Exercise 1 Calc. : ✓

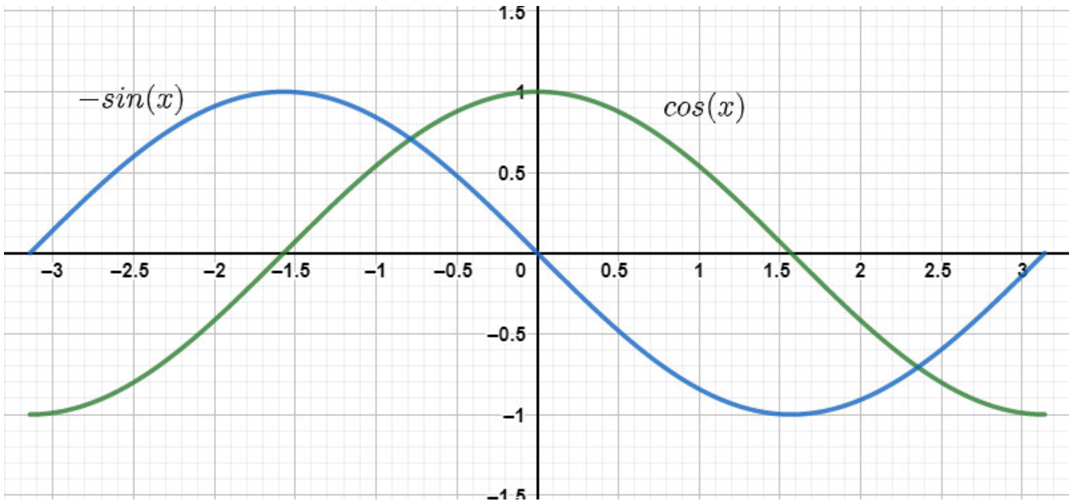
Gabriella is playing with her remote-controlled toy car. The following equation describes the path of the car: $$\begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} 16 \\ 1 \end{pmatrix} + t\begin{pmatrix} -12 \\ 5 \end{pmatrix}$$ The distance units are metres, and the time is in minutes.	
1. Write down the initial position of the car.	1 mark
2. Calculate the position of the car after 15 seconds.	1 mark
3. Compute the speed of the car.	1 mark
Grandma is watching Gabriela from point P$(-1, -6)$	
4. Find the shortest distance from point **P** to the path of the car.	3 marks
The edge of the cliff is at the point $\left(0, \dfrac{23}{3}\right)$ and Grandma walks in that direction with velocity vector $\begin{pmatrix} 3 \\ 41 \end{pmatrix}$.	
5. After how many minutes will the car reach the edge of the cliff?	2 marks
6. Will Grandma be able to catch the car before it falls down the cliff if she starts moving at the same time as the car? Explain your answer.	4 marks

Exercise 2 Calc. : ✓

1. A contractor must carry out work for a public body. If they do not complete the work on time, they will have to pay a daily penalty: 100 € on the first day, 110 € on the second day, and so on with a daily increase of 10 € a day. Let u_n be the penalty on the n-th day. Thus, the first term in sequence u is $u_1 = 100$.	
(a) State the nature and characteristics of sequence u.	1 mark
(b) Explain why $u_n = 90 + 10n$ for all values of integer n.	1.5 marks
(c) On what day would the daily penalty amount to 220 €?	1 mark
(d) What total amount of penalty would the contractor have paid after 20 days of delay?	2.5 marks
2. On another construction site, the penalty for delay is 80 € on the first day and then increases by 10% each day. Let v_n be the amount of the penalty on day n in this case.	
(a) Compute the values of the first three terms v_1, v_2 and v_3.	1.5 marks
(b) Explain why $v_n = 80 \cdot 1.10^{n-1}$ for all values of integer n.	1.5 marks
(c) What is the total amount of penalty the contractor would have paid after 20 days of delay?	2 marks
3. From which day onwards does the amount of the daily penalty in this case exceed that of the first case?	3 marks

Exercise 3 | Calc. : ✓

1. We consider the functions $x \mapsto \cos x$ and $x \mapsto -\sin x$ on $[-\pi;\pi]$ and their graphic representations below:



   Justify that the only solutions of the equation $\cos x + \sin x = 0$ on $[-\pi;\pi]$ are $\dfrac{-\pi}{4}$ and $\dfrac{3\pi}{4}$. — 3 marks

2. Let f be the function defined on $[-\pi;\pi]$ by: $f(x) = e^x \cdot \sin x$

   We note C_f its representative curve in a coordinate system.

   (a) Determine the variations of the function f on $[-\pi;\pi]$, specifying the abscissa, the value and the nature of each extremum. — 2 marks

   (b) Determine an equation of the tangent to the curve C_f at the point of abscissa $\dfrac{\pi}{2}$. — 2 marks

   (c) On what interval is C_f entirely above each of its tangents? To justify. — 2 marks

   (d) Using two successive integrations by parts, calculate the exact value of the integral: — 2 marks

$$\int_{-\pi}^{\pi} f(x)\,dx.$$

Exercise 4 Calc. : ✓

A company is conducting a study into the relationship between the experience and salary of their staff. The experience and salaries of 12 employees were tabulated.

Experience x (years)	0	2	4	6	8	10	12	14	16	18	20	22
Salary y (€)	4 200	4 800	4 600	5 000	5 200	5 600	5 650	5 660	5 500	6 000	5 831	6 200

1. One of the following correlation coefficients fits these data. Which is it? — 1 mark

$$r_1 = 0.95, \quad r_2 = -0.95 \quad \text{or} \quad r_3 = 1?$$

Explain without referring to any computations.

2. Compute the coordinates of the average point for these data, to the nearest integer. — 2 marks

3. The equation of regression line with the method of the least squares is $y = a + bx$, where — 2 marks

$$b = \frac{\sum_{i=1}^{n} (x_i - \overline{x})(y_i - \overline{y})}{\sum_{i=1}^{n} (x_i - \overline{x})^2} \quad \text{and} \quad a = \overline{y} - b\overline{x}.$$

Use the information given below to compute the values of coefficients a and b. Give answers to 2 decimal places.

x_i	$x_i - \bar{x}$	$(x_i - \bar{x})^2$
0	-11	121
2	-9	81
4	-7	49
6	-5	25
8	-3	9
10	-1	1
12	1	1
14	3	9
16	5	25
18	7	49
20	9	81
22	11	121

$$\sum_{i=1}^{n} (x_i - \overline{x})(y_i - \overline{y}) = 45\ 009$$

4. Use the linear model $f(x) = 78.7x + 4\ 488$ to estimate the salary of an employee with 40 years of experience. — 2 marks

The salaries of the employees of this company are normally distributed with mean $\mu = 5\ 353$ and standard deviation $\sigma = 553$.

5. Mr. Smith, an employee of this company, is paid 6 459 €. What proportion of the employees of this Company are paid less that Mr. Smith? — 1.5 marks

6. Compute the probability that an employee's salary is greater than 7 636 € and comment your answer for question **5**. — 1.5 marks

In another company, the salaries are normally distributed with standard deviation $s = 620$.

7. Knowing that the probability that an employee's salary is greater than 5 000 € is approximately 0.107, find the mean salary in that company. Write your answer to the nearest whole number. — 3 marks