 7

The yield of a tree plantation is given by $f(x) =$

$$\frac{-36 + 30x + 17x^2}{30x^8}, \text{ where } x \text{ is the distance in meters between two trees.}$$

What is the distance x that leads to the largest yield.

- 1) $\frac{7}{13}$
- 2) $\frac{16}{17}$
- 3) 2
- 4) 2
- 5) $\frac{1}{2}$

Exercise 8

A plastic firm receives an order to manufacture 5577

special plastic foam boards for swimming training. The firm have

23 machines but each of them will be able to participate

in the manufacturing of this special type of tables only after an

adaptation so that each adapted machine is capable of manufacturing

357 boards per hour; on the other hand, the non adapted ones cannot be

used for this special order. The cost to adapt each machine is

121 monetary units. Moreover, these adapted machines are automated and

only need staff to supervise the production whose salary is 1309

monetary units per hour. Taking into account the number of hours that will be

necessary to produce the ordered tables, the cost in salaries for those

hours, and the adaptation costs, how many of the machines that the company

has should be adapted to place the order at the lowest possible cost?

- 1) 24
- 2) 12
- 3) 27
- 4) 1
- 5) None of the other options is correct.

Exercise 9

Study the differentiability of the function $f(x) = \begin{cases} \sin(3-x) + 3\cos(3-x) + 1 & x \leq 3 \\ \frac{1}{2}((x-8)x + 23) & 3 < x < 4 \\ x - (x-3)\log(x-3) - \frac{1}{2} & 4 \leq x \end{cases}$

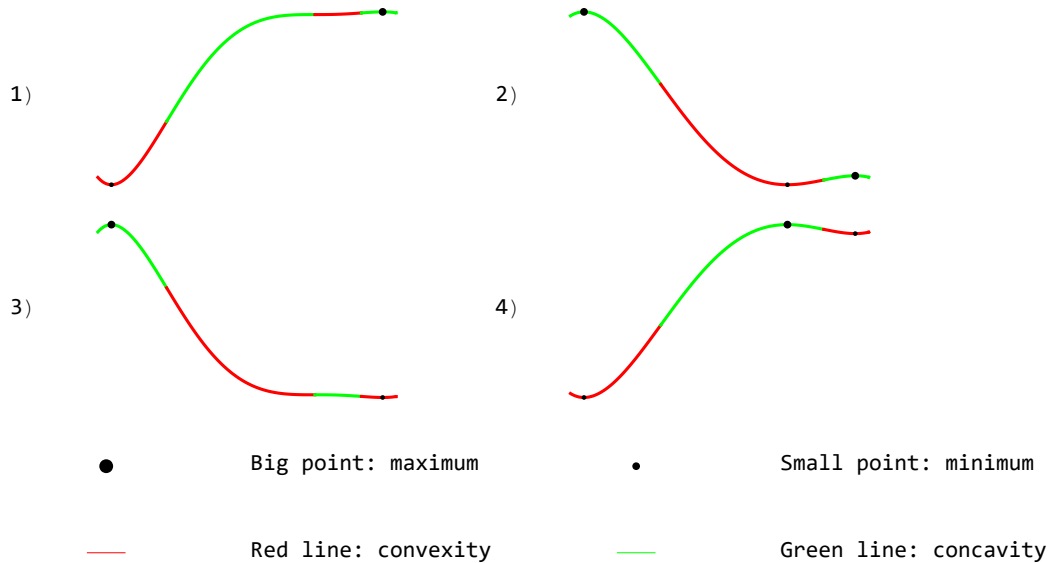
- 1) The function is differentiable for all points.
- 2) The function is not differentiable at any point.
- 3) The function is differentiable for all points except for $x=3$.
- 4) The function is differentiable for all points except for $x=4$.
- 5) The function is differentiable for all points except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

Mathematics 1 - ADE - English - 2026/2027

02-Derivatives for serial number: 49

Exercise 1

Study the shape properties of the $f(x) = 5 - 240x + 240x^2 - 60x^3 - 30x^4 + 12x^5$ to decide which amongst the following ones is the representation of the function.



Indication: To find the maximum and minimum points of the function, try (with Ruffini) the points $-2, -1, 0, 1, 2$. To solve this exercise it is necessary to determine the increasing and decreasing intervals.

Exercise 2

Determine the derivative of the function $f(t) = -6e^t \sin^2(t)$ and compute its value at the point $t=0$.

- 1) $f'(0) = -4$ 2) $f'(0) = 0$ 3) $f'(0) = -3$ 4) $f'(0) = 4$

Exercise 3

Compute the limit: $\lim_{x \rightarrow 0} \frac{-1 + e^{x^2} - x^2 - \frac{x^4}{2}}{x^5}$

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

Exercise 4

Compute the limit: $\lim_{x \rightarrow 2} \frac{6 - 5x + x^2}{-2x + x^2}$

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

Exercise 5

Between the months $t=1$ and $t=8$

, the funds in certain account (in millions of euros) are given by the function $F(t) = 10 + 192t - 36t^2 + 2t^3$.

Determine the interval within the funds oscillates between months $t=1$ and $t=5$.

- 1) It oscillates between 172 and 340.
- 2) It oscillates between 166 and 326.
- 3) It oscillates between 160 and 324.
- 4) It oscillates between 168 and 330.
- 5) It oscillates between 266 and 330.

Exercise 6

In a fish farm, data of precedings years reveal that, if the initial number of fish is x (x in thousands), after one month they reproduce until a number of $f(x) = \frac{25x}{16 + 28x}$ fishes.

What number of fish leads to the largest increase in the number of animals, $f(x) - x$?

- 1) $\frac{20}{3}$
- 2) $\frac{1}{7}$
- 3) $\frac{15}{16}$
- 4) $\frac{7}{4}$
- 5) $\frac{1}{2}$

Exercise 7

The yield of a tree plantation is given by $f(x) =$

$$\frac{-2 + 46x + 34x^2}{17x^2}, \text{ where } x \text{ is the distance in meters between two trees.}$$

What is the distance x that leads to the largest yield.

- 1) $\frac{34}{15}$
- 2) $\frac{7}{4}$
- 3) $\frac{7}{4}$
- 4) $\frac{29}{12}$
- 5) $\frac{2}{23}$

Exercise 8

A plastic firm receives an order to manufacture 43904 special plastic foam boards for swimming training. The firm has 15 machines but each of them will be able to participate in the manufacturing of this special type of tables only after an adaptation so that each adapted machine is capable of manufacturing 7 boards per hour; on the other hand, the non adapted ones cannot be used for this special order. The cost to adapt each machine is 5831 monetary units. Moreover, these adapted machines are automated and only need staff to supervise the production whose salary is 238 monetary units per hour. Taking into account the number of hours that will be necessary to produce the ordered tables, the cost in salaries for those hours, and the adaptation costs, how many of the machines that the company has should be adapted to place the order at the lowest possible cost?

- 1) 21
- 2) 21
- 3) 21
- 4) 6
- 5) None of the other options is correct.

Exercise 9

Study the differentiability of the function $f(x) = \begin{cases} \cos(x) & x \leq 0 \\ 1 & 0 < x < 3 \\ 3x - 3(x-2)\log(x-2) - 8 & 3 \leq x \end{cases}$

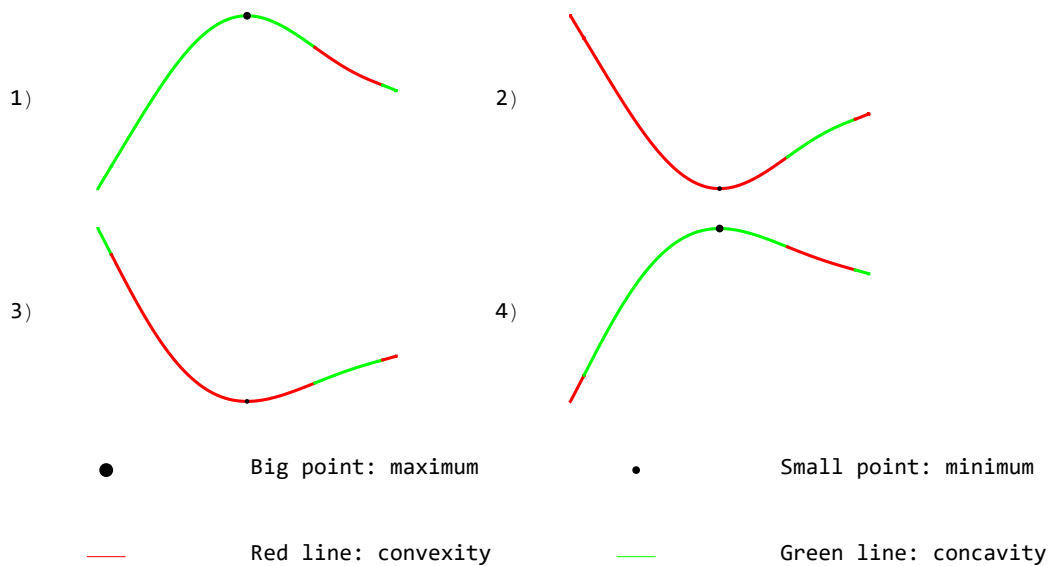
- 1) The function is differentiable for all points.
- 2) The function is not differentiable at any point.
- 3) The function is differentiable for all points except for $x=0$.
- 4) The function is differentiable for all points except for $x=3$.
- 5) The function is differentiable for all points except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

Mathematics 1 - ADE - English - 2026/2027

02-Derivatives for serial number: 50

Exercise 1

Study the shape properties of $f(x) = 3 + 24x^2 - 8x^3 - x^4 + \frac{3x^5}{5}$ to decide which amongst the following ones is the representation of the function.



Indication: To solve this exercise it is necessary to determine the concavity and convexity interval. To find the inflexion points separating the concavity and convexity intervals, check (by means of Ruffini) with the points $-2, -1, 0, 1, 2$.

Exercise 2

Determine the derivative of the function $f(t) = -3 \log(t+1) \sin(\sin(t)) \cos(t)$ and compute its value at the point $t=0$.

- 1) $f'(0) = -1$ 2) $f'(0) = 2$ 3) $f'(0) = 0$ 4) $f'(0) = 4$

Exercise 3

Compute the limit: $\lim_{x \rightarrow 1} \frac{\frac{25}{4} - 12x + 9x^2 - 4x^3 + \frac{3x^4}{4} + \text{Log}[x^3]}{-1 + 5x - 10x^2 + 10x^3 - 5x^4 + x^5}$

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

Exercise 4

Compute the limit: $\lim_{x \rightarrow 1} \frac{1 - x - x^2 + x^3}{2 - 3x + x^2}$

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

Exercise 5

Between the months $t=1$ and $t=6$

, the true value of the shares of a company (in euros) are given by the function $C(t) = 35 + 90t - 24t^2 + 2t^3$.

Determine the interval within the value oscillates between months $t=2$ and $t=3$.

- 1) It oscillates between 131 and 133.
- 2) It oscillates between 139 and 142.
- 3) It oscillates between 103 and 143.
- 4) It oscillates between 128 and 148.
- 5) It oscillates between 135 and 143.

Exercise 6

In a fish farm, data of precedings years reveal that, if the initial number of fish is x (x in thousands), after one month they reproduce until a number of $f(x) = \frac{32x}{18 + 19x}$ fishes.

What number of fish leads to the largest increase in the number of animals, $f(x) - x$?

- 1) $\frac{5}{3}$
- 2) $\frac{35}{2}$
- 3) $\frac{4}{3}$
- 4) $\frac{6}{19}$
- 5) $\frac{21}{4}$

Exercise 7

The yield of a tree plantation is given by $f(x) =$

$$\frac{-24 + 13x + 16x^2}{15x^9}, \text{ where } x \text{ is the distance in meters between two trees.}$$

What is the distance x that leads to the largest yield.

- 1) $\frac{3}{2}$
- 2) 1
- 3) $\frac{25}{14}$
- 4) $\frac{1}{16}$
- 5) $\frac{10}{11}$

Exercise 8

A plastic firm receives an order to manufacture 81081 special plastic foam boards for swimming training. The firm has 15 machines but each of them will be able to participate in the manufacturing of this special type of tables only after an adaptation so that each adapted machine is capable of manufacturing 65 boards per hour; on the other hand, the non adapted ones cannot be used for this special order. The cost to adapt each machine is 231 monetary units. Moreover, these adapted machines are automated and only need staff to supervise the production whose salary is 15 monetary units per hour. Taking into account the number of hours that will be necessary to produce the ordered tables, the cost in salaries for those hours, and the adaptation costs, how many of the machines that the company has should be adapted to place the order at the lowest possible cost?

- 1) None of the other options is correct.
- 2) 16
- 3) 8
- 4) 6
- 5) 9

Exercise 9

Study the differentiability of the function $f(x) =$

$$\begin{cases} 4 \sin^2\left(\frac{x+1}{2}\right) & x \leq -1 \\ -x + \sin(x+1) - 2 \cos(x+1) + 1 & -1 < x < 2 \\ -e^{x-2} + \cos(2-x) + 4 + \sin(3) - 2 \cos(3) & 2 \leq x \end{cases}$$

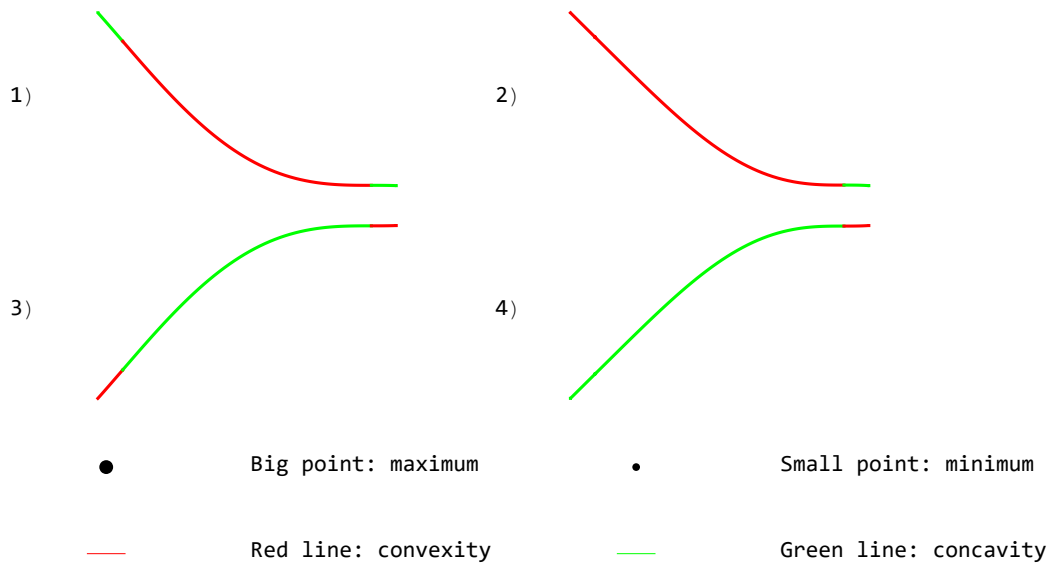
- 1) The function is differentiable for all points.
- 2) The function is not differentiable at any point.
- 3) The function is differentiable for all points except for $x = -1$.
- 4) The function is differentiable for all points except for $x = 2$.
- 5) The function is differentiable for all points except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

Mathematics 1 - ADE - English - 2026/2027

02-Derivatives for serial number: 51

Exercise 1

Study the shape properties of $f(x) = 4 + 2x^3 + \frac{x^4}{2}$ to decide which amongst the following ones is the representation of the function.



Indication: To solve this exercise it is necessary to determine the concavity and convexity interval. To find the inflexion points separating the concavity and convexity intervals, check (by means of Ruffini) with the points -2, -1, 0, 1, 2.

Exercise 2

Determine the derivative of the function $f(t) = 3e^t - 3\sin(t)$ and compute its value at the point $t=0$.

- 1) $f'(0) = -2$ 2) $f'(0) = 0$ 3) $f'(0) = 3$ 4) $f'(0) = -3$

Exercise 3

Compute the limit: $\lim_{x \rightarrow 0} \frac{-1 + e^{x^3} - x^3}{x^6}$

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

Exercise 4

Compute the limit: $\lim_{x \rightarrow -3} \frac{-3 + 2x + x^2}{-6 + x + x^2}$

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

Exercise 5

Between the months $t=4$ and $t=9$

, the true value of the shares of a company (in euros) are given by the function $C(t) = 751 + 336t - 45t^2 + 2t^3$.

Determine the interval within the value oscillates between months $t=4$ and $t=6$.

- 1) It oscillates between 1583 and 1584.
- 2) It oscillates between 1507 and 1572.
- 3) It oscillates between 1495 and 1588.
- 4) It oscillates between 1503 and 1579.
- 5) It oscillates between 1503 and 1588.

Exercise 6

In a fish farm, data of precedings years reveal that, if the initial number of fish is x (x in thousands), after one month they reproduce until a number of $f(x) = \frac{9x}{4+7x}$ fishes.

What number of fish leads to the largest increase in the number of animals, $f(x) - x$?

- 1) $\frac{37}{13}$
- 2) $\frac{2}{7}$
- 3) $\frac{31}{15}$
- 4) $\frac{37}{16}$
- 5) 6

Exercise 7

The yield of a tree plantation is given by $f(x) =$

$$\frac{-24 + 3x^2}{11x^4}, \text{ where } x \text{ is the distance in meters between two trees.}$$

What is the distance x that leads to the largest yield.

- 1) 4
- 2) $\frac{20}{7}$
- 3) 2
- 4) $\frac{11}{20}$
- 5) $\frac{7}{8}$

Exercise 8

A plastic firm receives an order to manufacture 4598 special plastic foam boards for swimming training. The firm has 13 machines but each of them will be able to participate in the manufacturing of this special type of tables only after an adaptation so that each adapted machine is capable of manufacturing 154 boards per hour; on the other hand, the non adapted ones cannot be used for this special order. The cost to adapt each machine is 121 monetary units. Moreover, these adapted machines are automated and only need staff to supervise the production whose salary is 1463 monetary units per hour. Taking into account the number of hours that will be necessary to produce the ordered tables, the cost in salaries for those hours, and the adaptation costs, how many of the machines that the company has should be adapted to place the order at the lowest possible cost?

- 1) 20
- 2) None of the other options is correct.
- 3) 10
- 4) 11
- 5) 20

Exercise 9

Study the differentiability of the function $f(x) = \begin{cases} -e^x + 3 \cos(x) + 4 & x \leq 0 \\ \frac{3x^2}{2} - x + 6 & 0 < x < 1 \\ 2e^{x-1} + \cos(1-x) + \frac{7}{2} & 1 \leq x \end{cases}$

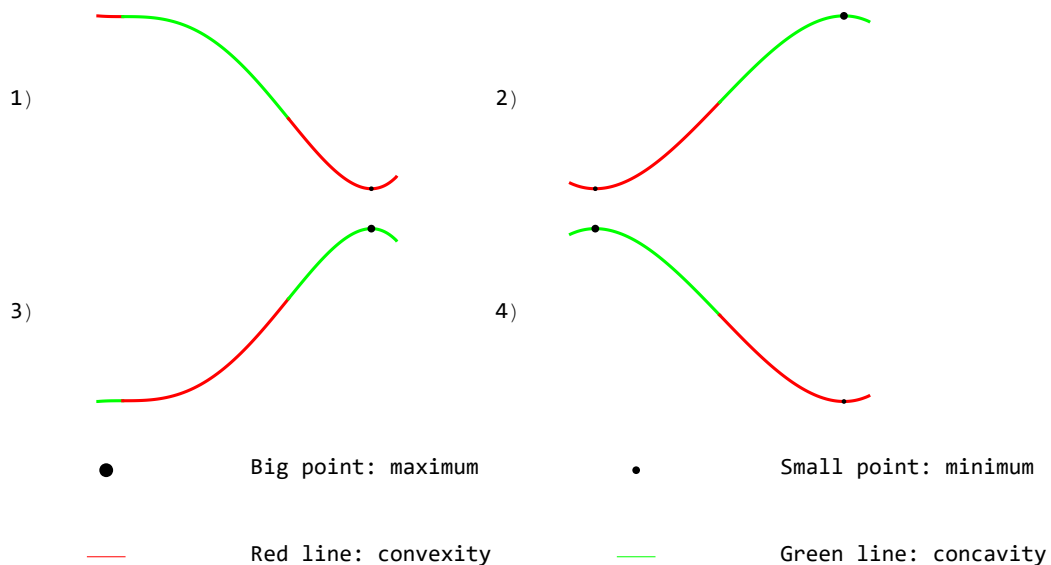
- 1) The function is differentiable for all points.
- 2) The function is not differentiable at any point.
- 3) The function is differentiable for all points except for $x=0$.
- 4) The function is differentiable for all points except for $x=1$.
- 5) The function is differentiable for all points except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

Mathematics 1 - ADE - English - 2026/2027

02-Derivatives for serial number: 52

Exercise 1

Study the shape properties of the $f(x) = 3 + 6x^2 + 2x^3$ to decide which amongst the following ones is the representation of the function.



Indication: To find the maximum and minimum points of the function, try (with Ruffini) the points $-2, -1, 0, 1, 2$. To solve this exercise it is necessary to determine the increasing and decreasing intervals.

Exercise 2

Determine the derivative of the function $f(t) = \log(t+1) (e^t - \sin(t) + 2)$ and compute its value at the point $t=0$.

- 1) $f'(0) = 2$ 2) $f'(0) = 0$ 3) $f'(0) = 3$ 4) $f'(0) = -2$

Exercise 3

Compute the limit: $\lim_{x \rightarrow 0} \frac{-x + \sin[x]}{x^3}$

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

Exercise 4

Compute the limit: $\lim_{x \rightarrow -1} \frac{-1 + x^2}{-2 - x + x^2}$

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

Exercise 5

Between the months $t=4$ and $t=9$

, the funds in certain account (in millions of euros) are given by the function $F(t) = -11 + 288t - 42t^2 + 2t^3$.

Determine the interval within the funds oscillates between months $t=4$ and $t=7$.

- 1) It oscillates between 629 and 637.
- 2) It oscillates between 590 and 642.
- 3) It oscillates between 597 and 637.
- 4) It oscillates between 605 and 643.
- 5) It oscillates between 598 and 647.

Exercise 6

In a fish farm, data of precedings years reveal that, if the initial number of fish is x (x in thousands), after one month they reproduce until a number of $f(x) = \frac{28x}{7+6x}$ fishes.

What number of fish leads to the largest increase in the number of animals, $f(x) - x$?

- 1) $\frac{5}{13}$
- 2) $\frac{10}{3}$
- 3) $\frac{11}{15}$
- 4) $\frac{7}{6}$
- 5) $\frac{5}{18}$

Exercise 7

The yield of a tree plantation is given by $f(x) =$

$$\frac{-50 + 49x + 10x^2}{38x^2}, \text{ where } x \text{ is the distance in meters between two trees.}$$

What is the distance x that leads to the largest yield.

- 1) $\frac{9}{11}$
- 2) $\frac{10}{3}$
- 3) $\frac{11}{15}$
- 4) $\frac{100}{49}$
- 5) $\frac{5}{18}$

Exercise 8

A plastic firm receives an order to manufacture 990 special plastic foam boards for swimming training. The firm has 14 machines but each of them will be able to participate in the manufacturing of this special type of tables only after an adaptation so that each adapted machine is capable of manufacturing 7 boards per hour; on the other hand, the non adapted ones cannot be used for this special order. The cost to adapt each machine is 330 monetary units. Moreover, these adapted machines are automated and only need staff to supervise the production whose salary is 525 monetary units per hour. Taking into account the number of hours that will be necessary to produce the ordered tables, the cost in salaries for those hours, and the adaptation costs, how many of the machines that the company has should be adapted to place the order at the lowest possible cost?

- 1) 26
- 2) 21
- 3) 14
- 4) None of the other options is correct.
- 5) 25

Exercise 9

Study the differentiability of the function $f(x) =$

$$f(x) = \begin{cases} \cos(x+3) - 2 & x \leq -3 \\ 3x \sin(1) - 2 \sin(x+3) + 2x \cos(1) + 3 \cos(x+3) + 1 + 9 \sin(1) + 6 \cos(1) & -3 < x < -2 \\ 3 + \sin(1) + 5 \cos(1) & -2 \leq x \end{cases}$$

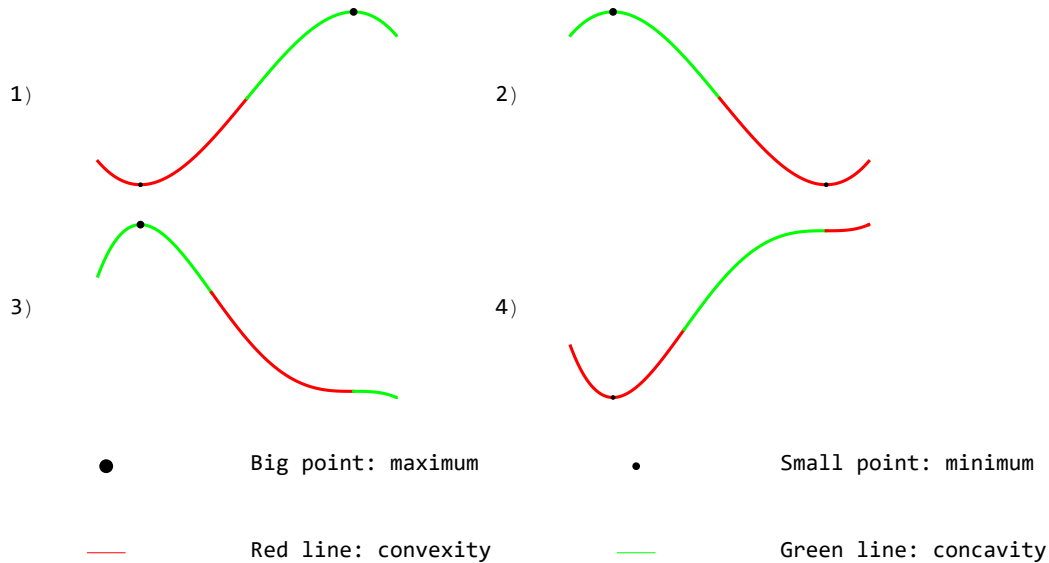
- 1) The function is differentiable for all points.
- 2) The function is not differentiable at any point.
- 3) The function is differentiable for all points except for $x = -3$.
- 4) The function is differentiable for all points except for $x = -2$.
- 5) The function is differentiable for all points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

Mathematics 1 - ADE - English - 2026/2027

02-Derivatives for serial number: 53

Exercise 1

Study the shape properties of the $f(x) = 1 + 3x^2 + 2x^3$ to decide which amongst the following ones is the representation of the function.



Indication: To find the maximum and minimum points of the function, try (with Ruffini) the points $-2, -1, 0, 1, 2$. To solve this exercise it is necessary to determine the increasing and decreasing intervals.

Exercise 2

Determine the derivative of the function $f(t) = 2 \log(\log(e^t + 1) + 1)$ and compute its value at the point $t=0$.

- 1) $f'(0) = -2$ 2) $f'(0) = -4$ 3) $f'(0) = -3$ 4) $f'(0) = \frac{1}{1 + \log[2]}$

Exercise 3

Compute the limit: $\lim_{x \rightarrow 0} \frac{-1 + e^x - x}{x^2}$

1) $-\infty$

2) $\frac{1}{2}$

3) ∞

4) 1

5) $-\frac{1}{3}$

6) -1

7) 0

Exercise 4

Compute the limit: $\lim_{x \rightarrow 1} \frac{-x + 3x^2 - 3x^3 + x^4}{-2 + 5x - 4x^2 + x^3}$

1) $-\infty$

2) 1

3) -1

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

5) 0

6) $-\frac{1}{2}$

7) ∞

Exercise 5

Between the months $t=4$ and $t=10$

, the funds in certain account (in millions of euros) are given by the function $F(t) = 10 + 270t - 42t^2 + 2t^3$.

Determine the interval within the funds oscillates between months $t=5$ and $t=10$.

1) It oscillates between 492 and 569.

2) It oscillates between 496 and 560.

3) It oscillates between 503 and 560.

4) It oscillates between 486 and 558.

5) It oscillates between 501 and 570.

Exercise 6

In a fish farm, data of precedings years reveal that, if the initial number of fish is x (x in thousands), after one month they reproduce until a number of $f(x) = \frac{49x}{1+x}$ fishes.

What number of fish leads to the largest increase in the number of animals, $f(x) - x$?

- 1) $\frac{16}{19}$
- 2) 6
- 3) $\frac{19}{7}$
- 4) 40
- 5) 2

Exercise 7

The yield of a tree plantation is given by $f(x) =$

$$\frac{-27 + 18x + 16x^2}{31x^2}, \text{ where } x \text{ is the distance in meters between two trees.}$$

What is the distance x that leads to the largest yield.

- 1) $\frac{16}{3}$
- 2) 3
- 3) $\frac{19}{7}$
- 4) 40
- 5) $\frac{27}{14}$

Exercise 8

A plastic firm receives an order to manufacture 17017 special plastic foam boards for swimming training. The firm has 20 machines but each of them will be able to participate in the manufacturing of this special type of tables only after an adaptation so that each adapted machine is capable of manufacturing 1547 boards per hour; on the other hand, the non adapted ones cannot be used for this special order. The cost to adapt each machine is 33 monetary units. Moreover, these adapted machines are automated and only need staff to supervise the production whose salary is 363 monetary units per hour. Taking into account the number of hours that will be necessary to produce the ordered tables, the cost in salaries for those hours, and the adaptation costs, how many of the machines that the company has should be adapted to place the order at the lowest possible cost?

- 1) 18
- 2) 1
- 3) None of the other options is correct.
- 4) 20
- 5) 23

Exercise 9

Study the differentiability of the function $f(x) =$

$$\begin{cases} 2 \sin(x+3) + \cos(x+3) + 3 & x \leq -3 \\ x + x(-\sin(2)) - \cos(x+3) + 8 - 3 \sin(2) & -3 < x < -1 \\ e^{x+1} + \cos(x+1) + 5 - 2 \sin(2) - \cos(2) & -1 \leq x \end{cases}$$

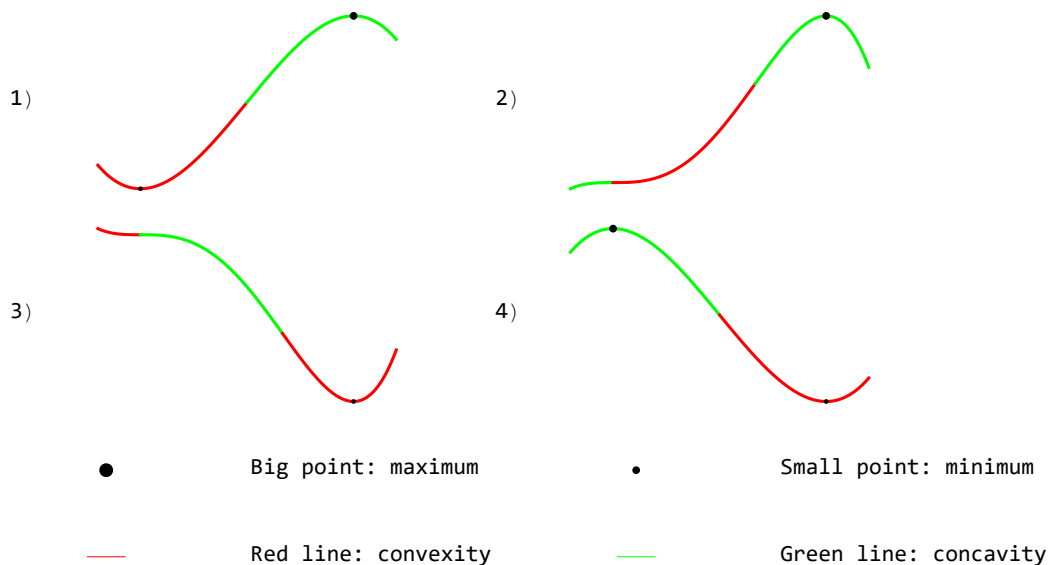
- 1) The function is differentiable for all points.
- 2) The function is not differentiable at any point.
- 3) The function is differentiable for all points except for $x = -3$.
- 4) The function is differentiable for all points except for $x = -1$.
- 5) The function is differentiable for all points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

Mathematics 1 - ADE - English - 2026/2027

02-Derivatives for serial number: 54

Exercise 1

Study the shape properties of the $f(x) = 3 - 24x + 30x^2 - 16x^3 + 3x^4$ to decide which amongst the following ones is the representation of the function.



Indication: To find the maximum and minimum points of the function, try (with Ruffini) the points $-2, -1, 0, 1, 2$. To solve this exercise it is necessary to determine the increasing and decreasing intervals.

Exercise 2

Determine the derivative of the function $f(t) = 2e^{\sin(t)} \log(\sin(t) + 1)$ and compute its value at the point $t=0$.

- 1) $f'(0) = -2$ 2) $f'(0) = -4$ 3) $f'(0) = 2$ 4) $f'(0) = 1$

Exercise 3

Compute the limit: $\lim_{x \rightarrow 1} \frac{\frac{11}{6} - 3x + \frac{3x^2}{2} - \frac{x^3}{3} + \text{Log}[x]}{1 - 4x + 6x^2 - 4x^3 + x^4}$

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

Exercise 4

Compute the limit: $\lim_{x \rightarrow 1} \frac{1 - x - x^2 + x^3}{2 - 3x + x^3}$

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

Exercise 5

Between the months $t=1$ and $t=7$

, the funds in certain account (in millions of euros) are given by the function $F(t) = 11 + 36t - 15t^2 + 2t^3$.

Determine the interval within the funds oscillates between months $t=2$ and $t=7$.

- 1) It oscillates between 43 and 221.
- 2) It oscillates between 34 and 214.
- 3) It oscillates between 38 and 39.
- 4) It oscillates between 46 and 220.
- 5) It oscillates between 38 and 214.

Exercise 6

In a fish farm, data of precedings years reveal that, if the initial number of fish is x (x in thousands), after one month they reproduce until a number of $f(x) = \frac{20x}{5 + 50x}$ fishes.

What number of fish leads to the largest increase in the number of animals, $f(x) - x$?

- 1) $\frac{1}{10}$
- 2) $\frac{1}{18}$
- 3) $\frac{19}{9}$
- 4) $\frac{5}{6}$
- 5) $\frac{23}{5}$

Exercise 7

The yield of a tree plantation is given by $f(x) =$

$$\frac{-5 + 10x + 28x^2}{11x^2}, \text{ where } x \text{ is the distance in meters between two trees.}$$

What is the distance x that leads to the largest yield.

- 1) 1
- 2) $\frac{38}{13}$
- 3) $\frac{24}{7}$
- 4) $\frac{4}{3}$
- 5) $\frac{17}{2}$

Exercise 8

A plastic firm receives an order to manufacture 8619 special plastic foam boards for swimming training. The firm has 18 machines but each of them will be able to participate in the manufacturing of this special type of tables only after an adaptation so that each adapted machine is capable of manufacturing 169 boards per hour; on the other hand, the non adapted ones cannot be used for this special order. The cost to adapt each machine is 153 monetary units. Moreover, these adapted machines are automated and only need staff to supervise the production whose salary is 867 monetary units per hour. Taking into account the number of hours that will be necessary to produce the ordered tables, the cost in salaries for those hours, and the adaptation costs, how many of the machines that the company has should be adapted to place the order at the lowest possible cost?

- 1) None of the other options is correct.
- 2) 19
- 3) 3
- 4) 2
- 5) 20

Exercise 9

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

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

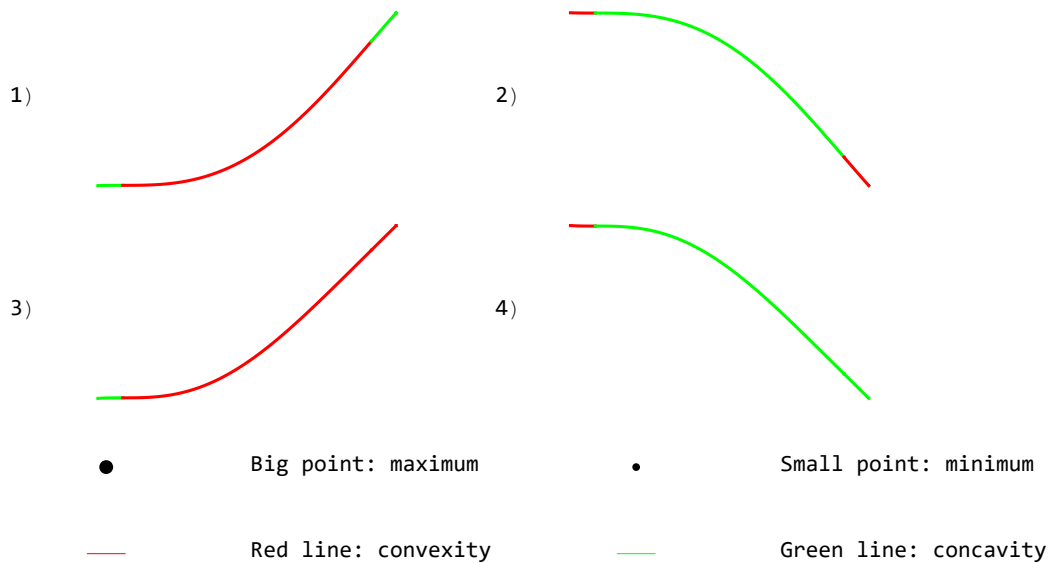
Mathematics 1 - ADE - English - 2026/2027

02-Derivatives for serial number: 55

Exercise 1

Study the shape properties of $f(x) = 4 + 8x^3 - 4x^4 + \frac{3x^5}{5}$

to decide which amongst the following ones is the representation of the function.



Indication: To solve this exercise it is necessary to determine the concavity and convexity interval. To find the inflexion points separating the concavity and convexity intervals, check (by means of Ruffini) with the points $-2, -1, 0, 1, 2$.

Exercise 2

Determine the derivative of the function $f(t) = 6 \sin(\log(\log(t+1) + 1))$ and compute its value at the point $t=0$.

- 1) $f'(0) = 4$ 2) $f'(0) = -2$ 3) $f'(0) = 6$ 4) $f'(0) = 1$

Exercise 3

Compute the limit: $\lim_{x \rightarrow 1} \frac{\frac{25}{4} - 12x + 9x^2 - 4x^3 + \frac{3x^4}{4} + \text{Log}[x^3]}{-1 + 5x - 10x^2 + 10x^3 - 5x^4 + x^5}$

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

Exercise 4

Compute the limit: $\lim_{x \rightarrow -3} \frac{-9 + 3x + 5x^2 + x^3}{-27 - 9x + 3x^2 + x^3}$

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

Exercise 5

Between the months $t=3$ and $t=7$

, the true value of the shares of a company (in euros) are given by the function $C(t) = 258 + 168t - 33t^2 + 2t^3$.

Determine the interval within the value oscillates between months $t=3$ and $t=5$.

- 1) It oscillates between 529 and 533.
- 2) It oscillates between 503 and 530.
- 3) It oscillates between 503 and 530.
- 4) It oscillates between 514 and 527.
- 5) It oscillates between 519 and 530.

Exercise 6

In a fish farm, data of precedings years reveal that, if the initial number of fish is x (x in thousands), after one month they reproduce until a number of $f(x) = \frac{8x}{2 + 49x}$ fishes.

What number of fish leads to the largest increase in the number of animals, $f(x) - x$?

- 1) $\frac{38}{13}$
- 2) $\frac{1}{2}$
- 3) $\frac{2}{49}$
- 4) $\frac{4}{17}$
- 5) 2

Exercise 7

The yield of a tree plantation is given by $f(x) =$

$$\frac{-6 + 45x + 27x^2}{16x^4}, \text{ where } x \text{ is the distance in meters between two trees.}$$

What is the distance x that leads to the largest yield.

- 1) $\frac{1}{6}$
- 2) $\frac{27}{10}$
- 3) 9
- 4) $\frac{23}{3}$
- 5) $\frac{29}{7}$

Exercise 8

A plastic firm receives an order to manufacture 5577 special plastic foam boards for swimming training. The firm has 13 machines but each of them will be able to participate in the manufacturing of this special type of tables only after an adaptation so that each adapted machine is capable of manufacturing 13 boards per hour; on the other hand, the non adapted ones cannot be used for this special order. The cost to adapt each machine is 3003 monetary units. Moreover, these adapted machines are automated and only need staff to supervise the production whose salary is 567 monetary units per hour. Taking into account the number of hours that will be necessary to produce the ordered tables, the cost in salaries for those hours, and the adaptation costs, how many of the machines that the company has should be adapted to place the order at the lowest possible cost?

- 1) None of the other options is correct.
- 2) 13
- 3) 13
- 4) 19
- 5) 1

Exercise 9

Study the differentiability of the function $f(x) = \begin{cases} 3 \cos(x) + 1 & x \leq 0 \\ 4 & 0 < x < 2 \\ 3 \cos(2 - x) + 5 & 2 \leq x \end{cases}$

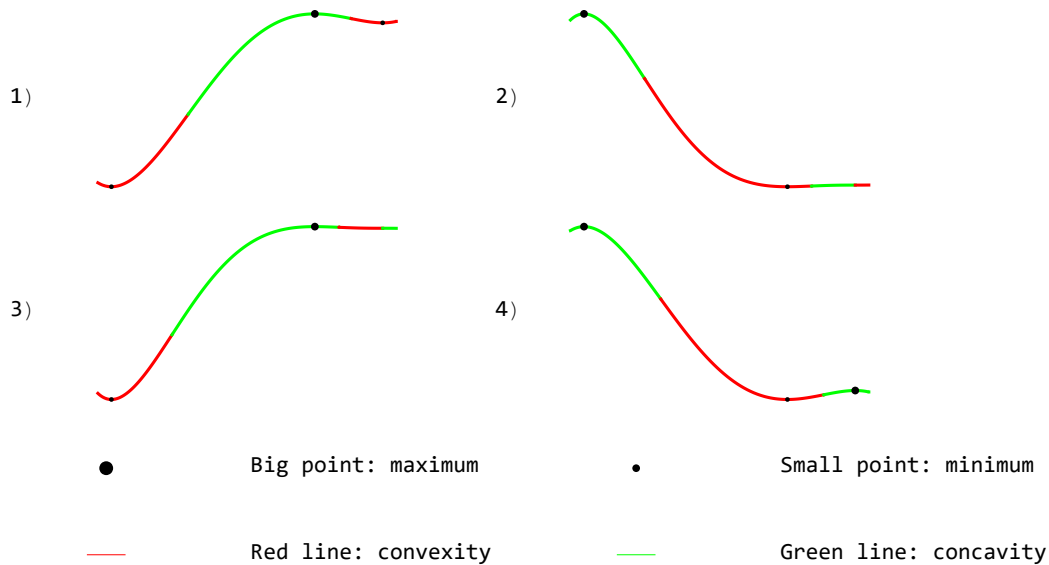
- 1) The function is differentiable for all points.
- 2) The function is not differentiable at any point.
- 3) The function is differentiable for all points except for $x = 0$.
- 4) The function is differentiable for all points except for $x = 2$.
- 5) The function is differentiable for all points except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

Mathematics 1 - ADE - English - 2026/2027

02-Derivatives for serial number: 56

Exercise 1

Study the shape properties of the $f(x) = 1 + 48x - 24x^2 - 4x^3 + 3x^4$ to decide which amongst the following ones is the representation of the function.



Indication: To find the maximum and minimum points of the function, try (with Ruffini) the points $-2, -1, 0, 1, 2$. To solve this exercise it is necessary to determine the increasing and decreasing intervals.

Exercise 2

Determine the derivative of the function $f(t) = t - 2 \log(t+1) + \sin(t) + 3$ and compute its value at the point $t=0$.

- 1) $f'(0) = -2$ 2) $f'(0) = 0$ 3) $f'(0) = 2$ 4) $f'(0) = 3$

Exercise 3

Compute the limit: $\lim_{x \rightarrow 0} \frac{-1 + \cos[x^2]}{x^3}$

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

Exercise 4

Compute the limit: $\lim_{x \rightarrow 2} \frac{-12 + 16x - 7x^2 + x^3}{2 - 3x + x^2}$

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

Exercise 5

Between the months $t=2$ and $t=6$

, the funds in certain account (in millions of euros) are given by the function $F(t) = 18 + 72t - 24t^2 + 2t^3$.

Determine the interval within the funds oscillates between months $t=2$ and $t=5$.

- 1) It oscillates between 28 and 82.
- 2) It oscillates between 24 and 87.
- 3) It oscillates between 36 and 87.
- 4) It oscillates between 18 and 82.
- 5) It oscillates between 18 and 82.

Exercise 6

In a fish farm, data of precedings years reveal that, if the initial number of fish is x (x in thousands), after one month they reproduce until a number of $f(x) = \frac{18x}{8 + 33x}$ fishes.

What number of fish leads to the largest increase in the number of animals, $f(x) - x$?

- 1) $\frac{29}{17}$
- 2) $\frac{26}{17}$
- 3) $\frac{32}{17}$
- 4) $\frac{4}{33}$
- 5) $\frac{3}{14}$

Exercise 7

The yield of a tree plantation is given by $f(x) =$

$$\frac{-42 + 36x + 7x^2}{43x^2}, \text{ where } x \text{ is the distance in meters between two trees.}$$

What is the distance x that leads to the largest yield.

- 1) $\frac{7}{3}$
- 2) $\frac{7}{18}$
- 3) $\frac{39}{4}$
- 4) $\frac{32}{5}$
- 5) $\frac{1}{5}$

Exercise 8

A plastic firm receives an order to manufacture 3388

special plastic foam boards for swimming training. The firm has

13 machines but each of them will be able to participate

in the manufacturing of this special type of tables only after an

adaptation so that each adapted machine is capable of manufacturing

242 boards per hour; on the other hand, the non adapted ones cannot be

used for this special order. The cost to adapt each machine is

14 monetary units. Moreover, these adapted machines are automated and

only need staff to supervise the production whose salary is 196

monetary units per hour. Taking into account the number of hours that will be

necessary to produce the ordered tables, the cost in salaries for those

hours, and the adaptation costs, how many of the machines that the company

has should be adapted to place the order at the lowest possible cost?

- 1) 13
- 2) 14
- 3) 23
- 4) None of the other options is correct.
- 5) 5

Exercise 9

Study the differentiability of the function $f(x) =$

$$\begin{cases} -2e^{x-2} + \sin(2)\sin(x) + \cos(2)\cos(x) + 1 & x \leq 2 \\ 4 - 2x & 2 < x < 3 \\ -4x + 2(x-2)\log(x-2) + 10 & 3 \leq x \end{cases}$$

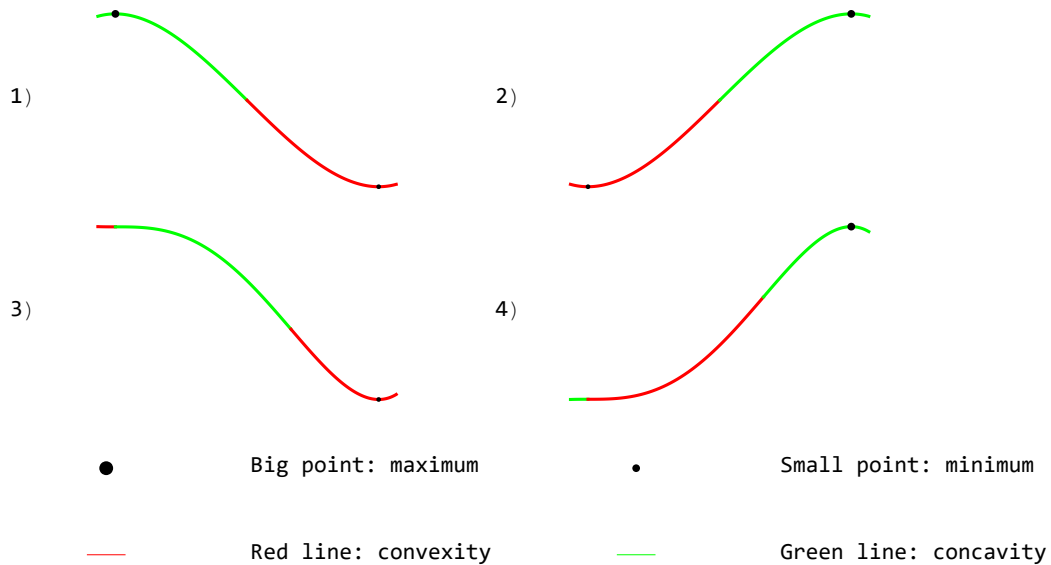
- 1) The function is differentiable for all points.
- 2) The function is not differentiable at any point.
- 3) The function is differentiable for all points except for $x=2$.
- 4) The function is differentiable for all points except for $x=3$.
- 5) The function is differentiable for all points except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

Mathematics 1 - ADE - English - 2026/2027

02-Derivatives for serial number: 57

Exercise 1

Study the shape properties of the $f(x) = 1 - 24x - 18x^2 + 3x^4$ to decide which amongst the following ones is the representation of the function.



Indication: To find the maximum and minimum points of the function, try (with Ruffini) the points $-2, -1, 0, 1, 2$. To solve this exercise it is necessary to determine the increasing and decreasing intervals.

Exercise 2

Determine the derivative of the function $f(t) = t^3 - e^t + \log(t+1) + 1$ and compute its value at the point $t=0$.

- 1) $f'(0) = 0$ 2) $f'(0) = -2$ 3) $f'(0) = 3$ 4) $f'(0) = 2$

Exercise 3

Compute the limit: $\lim_{x \rightarrow 0} \frac{-x + \frac{x^3}{6} + \sin[x]}{x^4}$

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

Exercise 4

Compute the limit: $\lim_{x \rightarrow 1} \frac{-1 + x^2}{-3 + 2x + x^2}$

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

Exercise 5

Between the months $t=0$ and $t=7$

, the funds in certain account (in millions of euros) are given by the function $F(t) = -16 - 15t^2 + 2t^3$.

Determine the interval within the funds oscillates between months $t=4$ and $t=6$.

- 1) It oscillates between -141 and -16 .
- 2) It oscillates between -141 and -16 .
- 3) It oscillates between -145 and -126 .
- 4) It oscillates between -142 and -121 .
- 5) It oscillates between -141 and -124 .

Exercise 6

In a fish farm, data of precedings years reveal that, if the initial number of fish is x (x in thousands), after one month they reproduce until a number of $f(x) = \frac{49x}{1+4x}$ fishes.

What number of fish leads to the largest increase in the number of animals, $f(x) - x$?

- 1) 3
- 2) $\frac{37}{7}$
- 3) $\frac{26}{11}$
- 4) $\frac{19}{14}$
- 5) $\frac{3}{2}$

Exercise 7

The yield of a tree plantation is given by $f(x) =$

$$\frac{-39 + 10x + 12x^2}{25x^2}, \text{ where } x \text{ is the distance in meters between two trees.}$$

What is the distance x that leads to the largest yield.

- 1) $\frac{37}{19}$
- 2) 3
- 3) $\frac{27}{5}$
- 4) $\frac{39}{5}$
- 5) $\frac{7}{13}$

Exercise 8

A plastic firm receives an order to manufacture 1365 special plastic foam boards for swimming training. The firm has 9 machines but each of them will be able to participate in the manufacturing of this special type of tables only after an adaptation so that each adapted machine is capable of manufacturing 3 boards per hour; on the other hand, the non adapted ones cannot be used for this special order. The cost to adapt each machine is 210 monetary units. Moreover, these adapted machines are automated and only need staff to supervise the production whose salary is 78 monetary units per hour. Taking into account the number of hours that will be necessary to produce the ordered tables, the cost in salaries for those hours, and the adaptation costs, how many of the machines that the company has should be adapted to place the order at the lowest possible cost?

- 1) 20
- 2) 28
- 3) 5
- 4) 22
- 5) None of the other options is correct.

Exercise 9

Study the differentiability of the function $f(x) =$

$$\begin{cases} 2e^x + 3\cos(x) + 3 & x \leq 0 \\ 4x - 2\sin(x) + 3\cos(x) + 5 & 0 < x < 1 \\ -e^{x-1} - 3\cos(1-x) + 13 - 2\sin(1) + 3\cos(1) & 1 \leq x \end{cases}$$

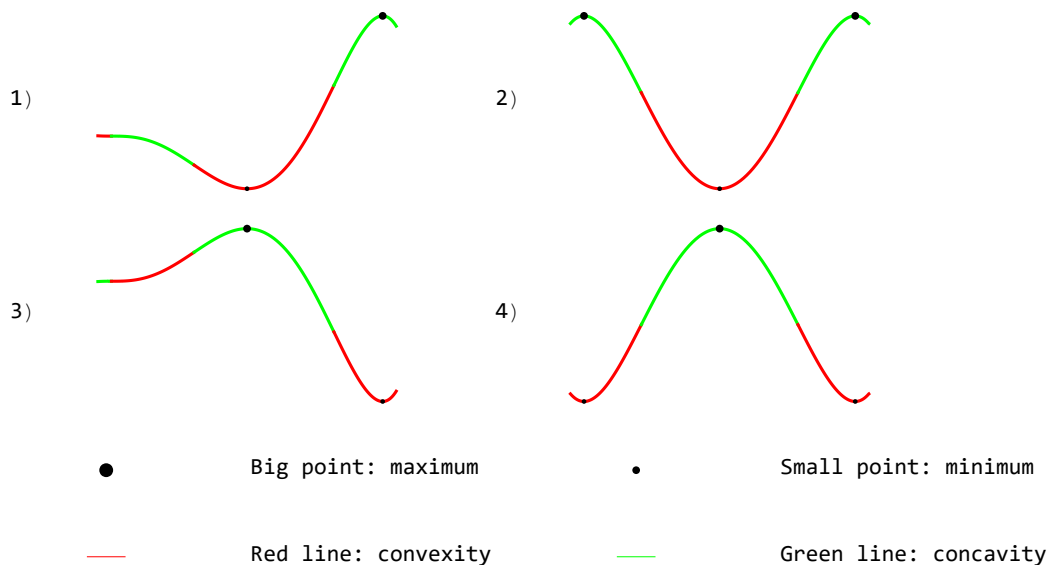
- 1) The function is differentiable for all points.
- 2) The function is not differentiable at any point.
- 3) The function is differentiable for all points except for $x=0$.
- 4) The function is differentiable for all points except for $x=1$.
- 5) The function is differentiable for all points except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

Mathematics 1 - ADE - English - 2026/2027

02-Derivatives for serial number: 58

Exercise 1

Study the shape properties of the $f(x) = 2 - 240x^2 - 80x^3 + 30x^4 + 12x^5$ to decide which amongst the following ones is the representation of the function.



Indication: To find the maximum and minimum points of the function, try (with Ruffini) the points $-2, -1, 0, 1, 2$. To solve this exercise it is necessary to determine the increasing and decreasing intervals.

Exercise 2

Determine the derivative of the function $f(t) = t + \cos(t) + 2\cos(3)$ and compute its value at the point $t=0$.

- 1) $f'(0) = 1$ 2) $f'(0) = 3$ 3) $f'(0) = -4$ 4) $f'(0) = 2$

Exercise 3

Compute the limit: $\lim_{x \rightarrow 0} \frac{-1 + e^{x^2} - x^2 - \frac{x^4}{2}}{x^5}$

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

Exercise 4

Compute the limit: $\lim_{x \rightarrow -2} \frac{24 + 44x + 30x^2 + 9x^3 + x^4}{4x + 4x^2 + x^3}$

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

Exercise 5

Between the months $t=2$ and $t=8$, the funds in certain account (in millions of euros) are given by the function $F(t) = -8 + 180t - 33t^2 + 2t^3$.

Determine the interval within the funds oscillates between months $t=2$ and $t=8$.

- 1) It oscillates between 242 and 352.
- 2) It oscillates between 236 and 344.
- 3) It oscillates between 228 and 336.
- 4) It oscillates between 228 and 347.
- 5) It oscillates between 316 and 317.

Exercise 6

In a fish farm, data of precedings years reveal that, if the initial number of fish is x (x in thousands), after one month they reproduce until a number of $f(x) = \frac{49x}{36 + 4x}$ fishes.

What number of fish leads to the largest increase in the number of animals, $f(x) - x$?

- 1) $\frac{34}{13}$
- 2) $\frac{3}{2}$
- 3) $\frac{19}{18}$
- 4) $\frac{39}{14}$
- 5) $\frac{1}{2}$

Exercise 7

The yield of a tree plantation is given by $f(x) =$

$$\frac{-32 + 21x + 47x^2}{37x^2}, \text{ where } x \text{ is the distance in meters between two trees.}$$

What is the distance x that leads to the largest yield.

- 1) $\frac{25}{9}$
- 2) $\frac{2}{5}$
- 3) $\frac{64}{21}$
- 4) $\frac{19}{8}$
- 5) $\frac{13}{2}$

Exercise 8

A plastic firm receives an order to manufacture 24310 special plastic foam boards for swimming training. The firm has 26 machines but each of them will be able to participate in the manufacturing of this special type of tables only after an adaptation so that each adapted machine is capable of manufacturing 2 boards per hour; on the other hand, the non adapted ones cannot be used for this special order. The cost to adapt each machine is 3575 monetary units. Moreover, these adapted machines are automated and only need staff to supervise the production whose salary is 85 monetary units per hour. Taking into account the number of hours that will be necessary to produce the ordered tables, the cost in salaries for those hours, and the adaptation costs, how many of the machines that the company has should be adapted to place the order at the lowest possible cost?

- 1) None of the other options is correct.
- 2) 7
- 3) 12
- 4) 17
- 5) 26

Exercise 9

Study the differentiability of the function $f(x) =$

$$\begin{cases} 2 \sin(x) + 1 & x \leq 0 \\ x + e^x - 2 \cos(x) + 2 & 0 < x < 2 \\ 2e^{x-2} + 3 \cos(2-x) + e^2 - 1 - 2 \cos(2) & 2 \leq x \end{cases}$$

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

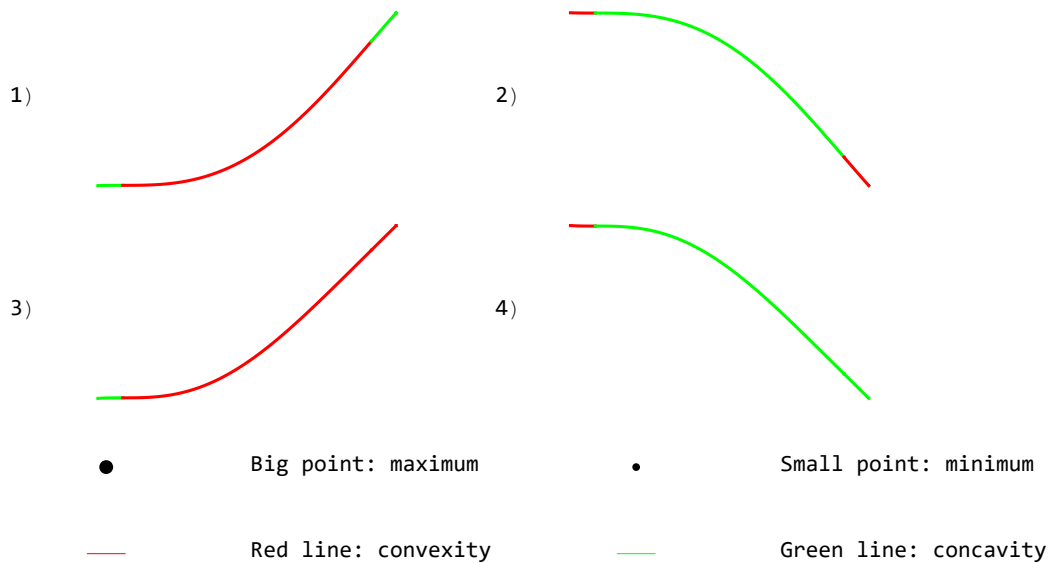
Mathematics 1 - ADE - English - 2026/2027

02-Derivatives for serial number: 59

Exercise 1

Study the shape properties of $f(x) = 4 - 2x^3 + \frac{x^4}{2}$

to decide which amongst the following ones is the representation of the function.



Indication: To solve this exercise it is necessary to determine the concavity and convexity interval. To find the inflexion points separating the concavity and convexity intervals, check (by means of Ruffini) with the points $-2, -1, 0, 1, 2$.

Exercise 2

Determine the derivative of the function $f(t) = (e^t + 3e^{2t})t^3$ and compute its value at the point $t=0$.

- 1) $f'(0) = 1$ 2) $f'(0) = -3$ 3) $f'(0) = 0$ 4) $f'(0) = -4$

Exercise 3

Compute the limit: $\lim_{x \rightarrow 0} \frac{-1 + e^{x^3} - x^3}{x^4}$

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

Exercise 4

Compute the limit: $\lim_{x \rightarrow 3} \frac{9x - 6x^2 + x^3}{18 - 3x - 4x^2 + x^3}$

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

Exercise 5

Between the months $t=1$ and $t=6$

, the true value of the shares of a company (in euros) are given by the function $C(t) = 122 + 120t - 27t^2 + 2t^3$.

Determine the interval within the value oscillates between months $t=1$ and $t=6$.

- 1) It oscillates between 222 and 293.
- 2) It oscillates between 297 and 298.
- 3) It oscillates between 217 and 302.
- 4) It oscillates between 223 and 297.
- 5) It oscillates between 227 and 303.

Exercise 6

In a fish farm, data of precedings years reveal that, if the initial number of fish is x (x in thousands), after one month they reproduce until a number of $f(x) = \frac{49x}{16 + 5x}$ fishes.

What number of fish leads to the largest increase in the number of animals, $f(x) - x$?

- 1) $\frac{27}{19}$
- 2) $\frac{8}{3}$
- 3) $\frac{25}{9}$
- 4) $\frac{12}{5}$
- 5) $\frac{29}{5}$

Exercise 7

The yield of a tree plantation is given by $f(x) =$

$$\frac{-31 + 38x + 49x^2}{33x^5}, \text{ where } x \text{ is the distance in meters between two trees.}$$

What is the distance x that leads to the largest yield.

- 1) $\frac{8}{3}$
- 2) $\frac{23}{7}$
- 3) 2
- 4) $\frac{27}{19}$
- 5) $\frac{31}{49}$

Exercise 8

A plastic firm receives an order to manufacture 5187 special plastic foam boards for swimming training. The firm has 25 machines but each of them will be able to participate in the manufacturing of this special type of tables only after an adaptation so that each adapted machine is capable of manufacturing 13 boards per hour; on the other hand, the non adapted ones cannot be used for this special order. The cost to adapt each machine is 714 monetary units. Moreover, these adapted machines are automated and only need staff to supervise the production whose salary is 646 monetary units per hour. Taking into account the number of hours that will be necessary to produce the ordered tables, the cost in salaries for those hours, and the adaptation costs, how many of the machines that the company has should be adapted to place the order at the lowest possible cost?

- 1) 15
- 2) None of the other options is correct.
- 3) 14
- 4) 24
- 5) 19

Exercise 9

Study the differentiability of the function $f(x) =$

$$\begin{cases} -e^{x+3} + \cos(x+3) + 1 & x \leq -3 \\ x + 2 \sin(x+3) - 2x \cos(2) + 4 - 6 \cos(2) & -3 < x < -1 \\ 3x - 2(x+2) \log(x+2) + 6 + 2 \sin(2) - 4 \cos(2) & -1 \leq x \end{cases}$$

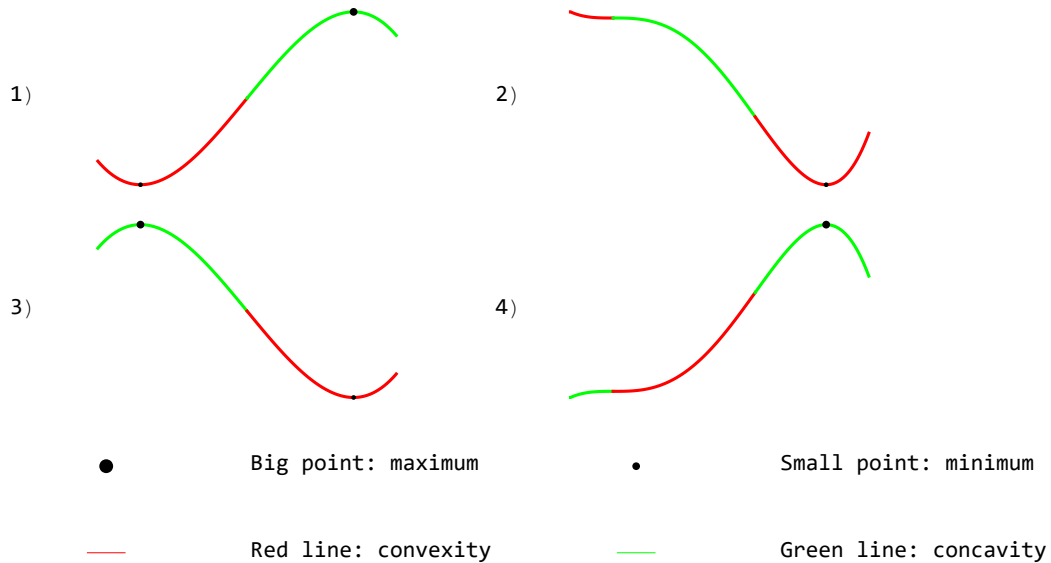
- 1) The function is differentiable for all points.
- 2) The function is not differentiable at any point.
- 3) The function is differentiable for all points except for $x = -3$.
- 4) The function is differentiable for all points except for $x = -1$.
- 5) The function is differentiable for all points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

Mathematics 1 - ADE - English - 2026/2027

02-Derivatives for serial number: 60

Exercise 1

Study the shape properties of the $f(x) = 1 - 24x + 30x^2 - 16x^3 + 3x^4$ to decide which amongst the following ones is the representation of the function.



Indication: To find the maximum and minimum points of the function, try (with Ruffini) the points $-2, -1, 0, 1, 2$. To solve this exercise it is necessary to determine the increasing and decreasing intervals.

Exercise 2

Determine the derivative of the function $f(t) = \sin(t) + e^2$ and compute its value at the point $t=0$.

- 1) $f'(0) = 3$ 2) $f'(0) = -1$ 3) $f'(0) = 1$ 4) $f'(0) = -3$

Exercise 3

Compute the limit: $\lim_{x \rightarrow 1} \frac{1 - x + \log[x]}{1 - 2x + x^2}$

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

Exercise 4

Compute the limit: $\lim_{x \rightarrow 1} \frac{-x + 3x^2 - 3x^3 + x^4}{2 - 3x + x^3}$

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

Exercise 5

Between the months $t=1$ and $t=8$, the funds in certain account (in millions of euros) are given by the function $F(t) = 20 + 252t - 39t^2 + 2t^3$.

Determine the interval within the funds oscillates between months $t=4$ and $t=5$.

- 1) It oscillates between 535 and 553.
- 2) It oscillates between 527 and 547.
- 3) It oscillates between 559 and 560.
- 4) It oscillates between 532 and 555.
- 5) It oscillates between 235 and 564.

Exercise 6

In a fish farm, data of precedings years reveal that, if the initial number of fish is x (x in thousands), after one month they reproduce until a number of $f(x) = \frac{45x}{20 + 47x}$ fishes.

What number of fish leads to the largest increase in the number of animals, $f(x) - x$?

- 1) $\frac{9}{17}$
- 2) $\frac{10}{47}$
- 3) 2
- 4) $\frac{10}{17}$
- 5) $\frac{27}{5}$

Exercise 7

The yield of a tree plantation is given by $f(x) =$

$$\frac{-27 + 28x + 30x^2}{44x^2}, \text{ where } x \text{ is the distance in meters between two trees.}$$

What is the distance x that leads to the largest yield.

- 1) 10
- 2) $\frac{1}{3}$
- 3) $\frac{3}{2}$
- 4) 1
- 5) $\frac{27}{14}$

Exercise 8

A plastic firm receives an order to manufacture 390 special plastic foam boards for swimming training. The firm has 12 machines but each of them will be able to participate in the manufacturing of this special type of tables only after an adaptation so that each adapted machine is capable of manufacturing 105 boards per hour; on the other hand, the non adapted ones cannot be used for this special order. The cost to adapt each machine is 39 monetary units. Moreover, these adapted machines are automated and only need staff to supervise the production whose salary is 378 monetary units per hour. Taking into account the number of hours that will be necessary to produce the ordered tables, the cost in salaries for those hours, and the adaptation costs, how many of the machines that the company has should be adapted to place the order at the lowest possible cost?

- 1) 12
- 2) 21
- 3) 6
- 4) None of the other options is correct.
- 5) 7

Exercise 9

Study the differentiability of the function $f(x) =$

$$\begin{cases} e^{x-2} - \sin(2) \sin(x) - \cos(2) \cos(x) + 5 & x \leq 2 \\ e^{x-2} + 2 \cos(2-x) + 3 & 2 < x < 5 \\ -2e^{x-5} + 3 \cos(5-x) + e^3 + 7 + 2 \cos(3) & 5 \leq x \end{cases}$$

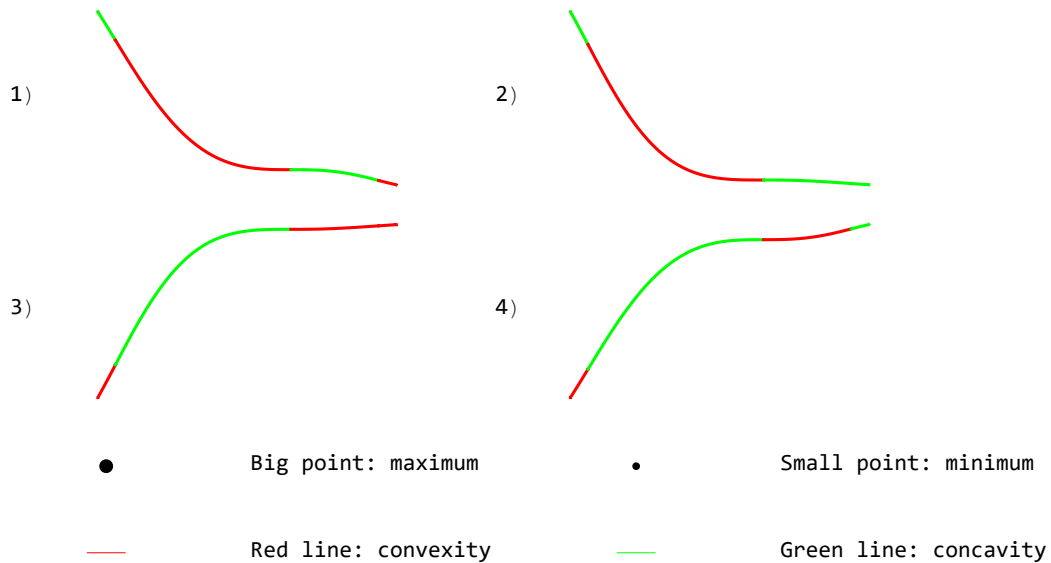
- 1) The function is differentiable for all points.
- 2) The function is not differentiable at any point.
- 3) The function is differentiable for all points except for $x=2$.
- 4) The function is differentiable for all points except for $x=5$.
- 5) The function is differentiable for all points except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

Mathematics 1 - ADE - English - 2026/2027

02-Derivatives for serial number: 61

Exercise 1

Study the shape properties of $f(x) = 1 + 20x^3 - 15x^4 + 2x^6$ to decide which amongst the following ones is the representation of the function.



Indication: To solve this exercise it is necessary to determine the concavity and convexity interval. To find the inflexion points separating the concavity and convexity intervals, check (by means of Ruffini) with the points $-2, -1, 0, 1, 2$.

Exercise 2

Determine the derivative of the function $f(t) = -2(t+1)^2 \cos(\log(t+1))$ and compute its value at the point $t=0$.

- 1) $f'(0) = 0$ 2) $f'(0) = -4$ 3) $f'(0) = 3$ 4) $f'(0) = -1$

Exercise 3

Compute the limit: $\lim_{x \rightarrow 0} \frac{-x^2 + \sin[x^2]}{x^4}$

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

Exercise 4

Compute the limit: $\lim_{x \rightarrow -2} \frac{-2 + x + x^2}{-4 + x^2}$

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

Exercise 5

Between the months $t=2$ and $t=9$

, the true value of the shares of a company (in euros) are given by the function $C(t) = 100 + 72t - 21t^2 + 2t^3$.

Determine the interval within the value oscillates between months $t=5$ and $t=9$.

- 1) It oscillates between 176 and 505.
- 2) It oscillates between 185 and 505.
- 3) It oscillates between 180 and 181.
- 4) It oscillates between 191 and 508.
- 5) It oscillates between 175 and 514.

Exercise 6

In a fish farm, data of precedings years reveal that, if the initial number of fish is x (x in thousands), after one month they reproduce until a number of $f(x) = \frac{27x}{3 + 19x}$ fishes.

What number of fish leads to the largest increase in the number of animals, $f(x) - x$?

- 1) $\frac{5}{2}$
- 2) $\frac{15}{7}$
- 3) $\frac{17}{4}$
- 4) $\frac{23}{18}$
- 5) $\frac{6}{19}$

Exercise 7

The yield of a tree plantation is given by $f(x) =$

$$\frac{-12 + 24x + 44x^2}{18x^8}, \text{ where } x \text{ is the distance in meters between two trees.}$$

What is the distance x that leads to the largest yield.

- 1) $\frac{28}{3}$
- 2) $\frac{32}{17}$
- 3) $\frac{10}{3}$
- 4) $\frac{38}{15}$
- 5) $\frac{4}{11}$

Exercise 8

A plastic firm receives an order to manufacture 9727740 special plastic foam boards for swimming training. The firm has 9 machines but each of them will be able to participate in the manufacturing of this special type of tables only after an adaptation so that each adapted machine is capable of manufacturing 289 boards per hour; on the other hand, the non adapted ones cannot be used for this special order. The cost to adapt each machine is 935 monetary units. Moreover, these adapted machines are automated and only need staff to supervise the production whose salary is 4 monetary units per hour. Taking into account the number of hours that will be necessary to produce the ordered tables, the cost in salaries for those hours, and the adaptation costs, how many of the machines that the company has should be adapted to place the order at the lowest possible cost?

- 1) None of the other options is correct.
- 2) 15
- 3) 2
- 4) 16
- 5) 20

Exercise 9

Study the differentiability of the function $f(x) =$

$$\begin{cases} -e^{x-1} - 3 \cos(1-x) - 3 & x \leq 1 \\ -2(\sin(1-x) + \cos(1-x)) + x(-1 + \sin(1) + \cos(1)) - 7 + 2(\sin(1) + \cos(1)) & 1 < x < 2 \\ 2e^{x-2} - 3 \cos(2-x) - 2 - 4 \cos(1) & 2 \leq x \end{cases}$$

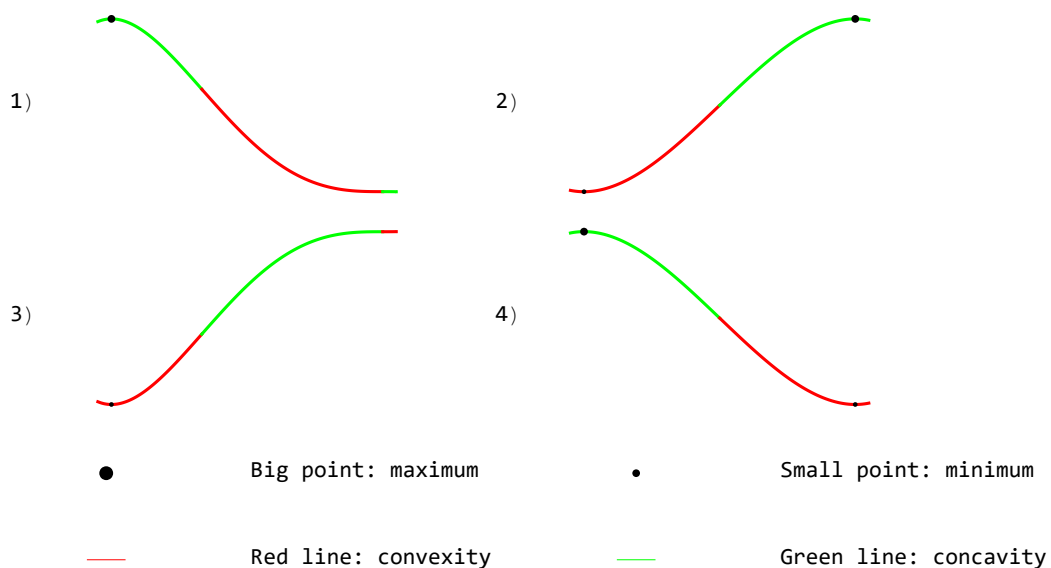
- 1) The function is differentiable for all points.
- 2) The function is not differentiable at any point.
- 3) The function is differentiable for all points except for $x=1$.
- 4) The function is differentiable for all points except for $x=2$.
- 5) The function is differentiable for all points except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

Mathematics 1 - ADE - English - 2026/2027

02-Derivatives for serial number: 62

Exercise 1

Study the shape properties of the $f(x) = 2 + 96x - 24x^2 - 8x^3 + 3x^4$ to decide which amongst the following ones is the representation of the function.



Indication: To find the maximum and minimum points of the function, try (with Ruffini) the points $-2, -1, 0, 1, 2$. To solve this exercise it is necessary to determine the increasing and decreasing intervals.

Exercise 2

Determine the derivative of the function $f(t) = t(e^t + \log(t+1) + 3)$ and compute its value at the point $t=0$.

- 1) $f'(0) = 4$ 2) $f'(0) = 2$ 3) $f'(0) = -1$ 4) $f'(0) = -4$

Exercise 3

Compute the limit: $\lim_{x \rightarrow 0} \frac{-1 + e^x - x - \frac{x^2}{2} - \frac{x^3}{6}}{x^4}$

- 1) -2
- 2) $-\infty$
- 3) 0
- 4) $\frac{1}{24}$
- 5) 1
- 6) -1
- 7) ∞

Exercise 4

Compute the limit: $\lim_{x \rightarrow 1} \frac{1 - x - x^2 + x^3}{3 - 5x + x^2 + x^3}$

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

Exercise 5

Between the months $t=0$ and $t=5$

, the funds in certain account (in millions of euros) are given by the function $F(t) = 4 - 12t^2 + 2t^3$.

Determine the interval within the funds oscillates between months $t=0$ and $t=5$.

- 1) It oscillates between -51 and 13.
- 2) It oscillates between -53 and -6.
- 3) It oscillates between -65 and 8.
- 4) It oscillates between -60 and 4.
- 5) It oscillates between -56 and 12.

Exercise 6

In a fish farm, data of precedings years reveal that, if the initial number of fish is x (x in thousands), after one month they reproduce until a number of $f(x) = \frac{36x}{25 + 2x}$ fishes.

What number of fish leads to the largest increase in the number of animals, $f(x) - x$?

- 1) 1
- 2) $\frac{5}{2}$
- 3) $\frac{34}{13}$
- 4) $\frac{3}{5}$
- 5) $\frac{25}{3}$

Exercise 7

The yield of a tree plantation is given by $f(x) =$

$$\frac{-34 + 47x + 39x^2}{32x^2}, \text{ where } x \text{ is the distance in meters between two trees.}$$

What is the distance x that leads to the largest yield.

- 1) $\frac{5}{2}$
- 2) $\frac{68}{47}$
- 3) $\frac{26}{17}$
- 4) $\frac{17}{18}$
- 5) $\frac{25}{3}$

Exercise 8

A plastic firm receives an order to manufacture 10080 special plastic foam boards for swimming training. The firm has 11 machines but each of them will be able to participate in the manufacturing of this special type of tables only after an adaptation so that each adapted machine is capable of manufacturing 18 boards per hour; on the other hand, the non adapted ones cannot be used for this special order. The cost to adapt each machine is 35 monetary units. Moreover, these adapted machines are automated and only need staff to supervise the production whose salary is 4 monetary units per hour. Taking into account the number of hours that will be necessary to produce the ordered tables, the cost in salaries for those hours, and the adaptation costs, how many of the machines that the company has should be adapted to place the order at the lowest possible cost?

- 1) None of the other options is correct.
- 2) 20
- 3) 3
- 4) 11
- 5) 4

Exercise 9

Study the differentiability of the function $f(x) =$

$$\begin{cases} \cos(x) - 2 \sin(x) & x \leq 0 \\ -3x + \sin(x) - 2 \cos(x) + 8 & 0 < x < 2 \\ -2e^{x-2} - \cos(2-x) + 5 + \sin(2) - 2 \cos(2) & 2 \leq x \end{cases}$$

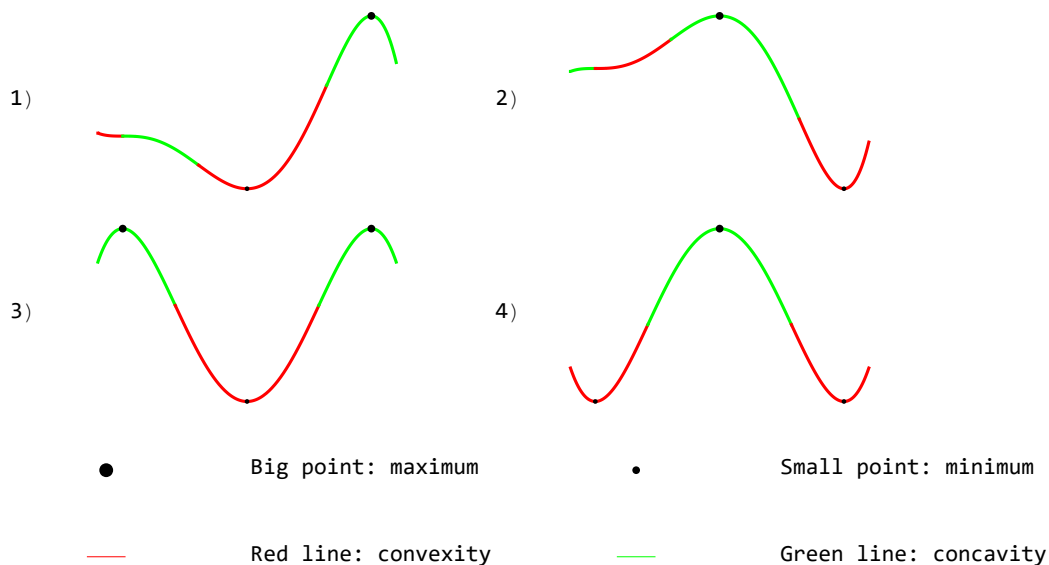
- 1) The function is differentiable for all points.
- 2) The function is not differentiable at any point.
- 3) The function is differentiable for all points except for $x=0$.
- 4) The function is differentiable for all points except for $x=2$.
- 5) The function is differentiable for all points except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

Mathematics 1 - ADE - English - 2026/2027

02-Derivatives for serial number: 63

Exercise 1

Study the shape properties of the $f(x) = 1 - 6x^2 + 3x^4$ to decide which amongst the following ones is the representation of the function.



Indication: To find the maximum and minimum points of the function, try (with Ruffini) the points $-2, -1, 0, 1, 2$. To solve this exercise it is necessary to determine the increasing and decreasing intervals.

Exercise 2

Determine the derivative of the function $f(t) = -2 \log(t+1) e^{t+\cos(t)}$ and compute its value at the point $t=0$.

- 1) $f'(0) = -2e$ 2) $f'(0) = 3$ 3) $f'(0) = 0$ 4) $f'(0) = -3$

Exercise 3

Compute the limit: $\lim_{x \rightarrow 1} \frac{\frac{11}{3} - 6x + 3x^2 - \frac{2x^3}{3} + \text{Log}[x^2]}{1 - 4x + 6x^2 - 4x^3 + x^4}$

1) $\emptyset$

2) $-\frac{1}{2}$

3) ∞

4) 1

5) $-\infty$

6) $\frac{1}{3}$

7) -1

Exercise 4

Compute the limit: $\lim_{x \rightarrow 2} \frac{12 - 8x - x^2 + x^3}{-2 - x + x^2}$

1) ∞

2) $\emptyset$

3) 1

4) $-\infty$

5) -2

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

7) -1

Exercise 5

Between the months $t=3$ and $t=7$

, the funds in certain account (in millions of euros) are given by the function $F(t) = -3 + 90t - 24t^2 + 2t^3$.

Determine the interval within the funds oscillates between months $t=4$ and $t=6$.

1) It oscillates between 101 and 104.

2) It oscillates between 98 and 105.

3) It oscillates between 97 and 137.

4) It oscillates between 90 and 111.

5) It oscillates between 97 and 105.

Exercise 6

In a fish farm, data of precedings years reveal that, if the initial number of fish is x (x in thousands), after one month they reproduce until a number of $f(x) = \frac{45x}{20 + 14x}$ fishes.

What number of fish leads to the largest increase in the number of animals, $f(x) - x$?

- 1) $\frac{7}{2}$
- 2) $\frac{38}{3}$
- 3) $\frac{9}{2}$
- 4) $\frac{5}{7}$
- 5) $\frac{21}{20}$

Exercise 7

The yield of a tree plantation is given by $f(x) =$

$$\frac{-5 + 20x + 35x^2}{7x^2}, \text{ where } x \text{ is the distance in meters between two trees.}$$

What is the distance x that leads to the largest yield.

- 1) $\frac{40}{17}$
- 2) $\frac{38}{3}$
- 3) 11
- 4) $\frac{1}{2}$
- 5) $\frac{21}{20}$

Exercise 8

A plastic firm receives an order to manufacture 47600 special plastic foam boards for swimming training. The firm has 19 machines but each of them will be able to participate in the manufacturing of this special type of tables only after an adaptation so that each adapted machine is capable of manufacturing 34 boards per hour; on the other hand, the non adapted ones cannot be used for this special order. The cost to adapt each machine is 175 monetary units. Moreover, these adapted machines are automated and only need staff to supervise the production whose salary is 50 monetary units per hour. Taking into account the number of hours that will be necessary to produce the ordered tables, the cost in salaries for those hours, and the adaptation costs, how many of the machines that the company has should be adapted to place the order at the lowest possible cost?

- 1) None of the other options is correct.
- 2) 30
- 3) 19
- 4) 20
- 5) 31

Exercise 9

Study the differentiability of the function $f(x) = \begin{cases} -2e^x - 5 & x \leq 0 \\ \frac{1}{2}(x-4)x - 3 & 0 < x < 3 \\ 2e^{x-3} + 3\cos(3-x) - \frac{19}{2} & 3 \leq x \end{cases}$

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

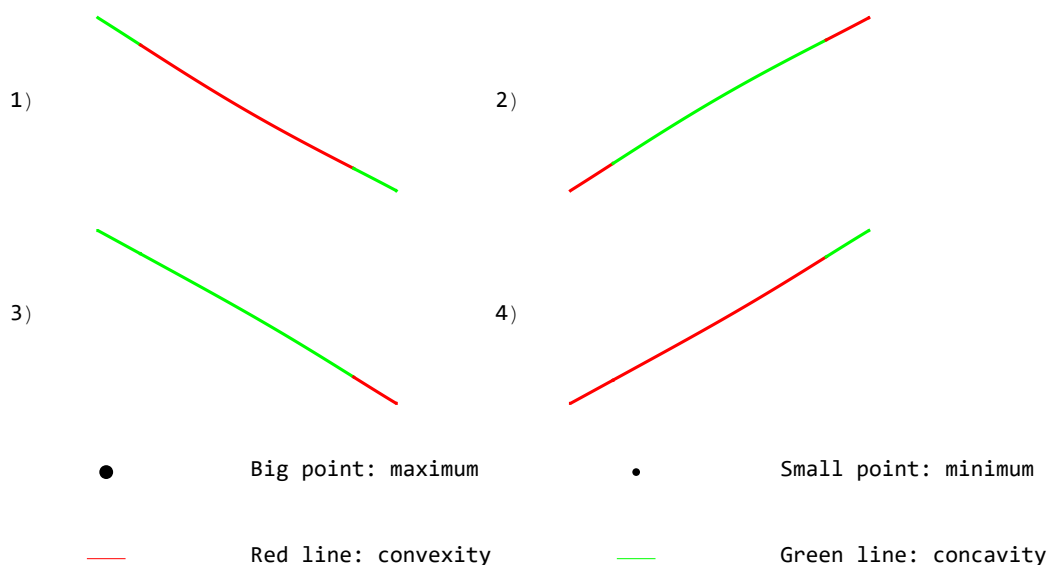
Mathematics 1 - ADE - English - 2026/2027

02-Derivatives for serial number: 64

Exercise 1

Study the shape properties of $f(x) = 2 - 12x^2 + 10x^3 - 4x^4 + \frac{3x^5}{5}$

to decide which amongst the following ones is the representation of the function.



Indication: To solve this exercise it is necessary to determine the concavity and convexity interval. To find the inflexion points separating the concavity and convexity intervals, check (by means of Ruffini) with the points $-2, -1, 0, 1, 2$.

Exercise 2

Determine the derivative of the function $f(t) = 3e^t \log^2(t+1)$ and compute its value at the point $t=0$.

- 1) $f'(0) = 0$ 2) $f'(0) = 2$ 3) $f'(0) = -3$ 4) $f'(0) = 1$

Exercise 3

Compute the limit: $\lim_{x \rightarrow 1} \frac{\frac{25}{4} - 12x + 9x^2 - 4x^3 + \frac{3x^4}{4} + \text{Log}[x^3]}{-1 + 5x - 10x^2 + 10x^3 - 5x^4 + x^5}$

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

Exercise 4

Compute the limit: $\lim_{x \rightarrow 3} \frac{9 + 3x - 5x^2 + x^3}{18 - 3x - 4x^2 + x^3}$

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

Exercise 5

Between the months $t=1$ and $t=8$

, the true value of the shares of a company (in euros) are given by the function $C(t) = 11 + 72t - 24t^2 + 2t^3$.

Determine the interval within the value oscillates between months $t=3$ and $t=7$.

- 1) It oscillates between 4 and 64.
- 2) It oscillates between 11 and 62.
- 3) It oscillates between 11 and 65.
- 4) It oscillates between 11 and 75.
- 5) It oscillates between 11 and 75.

Exercise 6

In a fish farm, data of precedings years reveal that, if the initial number of fish is x (x in thousands), after one month they reproduce until a number of $f(x) = \frac{16x}{1+23x}$ fishes.

What number of fish leads to the largest increase in the number of animals, $f(x) - x$?

- 1) $\frac{3}{23}$
- 2) $\frac{22}{13}$
- 3) $\frac{35}{9}$
- 4) $\frac{13}{10}$
- 5) 4

Exercise 7

The yield of a tree plantation is given by $f(x) =$

$$\frac{-35 + 11x + 17x^2}{16x^5}, \text{ where } x \text{ is the distance in meters between two trees.}$$

What is the distance x that leads to the largest yield.

- 1) $\frac{13}{3}$
- 2) $\frac{25}{17}$
- 3) $\frac{7}{5}$
- 4) $\frac{31}{19}$
- 5) $\frac{37}{7}$

Exercise 8

A plastic firm receives an order to manufacture 684450 special plastic foam boards for swimming training. The firm has 25 machines but each of them will be able to participate in the manufacturing of this special type of tables only after an adaptation so that each adapted machine is capable of manufacturing 845 boards per hour; on the other hand, the non adapted ones cannot be used for this special order. The cost to adapt each machine is 15 monetary units. Moreover, these adapted machines are automated and only need staff to supervise the production whose salary is 6 monetary units per hour. Taking into account the number of hours that will be necessary to produce the ordered tables, the cost in salaries for those hours, and the adaptation costs, how many of the machines that the company has should be adapted to place the order at the lowest possible cost?

- 1) 11
- 2) 5
- 3) 8
- 4) None of the other options is correct.
- 5) 18

Exercise 9

Study the differentiability of the function $f(x) =$

$$f(x) = \begin{cases} -2e^{x-1} + \sin(1)\sin(x) + \cos(1)\cos(x) & x \leq 1 \\ \frac{1}{4}(x-5)^2 & 1 < x < 3 \\ \sin(3-x) + 2\cos(3-x) - 1 & 3 \leq x \end{cases}$$

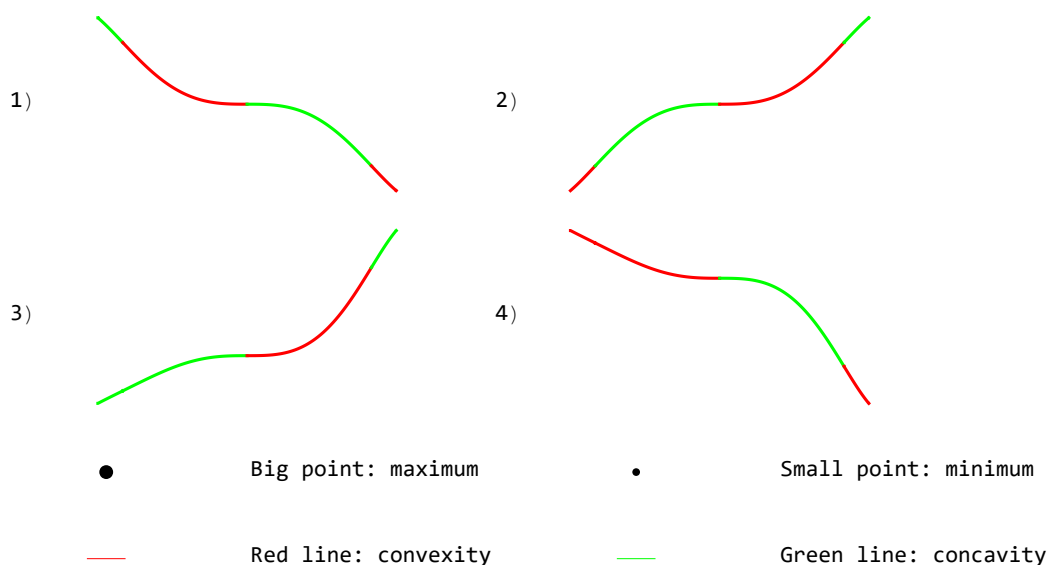
- 1) The function is differentiable for all points.
- 2) The function is not differentiable at any point.
- 3) The function is differentiable for all points except for $x=1$.
- 4) The function is differentiable for all points except for $x=3$.
- 5) The function is differentiable for all points except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

Mathematics 1 - ADE - English - 2026/2027

02-Derivatives for serial number: 65

Exercise 1

Study the shape properties of $f(x) = 1 - 2x^3 + \frac{3x^5}{5}$ to decide which amongst the following ones is the representation of the function.



Indication: To solve this exercise it is necessary to determine the concavity and convexity interval. To find the inflexion points separating the concavity and convexity intervals, check (by means of Ruffini) with the points $-2, -1, 0, 1, 2$.

Exercise 2

Determine the derivative of the function $f(t) = e^t - 2 \log(t+1) + 2 \sin(t)$ and compute its value at the point $t=0$.

- 1) $f'(0) = 2$ 2) $f'(0) = -4$ 3) $f'(0) = -1$ 4) $f'(0) = 1$

Exercise 3

Compute the limit: $\lim_{x \rightarrow 0} \frac{-1 + \cos[x^2]}{x^4}$

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

Exercise 4

Compute the limit: $\lim_{x \rightarrow -1} \frac{-2 - x + x^2}{-1 + x^2}$

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

Exercise 5

Between the months $t=0$ and $t=5$

, the true value of the shares of a company (in euros) are given by the function $C(t) = 131 - 15t^2 + 2t^3$.

Determine the interval within the value oscillates between months $t=2$ and $t=3$.

- 1) It oscillates between 50 and 87.
- 2) It oscillates between 6 and 131.
- 3) It oscillates between 45 and 87.
- 4) It oscillates between 50 and 85.
- 5) It oscillates between 6 and 131.

Exercise 6

In a fish farm, data of precedings years reveal that, if the initial number of fish is x (x in thousands), after one month they reproduce until a number of $f(x) = \frac{49x}{4 + 22x}$ fishes.

What number of fish leads to the largest increase in the number of animals, $f(x) - x$?

- 1) $\frac{13}{5}$
- 2) $\frac{4}{17}$
- 3) 2
- 4) $\frac{23}{11}$
- 5) $\frac{5}{11}$

Exercise 7

The yield of a tree plantation is given by $f(x) =$

$$\frac{-33 + 47x + 43x^2}{34x^8}, \text{ where } x \text{ is the distance in meters between two trees.}$$

What is the distance x that leads to the largest yield.

- 1) $\frac{24}{43}$
- 2) $\frac{29}{15}$
- 3) $\frac{40}{7}$
- 4) 2
- 5) $\frac{17}{6}$

Exercise 8

A plastic firm receives an order to manufacture 2618 special plastic foam boards for swimming training. The firm has 14 machines but each of them will be able to participate in the manufacturing of this special type of tables only after an adaptation so that each adapted machine is capable of manufacturing 17 boards per hour; on the other hand, the non adapted ones cannot be used for this special order. The cost to adapt each machine is 462 monetary units. Moreover, these adapted machines are automated and only need staff to supervise the production whose salary is 867 monetary units per hour. Taking into account the number of hours that will be necessary to produce the ordered tables, the cost in salaries for those hours, and the adaptation costs, how many of the machines that the company has should be adapted to place the order at the lowest possible cost?

- 1) 22
- 2) 25
- 3) 6
- 4) None of the other options is correct.
- 5) 14

Exercise 9

Study the differentiability of the function $f(x) =$

$$\begin{cases} e^{x-1} + 2 \sin(1) \sin(x) + 2 \cos(1) \cos(x) + 3 & x \leq 1 \\ \frac{1}{2} (-3x^2 + 8x + 17) & 1 < x < 2 \\ 2 \sin(2-x) - \cos(2-x) + \frac{29}{2} & 2 \leq x \end{cases}$$

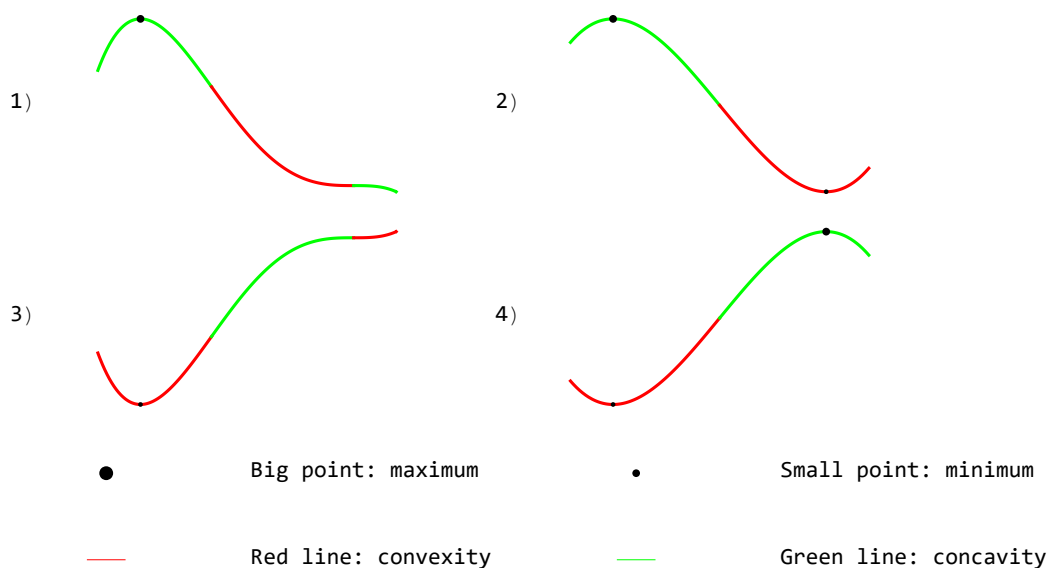
- 1) The function is differentiable for all points.
- 2) The function is not differentiable at any point.
- 3) The function is differentiable for all points except for $x=1$.
- 4) The function is differentiable for all points except for $x=2$.
- 5) The function is differentiable for all points except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

Mathematics 1 - ADE - English - 2026/2027

02-Derivatives for serial number: 66

Exercise 1

Study the shape properties of the $f(x) = 5 + 3x^2 + 2x^3$ to decide which amongst the following ones is the representation of the function.



Indication: To find the maximum and minimum points of the function, try (with Ruffini) the points $-2, -1, 0, 1, 2$. To solve this exercise it is necessary to determine the increasing and decreasing intervals.

Exercise 2

Determine the derivative of the function $f(t) = (t^3 - e^t) \cos(t) + \sin(t)$ and compute its value at the point $t=0$.

- 1) $f'(0) = 3$ 2) $f'(0) = -3$ 3) $f'(0) = 0$ 4) $f'(0) = 2$

Exercise 3

Compute the limit: $\lim_{x \rightarrow 1} \frac{1 - x + \log[x]}{1 - 2x + x^2}$

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

Exercise 4

Compute the limit: $\lim_{x \rightarrow 1} \frac{-2 + x + x^2}{-x + x^2}$

- 1) 1
- 2) 0
- 3) ∞
- 4) 3
- 5) -2
- 6) $-\infty$
- 7) -1

Exercise 5

Between the months $t=3$ and $t=7$

, the funds in certain account (in millions of euros) are given by the function $F(t) = -3 + 210t - 36t^2 + 2t^3$.

Determine the interval within the funds oscillates between months $t=3$ and $t=5$.

- 1) It oscillates between 347 and 388.
- 2) It oscillates between 357 and 394.
- 3) It oscillates between 357 and 397.
- 4) It oscillates between 389 and 397.
- 5) It oscillates between 358 and 389.

Exercise 6

In a fish farm, data of precedings years reveal that, if the initial number of fish is x (x

in thousands), after one month they reproduce until a number of $f(x) = \frac{32x}{8 + 28x}$ fishes.

What number of fish leads to the largest increase in the number of animals, $f(x) - x$?

- 1) $\frac{12}{5}$
- 2) $\frac{28}{5}$
- 3) $\frac{37}{16}$
- 4) $\frac{2}{7}$
- 5) $\frac{40}{9}$

Exercise 7

The yield of a tree plantation is given by $f(x) =$

$$\frac{-44 + 15x + 35x^2}{31x^2}, \text{ where } x \text{ is the distance in meters between two trees.}$$

What is the distance x that leads to the largest yield.

- 1) $\frac{23}{10}$
- 2) $\frac{28}{5}$
- 3) $\frac{9}{17}$
- 4) $\frac{88}{15}$
- 5) $\frac{40}{9}$

Exercise 8

A plastic firm receives an order to manufacture 189 special plastic foam boards for swimming training. The firm has 7 machines but each of them will be able to participate in the manufacturing of this special type of tables only after an adaptation so that each adapted machine is capable of manufacturing 63 boards per hour; on the other hand, the non adapted ones cannot be used for this special order. The cost to adapt each machine is 9 monetary units. Moreover, these adapted machines are automated and only need staff to supervise the production whose salary is 108 monetary units per hour. Taking into account the number of hours that will be necessary to produce the ordered tables, the cost in salaries for those hours, and the adaptation costs, how many of the machines that the company has should be adapted to place the order at the lowest possible cost?

- 1) 11
- 2) 15
- 3) 4
- 4) None of the other options is correct.
- 5) 20

Exercise 9

Study the differentiability of the function $f(x) =$

$$\begin{cases} 4 \sin^2\left(1 - \frac{x}{2}\right) & x \leq 2 \\ -2e^3(x-2) + 2e^{x-2} - 2(x-2)\sin(3) - 2\cos(2-x) & 2 < x < 5 \\ -3\cos(5-x) - 4e^3 + 3 - 6\sin(3) - 2\cos(3) & 5 \leq x \end{cases}$$

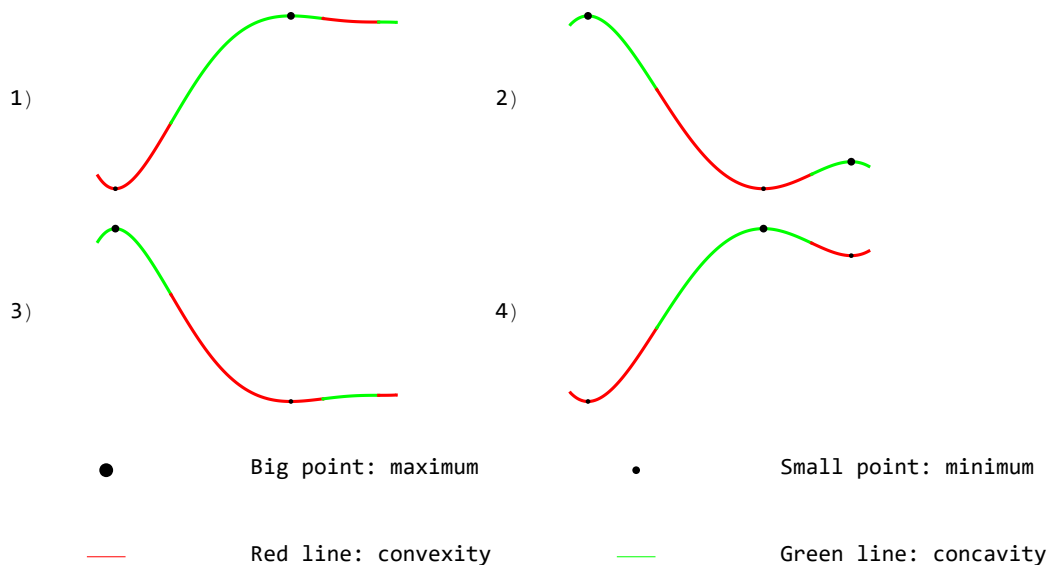
- 1) The function is differentiable for all points.
- 2) The function is not differentiable at any point.
- 3) The function is differentiable for all points except for $x=2$.
- 4) The function is differentiable for all points except for $x=5$.
- 5) The function is differentiable for all points except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

Mathematics 1 - ADE - English - 2026/2027

02-Derivatives for serial number: 67

Exercise 1

Study the shape properties of the $f(x) = 3 - 240x + 120x^2 + 60x^3 - 60x^4 + 12x^5$ to decide which amongst the following ones is the representation of the function.



Indication: To find the maximum and minimum points of the function, try (with Ruffini) the points $-2, -1, 0, 1, 2$. To solve this exercise it is necessary to determine the increasing and decreasing intervals.

Exercise 2

Determine the derivative of the function $f(t) = 2e^t \log^2(t+1) \sin(t)$ and compute its value at the point $t=0$.

- 1) $f'(0) = -2$ 2) $f'(0) = 1$ 3) $f'(0) = -4$ 4) $f'(0) = 0$

Exercise 3

Compute the limit: $\lim_{x \rightarrow 0} \frac{-1 + e^{x^2} - x^2 - \frac{x^4}{2}}{x^5}$

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

Exercise 4

Compute the limit: $\lim_{x \rightarrow 2} \frac{-8x + 12x^2 - 6x^3 + x^4}{-12 + 16x - 7x^2 + x^3}$

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

Exercise 5

Between the months $t=2$ and $t=8$

, the funds in certain account (in millions of euros) are given by the function $F(t) = 7 + 120t - 27t^2 + 2t^3$.

Determine the interval within the funds oscillates between months $t=3$ and $t=4$.

- 1) It oscillates between 182 and 183.
- 2) It oscillates between 155 and 263.
- 3) It oscillates between 186 and 175.
- 4) It oscillates between 178 and 183.
- 5) It oscillates between 185 and 188.

Exercise 6

In a fish farm, data of precedings years reveal that, if the initial number of fish is x (x in thousands), after one month they reproduce until a number of $f(x) = \frac{36x}{9+8x}$ fishes.

What number of fish leads to the largest increase in the number of animals, $f(x) - x$?

- 1) $\frac{9}{8}$
- 2) $\frac{21}{20}$
- 3) $\frac{14}{3}$
- 4) $\frac{15}{8}$
- 5) $\frac{24}{17}$

Exercise 7

The yield of a tree plantation is given by $f(x) =$

$$\frac{-14 + 38x + 21x^2}{30x^2}, \text{ where } x \text{ is the distance in meters between two trees.}$$

What is the distance x that leads to the largest yield.

- 1) 2
- 2) $\frac{19}{14}$
- 3) $\frac{14}{19}$
- 4) $\frac{7}{3}$
- 5) $\frac{29}{17}$

Exercise 8

A plastic firm receives an order to manufacture 10829 special plastic foam boards for swimming training. The firm has 19 machines but each of them will be able to participate in the manufacturing of this special type of tables only after an adaptation so that each adapted machine is capable of manufacturing 7 boards per hour; on the other hand, the non adapted ones cannot be used for this special order. The cost to adapt each machine is 20111 monetary units. Moreover, these adapted machines are automated and only need staff to supervise the production whose salary is 637 monetary units per hour. Taking into account the number of hours that will be necessary to produce the ordered tables, the cost in salaries for those hours, and the adaptation costs, how many of the machines that the company has should be adapted to place the order at the lowest possible cost?

- 1) 13
- 2) 7
- 3) 19
- 4) 6
- 5) None of the other options is correct.

Exercise 9

Study the differentiability of the function $f(x) = \begin{cases} -\sin(1-x) - 3 \cos(1-x) - 3 & x \leq 1 \\ \frac{1}{2} (x^2 - 13) & 1 < x < 2 \\ -2 (\sin(2-x) + \cos(2-x)) - \frac{5}{2} & 2 \leq x \end{cases}$

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

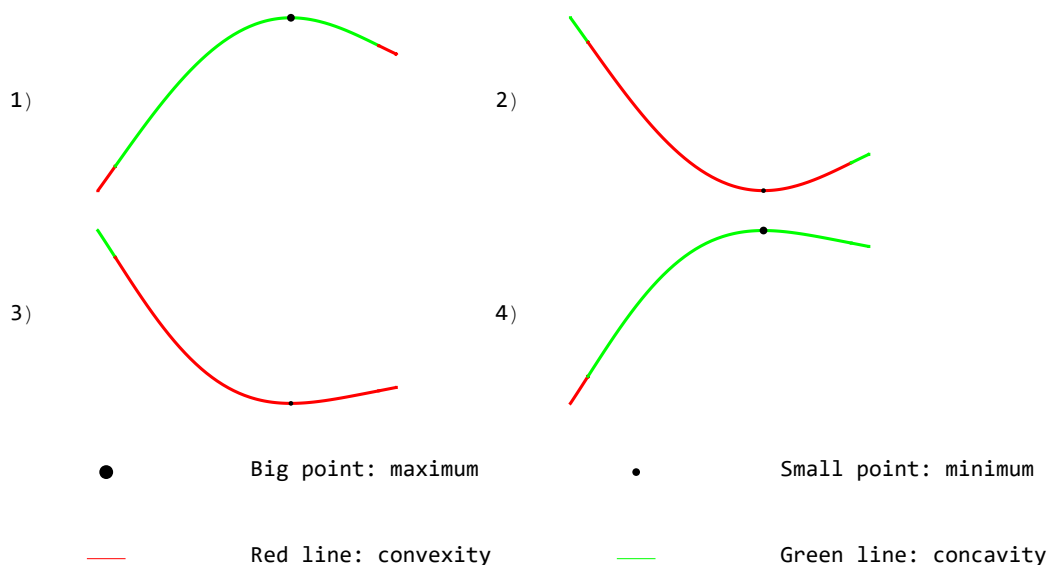
Mathematics 1 - ADE - English - 2026/2027

02-Derivatives for serial number: 68

Exercise 1

Study the shape properties of $f(x) = 3 + 12x^2 - 6x^3 + \frac{3x^5}{5}$

to decide which amongst the following ones is the representation of the function.



Indication: To solve this exercise it is necessary to determine the concavity and convexity interval. To find the inflexion points separating the concavity and convexity intervals, check (by means of Ruffini) with the points $-2, -1, 0, 1, 2$.

Exercise 2

Determine the derivative of the function $f(t) = t + 1 - 3 \log(3)$ and compute its value at the point $t=0$.

- 1) $f'(0) = 1$ 2) $f'(0) = 3$ 3) $f'(0) = 2$ 4) $f'(0) = 0$

Exercise 3

Compute the limit: $\lim_{x \rightarrow 0} \frac{-x^3 + \sin[x^3]}{x^6}$

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

Exercise 4

Compute the limit: $\lim_{x \rightarrow 3} \frac{18 - 3x - 4x^2 + x^3}{-3 - 2x + x^2}$

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

Exercise 5

Between the months $t=2$ and $t=8$

, the true value of the shares of a company (in euros) are given by the function $C(t) = 286 + 180t - 33t^2 + 2t^3$.

Determine the interval within the value oscillates between months $t=2$ and $t=8$.

- 1) It oscillates between 530 and 638.
- 2) It oscillates between 528 and 580.
- 3) It oscillates between 530 and 583.
- 4) It oscillates between 610 and 611.
- 5) It oscillates between 533 and 583.

Exercise 6

In a fish farm, data of precedings years reveal that, if the initial number of fish is x (x in thousands), after one month they reproduce until a number of $f(x) = \frac{50x}{18 + 32x}$ fishes.

What number of fish leads to the largest increase in the number of animals, $f(x) - x$?

- 1) $\frac{27}{11}$
- 2) $\frac{19}{5}$
- 3) 8
- 4) $\frac{34}{7}$
- 5) $\frac{3}{8}$

Exercise 7

The yield of a tree plantation is given by $f(x) =$

$$\frac{-49 + 50x + 29x^2}{20x^6}, \text{ where } x \text{ is the distance in meters between two trees.}$$

What is the distance x that leads to the largest yield.

- 1) $\frac{9}{11}$
- 2) $\frac{13}{19}$
- 3) $\frac{32}{13}$
- 4) $\frac{34}{7}$
- 5) $\frac{49}{58}$

Exercise 8

A plastic firm receives an order to manufacture 1614795 special plastic foam boards for swimming training. The firm has 10 machines but each of them will be able to participate in the manufacturing of this special type of tables only after an adaptation so that each adapted machine is capable of manufacturing 13 boards per hour; on the other hand, the non adapted ones cannot be used for this special order. The cost to adapt each machine is 2535 monetary units. Moreover, these adapted machines are automated and only need staff to supervise the production whose salary is 4 monetary units per hour. Taking into account the number of hours that will be necessary to produce the ordered tables, the cost in salaries for those hours, and the adaptation costs, how many of the machines that the company has should be adapted to place the order at the lowest possible cost?

- 1) 25
- 2) 14
- 3) 10
- 4) None of the other options is correct.
- 5) 21

Exercise 9

Study the differentiability of the function $f(x) = \begin{cases} -2 \sin(1-x) - 3 \cos(1-x) + 5 & x \leq 1 \\ \frac{5}{2} - \frac{1}{2}(x-6)x & 1 < x < 2 \\ e^{x-2} - 2 \cos(2-x) + \frac{23}{2} & 2 \leq x \end{cases}$

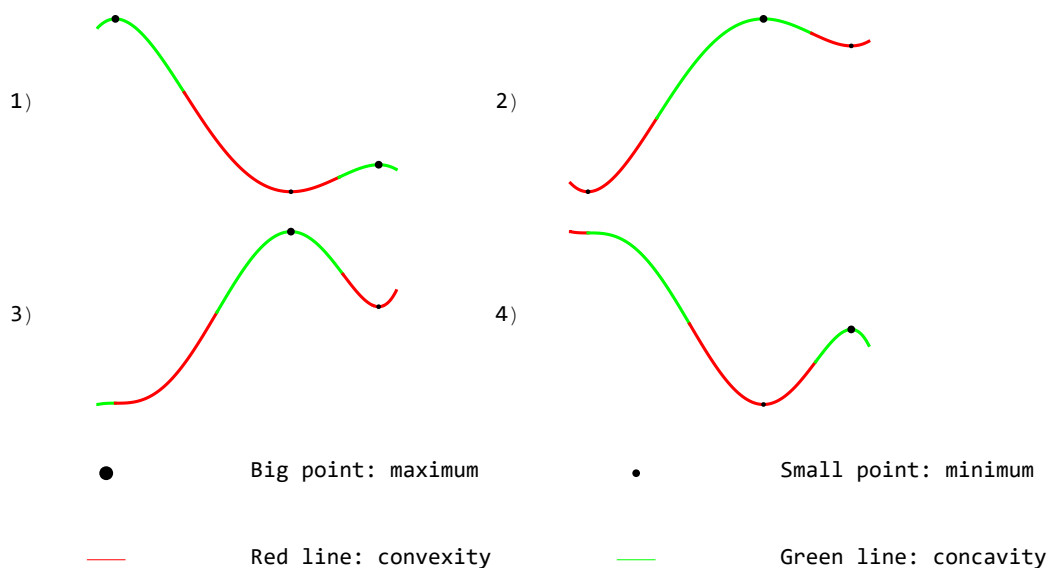
- 1) The function is differentiable for all points.
- 2) The function is not differentiable at any point.
- 3) The function is differentiable for all points except for $x=1$.
- 4) The function is differentiable for all points except for $x=2$.
- 5) The function is differentiable for all points except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

Mathematics 1 - ADE - English - 2026/2027

02-Derivatives for serial number: 69

Exercise 1

Study the shape properties of the $f(x) = 2 - 120x^2 + 45x^4 + 12x^5$ to decide which amongst the following ones is the representation of the function.



Indication: To find the maximum and minimum points of the function, try (with Ruffini) the points $-2, -1, 0, 1, 2$. To solve this exercise it is necessary to determine the increasing and decreasing intervals.

Exercise 2

Determine the derivative of the function $f(t) = \log(e^t + 1) - 2e^{2e^t}$ and compute its value at the point $t=0$.

- 1) $f'(0) = -3$ 2) $f'(0) = \frac{1}{2} - 4e^2$ 3) $f'(0) = 3$ 4) $f'(0) = 1$

Exercise 3

Compute the limit: $\lim_{x \rightarrow 1} \frac{\frac{11}{3} - 6x + 3x^2 - \frac{2x^3}{3} + \text{Log}[x^2]}{1 - 4x + 6x^2 - 4x^3 + x^4}$

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

Exercise 4

Compute the limit: $\lim_{x \rightarrow 2} \frac{4x - 4x^2 + x^3}{-4 + x^2}$

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

Exercise 5

Between the months $t=4$ and $t=9$

, the funds in certain account (in millions of euros) are given by the function $F(t) = 18 + 252t - 39t^2 + 2t^3$.

Determine the interval within the funds oscillates between months $t=6$ and $t=7$.

- 1) It oscillates between 560 and 550.
- 2) It oscillates between 559 and 553.
- 3) It oscillates between 530 and 585.
- 4) It oscillates between 557 and 558.
- 5) It oscillates between 556 and 566.

Exercise 6

In a fish farm, data of precedings years reveal that, if the initial number of fish is x (x in thousands), after one month they reproduce until a number of $f(x) = \frac{49x}{4 + 11x}$ fishes.

What number of fish leads to the largest increase in the number of animals, $f(x) - x$?

- 1) $\frac{19}{6}$
- 2) $\frac{10}{11}$
- 3) 26
- 4) 2
- 5) $\frac{11}{5}$

Exercise 7

The yield of a tree plantation is given by $f(x) =$

$$\frac{-45 + 23x + 26x^2}{5x^2}, \text{ where } x \text{ is the distance in meters between two trees.}$$

What is the distance x that leads to the largest yield.

- 1) $\frac{8}{5}$
- 2) $\frac{1}{2}$
- 3) 32
- 4) $\frac{26}{11}$
- 5) $\frac{90}{23}$

Exercise 8

A plastic firm receives an order to manufacture 5616 special plastic foam boards for swimming training. The firm has 9 machines but each of them will be able to participate in the manufacturing of this special type of tables only after an adaptation so that each adapted machine is capable of manufacturing 182 boards per hour; on the other hand, the non adapted ones cannot be used for this special order. The cost to adapt each machine is 21 monetary units. Moreover, these adapted machines are automated and only need staff to supervise the production whose salary is 98 monetary units per hour. Taking into account the number of hours that will be necessary to produce the ordered tables, the cost in salaries for those hours, and the adaptation costs, how many of the machines that the company has should be adapted to place the order at the lowest possible cost?

- 1) 17
- 2) 12
- 3) 9
- 4) None of the other options is correct.
- 5) 6

Exercise 9

Study the differentiability of the function $f(x) =$

$$\begin{cases} 2e^{x-2} - 3\sin(2) \sin(x) - 3\cos(2) \cos(x) + 2 & x \leq 2 \\ -2\sin(2-x) - \cos(2-x) + 6 & 2 < x < 3 \\ e^{x-3} + \cos(3-x) + 4 + 2\sin(1) - \cos(1) & 3 \leq x \end{cases}$$

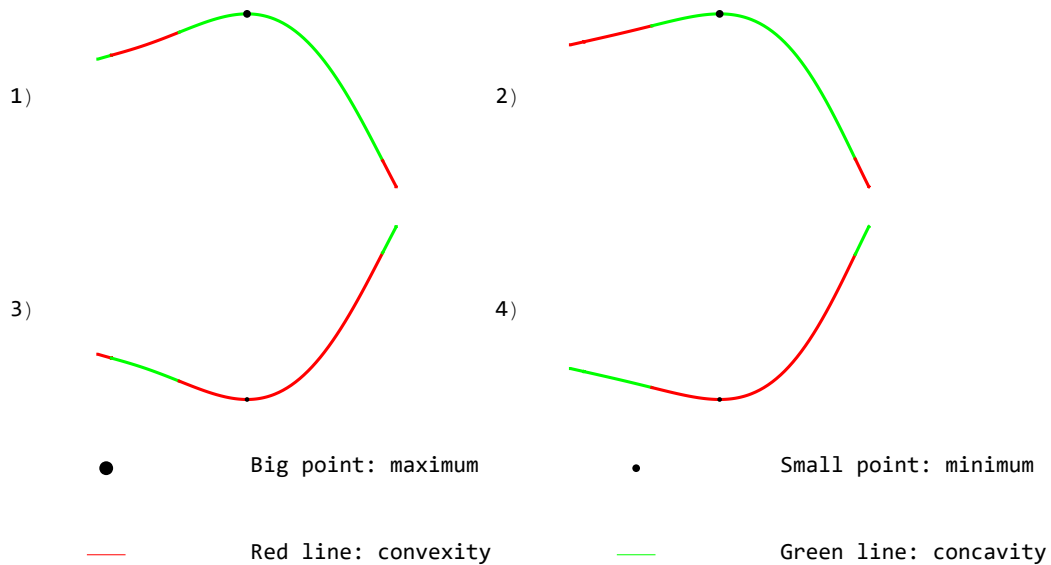
- 1) The function is differentiable for all points.
- 2) The function is not differentiable at any point.
- 3) The function is differentiable for all points except for $x=2$.
- 4) The function is differentiable for all points except for $x=3$.
- 5) The function is differentiable for all points except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

Mathematics 1 - ADE - English - 2026/2027

02-Derivatives for serial number: 70

Exercise 1

Study the shape properties of $f(x) = 5 - 240x^2 - 120x^3 - 10x^4 + 9x^5 + 2x^6$ to decide which amongst the following ones is the representation of the function.



Indication: To solve this exercise it is necessary to determine the concavity and convexity interval. To find the inflexion points separating the concavity and convexity intervals, check (by means of Ruffini) with the points $-2, -1, 0, 1, 2$.

Exercise 2

Determine the derivative of the function $f(t) = \log(t+1) (e^t - \cos(\sin(t)))$ and compute its value at the point $t=0$.

- 1) $f'(0) = -1$ 2) $f'(0) = 2$ 3) $f'(0) = 0$ 4) $f'(0) = 4$

Exercise 3

Compute the limit: $\lim_{x \rightarrow 0} \frac{-x + \sin[x]}{x^2}$

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

Exercise 4

Compute the limit: $\lim_{x \rightarrow -1} \frac{x + x^2}{-3 - 2x + x^2}$

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

Exercise 5

Between the months $t=0$ and $t=6$

, the true value of the shares of a company (in euros) are given by the function $C(t) = 18 - 3t^2 + 2t^3$.

Determine the interval within the value oscillates between months $t=1$ and $t=5$.

- 1) It oscillates between 17 and 342.
- 2) It oscillates between 17 and 193.
- 3) It oscillates between 24 and 189.
- 4) It oscillates between 24 and 187.
- 5) It oscillates between 17 and 18.

Exercise 6

In a fish farm, data of precedings years reveal that, if the initial number of fish is x (x in thousands), after one month they reproduce until a number of $f(x) = \frac{36x}{9+8x}$ fishes.

What number of fish leads to the largest increase in the number of animals, $f(x) - x$?

- 1) $\frac{9}{7}$
- 2) 1
- 3) $\frac{9}{8}$
- 4) $\frac{4}{5}$
- 5) $\frac{17}{3}$

Exercise 7

The yield of a tree plantation is given by $f(x) =$

$$\frac{-2 + 6x + 34x^2}{34x^7}, \text{ where } x \text{ is the distance in meters between two trees.}$$

What is the distance x that leads to the largest yield.

- 1) $\frac{35}{18}$
- 2) $\frac{7}{8}$
- 3) $\frac{37}{7}$
- 4) $\frac{1}{5}$
- 5) $\frac{12}{19}$

Exercise 8

A plastic firm receives an order to manufacture 14144 special plastic foam boards for swimming training. The firm has 13 machines but each of them will be able to participate in the manufacturing of this special type of tables only after an adaptation so that each adapted machine is capable of manufacturing 85 boards per hour; on the other hand, the non adapted ones cannot be used for this special order. The cost to adapt each machine is 442 monetary units. Moreover, these adapted machines are automated and only need staff to supervise the production whose salary is 170 monetary units per hour. Taking into account the number of hours that will be necessary to produce the ordered tables, the cost in salaries for those hours, and the adaptation costs, how many of the machines that the company has should be adapted to place the order at the lowest possible cost?

- 1) 21
- 2) 17
- 3) 11
- 4) 22
- 5) None of the other options is correct.

Exercise 9

Study the differentiability of the function $f(x) = \begin{cases} -2 & x \leq -2 \vee -2 < x < 0 \\ 2 \cos(x) & 0 \leq x \end{cases}$

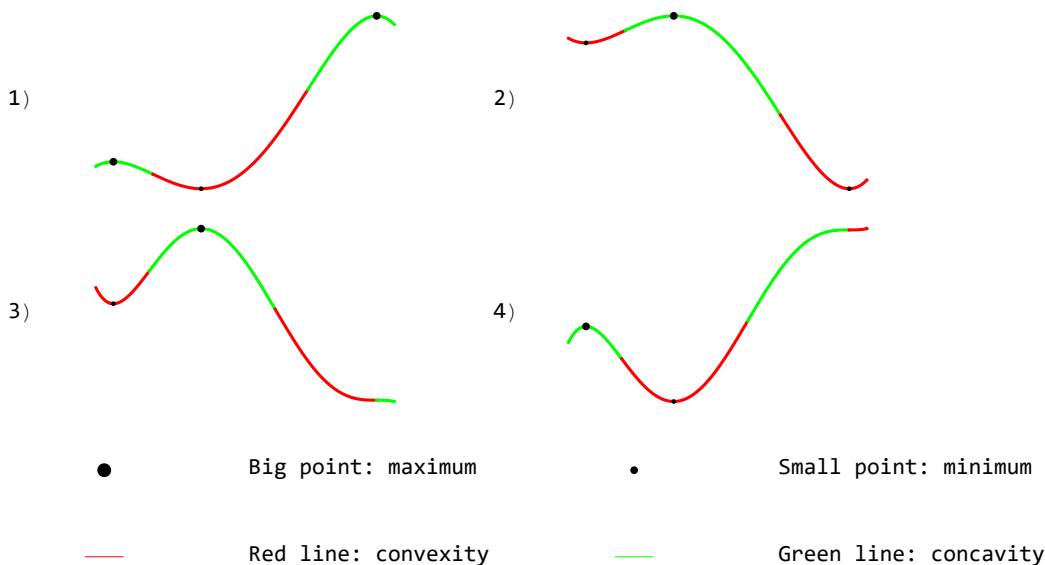
- 1) The function is differentiable for all points.
- 2) The function is not differentiable at any point.
- 3) The function is differentiable for all points except for $x = -2$.
- 4) The function is differentiable for all points except for $x = 0$.
- 5) The function is differentiable for all points except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

Mathematics 1 - ADE - English - 2026/2027

02-Derivatives for serial number: 71

Exercise 1

Study the shape properties of the $f(x) = 2 - 12x^2 - 4x^3 + 3x^4$ to decide which amongst the following ones is the representation of the function.



Indication: To find the maximum and minimum points of the function, try (with Ruffini) the points $-2, -1, 0, 1, 2$. To solve this exercise it is necessary to determine the increasing and decreasing intervals.

Exercise 2

Determine the derivative of the function $f(t) = 3(t + 2e^t) \log(t + 1)$ and compute its value at the point $t=0$.

- 1) $f'(0) = -3$ 2) $f'(0) = 4$ 3) $f'(0) = -1$ 4) $f'(0) = 6$

Exercise 3

Compute the limit: $\lim_{x \rightarrow 0} \frac{-1 + e^{x^2} - x^2}{x^3}$

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

Exercise 4

Compute the limit: $\lim_{x \rightarrow 2} \frac{-4 + 8x - 5x^2 + x^3}{12 - 8x - x^2 + x^3}$

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

Exercise 5

Between the months $t=2$ and $t=6$

, the funds in certain account (in millions of euros) are given by the function $F(t) = -7 + 108t - 27t^2 + 2t^3$.

Determine the interval within the funds oscillates between months $t=2$ and $t=6$.

- 1) It oscillates between 96 and 138.
- 2) It oscillates between 99 and 133.
- 3) It oscillates between 101 and 128.
- 4) It oscillates between 103 and 134.
- 5) It oscillates between 100 and 124.

Exercise 6

In a fish farm, data of precedings years reveal that, if the initial number of fish is x (x in thousands), after one month they reproduce until a number of $f(x) = \frac{48x}{3 + 40x}$ fishes.

What number of fish leads to the largest increase in the number of animals, $f(x) - x$?

- 1) $\frac{3}{2}$
- 2) $\frac{9}{40}$
- 3) $\frac{3}{4}$
- 4) $\frac{21}{13}$
- 5) $\frac{25}{17}$

Exercise 7

The yield of a tree plantation is given by $f(x) =$

$$\frac{-13 + 14x + 17x^2}{26x^2}, \text{ where } x \text{ is the distance in meters between two trees.}$$

What is the distance x that leads to the largest yield.

- 1) $\frac{13}{7}$
- 2) $\frac{1}{5}$
- 3) $\frac{12}{13}$
- 4) $\frac{13}{14}$
- 5) $\frac{33}{13}$

Exercise 8

A plastic firm receives an order to manufacture 9152

special plastic foam boards for swimming training. The firm has

15 machines but each of them will be able to participate

in the manufacturing of this special type of tables only after an

adaptation so that each adapted machine is capable of manufacturing

182 boards per hour; on the other hand, the non adapted ones cannot be

used for this special order. The cost to adapt each machine is

22 monetary units. Moreover, these adapted machines are automated and

only need staff to supervise the production whose salary is 28

monetary units per hour. Taking into account the number of hours that will be

necessary to produce the ordered tables, the cost in salaries for those

hours, and the adaptation costs, how many of the machines that the company

has should be adapted to place the order at the lowest possible cost?

- 1) 10
- 2) None of the other options is correct.
- 3) 10
- 4) 15
- 5) 4

Exercise 9

Study the differentiability of the function $f(x) =$

$$\begin{cases} 2 \sin(1-x) - \cos(1-x) + 5 & x \leq 1 \\ -x - e^{x-1} - 2 \cos(1-x) + 8 & 1 < x < 3 \\ -\sin(3-x) + 2 \cos(3-x) - e^2 + 3 - 2 \cos(2) & 3 \leq x \end{cases}$$

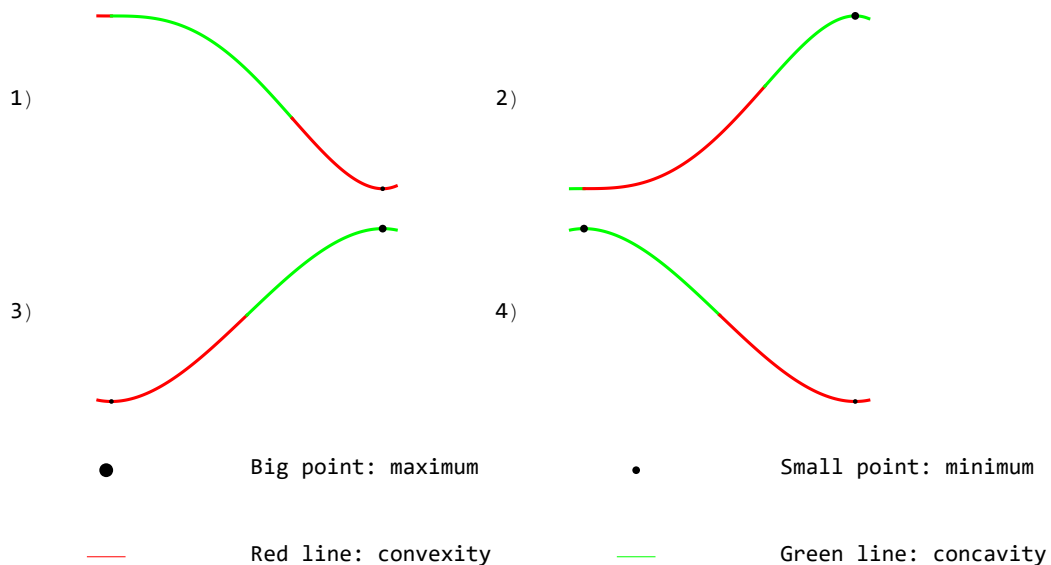
- 1) The function is differentiable for all points.
- 2) The function is not differentiable at any point.
- 3) The function is differentiable for all points except for $x=1$.
- 4) The function is differentiable for all points except for $x=3$.
- 5) The function is differentiable for all points except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

Mathematics 1 - ADE - English - 2026/2027

02-Derivatives for serial number: 72

Exercise 1

Study the shape properties of the $f(x) = 5 - 96x - 24x^2 + 8x^3 + 3x^4$ to decide which amongst the following ones is the representation of the function.



Indication: To find the maximum and minimum points of the function, try (with Ruffini) the points $-2, -1, 0, 1, 2$. To solve this exercise it is necessary to determine the increasing and decreasing intervals.

Exercise 2

Determine the derivative of the function $f(t) = 3e^{3t} \cos(e^t)$ and compute its value at the point $t=0$.

- 1) $f'(0) = -4$ 2) $f'(0) = 3$ 3) $f'(0) = -2$ 4) $f'(0) = 9 \cos[1] - 3 \sin[1]$

Exercise 3

Compute the limit: $\lim_{x \rightarrow 0} \frac{-1 + \frac{x^2}{2} + \cos[x]}{x^3}$

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

Exercise 4

Compute the limit: $\lim_{x \rightarrow -1} \frac{-2 - 3x + x^3}{2 + 5x + 4x^2 + x^3}$

- 1) ∞
- 2) -2
- 3) 0
- 4) $-\infty$
- 5) 1
- 6) -1
- 7) -3

Exercise 5

Between the months $t=1$ and $t=8$

, the funds in certain account (in millions of euros) are given by the function $F(t) = 7 + 144t - 33t^2 + 2t^3$.

Determine the interval within the funds oscillates between months $t=3$ and $t=4$.

- 1) It oscillates between 189 and 186.
- 2) It oscillates between 183 and 196.
- 3) It oscillates between 71 and 196.
- 4) It oscillates between 187 and 187.
- 5) It oscillates between 71 and 196.

Exercise 6

In a fish farm, data of precedings years reveal that, if the initial number of fish is x (x in thousands), after one month they reproduce until a number of $f(x) = \frac{49x}{25 + 41x}$ fishes.

What number of fish leads to the largest increase in the number of animals, $f(x) - x$?

- 1) $\frac{20}{13}$
- 2) $\frac{15}{2}$
- 3) $\frac{4}{5}$
- 4) $\frac{10}{41}$
- 5) $\frac{1}{5}$

Exercise 7

The yield of a tree plantation is given by $f(x) =$

$$\frac{-20 + 29x + 32x^2}{33x^2}, \text{ where } x \text{ is the distance in meters between two trees.}$$

What is the distance x that leads to the largest yield.

- 1) 2
- 2) $\frac{27}{16}$
- 3) $\frac{40}{29}$
- 4) $\frac{1}{5}$
- 5) $\frac{8}{9}$

Exercise 8

A plastic firm receives an order to manufacture 20196 special plastic foam boards for swimming training. The firm has 21 machines but each of them will be able to participate in the manufacturing of this special type of tables only after an adaptation so that each adapted machine is capable of manufacturing 242 boards per hour; on the other hand, the non adapted ones cannot be used for this special order. The cost to adapt each machine is 51 monetary units. Moreover, these adapted machines are automated and only need staff to supervise the production whose salary is 198 monetary units per hour. Taking into account the number of hours that will be necessary to produce the ordered tables, the cost in salaries for those hours, and the adaptation costs, how many of the machines that the company has should be adapted to place the order at the lowest possible cost?

- 1) 15
- 2) 8
- 3) None of the other options is correct.
- 4) 3
- 5) 28

Exercise 9

Study the differentiability of the function $f(x) = \begin{cases} -\sin(1-x) - \cos(1-x) + 2 & x \leq 1 \\ \frac{1}{4}(x+1)^2 & 1 < x < 3 \\ 7 - 2\sin(3-x) & 3 \leq x \end{cases}$

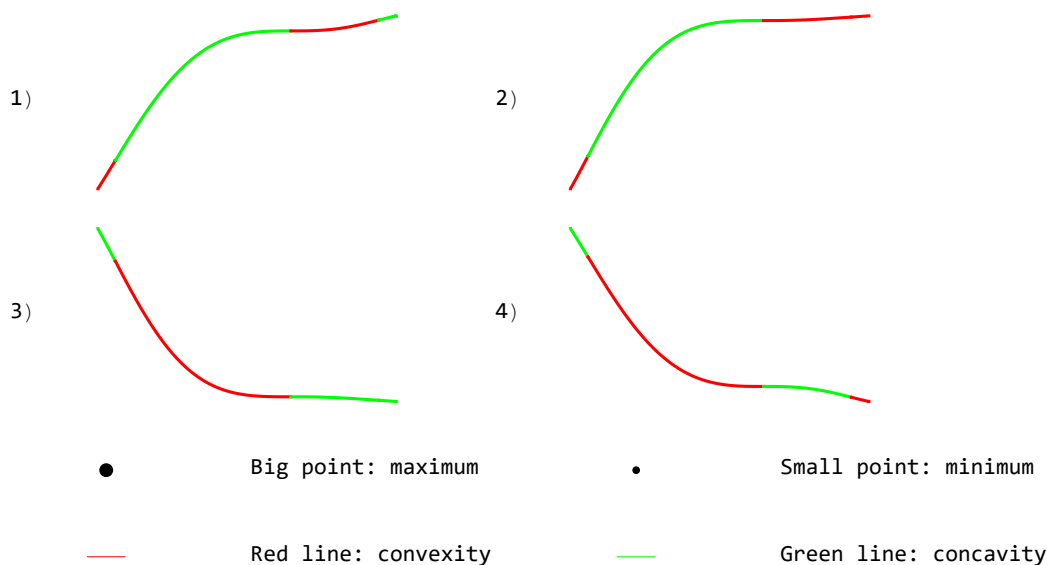
- 1) The function is differentiable for all points.
- 2) The function is not differentiable at any point.
- 3) The function is differentiable for all points except for $x=1$.
- 4) The function is differentiable for all points except for $x=3$.
- 5) The function is differentiable for all points except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

Mathematics 1 - ADE - English - 2026/2027

02-Derivatives for serial number: 73

Exercise 1

Study the shape properties of $f(x) = 5 + 20x^3 - 15x^4 + 2x^6$ to decide which amongst the following ones is the representation of the function.



Indication: To solve this exercise it is necessary to determine the concavity and convexity interval. To find the inflexion points separating the concavity and convexity intervals, check (by means of Ruffini) with the points $-2, -1, 0, 1, 2$.

Exercise 2

Determine the derivative of the function $f(t) = \cos(t) (e^{\cos(t)} + \sin(\cos(t)))$ and compute its value at the point $t=0$.

- 1) $f'(0) = 0$ 2) $f'(0) = -3$ 3) $f'(0) = 3$ 4) $f'(0) = -2$

Exercise 3

Compute the limit: $\lim_{x \rightarrow 1} \frac{1 - x + \log[x]}{1 - 2x + x^2}$

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

Exercise 4

Compute the limit: $\lim_{x \rightarrow 1} \frac{-x + 3x^2 - 3x^3 + x^4}{3 - 5x + x^2 + x^3}$

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

Exercise 5

Between the months $t=1$ and $t=5$

, the true value of the shares of a company (in euros) are given by the function $C(t) = 76 + 48t - 18t^2 + 2t^3$.

Determine the interval within the value oscillates between months $t=1$ and $t=5$.

- 1) It oscillates between 114 and 125.
- 2) It oscillates between 99 and 123.
- 3) It oscillates between 106 and 114.
- 4) It oscillates between 108 and 116.
- 5) It oscillates between 116 and 120.

Exercise 6

In a fish farm, data of precedings years reveal that, if the initial number of fish is x (x in thousands), after one month they reproduce until a number of $f(x) = \frac{32x}{18 + 13x}$ fishes.

What number of fish leads to the largest increase in the number of animals, $f(x) - x$?

- 1) $\frac{33}{5}$
- 2) 9
- 3) $\frac{6}{13}$
- 4) $\frac{23}{4}$
- 5) $\frac{7}{20}$

Exercise 7

The yield of a tree plantation is given by $f(x) =$

$$\frac{-41 + 37x + 13x^2}{23x^7}, \text{ where } x \text{ is the distance in meters between two trees.}$$

What is the distance x that leads to the largest yield.

- 1) $\frac{18}{13}$
- 2) $\frac{16}{3}$
- 3) 2
- 4) 4
- 5) 1

Exercise 8

A plastic firm receives an order to manufacture 3179 special plastic foam boards for swimming training. The firm has 12 machines but each of them will be able to participate in the manufacturing of this special type of tables only after an adaptation so that each adapted machine is capable of manufacturing 578 boards per hour; on the other hand, the non adapted ones cannot be used for this special order. The cost to adapt each machine is 51 monetary units. Moreover, these adapted machines are automated and only need staff to supervise the production whose salary is 1122 monetary units per hour. Taking into account the number of hours that will be necessary to produce the ordered tables, the cost in salaries for those hours, and the adaptation costs, how many of the machines that the company has should be adapted to place the order at the lowest possible cost?

- 1) 11
- 2) 4
- 3) None of the other options is correct.
- 4) 18
- 5) 12

Exercise 9

Study the differentiability of the function $f(x) = \begin{cases} 2 \sin(3 - x) - 5 & x \leq 3 \\ -4x + 2(x - 2) \log\left(\frac{x-2}{2}\right) + 7 + \log(4) & 3 < x < 4 \\ x - 3(x - 3) \log(x - 3) - 13 + \log(4) & 4 \leq x \end{cases}$

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

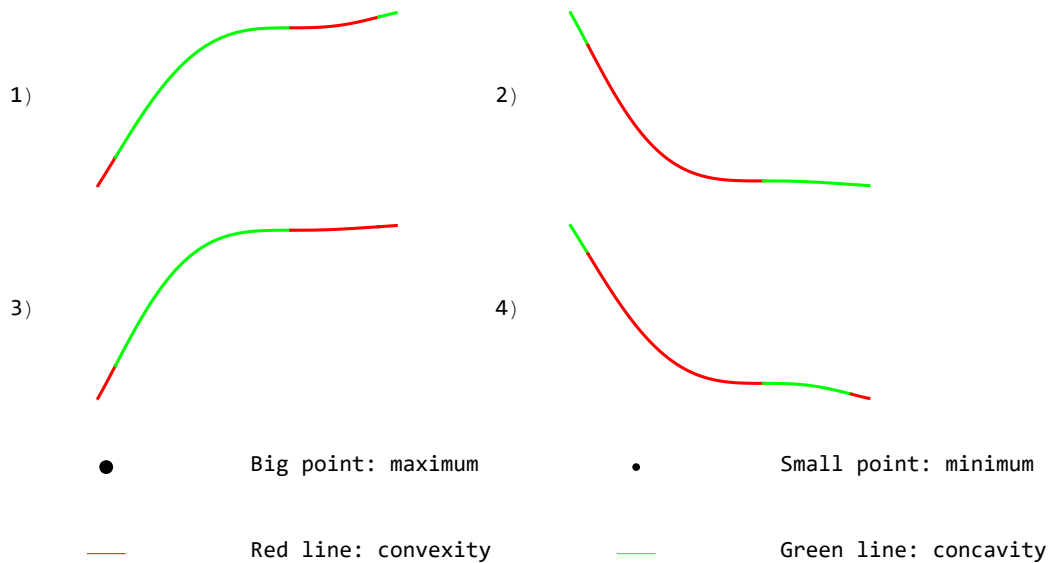
Mathematics 1 - ADE - English - 2026/2027

02-Derivatives for serial number: 74

Exercise 1

Study the shape properties of $f(x) = 5 - 4x^3 + x^4 + \frac{3x^5}{5}$

to decide which amongst the following ones is the representation of the function.



Indication: To solve this exercise it is necessary to determine the concavity and convexity interval. To find the inflexion points separating the concavity and convexity intervals, check (by means of Ruffini) with the points $-2, -1, 0, 1, 2$.

Exercise 2

Determine the derivative of the function $f(t) = -3t \sin^2(t)$ and compute its value at the point $t=0$.

- 1) $f'(0) = 1$ 2) $f'(0) = 0$ 3) $f'(0) = 3$ 4) $f'(0) = -3$

Exercise 3

Compute the limit: $\lim_{x \rightarrow 0} \frac{-1 + e^{x^3} - x^3}{x^6}$

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

Exercise 4

Compute the limit: $\lim_{x \rightarrow 1} \frac{-3 + 7x - 5x^2 + x^3}{-1 + x^2}$

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

Exercise 5

Between the months $t=1$ and $t=6$

, the true value of the shares of a company (in euros) are given by the function $C(t) = 27 + 60t - 21t^2 + 2t^3$.

Determine the interval within the value oscillates between months $t=1$ and $t=2$.

- 1) It oscillates between 52 and 79.
- 2) It oscillates between 52 and 79.
- 3) It oscillates between 65 and 85.
- 4) It oscillates between 77 and 81.
- 5) It oscillates between 68 and 79.

Exercise 6

In a fish farm, data of precedings years reveal that, if the initial number of fish is x (x in thousands), after one month they reproduce until a number of $f(x) = \frac{50x}{32 + 15x}$ fishes.

What number of fish leads to the largest increase in the number of animals, $f(x) - x$?

- 1) $\frac{8}{15}$
- 2) $\frac{13}{8}$
- 3) $\frac{13}{9}$
- 4) $\frac{21}{16}$
- 5) $\frac{19}{11}$

Exercise 7

The yield of a tree plantation is given by $f(x) =$

$$\frac{-40 + 10x + 40x^2}{8x^9}, \text{ where } x \text{ is the distance in meters between two trees.}$$

What is the distance x that leads to the largest yield.

- 1) $\frac{39}{16}$
- 2) 1
- 3) $\frac{25}{3}$
- 4) 7
- 5) 2

Exercise 8

A plastic firm receives and order to manufacture 11475 special plastic foam boards for swimming training. The firm have 14 machines but each of them will be able to participate in the manufacturing of this special type of tables only after an adaptation so that each adapted machine is capable of manufacturing 10 boards per hour; on the other hand, the non adapted ones cannot be used for this special order. The cost to adapt each machine is 255 monetary units. Moreover, these adapted machines are automated and only need staff to supervise the production whose salary is 50 monetary units per hour. Taking into account the number of hours that will be necessary to produce the ordered tables, the cost in salaries for those hours, and the adaptation costs, how many of the machines that the company has should be adapted to place the order at the lowest possible cost?

- 1) 14
- 2) 15
- 3) None of the other options is correct.
- 4) 4
- 5) 28

Exercise 9

Study the differentiability of the function $f(x) = \begin{cases} -4 \sin^2\left(\frac{x+3}{2}\right) & x \leq -3 \\ 0 & -3 < x < -2 \\ (x+3) \log(x+3) + 1 & -2 \leq x \end{cases}$

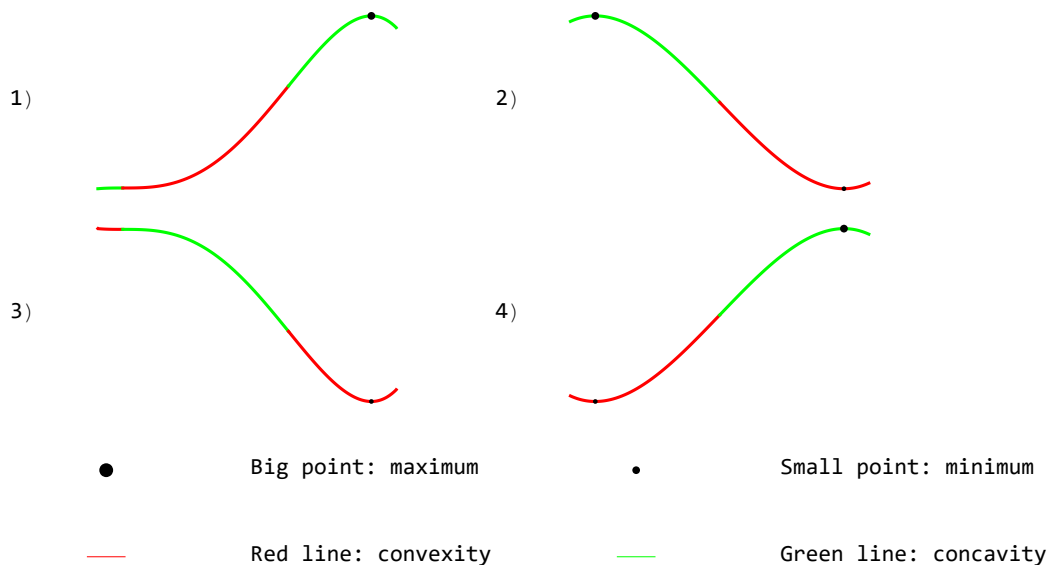
- 1) The function is differentiable for all points.
- 2) The function is not differentiable at any point.
- 3) The function is differentiable for all points except for $x = -3$.
- 4) The function is differentiable for all points except for $x = -2$.
- 5) The function is differentiable for all points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

Mathematics 1 - ADE - English - 2026/2027

02-Derivatives for serial number: 75

Exercise 1

Study the shape properties of the $f(x) = 4 - 8x^3 + 3x^4$ to decide which amongst the following ones is the representation of the function.



Indication: To find the maximum and minimum points of the function, try (with Ruffini) the points $-2, -1, 0, 1, 2$. To solve this exercise it is necessary to determine the increasing and decreasing intervals.

Exercise 2

Determine the derivative of the function $f(t) = -\log(t+1) \sin(t)$ and compute its value at the point $t=0$.

- 1) $f'(0) = 0$ 2) $f'(0) = -1$ 3) $f'(0) = 4$ 4) $f'(0) = -4$

Exercise 3

Compute the limit: $\lim_{x \rightarrow 0} \frac{-1 + e^x - x - \frac{x^2}{2}}{x^3}$

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

Exercise 4

Compute the limit: $\lim_{x \rightarrow 1} \frac{-3 + 7x - 5x^2 + x^3}{-1 + x^2}$

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

Exercise 5

Between the months $t=2$ and $t=7$

, the funds in certain account (in millions of euros) are given by the function $F(t) = 18 + 210t - 36t^2 + 2t^3$.

Determine the interval within the funds oscillates between months $t=3$ and $t=5$.

- 1) It oscillates between 410 and 418.
- 2) It oscillates between 377 and 420.
- 3) It oscillates between 378 and 418.
- 4) It oscillates between 310 and 418.
- 5) It oscillates between 378 and 427.

Exercise 6

In a fish farm, data of precedings years reveal that, if the initial number of fish is x (x in thousands), after one month they reproduce until a number of $f(x) = \frac{50x}{32 + 15x}$ fishes.

What number of fish leads to the largest increase in the number of animals, $f(x) - x$?

- 1) $\frac{29}{19}$
- 2) $\frac{7}{5}$
- 3) $\frac{3}{5}$
- 4) $\frac{8}{15}$
- 5) $\frac{8}{5}$

Exercise 7

The yield of a tree plantation is given by $f(x) =$

$$\frac{-14 + 16x + 50x^2}{28x^2}, \text{ where } x \text{ is the distance in meters between two trees.}$$

What is the distance x that leads to the largest yield.

- 1) $\frac{13}{12}$
- 2) $\frac{7}{4}$
- 3) $\frac{23}{9}$
- 4) $\frac{31}{19}$
- 5) $\frac{13}{3}$

Exercise 8

A plastic firm receives an order to manufacture 14365 special plastic foam boards for swimming training. The firm has 11 machines but each of them will be able to participate in the manufacturing of this special type of tables only after an adaptation so that each adapted machine is capable of manufacturing 3 boards per hour; on the other hand, the non adapted ones cannot be used for this special order. The cost to adapt each machine is 1275 monetary units. Moreover, these adapted machines are automated and only need staff to supervise the production whose salary is 45 monetary units per hour. Taking into account the number of hours that will be necessary to produce the ordered tables, the cost in salaries for those hours, and the adaptation costs, how many of the machines that the company has should be adapted to place the order at the lowest possible cost?

- 1) 22
- 2) 13
- 3) 5
- 4) 2
- 5) None of the other options is correct.

Exercise 9

Study the differentiability of the function $f(x) = \begin{cases} 2e^{x+2} + 3\cos(x+2) + 4 & x \leq -2 \\ 11 - \frac{x^2}{2} & -2 < x < -1 \\ e^{x+1} + \cos(x+1) + \frac{27}{2} & -1 \leq x \end{cases}$

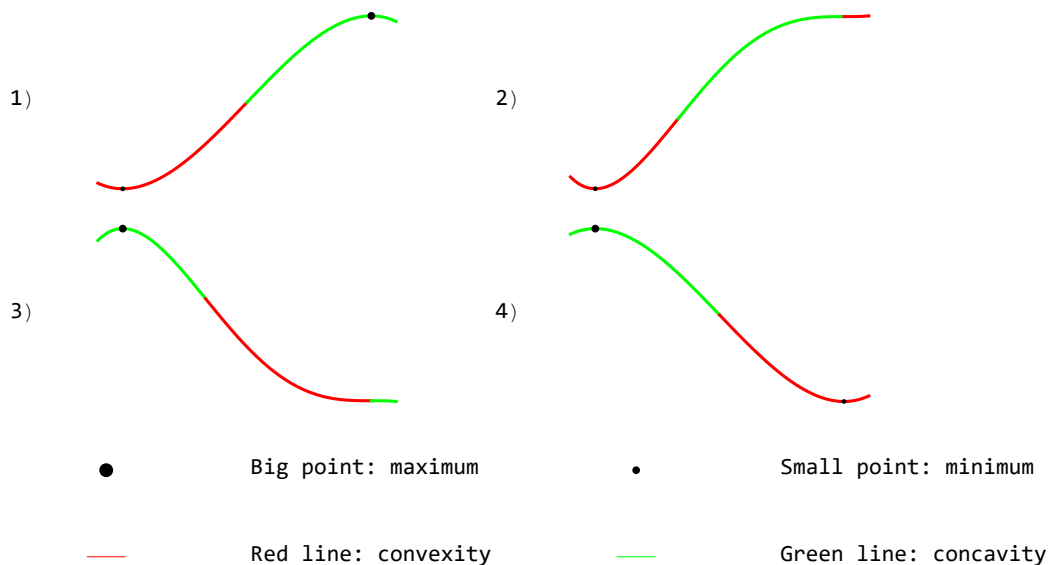
- 1) The function is differentiable for all points.
- 2) The function is not differentiable at any point.
- 3) The function is differentiable for all points except for $x = -2$.
- 4) The function is differentiable for all points except for $x = -1$.
- 5) The function is differentiable for all points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

Mathematics 1 - ADE - English - 2026/2027

02-Derivatives for serial number: 76

Exercise 1

Study the shape properties of the $f(x) = 3 + 8x^3 + 3x^4$ to decide which amongst the following ones is the representation of the function.



Indication: To find the maximum and minimum points of the function, try (with Ruffini) the points $-2, -1, 0, 1, 2$. To solve this exercise it is necessary to determine the increasing and decreasing intervals.

Exercise 2

Determine the derivative of the function $f(t) = (\cos(\cos(t)) + 2) \log(\cos(t) + 1)$ and compute its value at the point $t=0$.

- 1) $f'(0) = 0$ 2) $f'(0) = 2$ 3) $f'(0) = 1$ 4) $f'(0) = -1$

Exercise 3

Compute the limit: $\lim_{x \rightarrow 1} \frac{1 - x + \text{Log}[x]}{1 - 2x + x^2}$

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

Exercise 4

Compute the limit: $\lim_{x \rightarrow -1} \frac{x + 3x^2 + 3x^3 + x^4}{3 + 7x + 5x^2 + x^3}$

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

Exercise 5

Between the months $t=0$ and $t=6$

, the funds in certain account (in millions of euros) are given by the function $F(t) = 17 + 90t - 24t^2 + 2t^3$.

Determine the interval within the funds oscillates between months $t=1$ and $t=4$.

- 1) It oscillates between 83 and 121.
- 2) It oscillates between 78 and 126.
- 3) It oscillates between 85 and 125.
- 4) It oscillates between 117 and 125.
- 5) It oscillates between 17 and 125.

Exercise 6

In a fish farm, data of precedings years reveal that, if the initial number of fish is x (x in thousands), after one month they reproduce until a number of $f(x) = \frac{36x}{25 + 19x}$ fishes.

What number of fish leads to the largest increase in the number of animals, $f(x) - x$?

- 1) $\frac{19}{3}$
- 2) $\frac{1}{15}$
- 3) $\frac{5}{19}$
- 4) $\frac{11}{4}$
- 5) $\frac{12}{5}$

Exercise 7

The yield of a tree plantation is given by $f(x) =$

$$\frac{-21 + 30x + 37x^2}{43x^2}, \text{ where } x \text{ is the distance in meters between two trees.}$$

What is the distance x that leads to the largest yield.

- 1) $\frac{19}{17}$
- 2) $\frac{2}{11}$
- 3) $\frac{7}{5}$
- 4) $\frac{5}{6}$
- 5) 16

Exercise 8

A plastic firm receives and order to manufacture 2880 special plastic foam boards for swimming training. The firm have 21 machines but each of them will be able to participate in the manufacturing of this special type of tables only after an adaptation so that each adapted machine is capable of manufacturing 3 boards per hour; on the other hand, the non adapted ones cannot be used for this special order. The cost to adapt each machine is 260 monetary units. Moreover, these adapted machines are automated and only need staff to supervise the production whose salary is 39 monetary units per hour. Taking into account the number of hours that will be necessary to produce the ordered tables, the cost in salaries for those hours, and the adaptation costs, how many of the machines that the company has should be adapted to place the order at the lowest possible cost?

- 1) 20
- 2) None of the other options is correct.
- 3) 4
- 4) 21
- 5) 12

Exercise 9

Study the differentiability of the function $f(x) =$

$$\begin{cases} 4 - \sin(3 - x) & x \leq 3 \\ \sin(3 - x) + \cos(3 - x) + x(2 + \sin(2) + \cos(2)) + 3 - 3(2 + \sin(2) + \cos(2)) & 3 < x < 5 \\ -2\sin(5 - x) + 9 + \sin(2) + 3\cos(2) & 5 \leq x \end{cases}$$

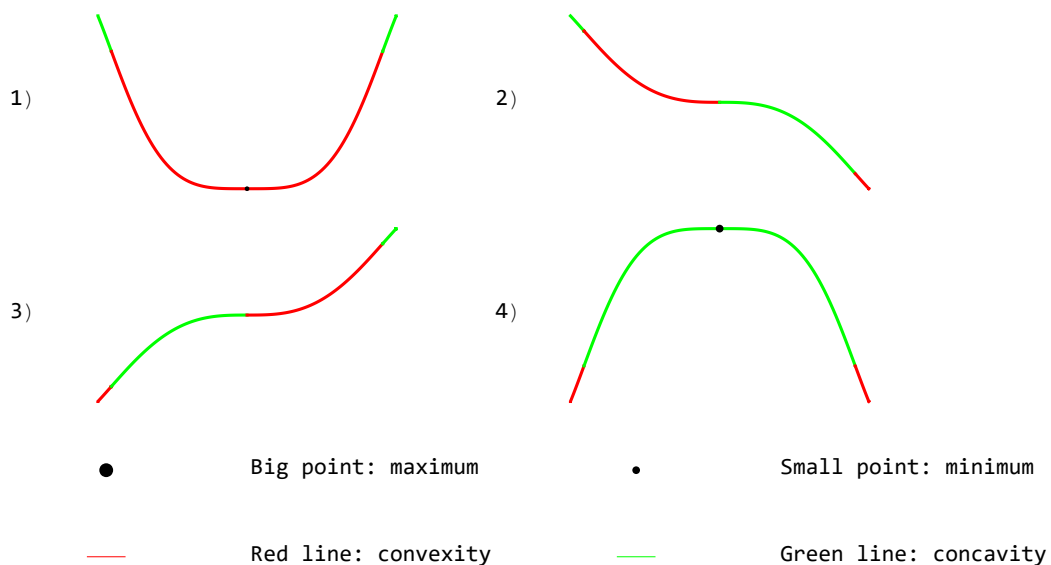
- 1) The function is differentiable for all points.
- 2) The function is not differentiable at any point.
- 3) The function is differentiable for all points except for $x=3$.
- 4) The function is differentiable for all points except for $x=5$.
- 5) The function is differentiable for all points except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

Mathematics 1 - ADE - English - 2026/2027

02-Derivatives for serial number: 77

Exercise 1

Study the shape properties of $f(x) = 3 - 20x^4 + 2x^6$ to decide which amongst the following ones is the representation of the function.



Indication: To solve this exercise it is necessary to determine the concavity and convexity interval. To find the inflexion points separating the concavity and convexity intervals, check (by means of Ruffini) with the points $-2, -1, 0, 1, 2$.

Exercise 2

Determine the derivative of the function $f(t) = \sin(t) - e^{e^t} \log(t+1)$ and compute its value at the point $t=0$.

- 1) $f'(0) = 2$ 2) $f'(0) = 1 - e$ 3) $f'(0) = -3$ 4) $f'(0) = -1$

Exercise 3

Compute the limit: $\lim_{x \rightarrow 0} \frac{-1 + e^x - x - \frac{x^2}{2}}{x^3}$

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

Exercise 4

Compute the limit: $\lim_{x \rightarrow -2} \frac{-4 + 3x^2 + x^3}{-4 + x^2}$

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

Exercise 5

Between the months $t=2$ and $t=8$

, the true value of the shares of a company (in euros) are given by the function $C(t) = 146 + 120t - 27t^2 + 2t^3$.

Determine the interval within the value oscillates between months $t=2$ and $t=5$.

- 1) It oscillates between 301 and 314.
- 2) It oscillates between 321 and 322.
- 3) It oscillates between 294 and 402.
- 4) It oscillates between 288 and 328.
- 5) It oscillates between 294 and 322.

Exercise 6

In a fish farm, data of precedings years reveal that, if the initial number of fish is x (x in thousands), after one month they reproduce until a number of $f(x) = \frac{36x}{25 + 24x}$ fishes.

What number of fish leads to the largest increase in the number of animals, $f(x) - x$?

- 1) $\frac{31}{9}$
- 2) $\frac{39}{17}$
- 3) $\frac{5}{24}$
- 4) $\frac{23}{13}$
- 5) $\frac{17}{19}$

Exercise 7

The yield of a tree plantation is given by $f(x) =$

$$\frac{-13 + 16x + 23x^2}{22x^7}, \text{ where } x \text{ is the distance in meters between two trees.}$$

What is the distance x that leads to the largest yield.

- 1) $\frac{13}{23}$
- 2) $\frac{17}{19}$
- 3) $\frac{23}{13}$
- 4) 2
- 5) $\frac{31}{9}$

Exercise 8

A plastic firm receives an order to manufacture 133705 special plastic foam boards for swimming training. The firm has 8 machines but each of them will be able to participate in the manufacturing of this special type of tables only after an adaptation so that each adapted machine is capable of manufacturing 935 boards per hour; on the other hand, the non adapted ones cannot be used for this special order. The cost to adapt each machine is 221 monetary units. Moreover, these adapted machines are automated and only need staff to supervise the production whose salary is 187 monetary units per hour. Taking into account the number of hours that will be necessary to produce the ordered tables, the cost in salaries for those hours, and the adaptation costs, how many of the machines that the company has should be adapted to place the order at the lowest possible cost?

- 1) 11
- 2) 8
- 3) 9
- 4) 11
- 5) None of the other options is correct.

Exercise 9

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

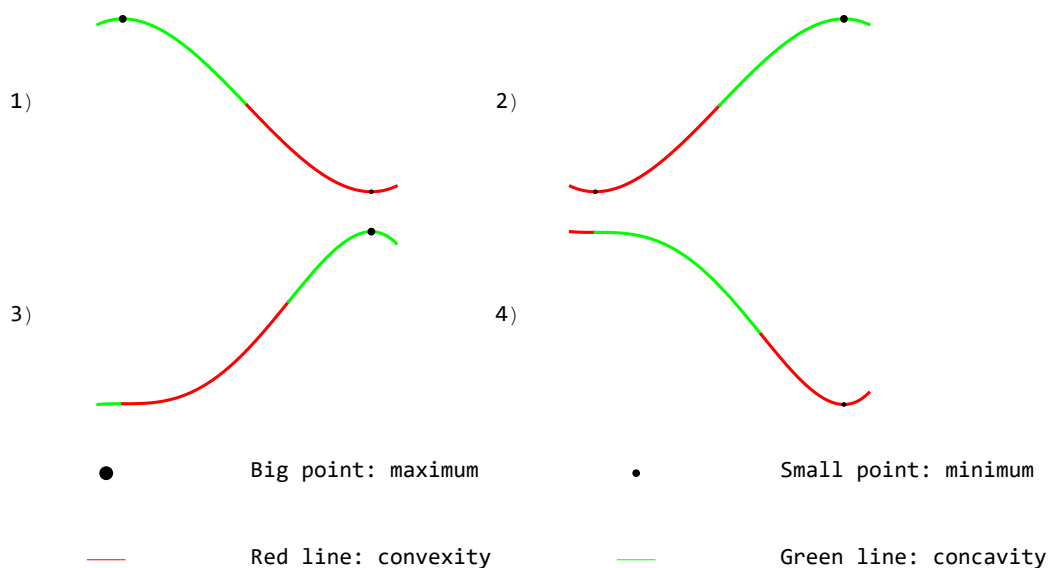
- 1) The function is differentiable for all points.
- 2) The function is not differentiable at any point.
- 3) The function is differentiable for all points except for $x=0$.
- 4) The function is differentiable for all points except for $x=3$.
- 5) The function is differentiable for all points except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

Mathematics 1 - ADE - English - 2026/2027

02-Derivatives for serial number: 78

Exercise 1

Study the shape properties of the $f(x) = 1 - 6x + 2x^3$ to decide which amongst the following ones is the representation of the function.



Indication: To find the maximum and minimum points of the function, try (with Ruffini) the points $-2, -1, 0, 1, 2$. To solve this exercise it is necessary to determine the increasing and decreasing intervals.

Exercise 2

Determine the derivative of the function $f(t) = -\sin(t)$ and compute its value at the point $t=0$.

- 1) $f'(0) = 3$ 2) $f'(0) = -3$ 3) $f'(0) = -1$ 4) $f'(0) = -2$

Exercise 3

Compute the limit: $\lim_{x \rightarrow 0} \frac{-1 + \frac{x^2}{2} + \cos[x]}{x^3}$

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

Exercise 4

Compute the limit: $\lim_{x \rightarrow -1} \frac{3 + 4x + x^2}{-2 - x + x^2}$

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

Exercise 5

Between the months $t=4$ and $t=8$

, the funds in certain account (in millions of euros) are given by the function $F(t) = 336t - 45t^2 + 2t^3$.

Determine the interval within the funds oscillates between months $t=6$ and $t=8$.

- 1) It oscillates between 828 and 833.
- 2) It oscillates between 828 and 839.
- 3) It oscillates between 821 and 837.
- 4) It oscillates between 752 and 833.
- 5) It oscillates between 832 and 833.

Exercise 6

In a fish farm, data of precedings years reveal that, if the initial number of fish is x (x in thousands), after one month they reproduce until a number of $f(x) = \frac{32x}{2+5x}$ fishes.

What number of fish leads to the largest increase in the number of animals, $f(x) - x$?

- 1) $\frac{21}{19}$
- 2) $\frac{29}{5}$
- 3) $\frac{6}{5}$
- 4) $\frac{7}{17}$
- 5) $\frac{32}{19}$

Exercise 7

The yield of a tree plantation is given by $f(x) =$

$$\frac{-19 + 40x + 2x^2}{39x^2}, \text{ where } x \text{ is the distance in meters between two trees.}$$

What is the distance x that leads to the largest yield.

- 1) $\frac{19}{20}$
- 2) 14
- 3) $\frac{14}{13}$
- 4) 12
- 5) 1

Exercise 8

A plastic firm receives an order to manufacture 1452 special plastic foam boards for swimming training. The firm has 8 machines but each of them will be able to participate in the manufacturing of this special type of tables only after an adaptation so that each adapted machine is capable of manufacturing 6 boards per hour; on the other hand, the non adapted ones cannot be used for this special order. The cost to adapt each machine is 374 monetary units. Moreover, these adapted machines are automated and only need staff to supervise the production whose salary is 187 monetary units per hour. Taking into account the number of hours that will be necessary to produce the ordered tables, the cost in salaries for those hours, and the adaptation costs, how many of the machines that the company has should be adapted to place the order at the lowest possible cost?

- 1) 11
- 2) 7
- 3) None of the other options is correct.
- 4) 14
- 5) 17

Exercise 9

Study the differentiability of the function $f(x) = \begin{cases} 2e^{x+2} - \cos(x+2) - 5 & x \leq -2 \\ -\frac{1}{2}x(3x+4) - 2 & -2 < x < 0 \\ -2\sin(x) - \cos(x) - 1 & 0 \leq x \end{cases}$

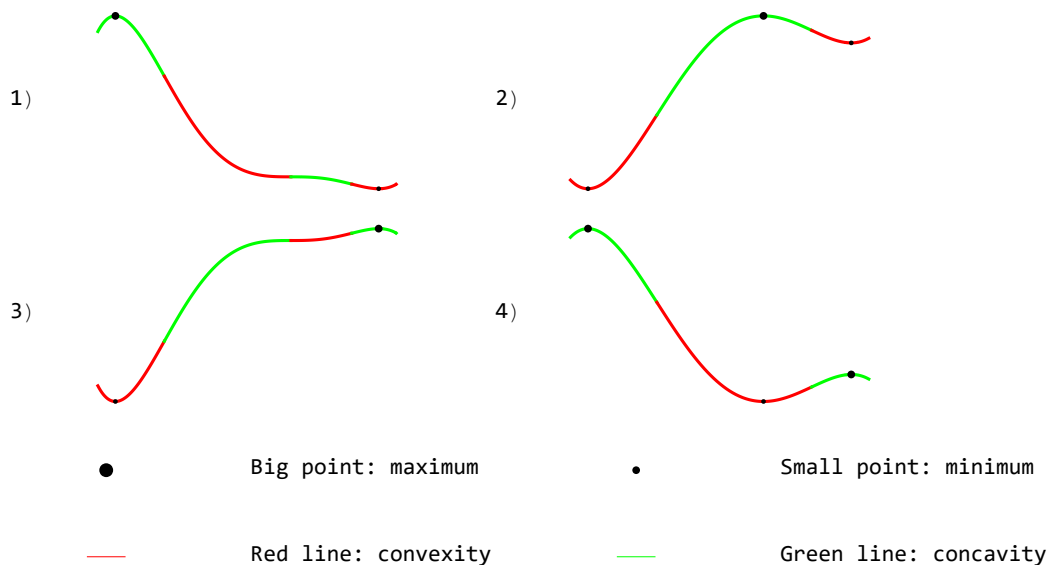
- 1) The function is differentiable for all points.
- 2) The function is not differentiable at any point.
- 3) The function is differentiable for all points except for $x = -2$.
- 4) The function is differentiable for all points except for $x = 0$.
- 5) The function is differentiable for all points except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

Mathematics 1 - ADE - English - 2026/2027

02-Derivatives for serial number: 79

Exercise 1

Study the shape properties of the $f(x) = 2 - 40x^3 + 15x^4 + 12x^5$ to decide which amongst the following ones is the representation of the function.



Indication: To find the maximum and minimum points of the function, try (with Ruffini) the points $-2, -1, 0, 1, 2$. To solve this exercise it is necessary to determine the increasing and decreasing intervals.

Exercise 2

Determine the derivative of the function $f(t) = e^t - 2 \sin(t) \cos(t) + 1$ and compute its value at the point $t=0$.

- 1) $f'(0) = -4$ 2) $f'(0) = 3$ 3) $f'(0) = -1$ 4) $f'(0) = 2$

Exercise 3

Compute the limit: $\lim_{x \rightarrow 0} \frac{-1 + \cos[x^2]}{x^3}$

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

Exercise 4

Compute the limit: $\lim_{x \rightarrow -2} \frac{-12 - 8x + x^2 + x^3}{2 + 3x + x^2}$

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

Exercise 5

Between the months $t=1$ and $t=5$

, the funds in certain account (in millions of euros) are given by the function $F(t) = -4 + 60t - 21t^2 + 2t^3$.

Determine the interval within the funds oscillates between months $t=4$ and $t=5$.

- 1) It oscillates between 21 and 28.
- 2) It oscillates between 21 and 48.
- 3) It oscillates between 21 and 48.
- 4) It oscillates between 14 and 24.
- 5) It oscillates between 27 and 38.

Exercise 6

In a fish farm, data of precedings years reveal that, if the initial number of fish is x (x in thousands), after one month they reproduce until a number of $f(x) = \frac{44x}{11 + 12x}$ fishes.

What number of fish leads to the largest increase in the number of animals, $f(x) - x$?

- 1) $\frac{18}{5}$
- 2) $\frac{11}{12}$
- 3) $\frac{7}{16}$
- 4) $\frac{9}{16}$
- 5) $\frac{31}{11}$

Exercise 7

The yield of a tree plantation is given by $f(x) =$

$$\frac{-6 + x + 6x^2}{42x^2}, \text{ where } x \text{ is the distance in meters between two trees.}$$

What is the distance x that leads to the largest yield.

- 1) 7
- 2) $\frac{10}{3}$
- 3) 12
- 4) $\frac{13}{9}$
- 5) $\frac{35}{9}$

Exercise 8

A plastic firm receives an order to manufacture 2275 special plastic foam boards for swimming training. The firm has 11 machines but each of them will be able to participate in the manufacturing of this special type of tables only after an adaptation so that each adapted machine is capable of manufacturing 30 boards per hour; on the other hand, the non adapted ones cannot be used for this special order. The cost to adapt each machine is 33 monetary units. Moreover, these adapted machines are automated and only need staff to supervise the production whose salary is 10 monetary units per hour. Taking into account the number of hours that will be necessary to produce the ordered tables, the cost in salaries for those hours, and the adaptation costs, how many of the machines that the company has should be adapted to place the order at the lowest possible cost?

- 1) None of the other options is correct.
- 2) 16
- 3) 25
- 4) 22
- 5) 15

Exercise 9

Study the differentiability of the function $f(x) =$

$$\begin{cases} -4 & x \leq -3 \\ -2x + 2e^{x+3} - 3\cos(x+3) - 9 & -3 < x < -1 \\ -2(\sin(x+1) + \cos(x+1)) + 2e^2 - 2 - 3\cos(2) & -1 \leq x \end{cases}$$

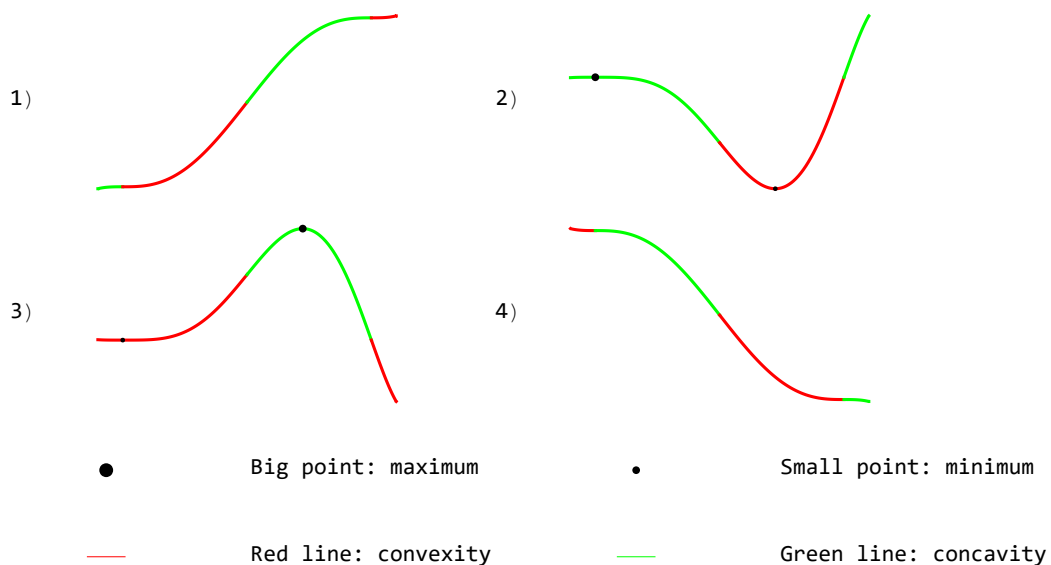
- 1) The function is differentiable for all points.
- 2) The function is not differentiable at any point.
- 3) The function is differentiable for all points except for $x = -3$.
- 4) The function is differentiable for all points except for $x = -1$.
- 5) The function is differentiable for all points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

Mathematics 1 - ADE - English - 2026/2027

02-Derivatives for serial number: 80

Exercise 1

Study the shape properties of $f(x) = 2 + 10x^4 - 9x^5 + 2x^6$ to decide which amongst the following ones is the representation of the function.



Indication: To solve this exercise it is necessary to determine the concavity and convexity interval. To find the inflexion points separating the concavity and convexity intervals, check (by means of Ruffini) with the points $-2, -1, 0, 1, 2$.

Exercise 2

Determine the derivative of the function $f(t) = 9e^t \log(t+1) \sin(t)$ and compute its value at the point $t=0$.

- 1) $f'(0) = 0$ 2) $f'(0) = 2$ 3) $f'(0) = 1$ 4) $f'(0) = 3$

Exercise 3

Compute the limit: $\lim_{x \rightarrow 0} \frac{-x^3 + \sin[x^3]}{x^5}$

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

Exercise 4

Compute the limit: $\lim_{x \rightarrow 2} \frac{-8x + 12x^2 - 6x^3 + x^4}{-4 + 8x - 5x^2 + x^3}$

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

Exercise 5

Between the months $t=3$ and $t=10$

, the true value of the shares of a company (in euros) are given by the function $C(t) = 240 + 144t - 30t^2 + 2t^3$.

Determine the interval within the value oscillates between months $t=4$ and $t=7$.

- 1) It oscillates between 456 and 680.
- 2) It oscillates between 451 and 473.
- 3) It oscillates between 447 and 467.
- 4) It oscillates between 449 and 461.
- 5) It oscillates between 456 and 464.

Exercise 6

In a fish farm, data of precedings years reveal that, if the initial number of fish is x (x

in thousands), after one month they reproduce until a number of $f(x) = \frac{16x}{9 + 12x}$ fishes.

What number of fish leads to the largest increase in the number of animals, $f(x) - x$?

- 1) $\frac{19}{10}$
- 2) $\frac{1}{2}$
- 3) $\frac{1}{3}$
- 4) $\frac{1}{4}$
- 5) $\frac{35}{8}$

Exercise 7

The yield of a tree plantation is given by $f(x) =$

$$\frac{-19 + 3x + 21x^2}{12x^9}, \text{ where } x \text{ is the distance in meters between two trees.}$$

What is the distance x that leads to the largest yield.

- 1) $\frac{35}{8}$
- 2) $\frac{7}{4}$
- 3) $\frac{1}{3}$
- 4) $\frac{3}{2}$
- 5) 1

Exercise 8

A plastic firm receives an order to manufacture 1089088 special plastic foam boards for swimming training. The firm has 25 machines but each of them will be able to participate in the manufacturing of this special type of tables only after an adaptation so that each adapted machine is capable of manufacturing 13 boards per hour; on the other hand, the non adapted ones cannot be used for this special order. The cost to adapt each machine is 17017 monetary units. Moreover, these adapted machines are automated and only need staff to supervise the production whose salary is 52 monetary units per hour. Taking into account the number of hours that will be necessary to produce the ordered tables, the cost in salaries for those hours, and the adaptation costs, how many of the machines that the company has should be adapted to place the order at the lowest possible cost?

- 1) 25
- 2) 13
- 3) 9
- 4) 12
- 5) None of the other options is correct.

Exercise 9

Study the differentiability of the function $f(x) =$

$$\begin{cases} -2 \sin(1-x) + \cos(1-x) - 5 & x \leq 1 \\ x(3 \sin(1) - 2) + 3 \cos(1-x) - 3(1 + \sin(1)) & 1 < x < 2 \\ 2 \sin(2-x) - 7 + 3 \sin(1) + 3 \cos(1) & 2 \leq x \end{cases}$$

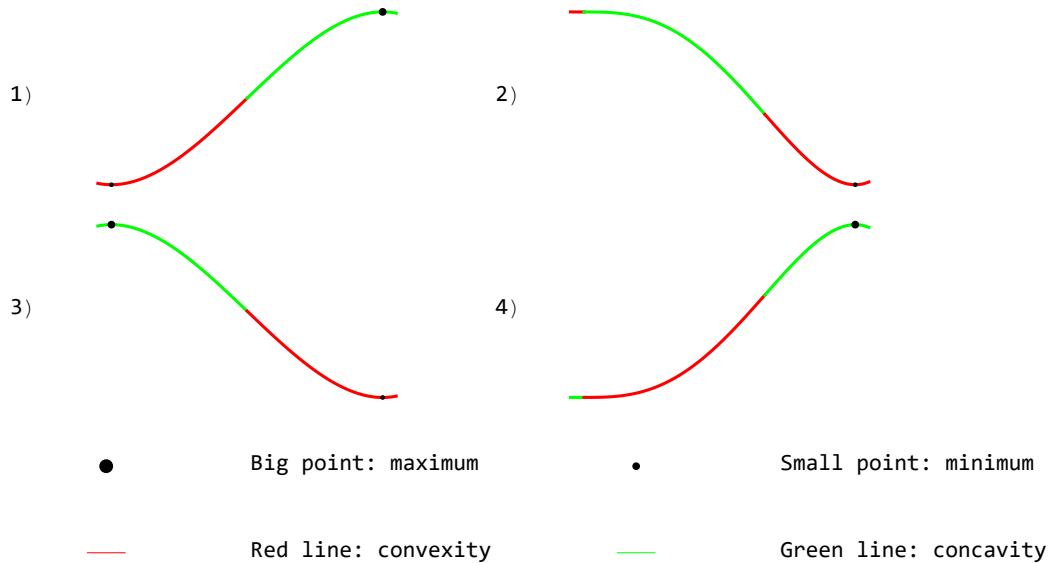
- 1) The function is differentiable for all points.
- 2) The function is not differentiable at any point.
- 3) The function is differentiable for all points except for $x=1$.
- 4) The function is differentiable for all points except for $x=2$.
- 5) The function is differentiable for all points except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

Mathematics 1 - ADE - English - 2026/2027

02-Derivatives for serial number: 81

Exercise 1

Study the shape properties of the $f(x) = 3 - 96x - 24x^2 + 8x^3 + 3x^4$ to decide which amongst the following ones is the representation of the function.



Indication: To find the maximum and minimum points of the function, try (with Ruffini) the points $-2, -1, 0, 1, 2$. To solve this exercise it is necessary to determine the increasing and decreasing intervals.

Exercise 2

Determine the derivative of the function $f(t) = 2(\sin(t) - \sin(t) \cos(t))$ and compute its value at the point $t=0$.

- 1) $f'(0) = -3$ 2) $f'(0) = -4$ 3) $f'(0) = 0$ 4) $f'(0) = 4$

Exercise 3

Compute the limit: $\lim_{x \rightarrow 1} \frac{1 - x + \text{Log}[x]}{1 - 2x + x^2}$

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

Exercise 4

Compute the limit: $\lim_{x \rightarrow -1} \frac{-3 - 2x + x^2}{2 + 3x + x^2}$

- 1) 0
- 2) ∞
- 3) -1
- 4) -4
- 5) -2
- 6) $-\infty$
- 7) 1

Exercise 5

Between the months $t=1$ and $t=8$

, the funds in certain account (in millions of euros) are given by the function $F(t) = 13 + 240t - 39t^2 + 2t^3$.

Determine the interval within the funds oscillates between months $t=3$ and $t=4$.

- 1) It oscillates between 444 and 473.
- 2) It oscillates between 436 and 477.
- 3) It oscillates between 216 and 488.
- 4) It oscillates between 461 and 488.
- 5) It oscillates between 442 and 472.

Exercise 6

In a fish farm, data of precedings years reveal that, if the initial number of fish is x (x in thousands), after one month they reproduce until a number of $f(x) = \frac{50x}{18 + 49x}$ fishes.

What number of fish leads to the largest increase in the number of animals, $f(x) - x$?

- 1) $\frac{2}{19}$
- 2) $\frac{2}{5}$
- 3) $\frac{12}{49}$
- 4) $\frac{13}{6}$
- 5) 3

Exercise 7

The yield of a tree plantation is given by $f(x) =$

$$\frac{-32 + 16x + x^2}{44x^2}, \text{ where } x \text{ is the distance in meters between two trees.}$$

What is the distance x that leads to the largest yield.

- 1) 1
- 2) $\frac{4}{5}$
- 3) $\frac{34}{9}$
- 4) 4
- 5) 1

Exercise 8

A plastic firm receives an order to manufacture 4860 special plastic foam boards for swimming training. The firm has 9 machines but each of them will be able to participate in the manufacturing of this special type of tables only after an adaptation so that each adapted machine is capable of manufacturing 20 boards per hour; on the other hand, the non adapted ones cannot be used for this special order. The cost to adapt each machine is 9 monetary units. Moreover, these adapted machines are automated and only need staff to supervise the production whose salary is 12 monetary units per hour. Taking into account the number of hours that will be necessary to produce the ordered tables, the cost in salaries for those hours, and the adaptation costs, how many of the machines that the company has should be adapted to place the order at the lowest possible cost?

- 1) 10
- 2) None of the other options is correct.
- 3) 22
- 4) 9
- 5) 19

Exercise 9

Study the differentiability of the function $f(x) = \begin{cases} 3 \cos(3 - x) + 4 & x \leq 3 \\ \frac{1}{4}((x - 6)x + 37) & 3 < x < 5 \\ x + 3 & 5 \leq x \end{cases}$

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

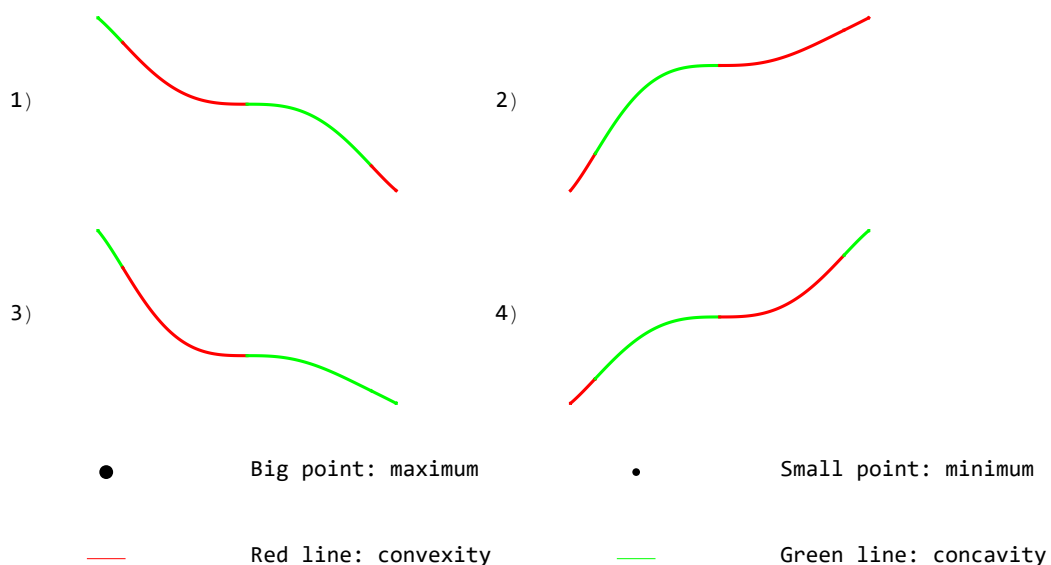
Mathematics 1 - ADE - English - 2026/2027

02-Derivatives for serial number: 82

Exercise 1

Study the shape properties of $f(x) = 5 - 2x^3 + \frac{3x^5}{5}$

to decide which amongst the following ones is the representation of the function.



Indication: To solve this exercise it is necessary to determine the concavity and convexity interval. To find the inflexion points separating the concavity and convexity intervals, check (by means of Ruffini) with the points $-2, -1, 0, 1, 2$.

Exercise 2

Determine the derivative of the function $f(t) = t + 4e^t + \cos(t)$ and compute its value at the point $t=0$.

- 1) $f'(0) = -3$ 2) $f'(0) = 4$ 3) $f'(0) = 5$ 4) $f'(0) = -4$

Exercise 3

Compute the limit: $\lim_{x \rightarrow 0} \frac{-1 + \cos[x^3]}{x^4}$

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

Exercise 4

Compute the limit: $\lim_{x \rightarrow -2} \frac{12 + 16x + 7x^2 + x^3}{4x + 4x^2 + x^3}$

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

Exercise 5

Between the months $t=3$ and $t=7$

, the true value of the shares of a company (in euros) are given by the function $C(t) = 86 + 126t - 30t^2 + 2t^3$.

Determine the interval within the value oscillates between months $t=3$ and $t=6$.

- 1) It oscillates between 194 and 248.
- 2) It oscillates between 184 and 248.
- 3) It oscillates between 186 and 245.
- 4) It oscillates between 184 and 248.
- 5) It oscillates between 204 and 243.

Exercise 6

In a fish farm, data of precedings years reveal that, if the initial number of fish is x (x in thousands), after one month they reproduce until a number of $f(x) = \frac{36x}{1+33x}$ fishes.

What number of fish leads to the largest increase in the number of animals, $f(x) - x$?

- 1) 3
- 2) $\frac{5}{33}$
- 3) $\frac{2}{17}$
- 4) $\frac{10}{9}$
- 5) $\frac{17}{2}$

Exercise 7

The yield of a tree plantation is given by $f(x) =$

$$\frac{-35 + 20x + 45x^2}{2x^9}, \text{ where } x \text{ is the distance in meters between two trees.}$$

What is the distance x that leads to the largest yield.

- 1) $\frac{16}{7}$
- 2) $\frac{33}{13}$
- 3) $\frac{9}{5}$
- 4) $\frac{13}{7}$
- 5) $\frac{7}{9}$

Exercise 8

A plastic firm receives an order to manufacture 663 special plastic foam boards for swimming training. The firm has 18 machines but each of them will be able to participate in the manufacturing of this special type of tables only after an adaptation so that each adapted machine is capable of manufacturing 3 boards per hour; on the other hand, the non adapted ones cannot be used for this special order. The cost to adapt each machine is 850 monetary units. Moreover, these adapted machines are automated and only need staff to supervise the production whose salary is 650 monetary units per hour. Taking into account the number of hours that will be necessary to produce the ordered tables, the cost in salaries for those hours, and the adaptation costs, how many of the machines that the company has should be adapted to place the order at the lowest possible cost?

- 1) 17
- 2) 1
- 3) 23
- 4) None of the other options is correct.
- 5) 11

Exercise 9

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

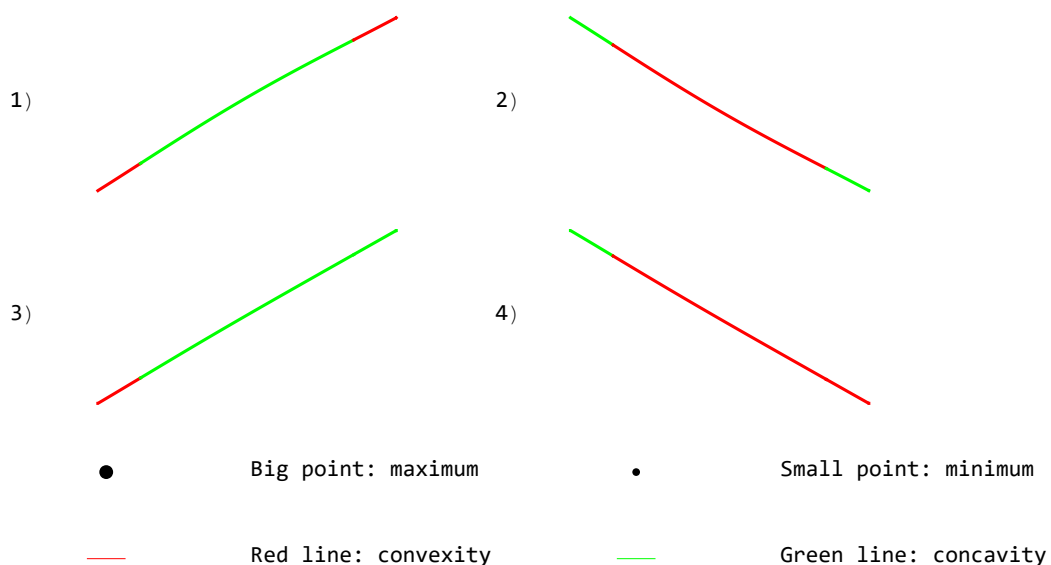
- 1) The function is differentiable for all points.
- 2) The function is not differentiable at any point.
- 3) The function is differentiable for all points except for $x=0$.
- 4) The function is differentiable for all points except for $x=2$.
- 5) The function is differentiable for all points except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

Mathematics 1 - ADE - English - 2026/2027

02-Derivatives for serial number: 83

Exercise 1

Study the shape properties of $f(x) = 3 - 24x^2 + 16x^3 - 5x^4 + \frac{3x^5}{5}$ to decide which amongst the following ones is the representation of the function.



Indication: To solve this exercise it is necessary to determine the concavity and convexity interval. To find the inflexion points separating the concavity and convexity intervals, check (by means of Ruffini) with the points $-2, -1, 0, 1, 2$.

Exercise 2

Determine the derivative of the function $f(t) = 3(e^{t^3} - 3 \log(t^3 + 1))$ and compute its value at the point $t=0$.

- 1) $f'(0) = 0$ 2) $f'(0) = -2$ 3) $f'(0) = 4$ 4) $f'(0) = -4$

Exercise 3

Compute the limit: $\lim_{x \rightarrow 0} \frac{-x^3 + \sin[x^3]}{x^6}$

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

Exercise 4

Compute the limit: $\lim_{x \rightarrow 3} \frac{-3x + x^2}{3 - 4x + x^2}$

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

Exercise 5

Between the months $t=4$ and $t=11$

, the true value of the shares of a company (in euros) are given by the function $C(t) = 399 + 210t - 36t^2 + 2t^3$.

Determine the interval within the value oscillates between months $t=10$ and $t=11$.

- 1) It oscillates between 791 and 1015.
- 2) It oscillates between 899 and 1015.
- 3) It oscillates between 791 and 799.
- 4) It oscillates between 906 and 1008.
- 5) It oscillates between 901 and 1012.

Exercise 6

In a fish farm, data of precedings years reveal that, if the initial number of fish is x (x in thousands), after one month they reproduce until a number of $f(x) = \frac{49x}{25 + 7x}$ fishes.

What number of fish leads to the largest increase in the number of animals, $f(x) - x$?

- 1) $\frac{31}{14}$
- 2) $\frac{10}{7}$
- 3) $\frac{6}{13}$
- 4) $\frac{5}{3}$
- 5) 10

Exercise 7

The yield of a tree plantation is given by $f(x) =$

$$\frac{-47 + 31x + 37x^2}{32x^6}, \text{ where } x \text{ is the distance in meters between two trees.}$$

What is the distance x that leads to the largest yield.

- 1) $\frac{20}{17}$
- 2) $\frac{37}{5}$
- 3) $\frac{141}{148}$
- 4) 3
- 5) $\frac{7}{10}$

Exercise 8

A plastic firm receives an order to manufacture 3471468 special plastic foam boards for swimming training. The firm has 13 machines but each of them will be able to participate in the manufacturing of this special type of tables only after an adaptation so that each adapted machine is capable of manufacturing 289 boards per hour; on the other hand, the non adapted ones cannot be used for this special order. The cost to adapt each machine is 1001 monetary units. Moreover, these adapted machines are automated and only need staff to supervise the production whose salary is 27 monetary units per hour. Taking into account the number of hours that will be necessary to produce the ordered tables, the cost in salaries for those hours, and the adaptation costs, how many of the machines that the company has should be adapted to place the order at the lowest possible cost?

- 1) 10
- 2) 32
- 3) 6
- 4) None of the other options is correct.
- 5) 21

Exercise 9

Study the differentiability of the function $f(x) = \begin{cases} -\sin(x+1) + 2 \cos(x+1) + 4 & x \leq -1 \\ \frac{1}{2}(x^2 + 15) & -1 < x < 0 \\ 2 \cos(x) + \frac{11}{2} & 0 \leq x \end{cases}$

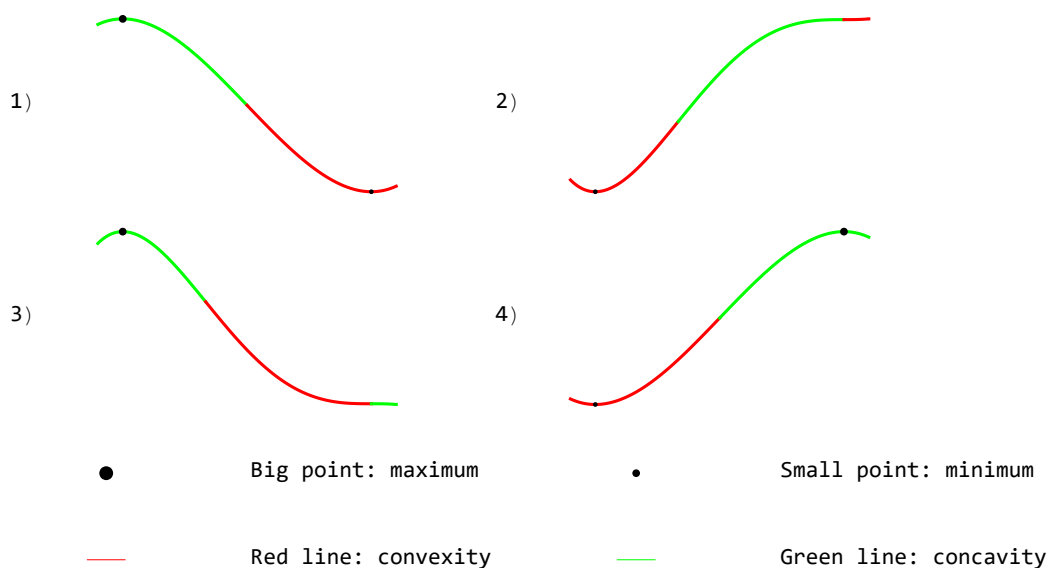
- 1) The function is differentiable for all points.
- 2) The function is not differentiable at any point.
- 3) The function is differentiable for all points except for $x = -1$.
- 4) The function is differentiable for all points except for $x = 0$.
- 5) The function is differentiable for all points except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

Mathematics 1 - ADE - English - 2026/2027

02-Derivatives for serial number: 84

Exercise 1

Study the shape properties of the $f(x) = 2 - 6x^2 + 2x^3$ to decide which amongst the following ones is the representation of the function.



Indication: To find the maximum and minimum points of the function, try (with Ruffini) the points $-2, -1, 0, 1, 2$. To solve this exercise it is necessary to determine the increasing and decreasing intervals.

Exercise 2

Determine the derivative of the function $f(t) = \cos(t) - 2e^t \cos(\cos(t))$ and compute its value at the point $t=0$.

- 1) $f'(0) = -2 \cos[1]$ 2) $f'(0) = -3$ 3) $f'(0) = 4$ 4) $f'(0) = 2$

Exercise 3

Compute the limit: $\lim_{x \rightarrow 0} \frac{-1 + \cos[x]}{x^2}$

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

Exercise 4

Compute the limit: $\lim_{x \rightarrow -1} \frac{-2 - 3x + x^3}{-3 - 5x - x^2 + x^3}$

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

Exercise 5

Between the months $t=4$ and $t=11$

, the funds in certain account (in millions of euros) are given by the function $F(t) = -5 + 480t - 54t^2 + 2t^3$.

Determine the interval within the funds oscillates between months $t=6$ and $t=10$.

- 1) It oscillates between 1361 and 1401.
- 2) It oscillates between 1363 and 1403.
- 3) It oscillates between 1179 and 1403.
- 4) It oscillates between 1359 and 1411.
- 5) It oscillates between 1395 and 1403.

Exercise 6

In a fish farm, data of precedings years reveal that, if the initial number of fish is x (x in thousands), after one month they reproduce until a number of $f(x) = \frac{32x}{8 + 34x}$ fishes.

What number of fish leads to the largest increase in the number of animals, $f(x) - x$?

- 1) $\frac{1}{12}$
- 2) 10
- 3) $\frac{39}{8}$
- 4) $\frac{3}{10}$
- 5) $\frac{4}{17}$

Exercise 7

The yield of a tree plantation is given by $f(x) =$

$$\frac{-47 + x + 39x^2}{24x^2}, \text{ where } x \text{ is the distance in meters between two trees.}$$

What is the distance x that leads to the largest yield.

- 1) $\frac{2}{13}$
- 2) $\frac{13}{16}$
- 3) $\frac{23}{10}$
- 4) 94
- 5) $\frac{3}{2}$

Exercise 8

A plastic firm receives an order to manufacture 4719 special plastic foam boards for swimming training. The firm has 15 machines but each of them will be able to participate in the manufacturing of this special type of tables only after an adaptation so that each adapted machine is capable of manufacturing 429 boards per hour; on the other hand, the non adapted ones cannot be used for this special order. The cost to adapt each machine is 22 monetary units. Moreover, these adapted machines are automated and only need staff to supervise the production whose salary is 288 monetary units per hour. Taking into account the number of hours that will be necessary to produce the ordered tables, the cost in salaries for those hours, and the adaptation costs, how many of the machines that the company has should be adapted to place the order at the lowest possible cost?

- 1) 9
- 2) 19
- 3) 20
- 4) 20
- 5) None of the other options is correct.

Exercise 9

Study the differentiability of the function $f(x) =$

$$\begin{cases} e^{x+3} - \cos(x+3) + 3 & x \leq -3 \\ -2x + 2e^{x+3} - 2e^{(x+3)} - 3x \sin(1) - 3\cos(x+3) - 2 - 9\sin(1) & -3 < x < -2 \\ -2e^{x+2} + \cos(x+2) + 4 - 3\sin(1) - 3\cos(1) & -2 \leq x \end{cases}$$

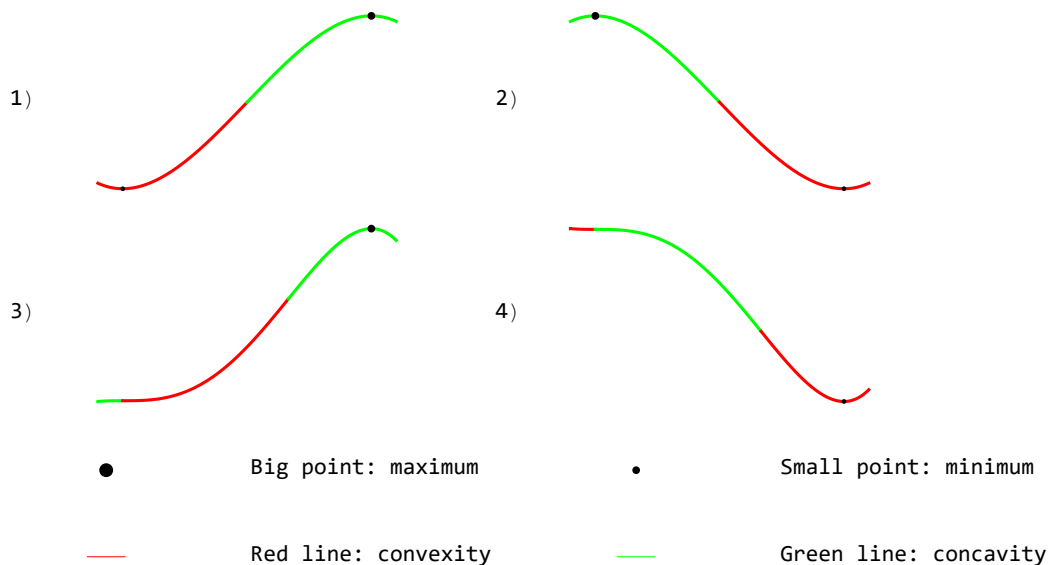
- 1) The function is differentiable for all points.
- 2) The function is not differentiable at any point.
- 3) The function is differentiable for all points except for $x = -3$.
- 4) The function is differentiable for all points except for $x = -2$.
- 5) The function is differentiable for all points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

Mathematics 1 - ADE - English - 2026/2027

02-Derivatives for serial number: 85

Exercise 1

Study the shape properties of the $f(x) = 2 + 6x^2 + 2x^3$ to decide which amongst the following ones is the representation of the function.



Indication: To find the maximum and minimum points of the function, try (with Ruffini) the points $-2, -1, 0, 1, 2$. To solve this exercise it is necessary to determine the increasing and decreasing intervals.

Exercise 2

Determine the derivative of the function $f(t) = \sin(t) + \cos(\sin(t))$ and compute its value at the point $t=0$.

- 1) $f'(0) = -4$ 2) $f'(0) = 2$ 3) $f'(0) = -2$ 4) $f'(0) = 1$

Exercise 3

Compute the limit: $\lim_{x \rightarrow 0} \frac{-1 + e^x - x}{x^2}$

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

Exercise 4

Compute the limit: $\lim_{x \rightarrow -1} \frac{-2 - 5x - 3x^2 + x^3 + x^4}{3 + 7x + 5x^2 + x^3}$

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

Exercise 5

Between the months $t=0$ and $t=6$

, the funds in certain account (in millions of euros) are given by the function $F(t) = 2 - 12t^2 + 2t^3$.

Determine the interval within the funds oscillates between months $t=2$ and $t=4$.

- 1) It oscillates between -62 and 2.
- 2) It oscillates between -62 and 2.
- 3) It oscillates between -62 and -30.
- 4) It oscillates between -64 and -34.
- 5) It oscillates between -71 and -37.

Exercise 6

In a fish farm, data of precedings years reveal that, if the initial number of fish is x (x in thousands), after one month they reproduce until a number of $f(x) = \frac{36x}{1+50x}$ fishes.

What number of fish leads to the largest increase in the number of animals, $f(x) - x$?

- 1) $\frac{35}{6}$
- 2) $\frac{8}{15}$
- 3) $\frac{1}{10}$
- 4) $\frac{1}{17}$
- 5) $\frac{17}{11}$

Exercise 7

The yield of a tree plantation is given by $f(x) =$

$$\frac{-32 + 8x + 22x^2}{43x^2}, \text{ where } x \text{ is the distance in meters between two trees.}$$

What is the distance x that leads to the largest yield.

- 1) 1
- 2) 15
- 3) 2
- 4) 8
- 5) $\frac{1}{2}$

Exercise 8

A plastic firm receives an order to manufacture 8448 special plastic foam boards for swimming training. The firm has 18 machines but each of them will be able to participate in the manufacturing of this special type of tables only after an adaptation so that each adapted machine is capable of manufacturing 6 boards per hour; on the other hand, the non adapted ones cannot be used for this special order. The cost to adapt each machine is 44 monetary units. Moreover, these adapted machines are automated and only need staff to supervise the production whose salary is 8 monetary units per hour. Taking into account the number of hours that will be necessary to produce the ordered tables, the cost in salaries for those hours, and the adaptation costs, how many of the machines that the company has should be adapted to place the order at the lowest possible cost?

- 1) None of the other options is correct.
- 2) 15
- 3) 18
- 4) 8
- 5) 24

Exercise 9

Study the differentiability of the function $f(x) = \begin{cases} -e^{x-3} - 2 \cos(3-x) - 1 & x \leq 3 \\ -x - 3 \cos(3-x) + 2 & 3 < x < 5 \\ -(x-4) \log(x-4) - 6 \cos^2(1) & 5 \leq x \end{cases}$

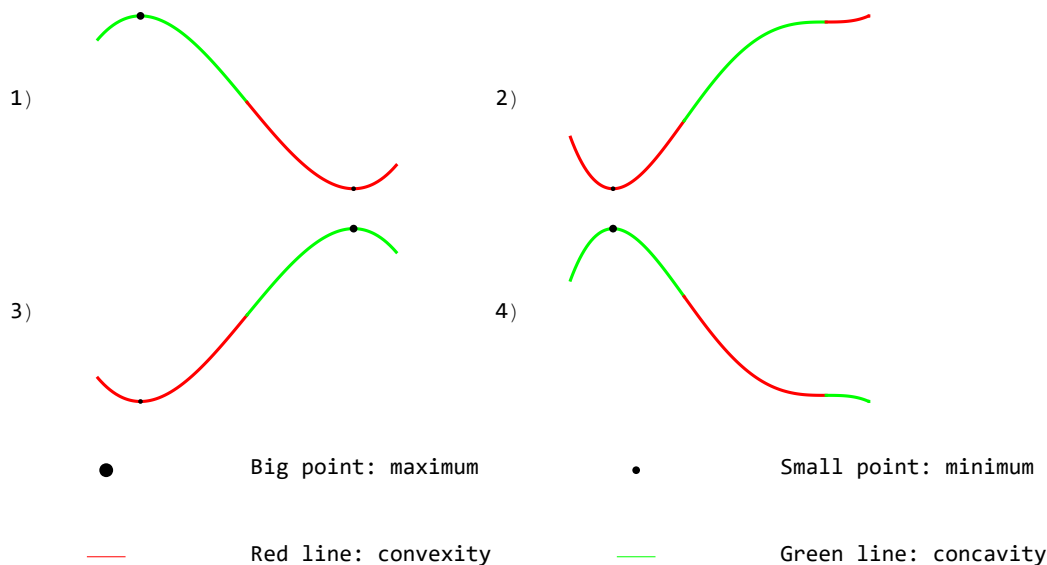
- 1) The function is differentiable for all points.
- 2) The function is not differentiable at any point.
- 3) The function is differentiable for all points except for $x=3$.
- 4) The function is differentiable for all points except for $x=5$.
- 5) The function is differentiable for all points except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

Mathematics 1 - ADE - English - 2026/2027

02-Derivatives for serial number: 86

Exercise 1

Study the shape properties of the $f(x) = 4 + 4x^3 + 3x^4$ to decide which amongst the following ones is the representation of the function.



Indication: To find the maximum and minimum points of the function, try (with Ruffini) the points $-2, -1, 0, 1, 2$. To solve this exercise it is necessary to determine the increasing and decreasing intervals.

Exercise 2

Determine the derivative of the function $f(t) = \log(t+1) + \log(t+1) (e^t - \sin(t))$ and compute its value at the point $t=0$.

- 1) $f'(0) = -2$ 2) $f'(0) = 2$ 3) $f'(0) = 0$ 4) $f'(0) = 3$

Exercise 3

Compute the limit: $\lim_{x \rightarrow 0} \frac{-x + \sin[x]}{x^2}$

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

Exercise 4

Compute the limit: $\lim_{x \rightarrow -1} \frac{-1 - x + x^2 + x^3}{-2 - x + x^2}$

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

Exercise 5

Between the months $t=4$ and $t=11$

, the funds in certain account (in millions of euros) are given by the function $F(t) = -4 + 270t - 42t^2 + 2t^3$.

Determine the interval within the funds oscillates between months $t=5$ and $t=9$.

- 1) It oscillates between 481 and 537.
- 2) It oscillates between 486 and 543.
- 3) It oscillates between 482 and 546.
- 4) It oscillates between 483 and 549.
- 5) It oscillates between 487 and 546.

Exercise 6

In a fish farm, data of precedings years reveal that, if the initial number of fish is x (x in thousands), after one month they reproduce until a number of $f(x) = \frac{45x}{5 + 20x}$ fishes.

What number of fish leads to the largest increase in the number of animals, $f(x) - x$?

- 1) $\frac{16}{3}$
- 2) $\frac{5}{2}$
- 3) $\frac{1}{2}$
- 4) $\frac{15}{16}$
- 5) $\frac{19}{12}$

Exercise 7

The yield of a tree plantation is given by $f(x) =$

$$\frac{-24 + 14x + 49x^2}{42x^2}, \text{ where } x \text{ is the distance in meters between two trees.}$$

What is the distance x that leads to the largest yield.

- 1) $\frac{24}{7}$
- 2) $\frac{11}{10}$
- 3) $\frac{13}{9}$
- 4) $\frac{7}{2}$
- 5) $\frac{1}{2}$

Exercise 8

A plastic firm receives an order to manufacture 2431

special plastic foam boards for swimming training. The firm has

8 machines but each of them will be able to participate

in the manufacturing of this special type of tables only after an

adaptation so that each adapted machine is capable of manufacturing

22 boards per hour; on the other hand, the non adapted ones cannot be

used for this special order. The cost to adapt each machine is

595 monetary units. Moreover, these adapted machines are automated and

only need staff to supervise the production whose salary is 910

monetary units per hour. Taking into account the number of hours that will be

necessary to produce the ordered tables, the cost in salaries for those

hours, and the adaptation costs, how many of the machines that the company

has should be adapted to place the order at the lowest possible cost?

- 1) 13
- 2) 7
- 3) 3
- 4) None of the other options is correct.
- 5) 26

Exercise 9

Study the differentiability of the function $f(x) = \begin{cases} \sin(1) \sin(x) + \cos(1) \cos(x) - 1 & x \leq 1 \\ 0 & 1 < x < 2 \\ -3x + 3(x-1) \log(x-1) + 6 & 2 \leq x \end{cases}$

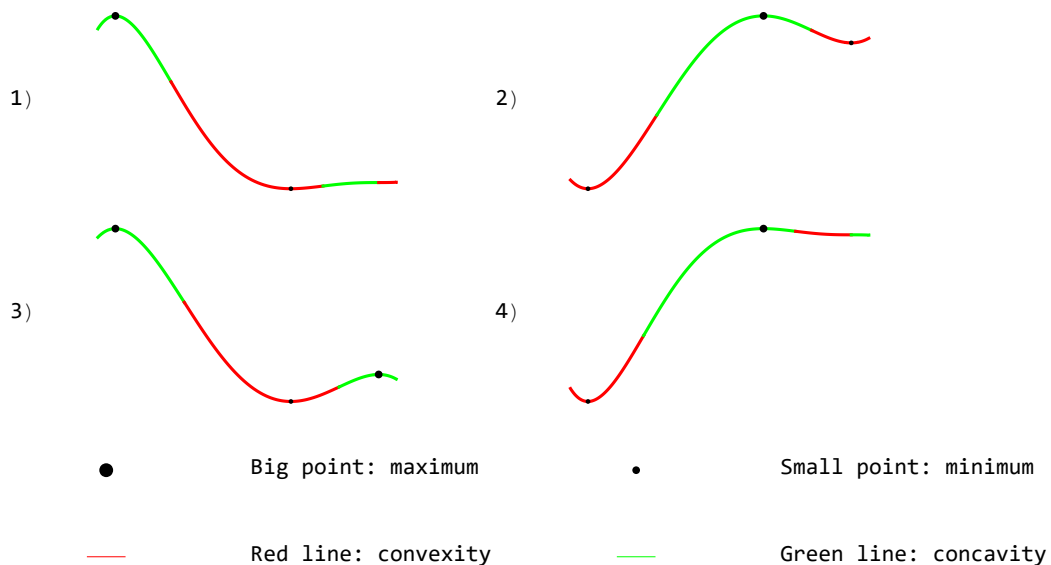
- 1) The function is differentiable for all points.
- 2) The function is not differentiable at any point.
- 3) The function is differentiable for all points except for $x=1$.
- 4) The function is differentiable for all points except for $x=2$.
- 5) The function is differentiable for all points except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

Mathematics 1 - ADE - English - 2026/2027

02-Derivatives for serial number: 87

Exercise 1

Study the shape properties of the $f(x) = 4 - 240x + 120x^2 + 60x^3 - 60x^4 + 12x^5$ to decide which amongst the following ones is the representation of the function.



Indication: To find the maximum and minimum points of the function, try (with Ruffini) the points $-2, -1, 0, 1, 2$. To solve this exercise it is necessary to determine the increasing and decreasing intervals.

Exercise 2

Determine the derivative of the function $f(t) = -2t^3 \sin^2(t^2)$ and compute its value at the point $t=0$.

- 1) $f'(0) = 0$ 2) $f'(0) = -3$ 3) $f'(0) = -4$ 4) $f'(0) = 1$

Exercise 3

Compute the limit: $\lim_{x \rightarrow 0} \frac{-1 + \cos [x^2]}{x^3}$

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

Exercise 4

Compute the limit: $\lim_{x \rightarrow -2} \frac{2 + 3x + x^2}{-6 - x + x^2}$

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

Exercise 5

Between the months $t=1$ and $t=7$

, the funds in certain account (in millions of euros) are given by the function $F(t) = 1 + 90t - 24t^2 + 2t^3$.

Determine the interval within the funds oscillates between months $t=1$ and $t=7$.

- 1) It oscillates between 69 and 141.
- 2) It oscillates between 59 and 132.
- 3) It oscillates between 101 and 109.
- 4) It oscillates between 70 and 151.
- 5) It oscillates between 62 and 140.

Exercise 6

In a fish farm, data of precedings years reveal that, if the initial number of fish is x (x in thousands), after one month they reproduce until a number of $f(x) = \frac{32x}{8 + 37x}$ fishes.

What number of fish leads to the largest increase in the number of animals, $f(x) - x$?

- 1) $\frac{19}{9}$
- 2) 1
- 3) $\frac{8}{37}$
- 4) $\frac{11}{3}$
- 5) $\frac{38}{11}$

Exercise 7

The yield of a tree plantation is given by $f(x) =$

$$\frac{-21 + 9x + 48x^2}{31x^2}, \text{ where } x \text{ is the distance in meters between two trees.}$$

What is the distance x that leads to the largest yield.

- 1) $\frac{37}{8}$
- 2) $\frac{1}{5}$
- 3) $\frac{18}{13}$
- 4) $\frac{11}{8}$
- 5) $\frac{14}{3}$

Exercise 8

A plastic firm receives an order to manufacture 324480 special plastic foam boards for swimming training. The firm has 8 machines but each of them will be able to participate in the manufacturing of this special type of tables only after an adaptation so that each adapted machine is capable of manufacturing 39 boards per hour; on the other hand, the non adapted ones cannot be used for this special order. The cost to adapt each machine is 130 monetary units. Moreover, these adapted machines are automated and only need staff to supervise the production whose salary is 4 monetary units per hour. Taking into account the number of hours that will be necessary to produce the ordered tables, the cost in salaries for those hours, and the adaptation costs, how many of the machines that the company has should be adapted to place the order at the lowest possible cost?

- 1) 11
- 2) 5
- 3) 28
- 4) 9
- 5) None of the other options is correct.

Exercise 9

Study the differentiability of the function $f(x) = \begin{cases} 2e^{x-2} & x \leq 2 \\ -\frac{1}{2}(x-8)x - 1 & 2 < x < 3 \\ e^{x-3} - 2\cos(3-x) + \frac{15}{2} & 3 \leq x \end{cases}$

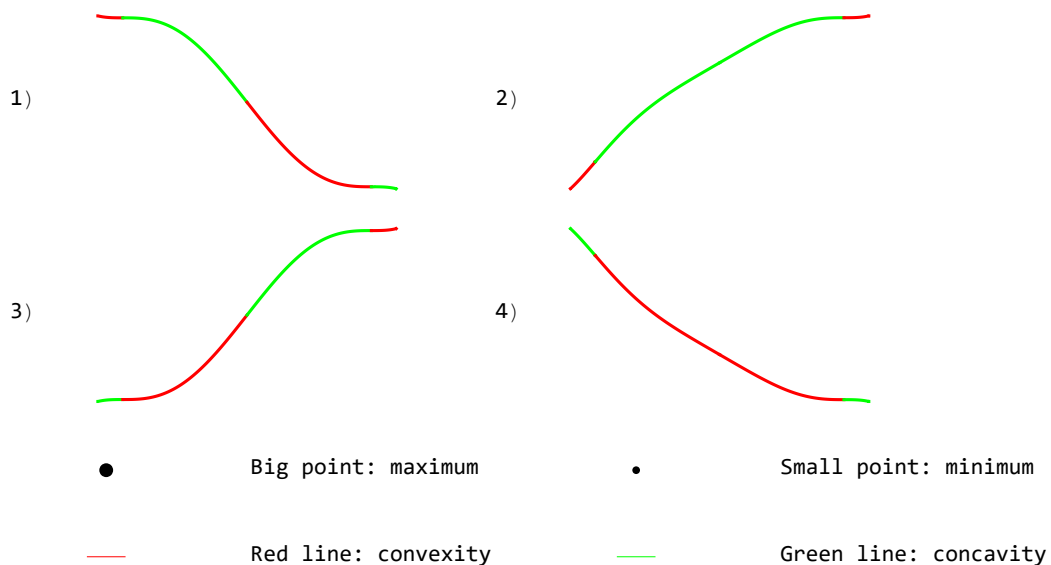
- 1) The function is differentiable for all points.
- 2) The function is not differentiable at any point.
- 3) The function is differentiable for all points except for $x=2$.
- 4) The function is differentiable for all points except for $x=3$.
- 5) The function is differentiable for all points except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

Mathematics 1 - ADE - English - 2026/2027

02-Derivatives for serial number: 88

Exercise 1

Study the shape properties of $f(x) = 2 + 20x^3 + 25x^4 + 12x^5 + 2x^6$ to decide which amongst the following ones is the representation of the function.



Indication: To solve this exercise it is necessary to determine the concavity and convexity interval. To find the inflexion points separating the concavity and convexity intervals, check (by means of Ruffini) with the points $-2, -1, 0, 1, 2$.

Exercise 2

Determine the derivative of the function $f(t) = 2t^3 (2e^t + \log(t+1))$ and compute its value at the point $t=0$.

- 1) $f'(0) = 0$ 2) $f'(0) = -4$ 3) $f'(0) = 2$ 4) $f'(0) = -2$

Exercise 3

Compute the limit: $\lim_{x \rightarrow 1} \frac{3 - 4x + x^2 + \text{Log}[x^2]}{-1 + 3x - 3x^2 + x^3}$

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

Exercise 4

Compute the limit: $\lim_{x \rightarrow -1} \frac{-1 - 2x + 2x^3 + x^4}{-2 - 3x + x^3}$

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

Exercise 5

Between the months $t=0$ and $t=6$

, the true value of the shares of a company (in euros) are given by the function $C(t) = 2 + 36t - 15t^2 + 2t^3$.

Determine the interval within the value oscillates between months $t=0$ and $t=6$.

- 1) It oscillates between 9 and 108.
- 2) It oscillates between 10 and 117.
- 3) It oscillates between 2 and 110.
- 4) It oscillates between 29 and 30.
- 5) It oscillates between 5 and 102.

Exercise 6

In a fish farm, data of precedings years reveal that, if the initial number of fish is x (x in thousands), after one month they reproduce until a number of $f(x) = \frac{25x}{4 + 43x}$ fishes.

What number of fish leads to the largest increase in the number of animals, $f(x) - x$?

- 1) $\frac{17}{8}$
- 2) $\frac{11}{8}$
- 3) $\frac{6}{43}$
- 4) $\frac{8}{9}$
- 5) $\frac{1}{2}$

Exercise 7

The yield of a tree plantation is given by $f(x) =$

$$\frac{-32 + 6x^2}{45x^8}, \text{ where } x \text{ is the distance in meters between two trees.}$$

What is the distance x that leads to the largest yield.

- 1) $\frac{19}{17}$
- 2) $\frac{11}{8}$
- 3) $\frac{8}{3}$
- 4) $\frac{29}{3}$
- 5) $\frac{34}{7}$

Exercise 8

A plastic firm receives and order to manufacture 203456 special plastic foam boards for swimming training. The firm have 21 machines but each of them will be able to participate in the manufacturing of this special type of tables only after an adaptation so that each adapted machine is capable of manufacturing 17 boards per hour; on the other hand, the non adapted ones cannot be used for this special order. The cost to adapt each machine is 6358 monetary units. Moreover, these adapted machines are automated and only need staff to supervise the production whose salary is 136 monetary units per hour. Taking into account the number of hours that will be necessary to produce the ordered tables, the cost in salaries for those hours, and the adaptation costs, how many of the machines that the company has should be adapted to place the order at the lowest possible cost?

- 1) 21
- 2) 24
- 3) 17
- 4) 24
- 5) None of the other options is correct.

Exercise 9

Study the differentiability of the function $f(x) =$

$$\begin{cases} -2(\sin(3-x) + 2) - \cos(3-x) & x \leq 3 \\ 4x - 2(x-2)\log(x-2) - 15 & 3 < x < 6 \\ -2\sin(6-x) + 3\cos(6-x) + 6 - 8\log(4) & 6 \leq x \end{cases}$$

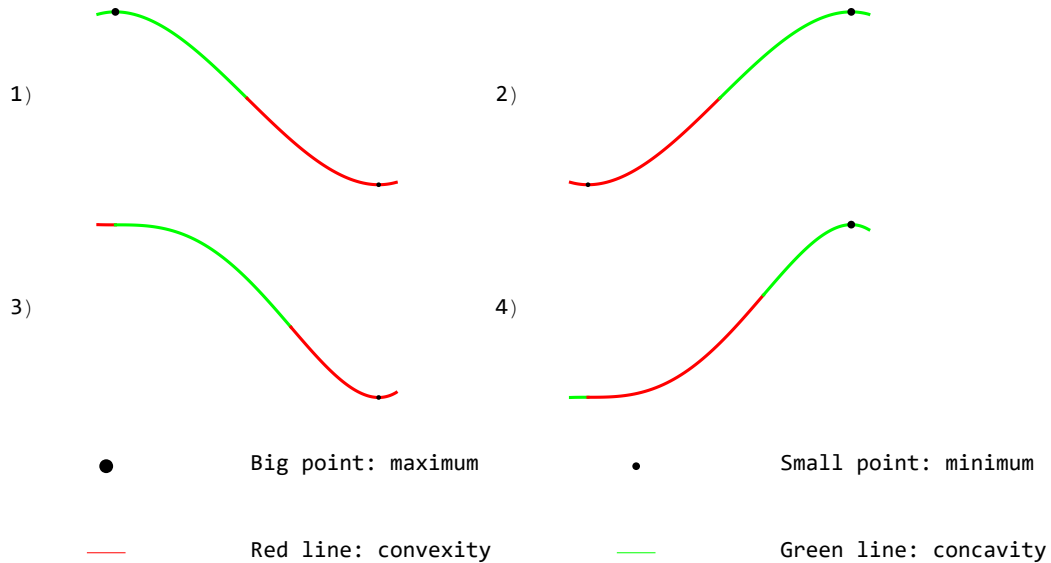
- 1) The function is differentiable for all points.
- 2) The function is not differentiable at any point.
- 3) The function is differentiable for all points except for $x=3$.
- 4) The function is differentiable for all points except for $x=6$.
- 5) The function is differentiable for all points except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

Mathematics 1 - ADE - English - 2026/2027

02-Derivatives for serial number: 89

Exercise 1

Study the shape properties of the $f(x) = 3 - 24x - 18x^2 + 3x^4$ to decide which amongst the following ones is the representation of the function.



Indication: To find the maximum and minimum points of the function, try (with Ruffini) the points $-2, -1, 0, 1, 2$. To solve this exercise it is necessary to determine the increasing and decreasing intervals.

Exercise 2

Determine the derivative of the function $f(t) = t^2 - \log(\log(t+1) + 1) \sin(\log(t+1))$ and compute its value at the point $t=0$.

- 1) $f'(0) = 0$ 2) $f'(0) = 3$ 3) $f'(0) = -3$ 4) $f'(0) = 4$

Exercise 3

Compute the limit: $\lim_{x \rightarrow 0} \frac{-x + \frac{x^3}{6} + \sin[x]}{x^4}$

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

Exercise 4

Compute the limit: $\lim_{x \rightarrow 1} \frac{2 - 3x + x^3}{3 - 4x + x^2}$

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

Exercise 5

Between the months $t=1$ and $t=8$

, the funds in certain account (in millions of euros) are given by the function $F(t) = -3 + 240t - 39t^2 + 2t^3$.

Determine the interval within the funds oscillates between months $t=2$ and $t=4$.

- 1) It oscillates between 200 and 472.
- 2) It oscillates between 327 and 469.
- 3) It oscillates between 339 and 464.
- 4) It oscillates between 337 and 461.
- 5) It oscillates between 445 and 472.

Exercise 6

In a fish farm, data of precedings years reveal that, if the initial number of fish is x (x in thousands), after one month they reproduce until a number of $f(x) = \frac{49x}{25 + 47x}$ fishes.

What number of fish leads to the largest increase in the number of animals, $f(x) - x$?

- 1) 34
- 2) $\frac{7}{10}$
- 3) $\frac{9}{16}$
- 4) $\frac{10}{11}$
- 5) $\frac{10}{47}$

Exercise 7

The yield of a tree plantation is given by $f(x) =$

$$\frac{-28 + 35x + 13x^2}{16x^2}, \text{ where } x \text{ is the distance in meters between two trees.}$$

What is the distance x that leads to the largest yield.

- 1) $\frac{7}{2}$
- 2) $\frac{37}{9}$
- 3) $\frac{38}{9}$
- 4) $\frac{8}{5}$
- 5) 5

Exercise 8

A plastic firm receives an order to manufacture 6591 special plastic foam boards for swimming training. The firm has 8 machines but each of them will be able to participate in the manufacturing of this special type of tables only after an adaptation so that each adapted machine is capable of manufacturing 13 boards per hour; on the other hand, the non adapted ones cannot be used for this special order. The cost to adapt each machine is 54 monetary units. Moreover, these adapted machines are automated and only need staff to supervise the production whose salary is 18 monetary units per hour. Taking into account the number of hours that will be necessary to produce the ordered tables, the cost in salaries for those hours, and the adaptation costs, how many of the machines that the company has should be adapted to place the order at the lowest possible cost?

- 1) 17
- 2) 13
- 3) 22
- 4) 11
- 5) None of the other options is correct.

Exercise 9

Study the differentiability of the function $f(x) = \begin{cases} 2 \sin(x) - 5 & x \leq 0 \\ -\frac{1}{2}(x-4)x - 4 & 0 < x < 3 \\ 3 \cos(3-x) - \frac{7}{2} & 3 \leq x \end{cases}$

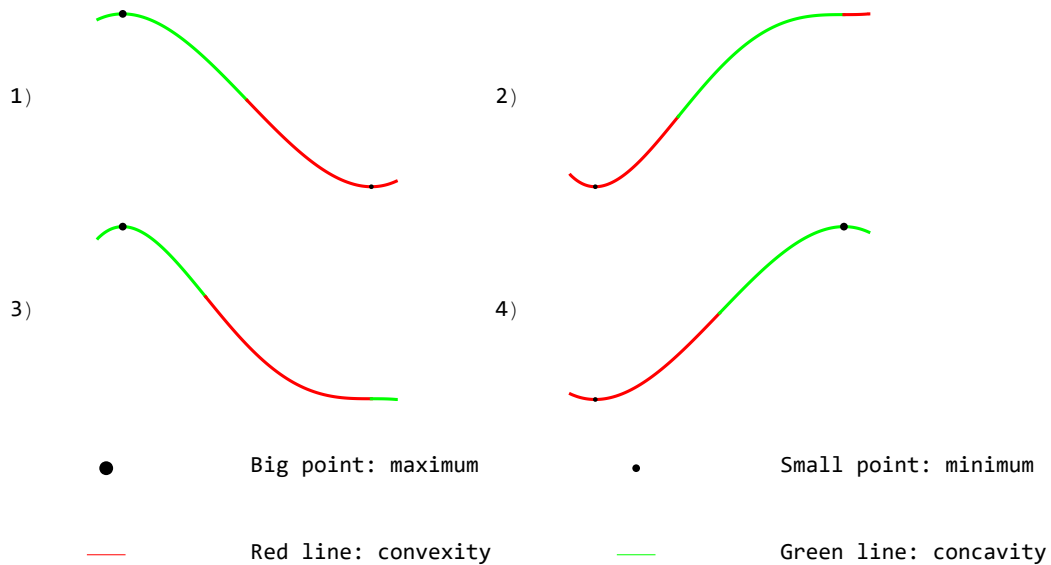
- 1) The function is differentiable for all points.
- 2) The function is not differentiable at any point.
- 3) The function is differentiable for all points except for $x=0$.
- 4) The function is differentiable for all points except for $x=3$.
- 5) The function is differentiable for all points except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

Mathematics 1 - ADE - English - 2026/2027

02-Derivatives for serial number: 90

Exercise 1

Study the shape properties of the $f(x) = 5 - 6x + 2x^3$ to decide which amongst the following ones is the representation of the function.



Indication: To find the maximum and minimum points of the function, try (with Ruffini) the points $-2, -1, 0, 1, 2$. To solve this exercise it is necessary to determine the increasing and decreasing intervals.

Exercise 2

Determine the derivative of the function $f(t) = \log(t+1) (\cos(t) - \sin(t^3))$ and compute its value at the point $t=0$.

- 1) $f'(0) = -3$ 2) $f'(0) = 1$ 3) $f'(0) = 4$ 4) $f'(0) = -4$

Exercise 3

Compute the limit: $\lim_{x \rightarrow 0} \frac{-1 + \cos[x]}{x^2}$

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

Exercise 4

Compute the limit: $\lim_{x \rightarrow -1} \frac{-3 - 2x + x^2}{-2 - x + x^2}$

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

Exercise 5

Between the months $t=4$ and $t=10$

, the funds in certain account (in millions of euros) are given by the function $F(t) = -15 + 300t - 45t^2 + 2t^3$.

Determine the interval within the funds oscillates between months $t=4$ and $t=5$.

- 1) It oscillates between 593 and 610.
- 2) It oscillates between 485 and 610.
- 3) It oscillates between 591 and 614.
- 4) It oscillates between 485 and 610.
- 5) It oscillates between 594 and 605.

Exercise 6

In a fish farm, data of precedings years reveal that, if the initial number of fish is x (x in thousands), after one month they reproduce until a number of $f(x) = \frac{25x}{9+7x}$ fishes.

What number of fish leads to the largest increase in the number of animals, $f(x) - x$?

- 1) $\frac{15}{7}$
- 2) $\frac{6}{7}$
- 3) $\frac{7}{19}$
- 4) $\frac{21}{17}$
- 5) $\frac{10}{3}$

Exercise 7

The yield of a tree plantation is given by $f(x) = \frac{-2 + 30x}{17x^2}$, where x is the distance in meters between two trees.

What is the distance x that leads to the largest yield.

- 1) $\frac{29}{14}$
- 2) $\frac{2}{15}$
- 3) $\frac{14}{5}$
- 4) 1
- 5) $\frac{10}{3}$

Exercise 8

A plastic firm receives and order to manufacture 13013 special plastic foam boards for swimming training. The firm have 12 machines but each of them will be able to participate in the manufacturing of this special type of tables only after an adaptation so that each adapted machine is capable of manufacturing 242 boards per hour; on the other hand, the non adapted ones cannot be used for this special order. The cost to adapt each machine is 119 monetary units. Moreover, these adapted machines are automated and only need staff to supervise the production whose salary is 374 monetary units per hour. Taking into account the number of hours that will be necessary to produce the ordered tables, the cost in salaries for those hours, and the adaptation costs, how many of the machines that the company has should be adapted to place the order at the lowest possible cost?

- 1) 15
- 2) None of the other options is correct.
- 3) 17
- 4) 2
- 5) 7

Exercise 9

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

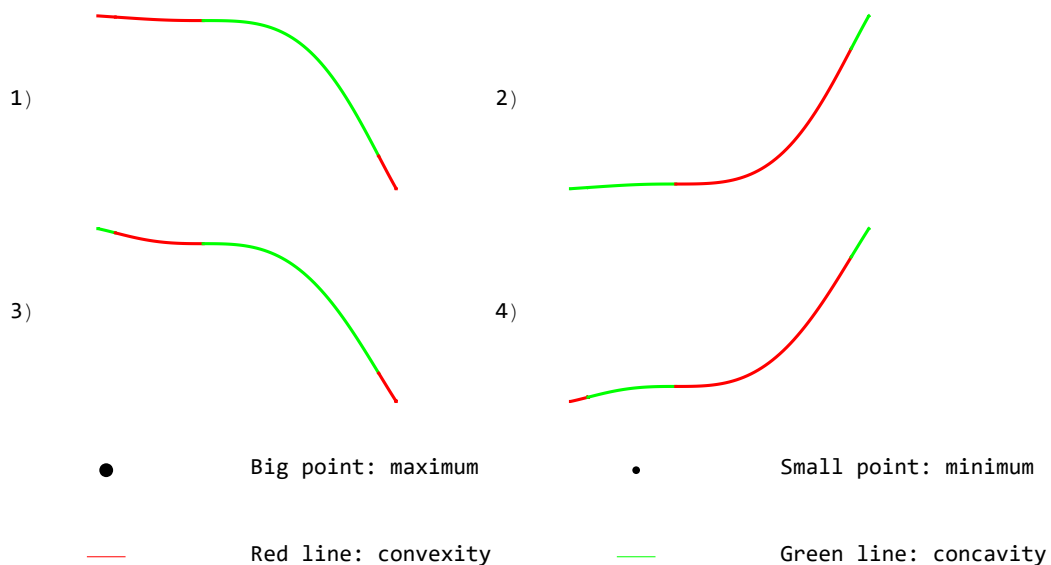
- 1) The function is differentiable for all points.
- 2) The function is not differentiable at any point.
- 3) The function is differentiable for all points except for $x = -2$.
- 4) The function is differentiable for all points except for $x = -1$.
- 5) The function is differentiable for all points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

Mathematics 1 - ADE - English - 2026/2027

02-Derivatives for serial number: 91

Exercise 1

Study the shape properties of $f(x) = 3 - 20x^3 - 15x^4 + 2x^6$ to decide which amongst the following ones is the representation of the function.



Indication: To solve this exercise it is necessary to determine the concavity and convexity interval. To find the inflexion points separating the concavity and convexity intervals, check (by means of Ruffini) with the points $-2, -1, 0, 1, 2$.

Exercise 2

Determine the derivative of the function $f(t) = \log(t+1) (t^2 - 2 \cos(\log(t+1)))$ and compute its value at the point $t=0$.

- 1) $f'(0) = 2$ 2) $f'(0) = 3$ 3) $f'(0) = -2$ 4) $f'(0) = -3$

Exercise 3

Compute the limit: $\lim_{x \rightarrow 0} \frac{-1 + \cos[x^2]}{x^4}$

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

Exercise 4

Compute the limit: $\lim_{x \rightarrow 3} \frac{-3x + x^2}{-6 - x + x^2}$

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

Exercise 5

Between the months $t=4$ and $t=10$

, the true value of the shares of a company (in euros) are given by the function $C(t) = 785 + 360t - 48t^2 + 2t^3$.

Determine the interval within the value oscillates between months $t=5$ and $t=6$.

- 1) It oscillates between 1635 and 1649.
- 2) It oscillates between 1625 and 1642.
- 3) It oscillates between 1585 and 1649.
- 4) It oscillates between 1641 and 1659.
- 5) It oscillates between 1585 and 1649.

Exercise 6

In a fish farm, data of precedings years reveal that, if the initial number of fish is x (x in thousands), after one month they reproduce until a number of $f(x) = \frac{36x}{4 + 39x}$ fishes.

What number of fish leads to the largest increase in the number of animals, $f(x) - x$?

- 1) $\frac{18}{11}$
- 2) $\frac{8}{39}$
- 3) $\frac{1}{2}$
- 4) $\frac{12}{5}$
- 5) $\frac{5}{9}$

Exercise 7

The yield of a tree plantation is given by $f(x) =$

$$\frac{-17 + 21x + 27x^2}{37x^5}, \text{ where } x \text{ is the distance in meters between two trees.}$$

What is the distance x that leads to the largest yield.

- 1) $\frac{17}{4}$
- 2) $\frac{17}{27}$
- 3) $\frac{30}{17}$
- 4) $\frac{23}{9}$
- 5) 7

Exercise 8

A plastic firm receives an order to manufacture 15379 special plastic foam boards for swimming training. The firm has 12 machines but each of them will be able to participate in the manufacturing of this special type of tables only after an adaptation so that each adapted machine is capable of manufacturing 3 boards per hour; on the other hand, the non adapted ones cannot be used for this special order. The cost to adapt each machine is 546 monetary units. Moreover, these adapted machines are automated and only need staff to supervise the production whose salary is 18 monetary units per hour. Taking into account the number of hours that will be necessary to produce the ordered tables, the cost in salaries for those hours, and the adaptation costs, how many of the machines that the company has should be adapted to place the order at the lowest possible cost?

- 1) 16
- 2) 9
- 3) None of the other options is correct.
- 4) 9
- 5) 25

Exercise 9

Study the differentiability of the function $f(x) = \begin{cases} 4 - e^x & x \leq 0 \\ \frac{3x^2}{4} - x + 3 & 0 < x < 2 \\ -x + 3 + (x-1) \log(x-1) + 7 & 2 \leq x \end{cases}$

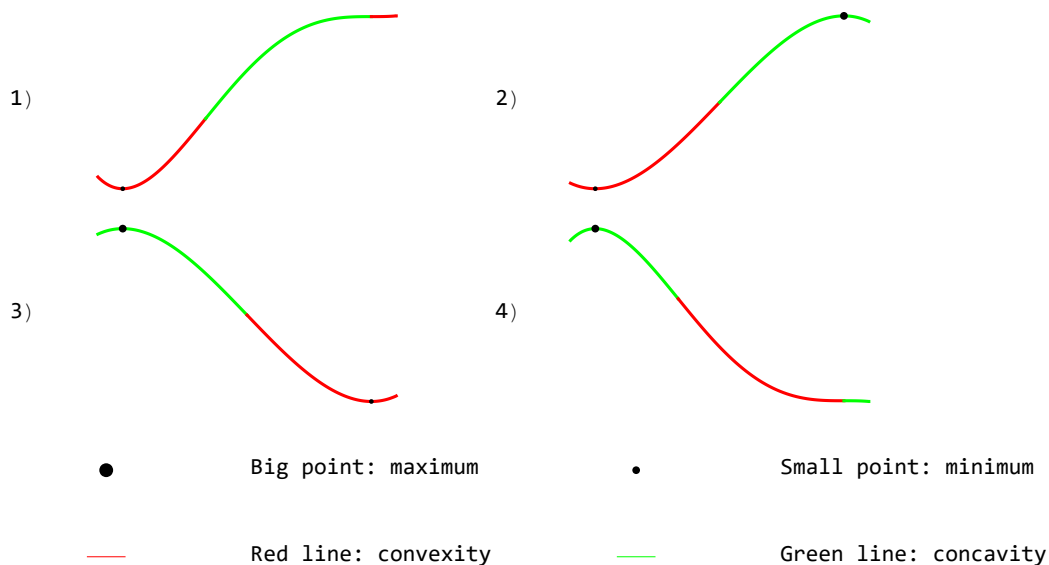
- 1) The function is differentiable for all points.
- 2) The function is not differentiable at any point.
- 3) The function is differentiable for all points except for $x=0$.
- 4) The function is differentiable for all points except for $x=2$.
- 5) The function is differentiable for all points except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

Mathematics 1 - ADE - English - 2026/2027

02-Derivatives for serial number: 92

Exercise 1

Study the shape properties of the $f(x) = 4 + 12x - 6x^2 - 4x^3 + 3x^4$ to decide which amongst the following ones is the representation of the function.



Indication: To find the maximum and minimum points of the function, try (with Ruffini) the points $-2, -1, 0, 1, 2$. To solve this exercise it is necessary to determine the increasing and decreasing intervals.

Exercise 2

Determine the derivative of the function $f(t) = \sin(e^{e^t}) \cos(e^t)$ and compute its value at the point $t=0$.

- 1) $f'(0) = 0$ 2) $f'(0) = 1$ 3) $f'(0) = -4$ 4) $f'(0) = e \cos[1] \cos[e] - \sin[1] \sin[e]$

Exercise 3

Compute the limit: $\lim_{x \rightarrow 0} \frac{-1 + \frac{x^2}{2} + \cos[x]}{x^4}$

- 1) 1
- 2) $\frac{1}{24}$
- 3) $-\frac{1}{2}$
- 4) 0
- 5) $-\infty$
- 6) -1
- 7) ∞

Exercise 4

Compute the limit: $\lim_{x \rightarrow -1} \frac{x + 2x^2 + x^3}{-1 - x + x^2 + x^3}$

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

Exercise 5

Between the months $t=3$ and $t=8$

, the funds in certain account (in millions of euros) are given by the function $F(t) = 17 + 126t - 30t^2 + 2t^3$.

Determine the interval within the funds oscillates between months $t=4$ and $t=8$.

- 1) It oscillates between 113 and 171.
- 2) It oscillates between 115 and 169.
- 3) It oscillates between 114 and 177.
- 4) It oscillates between 115 and 179.
- 5) It oscillates between 115 and 179.

Exercise 6

In a fish farm, data of precedings years reveal that, if the initial number of fish is x (x in thousands), after one month they reproduce until a number of $f(x) = \frac{4x}{1+13x}$ fishes.

What number of fish leads to the largest increase in the number of animals, $f(x) - x$?

- 1) 1
- 2) $\frac{3}{2}$
- 3) $\frac{35}{16}$
- 4) $\frac{15}{7}$
- 5) $\frac{1}{13}$

Exercise 7

The yield of a tree plantation is given by $f(x) =$

$$\frac{-17 + 23x + 4x^2}{28x^2}, \text{ where } x \text{ is the distance in meters between two trees.}$$

What is the distance x that leads to the largest yield.

- 1) 1
- 2) $\frac{18}{5}$
- 3) $\frac{3}{2}$
- 4) $\frac{1}{3}$
- 5) $\frac{34}{23}$

Exercise 8

A plastic firm receives and order to manufacture 36414 special plastic foam boards for swimming training. The firm have 23 machines but each of them will be able to participate in the manufacturing of this special type of tables only after an adaptation so that each adapted machine is capable of manufacturing 34 boards per hour; on the other hand, the non adapted ones cannot be used for this special order. The cost to adapt each machine is 2023 monetary units. Moreover, these adapted machines are automated and only need staff to supervise the production whose salary is 153 monetary units per hour. Taking into account the number of hours that will be necessary to produce the ordered tables, the cost in salaries for those hours, and the adaptation costs, how many of the machines that the company has should be adapted to place the order at the lowest possible cost?

- 1) 15
- 2) 15
- 3) None of the other options is correct.
- 4) 4
- 5) 23

Exercise 9

Study the differentiability of the function $f(x) =$

$$\begin{cases} \cos(x+3) - 2(e^{x+3} + 2) & x \leq -3 \\ -(x(2 + \log(27))) + 3(x+4)\log(x+4) - 11 - 3\log(27) & -3 < x < -1 \\ 4x - 3(x+2)\log(x+2) - 1 + \log(27) & -1 \leq x \end{cases}$$

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

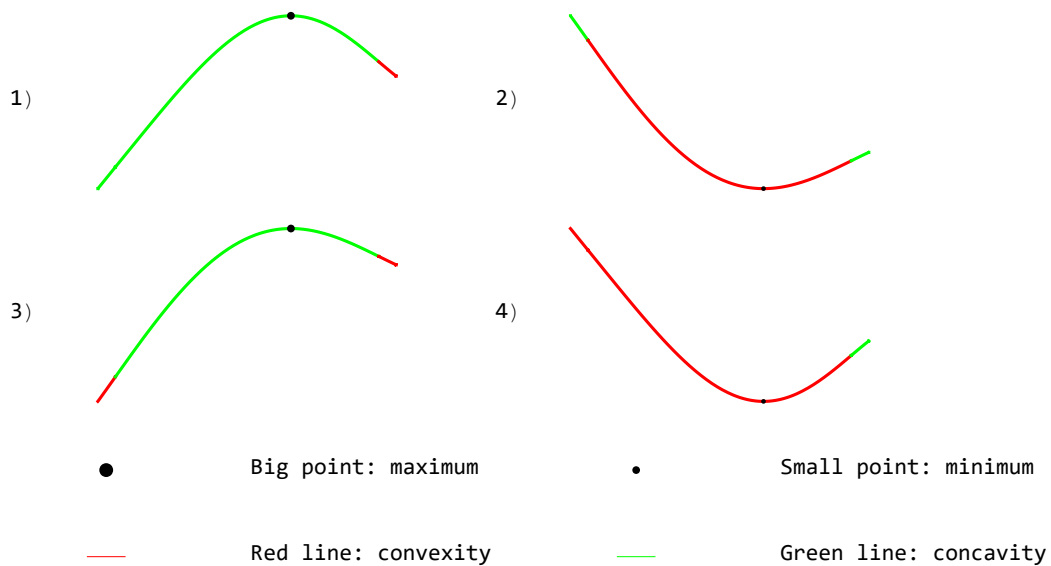
Mathematics 1 - ADE - English - 2026/2027

02-Derivatives for serial number: 93

Exercise 1

Study the shape properties of $f(x) = 3 - 24x^2 + 3x^4 + \frac{3x^5}{5}$

to decide which amongst the following ones is the representation of the function.



Indication: To solve this exercise it is necessary to determine the concavity and convexity interval. To find the inflexion points separating the concavity and convexity intervals, check (by means of Ruffini) with the points $-2, -1, 0, 1, 2$.

Exercise 2

Determine the derivative of the function $f(t) = -3e^t t^2 \log(t+1) \cos(t)$ and compute its value at the point $t=0$.

- 1) $f'(0) = 1$ 2) $f'(0) = -3$ 3) $f'(0) = 0$ 4) $f'(0) = 3$

Exercise 3

Compute the limit: $\lim_{x \rightarrow 0} \frac{-1 + \cos[x^3]}{x^6}$

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

Exercise 4

Compute the limit: $\lim_{x \rightarrow -3} \frac{3x + x^2}{3 + 4x + x^2}$

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

Exercise 5

Between the months $t=1$ and $t=6$

, the true value of the shares of a company (in euros) are given by the function $C(t) = 56 + 48t - 18t^2 + 2t^3$.

Determine the interval within the value oscillates between months $t=4$ and $t=6$.

- 1) It oscillates between 97 and 138.
- 2) It oscillates between 88 and 128.
- 3) It oscillates between 95 and 132.
- 4) It oscillates between 88 and 96.
- 5) It oscillates between 92 and 124.

Exercise 6

In a fish farm, data of precedings years reveal that, if the initial number of fish is x (x in thousands), after one month they reproduce until a number of $f(x) = \frac{32x}{18 + 34x}$ fishes.

What number of fish leads to the largest increase in the number of animals, $f(x) - x$?

- 1) $\frac{21}{8}$
- 2) 2
- 3) $\frac{29}{19}$
- 4) $\frac{17}{5}$
- 5) $\frac{3}{17}$

Exercise 7

The yield of a tree plantation is given by $f(x) =$

$$\frac{-6 + 3x + 24x^2}{3x^3}, \text{ where } x \text{ is the distance in meters between two trees.}$$

What is the distance x that leads to the largest yield.

- 1) $\frac{15}{7}$
- 2) 4
- 3) 3
- 4) $\frac{3}{4}$
- 5) $\frac{21}{4}$

Exercise 8

A plastic firm receives an order to manufacture 140250 special plastic foam boards for swimming training. The firm has 9 machines but each of them will be able to participate in the manufacturing of this special type of tables only after an adaptation so that each adapted machine is capable of manufacturing 165 boards per hour; on the other hand, the non adapted ones cannot be used for this special order. The cost to adapt each machine is 85 monetary units. Moreover, these adapted machines are automated and only need staff to supervise the production whose salary is 40 monetary units per hour. Taking into account the number of hours that will be necessary to produce the ordered tables, the cost in salaries for those hours, and the adaptation costs, how many of the machines that the company has should be adapted to place the order at the lowest possible cost?

- 1) 28
- 2) 18
- 3) 9
- 4) 25
- 5) None of the other options is correct.

Exercise 9

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

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

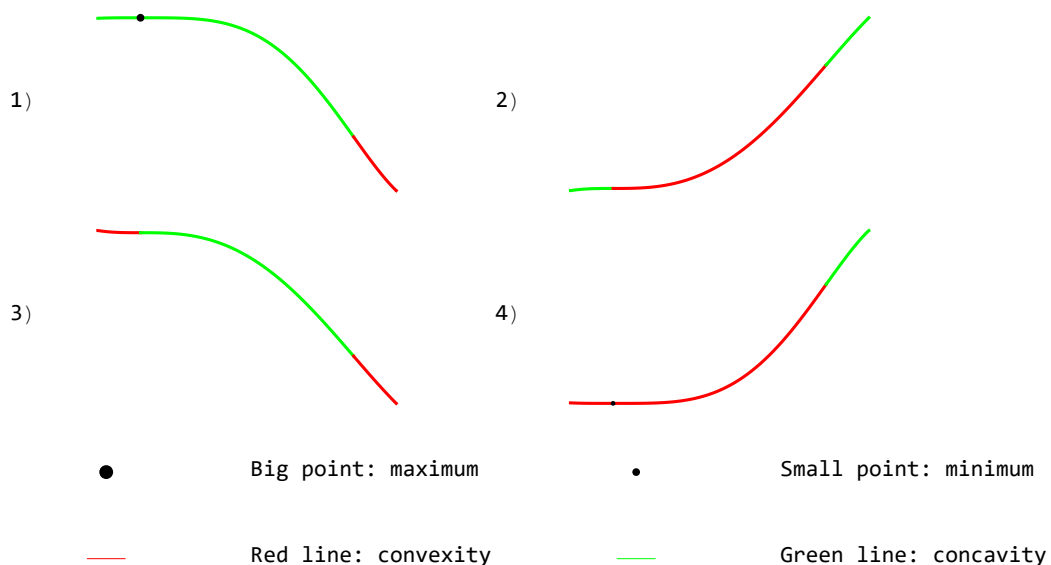
Mathematics 1 - ADE - English - 2026/2027

02-Derivatives for serial number: 94

Exercise 1

Study the shape properties of $f(x) = 5 - x^4 + \frac{3x^5}{5}$

to decide which amongst the following ones is the representation of the function.



Indication: To solve this exercise it is necessary to determine the concavity and convexity interval. To find the inflexion points separating the concavity and convexity intervals, check (by means of Ruffini) with the points $-2, -1, 0, 1, 2$.

Exercise 2

Determine the derivative of the function $f(t) =$

$e^t - 3 \log(\cos(t) + 1) \sin(\cos(t))$ and compute its value at the point $t=0$.

- 1) $f'(0) = 0$ 2) $f'(0) = 1$ 3) $f'(0) = 3$ 4) $f'(0) = -3$

Exercise 3

Compute the limit: $\lim_{x \rightarrow 0} \frac{-1 + \cos[x^3]}{x^6}$

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

Exercise 4

Compute the limit: $\lim_{x \rightarrow -3} \frac{9x + 6x^2 + x^3}{-9 + x^2}$

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

Exercise 5

Between the months $t=2$ and $t=8$

, the true value of the shares of a company (in euros) are given by the function $C(t) = 26 + 36t - 15t^2 + 2t^3$.

Determine the interval within the value oscillates between months $t=3$ and $t=5$.

- 1) It oscillates between 53 and 81.
- 2) It oscillates between 55 and 81.
- 3) It oscillates between 44 and 84.
- 4) It oscillates between 53 and 378.
- 5) It oscillates between 53 and 54.

Exercise 6

In a fish farm, data of precedings years reveal that, if the initial number of fish is x (x in thousands), after one month they reproduce until a number of $f(x) = \frac{28x}{7 + 18x}$ fishes.

What number of fish leads to the largest increase in the number of animals, $f(x) - x$?

- 1) $\frac{7}{18}$
- 2) $\frac{2}{5}$
- 3) $\frac{10}{3}$
- 4) $\frac{38}{11}$
- 5) 3

Exercise 7

The yield of a tree plantation is given by $f(x) =$

$$\frac{-11 + 22x^2}{7x^4}, \text{ where } x \text{ is the distance in meters between two trees.}$$

What is the distance x that leads to the largest yield.

- 1) 1
- 2) 22
- 3) $\frac{30}{19}$
- 4) $\frac{15}{13}$
- 5) $\frac{35}{6}$

Exercise 8

A plastic firm receives an order to manufacture 43560 special plastic foam boards for swimming training. The firm has 10 machines but each of them will be able to participate in the manufacturing of this special type of tables only after an adaptation so that each adapted machine is capable of manufacturing 143 boards per hour; on the other hand, the non adapted ones cannot be used for this special order. The cost to adapt each machine is 110 monetary units. Moreover, these adapted machines are automated and only need staff to supervise the production whose salary is 52 monetary units per hour. Taking into account the number of hours that will be necessary to produce the ordered tables, the cost in salaries for those hours, and the adaptation costs, how many of the machines that the company has should be adapted to place the order at the lowest possible cost?

- 1) 1
- 2) 12
- 3) None of the other options is correct.
- 4) 10
- 5) 25

Exercise 9

Study the differentiability of the function $f(x) = \begin{cases} 3 \cos(2 - x) - 2(\sin(2 - x) + 2) & x \leq 2 \\ -\frac{2}{3}(x - 7)x - \frac{17}{3} & 2 < x < 5 \\ -2e^{x-5} - 2 \cos(5 - x) + 5 & 5 \leq x \end{cases}$

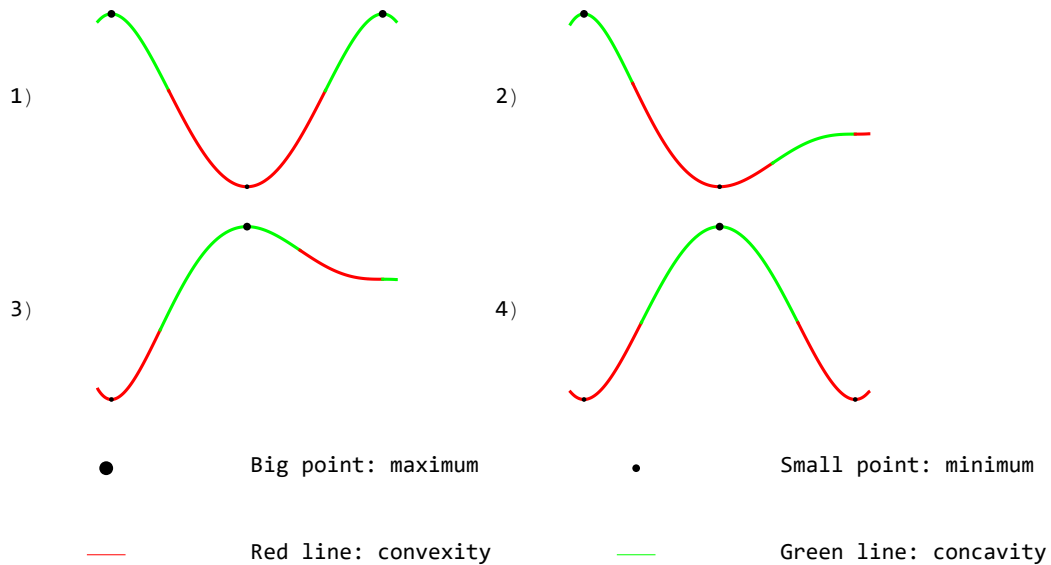
- 1) The function is differentiable for all points.
- 2) The function is not differentiable at any point.
- 3) The function is differentiable for all points except for $x = 2$.
- 4) The function is differentiable for all points except for $x = 5$.
- 5) The function is differentiable for all points except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

Mathematics 1 - ADE - English - 2026/2027

02-Derivatives for serial number: 95

Exercise 1

Study the shape properties of the $f(x) = 3 + 240x^2 - 80x^3 - 30x^4 + 12x^5$ to decide which amongst the following ones is the representation of the function.



Indication: To find the maximum and minimum points of the function, try (with Ruffini) the points $-2, -1, 0, 1, 2$. To solve this exercise it is necessary to determine the increasing and decreasing intervals.

Exercise 2

Determine the derivative of the function $f(t) = \log(t+1) (e^t + 2 \log(t+1)) \cos(t)$ and compute its value at the point $t=0$.

- 1) $f'(0) = -2$ 2) $f'(0) = 2$ 3) $f'(0) = 0$ 4) $f'(0) = 1$

Exercise 3

Compute the limit: $\lim_{x \rightarrow 1} \frac{3 - 4x + x^2 + \text{Log}[x^2]}{-1 + 3x - 3x^2 + x^3}$

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

Exercise 4

Compute the limit: $\lim_{x \rightarrow 2} \frac{-8x + 12x^2 - 6x^3 + x^4}{-4 + 8x - 5x^2 + x^3}$

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

Exercise 5

Between the months $t=1$ and $t=8$

, the funds in certain account (in millions of euros) are given by the function $F(t) = -1 + 252t - 39t^2 + 2t^3$.

Determine the interval within the funds oscillates between months $t=2$ and $t=7$.

- 1) It oscillates between 358 and 545.
- 2) It oscillates between 214 and 543.
- 3) It oscillates between 363 and 539.
- 4) It oscillates between 373 and 541.
- 5) It oscillates between 538 and 539.

Exercise 6

In a fish farm, data of precedings years reveal that, if the initial number of fish is x (x in thousands), after one month they reproduce until a number of $f(x) = \frac{9x}{1+29x}$ fishes.

What number of fish leads to the largest increase in the number of animals, $f(x) - x$?

- 1) $\frac{29}{16}$
- 2) $\frac{29}{20}$
- 3) $\frac{2}{29}$
- 4) 8
- 5) 2

Exercise 7

The yield of a tree plantation is given by $f(x) =$

$$\frac{-38 + 50x + 25x^2}{5x^2}, \text{ where } x \text{ is the distance in meters between two trees.}$$

What is the distance x that leads to the largest yield.

- 1) $\frac{13}{2}$
- 2) $\frac{38}{25}$
- 3) $\frac{31}{5}$
- 4) 1
- 5) $\frac{11}{7}$

Exercise 8

A plastic firm receives and order to manufacture 34496 special plastic foam boards for swimming training. The firm have 14 machines but each of them will be able to participate in the manufacturing of this special type of tables only after an adaptation so that each adapted machine is capable of manufacturing 11 boards per hour; on the other hand, the non adapted ones cannot be used for this special order. The cost to adapt each machine is 2499 monetary units. Moreover, these adapted machines are automated and only need staff to supervise the production whose salary is 51 monetary units per hour. Taking into account the number of hours that will be necessary to produce the ordered tables, the cost in salaries for those hours, and the adaptation costs, how many of the machines that the company has should be adapted to place the order at the lowest possible cost?

- 1) 14
- 2) 9
- 3) 8
- 4) None of the other options is correct.
- 5) 4

Exercise 9

Study the differentiability of the function $f(x) =$

$$\begin{cases} e^{x-2} - 2 \sin(2) \sin(x) - 2 \cos(2) \cos(x) + 3 & x \leq 2 \\ -x - 2 \sin(2-x) + 2 \cos(2-x) + 2 & 2 < x < 5 \\ -x - (x-4) \log(x-4) + 2(1 + \sin(3) + \cos(3)) & 5 \leq x \end{cases}$$

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

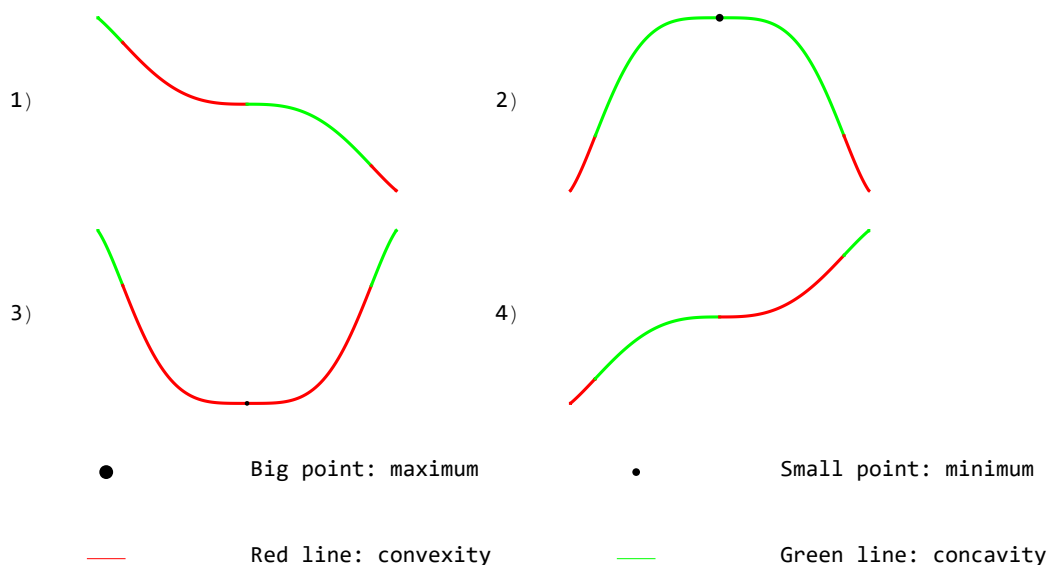
Mathematics 1 - ADE - English - 2026/2027

02-Derivatives for serial number: 96

Exercise 1

Study the shape properties of $f(x) = 3 - 2x^3 + \frac{3x^5}{5}$

to decide which amongst the following ones is the representation of the function.



Indication: To solve this exercise it is necessary to determine the concavity and convexity interval. To find the inflexion points separating the concavity and convexity intervals, check (by means of Ruffini) with the points $-2, -1, 0, 1, 2$.

Exercise 2

Determine the derivative of the function $f(t) = t^3 - 3e^{t^3} + 2$ and compute its value at the point $t=0$.

- 1) $f'(0) = -1$ 2) $f'(0) = 2$ 3) $f'(0) = 0$ 4) $f'(0) = -3$

Exercise 3

Compute the limit: $\lim_{x \rightarrow 0} \frac{-1 + \cos [x^3]}{x^4}$

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

Exercise 4

Compute the limit: $\lim_{x \rightarrow -2} \frac{2 + 3x + x^2}{-2 + x + x^2}$

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

Exercise 5

Between the months $t=3$ and $t=7$

, the true value of the shares of a company (in euros) are given by the function $C(t) = 145 + 120t - 27t^2 + 2t^3$.

Determine the interval within the value oscillates between months $t=3$ and $t=7$.

- 1) It oscillates between 316 and 348.
- 2) It oscillates between 319 and 342.
- 3) It oscillates between 320 and 321.
- 4) It oscillates between 314 and 343.
- 5) It oscillates between 310 and 343.

Exercise 6

In a fish farm, data of precedings years reveal that, if the initial number of fish is x (x in thousands), after one month they reproduce until a number of $f(x) = \frac{45x}{5 + 45x}$ fishes.

What number of fish leads to the largest increase in the number of animals, $f(x) - x$?

- 1) $\frac{25}{6}$
- 2) $\frac{9}{11}$
- 3) $\frac{19}{6}$
- 4) 15
- 5) $\frac{2}{9}$

Exercise 7

The yield of a tree plantation is given by $f(x) =$

$$\frac{-23 + 43x + 20x^2}{5x^9}, \text{ where } x \text{ is the distance in meters between two trees.}$$

What is the distance x that leads to the largest yield.

- 1) $\frac{31}{20}$
- 2) $\frac{1}{2}$
- 3) $\frac{19}{3}$
- 4) $\frac{40}{9}$
- 5) 3

Exercise 8

A plastic firm receives an order to manufacture 70805 special plastic foam boards for swimming training. The firm has 14 machines but each of them will be able to participate in the manufacturing of this special type of tables only after an adaptation so that each adapted machine is capable of manufacturing 7 boards per hour; on the other hand, the non adapted ones cannot be used for this special order. The cost to adapt each machine is 18785 monetary units. Moreover, these adapted machines are automated and only need staff to supervise the production whose salary is 91 monetary units per hour. Taking into account the number of hours that will be necessary to produce the ordered tables, the cost in salaries for those hours, and the adaptation costs, how many of the machines that the company has should be adapted to place the order at the lowest possible cost?

- 1) 15
- 2) 14
- 3) None of the other options is correct.
- 4) 6
- 5) 2

Exercise 9

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

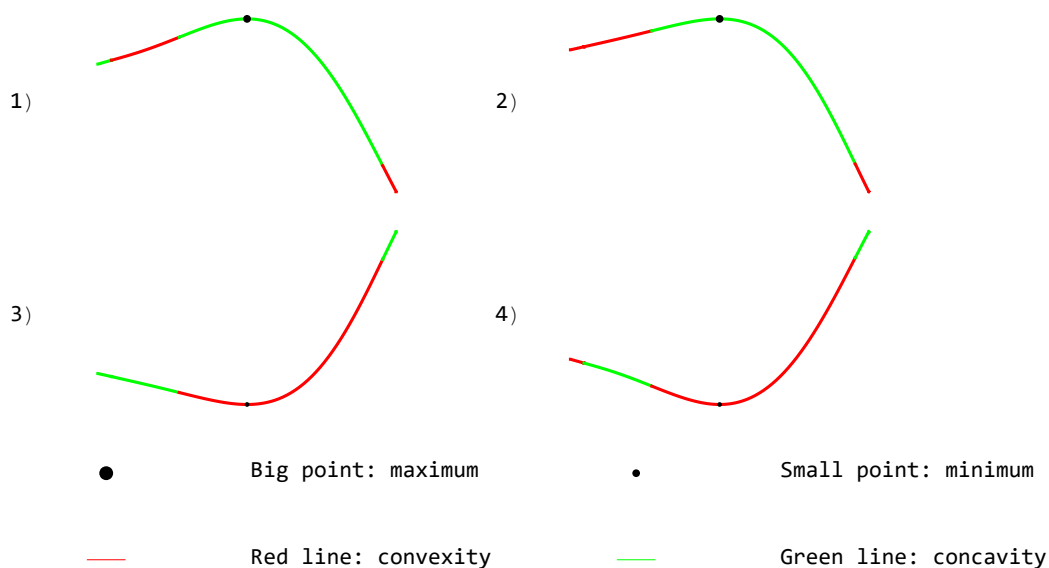
- 1) The function is differentiable for all points.
- 2) The function is not differentiable at any point.
- 3) The function is differentiable for all points except for $x=0$.
- 4) The function is differentiable for all points except for $x=1$.
- 5) The function is differentiable for all points except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

Mathematics 1 - ADE - English - 2026/2027

02-Derivatives for serial number: 97

Exercise 1

Study the shape properties of $f(x) = 4 - 240x^2 - 120x^3 - 10x^4 + 9x^5 + 2x^6$ to decide which amongst the following ones is the representation of the function.



Indication: To solve this exercise it is necessary to determine the concavity and convexity interval. To find the inflexion points separating the concavity and convexity intervals, check (by means of Ruffini) with the points $-2, -1, 0, 1, 2$.

Exercise 2

Determine the derivative of the function $f(t) = \sin(e^t) \left(-\cos(e^{e^t}) \right)$ and compute its value at the point $t=0$.

- 1) $f'(0) = -\cos[1] \cos[e] + e \sin[1] \sin[e]$ 2) $f'(0) = 4$ 3) $f'(0) = 2$ 4) $f'(0) = 1$

Exercise 3

Compute the limit: $\lim_{x \rightarrow 0} \frac{-x + \sin[x]}{x^2}$

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

Exercise 4

Compute the limit: $\lim_{x \rightarrow -3} \frac{-9 + 3x + 5x^2 + x^3}{3 + 4x + x^2}$

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

Exercise 5

Between the months $t=0$ and $t=6$

, the true value of the shares of a company (in euros) are given by the function $C(t) = 27 + 72t - 21t^2 + 2t^3$.

Determine the interval within the value oscillates between months $t=0$ and $t=4$.

- 1) It oscillates between 27 and 135.
- 2) It oscillates between 23 and 99.
- 3) It oscillates between 27 and 108.
- 4) It oscillates between 30 and 110.
- 5) It oscillates between 107 and 108.

Exercise 6

In a fish farm, data of precedings years reveal that, if the initial number of fish is x (x in thousands), after one month they reproduce until a number of $f(x) = \frac{49x}{4 + 34x}$ fishes.

What number of fish leads to the largest increase in the number of animals, $f(x) - x$?

- 1) $\frac{5}{17}$
- 2) 12
- 3) $\frac{20}{7}$
- 4) 2
- 5) $\frac{20}{7}$

Exercise 7

The yield of a tree plantation is given by $f(x) =$

$$\frac{-37 + 47x + 17x^2}{33x^3}, \text{ where } x \text{ is the distance in meters between two trees.}$$

What is the distance x that leads to the largest yield.

- 1) 28
- 2) $\frac{3}{2}$
- 3) 1
- 4) 2
- 5) $\frac{5}{2}$

Exercise 8

A plastic firm receives an order to manufacture 1573 special plastic foam boards for swimming training. The firm has 9 machines but each of them will be able to participate in the manufacturing of this special type of tables only after an adaptation so that each adapted machine is capable of manufacturing 11 boards per hour; on the other hand, the non adapted ones cannot be used for this special order. The cost to adapt each machine is 1365 monetary units. Moreover, these adapted machines are automated and only need staff to supervise the production whose salary is 1155 monetary units per hour. Taking into account the number of hours that will be necessary to produce the ordered tables, the cost in salaries for those hours, and the adaptation costs, how many of the machines that the company has should be adapted to place the order at the lowest possible cost?

- 1) 17
- 2) 11
- 3) 9
- 4) 22
- 5) None of the other options is correct.

Exercise 9

Study the differentiability of the function $f(x) =$

$$\begin{cases} -e^{x-2} - 2 \sin(2) \sin(x) - 2 \cos(2) \cos(x) + 4 & x \leq 2 \\ \frac{3x^2}{2} - 7x + 9 & 2 < x < 3 \\ 2e^{x-3} + \cos(3-x) - \frac{3}{2} & 3 \leq x \end{cases}$$

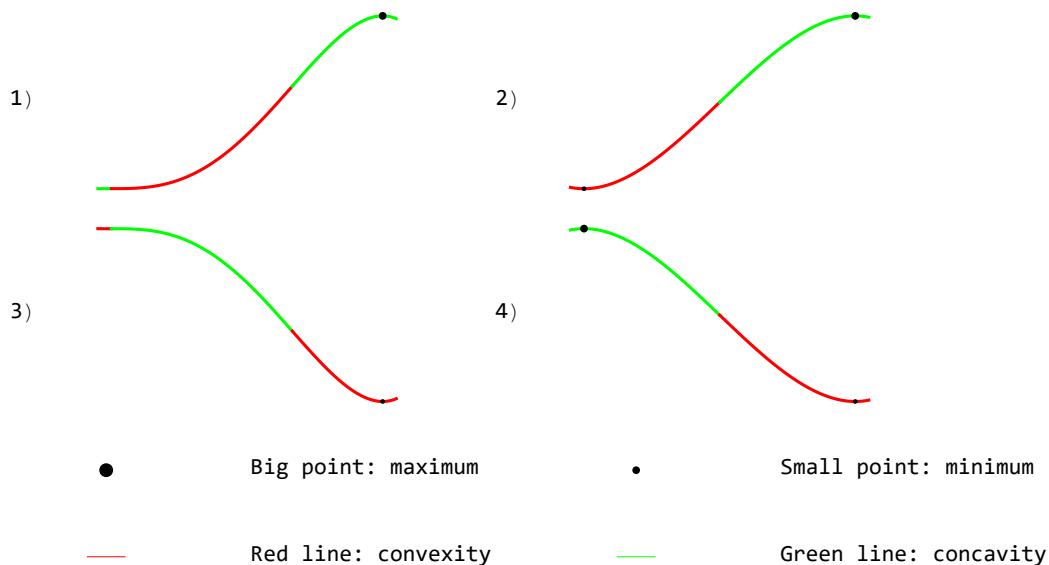
- 1) The function is differentiable for all points.
- 2) The function is not differentiable at any point.
- 3) The function is differentiable for all points except for $x=2$.
- 4) The function is differentiable for all points except for $x=3$.
- 5) The function is differentiable for all points except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

Mathematics 1 - ADE - English - 2026/2027

02-Derivatives for serial number: 98

Exercise 1

Study the shape properties of the $f(x) = 4 - 96x - 24x^2 + 8x^3 + 3x^4$ to decide which amongst the following ones is the representation of the function.



Indication: To find the maximum and minimum points of the function, try (with Ruffini) the points $-2, -1, 0, 1, 2$. To solve this exercise it is necessary to determine the increasing and decreasing intervals.

Exercise 2

Determine the derivative of the function $f(t) = \cos(t) + 1$ and compute its value at the point $t=0$.

- 1) $f'(0) = -4$ 2) $f'(0) = 3$ 3) $f'(0) = 2$ 4) $f'(0) = 0$

Exercise 3

Compute the limit: $\lim_{x \rightarrow 0} \frac{-1 + e^x - x - \frac{x^2}{2} - \frac{x^3}{6}}{x^4}$

- 1) ∞
- 2) 1
- 3) 0
- 4) $\frac{1}{24}$
- 5) $-\infty$
- 6) $-\frac{1}{2}$
- 7) -1

Exercise 4

Compute the limit: $\lim_{x \rightarrow 1} \frac{3 - 10x + 12x^2 - 6x^3 + x^4}{1 - x - x^2 + x^3}$

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

Exercise 5

Between the months $t=2$ and $t=9$

, the funds in certain account (in millions of euros) are given by the function $F(t) = -17 + 168t - 33t^2 + 2t^3$.

Determine the interval within the funds oscillates between months $t=5$ and $t=7$.

- 1) It oscillates between 228 and 255.
- 2) It oscillates between 218 and 256.
- 3) It oscillates between 233 and 243.
- 4) It oscillates between 228 and 248.
- 5) It oscillates between 203 and 280.

Exercise 6

In a fish farm, data of precedings years reveal that, if the initial number of fish is x (x in thousands), after one month they reproduce until a number of $f(x) = \frac{32x}{2+8x}$ fishes.

What number of fish leads to the largest increase in the number of animals, $f(x) - x$?

- 1) $\frac{1}{3}$
- 2) 1
- 3) $\frac{11}{9}$
- 4) $\frac{15}{8}$
- 5) $\frac{3}{4}$

Exercise 7

The yield of a tree plantation is given by $f(x) =$

$$\frac{-28 + 31x + 23x^2}{25x^2}, \text{ where } x \text{ is the distance in meters between two trees.}$$

What is the distance x that leads to the largest yield.

- 1) $\frac{38}{5}$
- 2) $\frac{56}{31}$
- 3) 32
- 4) $\frac{22}{17}$
- 5) 2

Exercise 8

A plastic firm receives and order to manufacture 3971 special plastic foam boards for swimming training. The firm have 22 machines but each of them will be able to participate in the manufacturing of this special type of tables only after an adaptation so that each adapted machine is capable of manufacturing 22 boards per hour; on the other hand, the non adapted ones cannot be used for this special order. The cost to adapt each machine is 75 monetary units. Moreover, these adapted machines are automated and only need staff to supervise the production whose salary is 150 monetary units per hour. Taking into account the number of hours that will be necessary to produce the ordered tables, the cost in salaries for those hours, and the adaptation costs, how many of the machines that the company has should be adapted to place the order at the lowest possible cost?

- 1) 14
- 2) 22
- 3) 19
- 4) None of the other options is correct.
- 5) 4

Exercise 9

Study the differentiability of the function $f(x) = \begin{cases} 2 \sin(2-x) - 3 \cos(2-x) + 2 & x \leq 2 \\ \frac{3x^2}{4} - 7x + 10 & 2 < x < 4 \\ \sin(4-x) - \cos(4-x) - 4 & 4 \leq x \end{cases}$

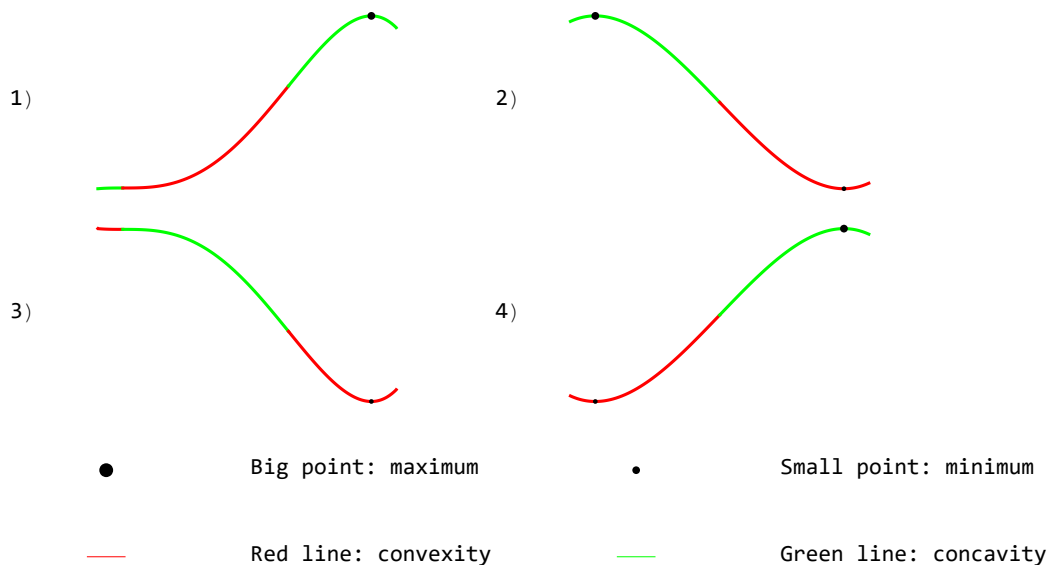
- 1) The function is differentiable for all points.
- 2) The function is not differentiable at any point.
- 3) The function is differentiable for all points except for $x=2$.
- 4) The function is differentiable for all points except for $x=4$.
- 5) The function is differentiable for all points except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

Mathematics 1 - ADE - English - 2026/2027

02-Derivatives for serial number: 99

Exercise 1

Study the shape properties of the $f(x) = 3 - 12x - 6x^2 + 4x^3 + 3x^4$ to decide which amongst the following ones is the representation of the function.



Indication: To find the maximum and minimum points of the function, try (with Ruffini) the points $-2, -1, 0, 1, 2$. To solve this exercise it is necessary to determine the increasing and decreasing intervals.

Exercise 2

Determine the derivative of the function $f(t) = e^t - t \sin(\log(t+1))$ and compute its value at the point $t=0$.

- 1) $f'(0) = 2$ 2) $f'(0) = -2$ 3) $f'(0) = 1$ 4) $f'(0) = -3$

Exercise 3

Compute the limit: $\lim_{x \rightarrow 0} \frac{-1 + e^x - x - \frac{x^2}{2}}{x^3}$

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

Exercise 4

Compute the limit: $\lim_{x \rightarrow -1} \frac{x + 2x^2 + x^3}{-3 - 5x - x^2 + x^3}$

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

Exercise 5

Between the months $t=2$ and $t=8$

, the funds in certain account (in millions of euros) are given by the function $F(t) = -19 + 126t - 30t^2 + 2t^3$.

Determine the interval within the funds oscillates between months $t=6$ and $t=7$.

- 1) It oscillates between 79 and 143.
- 2) It oscillates between 80 and 86.
- 3) It oscillates between 79 and 143.
- 4) It oscillates between 79 and 89.
- 5) It oscillates between 70 and 85.

Exercise 6

In a fish farm, data of precedings years reveal that, if the initial number of fish is x (x in thousands), after one month they reproduce until a number of $f(x) = \frac{27x}{3 + 20x}$ fishes.

What number of fish leads to the largest increase in the number of animals, $f(x) - x$?

- 1) $\frac{7}{9}$
- 2) 24
- 3) $\frac{33}{16}$
- 4) $\frac{25}{2}$
- 5) $\frac{3}{10}$

Exercise 7

The yield of a tree plantation is given by $f(x) =$

$$\frac{-49 + 27x + 42x^2}{37x^2}, \text{ where } x \text{ is the distance in meters between two trees.}$$

What is the distance x that leads to the largest yield.

- 1) $\frac{27}{13}$
- 2) 36
- 3) $\frac{14}{11}$
- 4) $\frac{98}{27}$
- 5) $\frac{33}{7}$

Exercise 8

A plastic firm receives an order to manufacture 6240 special plastic foam boards for swimming training. The firm has 19 machines but each of them will be able to participate in the manufacturing of this special type of tables only after an adaptation so that each adapted machine is capable of manufacturing 5 boards per hour; on the other hand, the non adapted ones cannot be used for this special order. The cost to adapt each machine is 4862 monetary units. Moreover, these adapted machines are automated and only need staff to supervise the production whose salary is 561 monetary units per hour. Taking into account the number of hours that will be necessary to produce the ordered tables, the cost in salaries for those hours, and the adaptation costs, how many of the machines that the company has should be adapted to place the order at the lowest possible cost?

- 1) 1
- 2) None of the other options is correct.
- 3) 23
- 4) 12
- 5) 25

Exercise 9

Study the differentiability of the function $f(x) = \begin{cases} \sin(2-x) - 2 & x \leq 2 \\ \frac{3x^2}{4} - 4x + 3 & 2 < x < 4 \\ 2e^{x-4} + 2\cos(4-x) - 5 & 4 \leq x \end{cases}$

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

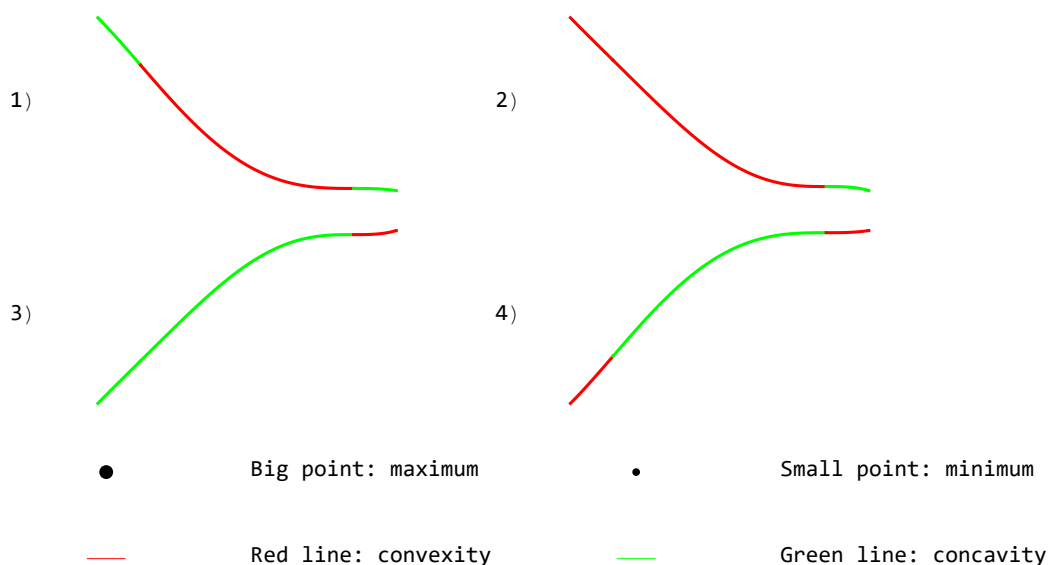
Mathematics 1 - ADE - English - 2026/2027

02-Derivatives for serial number: 100

Exercise 1

Study the shape properties of $f(x) = 3 + 2x^3 + 2x^4 + \frac{3x^5}{5}$

to decide which amongst the following ones is the representation of the function.



Indication: To solve this exercise it is necessary to determine the concavity and convexity interval. To find the inflexion points separating the concavity and convexity intervals, check (by means of Ruffini) with the points $-2, -1, 0, 1, 2$.

Exercise 2

Determine the derivative of the function $f(t) = 3 \log(t^3 + 1) + t^2 + 3$ and compute its value at the point $t=0$.

- 1) $f'(0) = -2$ 2) $f'(0) = -1$ 3) $f'(0) = 4$ 4) $f'(0) = 0$

Exercise 3

Compute the limit: $\lim_{x \rightarrow 1} \frac{\frac{137}{20} - 15x + 15x^2 - 10x^3 + \frac{15x^4}{4} - \frac{3x^5}{5} + \text{Log}[x^3]}{1 - 6x + 15x^2 - 20x^3 + 15x^4 - 6x^5 + x^6}$

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

Exercise 4

Compute the limit: $\lim_{x \rightarrow 3} \frac{-18 + 21x - 8x^2 + x^3}{-9 + 15x - 7x^2 + x^3}$

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

Exercise 5

Between the months $t=4$ and $t=10$

, the true value of the shares of a company (in euros) are given by the function $C(t) = 824 + 360t - 48t^2 + 2t^3$.

Determine the interval within the value oscillates between months $t=6$ and $t=7$.

- 1) It oscillates between 1688 and 1682.
- 2) It oscillates between 1671 and 1684.
- 3) It oscillates between 1624 and 1688.
- 4) It oscillates between 1678 and 1688.
- 5) It oscillates between 1624 and 1688.

Exercise 6

In a fish farm, data of precedings years reveal that, if the initial number of fish is x (x in thousands), after one month they reproduce until a number of $f(x) = \frac{50x}{2+x}$ fishes.

What number of fish leads to the largest increase in the number of animals, $f(x) - x$?

- 1) 2
- 2) $\frac{31}{8}$
- 3) $\frac{6}{5}$
- 4) 8
- 5) $\frac{28}{13}$

Exercise 7

The yield of a tree plantation is given by $f(x) =$

$$\frac{-25 + 10x + 50x^2}{3x^6}, \text{ where } x \text{ is the distance in meters between two trees.}$$

What is the distance x that leads to the largest yield.

- 1) $\frac{3}{4}$
- 2) 8
- 3) $\frac{2}{5}$
- 4) $\frac{20}{9}$
- 5) $\frac{13}{7}$

Exercise 8

A plastic firm receives and order to manufacture 1711424 special plastic foam boards for swimming training. The firm have 22 machines but each of them will be able to participate in the manufacturing of this special type of tables only after an adaptation so that each adapted machine is capable of manufacturing 143 boards per hour; on the other hand, the non adapted ones cannot be used for this special order. The cost to adapt each machine is 2431 monetary units. Moreover, these adapted machines are automated and only need staff to supervise the production whose salary is 52 monetary units per hour. Taking into account the number of hours that will be necessary to produce the ordered tables, the cost in salaries for those hours, and the adaptation costs, how many of the machines that the company has should be adapted to place the order at the lowest possible cost?

- 1) 9
- 2) None of the other options is correct.
- 3) 29
- 4) 28
- 5) 15

Exercise 9

Study the differentiability of the function $f(x) =$

$$\begin{cases} -2e^{x+1} + 2\cos(x+1) - 1 & x \leq -1 \\ -2\sin(x+1) + 3\cos(x+1) - 3 & -1 < x < 1 \\ e^{x-1} + 2\cos(1-x) - 3 - 2\sin(2) + 3\cos(2) & 1 \leq x \end{cases}$$

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