MATHEMATICS 3 PERIODS
PART A

DATE : 10th June 2024, afternoon

DURATION OF THE EXAMINATION:

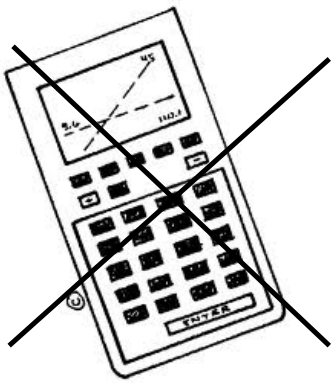
2 hours (120 minutes)

AUTHORISED MATERIAL:

Examination without technological tool

Pencil for the graphs

Formelsammlung / Formula booklet / Recueil de formules



SPECIFIC INSTRUCTIONS:

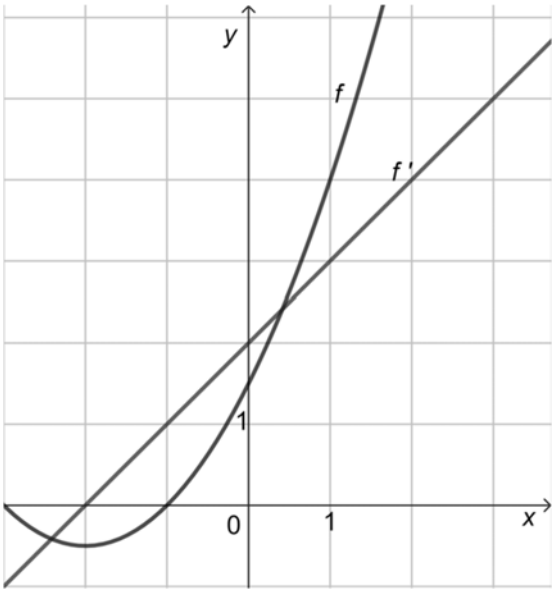
- Answers must be supported by explanations.
- They must show the reasoning behind the results or solutions provided.
- If graphs are used to find a solution, they must be sketched as part of the answer.

- Unless indicated otherwise, full marks will not be awarded if a correct answer is not accompanied by supporting evidence or explanations of how the results or the solutions have been achieved.

- When the answer provided is not the correct one, some marks can be awarded if it is evident that an appropriate method and/or a correct approach has been used.

PART A	Page 1/4	Marks

1) The diagram below shows the graph of a function *f* and the graph of its derivative f'.

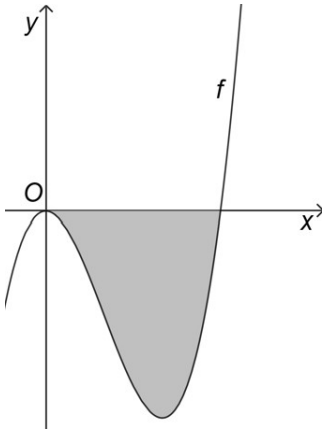


Determine an equation of the tangent to the graph of *f* at the point where $x = 1$. — 5 marks

2) Consider the function *f* defined by

$f(x) = -2x^2 \cdot (2 - x)$.

The diagram below shows the graph of *f*.



Write an integral that gives the area of the shaded region.
(You do not need to calculate this integral, only give an appropriate expression). — 5 marks

PART A	Page 2/4	Marks
3) The velocity of a moving object is given by a function f. A primitive of f is given by the function F defined by $F(t)=\frac{2}{3}t^3+3t$ where t is the time expressed in seconds and $F(t)$ is expressed in metres.		
a) **Determine** an expression for $f(t)$, the velocity in m/s.		2 marks
b) The displacement, in metres, of the moving object between $t=a$ and $t=b$ is given by $\int_a^b f(t)dt$.		
Calculate the displacement of the moving object between $t=0$ and $t=3$.		3 marks
4) The height of water in a harbour is modelled by the function h defined by $h(t)=2\sin\left(\frac{\pi}{6}t\right)+3$, where t is the time in hours and $h(t)$ is the height in metres.		
a) **Determine** the maximum height of the water in the harbour.		1 mark
b) **Determine** two different values of the time t, when the water is at its highest level.		2 marks
c) On graph paper, **draw** the graph of the function h for t between 0 and 16 hours. Use 1 cm for 1 hour on the x-axis and 1 cm for 1 metre on the y-axis.		2 marks

PART A	Page 3/4	Marks

5) a) The number of plants of a certain species can be modelled by the function A, given by

$A(t) = a \cdot b^t$,

where a is the initial number of plants and t is the time in years.

It is given that $\frac{A(1)}{A(0)} = 0.98$.

Determine b and **explain** its meaning in this context. — 2 marks

b) Now consider the population of a second species, which decreases at a constant rate of 10 % per year. The initial number of plants of this species is 500.

Determine which one of the following formulae describes the number $B(t)$ of plants of this species after t years. — 1 mark

Option 1: $B(t) = 500 \cdot (-0.10)^t$	**Option 2:** $B(t) = 500 \cdot (1.10)^t$
Option 3: $B(t) = 500 \cdot (0.90)^t$	**Option 4:** $B(t) = 500 - 0.10 \cdot t$

c) The number of plants of a third species can be modelled by the function C defined by

$C(t) = 400 \cdot (0.85)^t$, where t is the time in years.

Using this model, **describe** how the number of plants evolve over many years**.** — 2 marks

6) A multiple-choice test consists of 4 questions. Each question has three possible answers, with only one answer being correct.
One student answers each question at random.

a) **Calculate** the probability that the student will answer all 4 questions correctly. — 1 mark

b) **Calculate** the probability that the student will get at least one correct answer. — 2 marks

c) **Determine** the expected value of the number of correct answers obtained by the student. — 2 marks

PART A	Page 4/4	Marks

7) 400 patients have volunteered to take part in medical research.

153 patients were treated with medicine A, 53 of them were cured.

247 patients were treated with medicine B, 117 of them were cured.

A patient is chosen at random.

Given that the patient is not cured, **determine** the probability that the patient was treated with medicine B. — 5 marks

8) 5 different books are placed on a shelf.

a) **Calculate** the number of ways in which these books can be arranged. — 1 mark

b) There are 2 mathematics books and 3 physics books.

Calculate the number of ways in which the books can be placed on the shelf, if the mathematics books must be together and the physics books must be together. — 2 marks

c) Claude would like to borrow any 2 of the 5 books.

Calculate the number of different pairs of books Claude can borrow. — 2 marks

9) In a marine research study, the length of fins of a certain species of sharks is found to be normally distributed with mean $\mu = 120$ cm and standard deviation $\sigma = 15$ cm.
Researchers plan to place a tracking device on a single shark for the study. For the tracking device to fit securely, they should select a shark with a fin length greater than 135 cm.
The researchers isolate the sharks with a fin length above the mean and select one of these at random.
Determine the probability that the device will fit securely. — 5 marks

10) **Match** the following correlation coefficients with scatter diagrams below: — 5 marks

a) $r = -1$ b) $r = 0.92$ c) $r = 0.74$ d) $r = 0$ e) $r = -0.73$

and **describe** the type of correlation and the strength of the relationship.

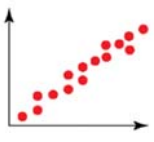


Figure 1

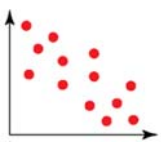


Figure 2

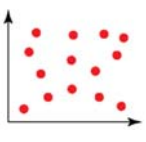


Figure 3

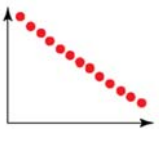


Figure 4

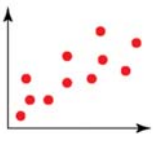


Figure 5