Diploma Programme
Programme du diplôme
Programa del Diploma

Mathematics: analysis and approaches
Standard level
Paper 2

11 November 2025

Zone A morning | **Zone B** morning | **Zone C** morning

Candidate session number

1 hour 30 minutes

Instructions to candidates

- Write your session number in the boxes above.
- Do not open this examination paper until instructed to do so.
- A graphic display calculator is required for this paper.
- Section A: answer all questions. Answers must be written within the answer boxes provided.
- Section B: answer all questions in the answer booklet provided. Fill in your session number on the front of the answer booklet, and attach it to this examination paper and your cover sheet using the tag provided.
- Unless otherwise stated in the question, all numerical answers should be given exactly or correct to three significant figures.
- A clean copy of the **mathematics: analysis and approaches SL formula booklet** is required for this paper.
- The maximum mark for this examination paper is **[80 marks]**.

8825–7110

Full marks are not necessarily awarded for a correct answer with no working. Answers must be supported by working and/or explanations. Solutions found from a graphic display calculator should be supported by suitable working. For example, if graphs are used to find a solution, you should sketch these as part of your answer. Where an answer is incorrect, some marks may be given for a correct method, provided this is shown by written working. You are therefore advised to show all working.

Section A

Answer **all** questions. Answers must be written within the answer boxes provided. Working may be continued below the lines, if necessary.

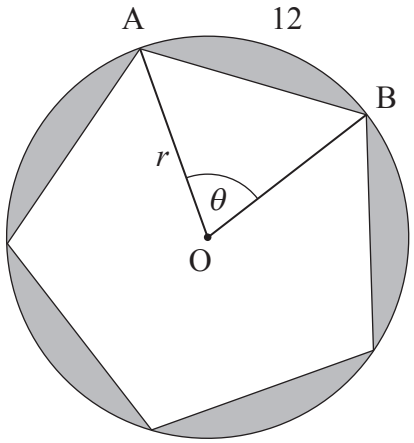
1. [Maximum mark: 6]

The following diagram shows a regular pentagon inscribed in a circle with centre O and radius $r\,\mathrm{cm}$.

The angle $\mathrm{A\hat{O}B}$ is θ, where θ is measured in radians.

The arc AB is $12\,\mathrm{cm}$.

diagram not to scale



(a) Find

(i) θ;

(ii) r. [3]

(b) Find the area of the shaded region. [3]

(This question continues on the following page)

(Question 1 continued)

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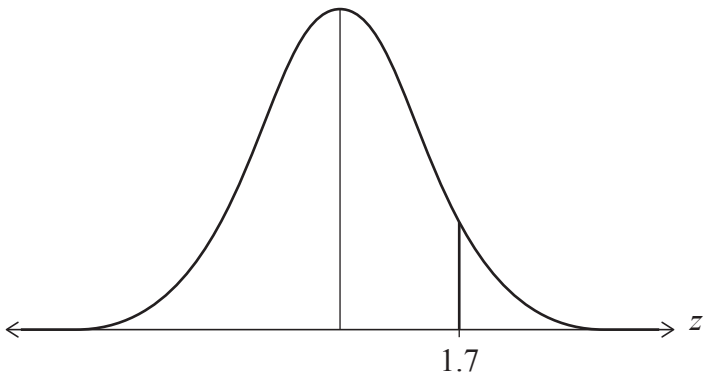
2. [Maximum mark: 4]

The random variable Z has a standard normal distribution with mean 0 and standard deviation 1.

(a) Find $\mathrm{P}(\mathrm{Z} < 1.7)$. [1]

It is known that $\mathrm{P}(a < \mathrm{Z} < 1.7) = 0.7865$, correct to four significant figures.

(b) Sketch this information on the following diagram. [1]



(c) Hence, or otherwise, find the value of a. [2]

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3. [Maximum mark: 7]

Data was collected on two variables, x and y, from eight members of a population. The data is shown in the table below.

x	3.8	6.3	2.5	2.4	8.9	10.7	6.7	10.3
y	11.8	9.7	6.1	4.1	p	23.3	13.7	24.5

(a) Find $\overline{x}$. [2]

The regression line of y on x for this data is $y = 0.014375 + 2.1625x$.

(b) Find

(i) $\overline{y}$;

(ii) the value of p. [4]

(c) Hence, find Pearson's product-moment correlation coefficient, r. [1]

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Answers written on this page
will not be marked.

4. [Maximum mark: 5]

In the expansion of $\left(\sqrt{x}+k\right)^{12}$ where $k \in \mathbb{Z}$, the coefficient of the term in $x^{\frac{3}{2}}$ is -112640.

Find the value of k.

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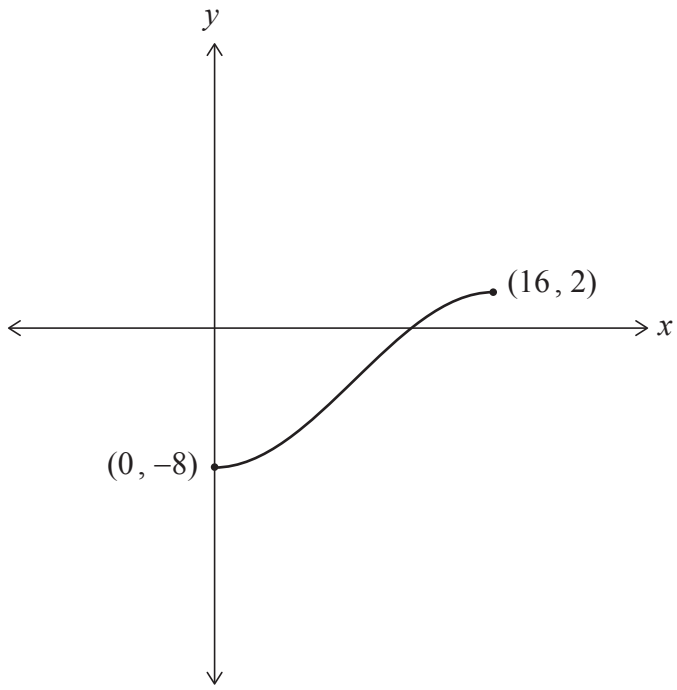
5. [Maximum mark: 7]

Consider the function $g(x) = a\cos(bx) - 3$, where $x \in \mathbb{R}$ and $a, b \in \mathbb{R}$.

The following diagram shows part of the graph of g.



The graph of g has a local minimum at $(0, -8)$ and a local maximum at $(16, 2)$.

(a) Find the value of

(i) a;

(ii) b, where $b > 0$. [3]

(b) Write down the smallest positive value of the constant k such that $g(x + k) = g(x)$ for all x. [1]

(c) The function $g(x)$ can be written in the form $f(x) = p\sin b(x - q) - 3$ where $p, q \in \mathbb{Z}^+$.

(i) Find the smallest positive value of q.

(ii) For this value of q, write down the value of p. [3]

(This question continues on the following page)

(Question 5 continued)

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6. [Maximum mark: 7]

Two machines are used in a factory to manufacture semiconductors. Machine A manufactures defective semiconductors 10% of the time, while machine B manufactures defective semiconductors 5% of the time.

A randomly selected machine manufactures ten semiconductors.

Both machines are equally likely to be selected.

(a) Find the probability that exactly two semiconductors are defective. [4]

(b) Given that exactly two semiconductors are defective, find the probability that they were manufactured by machine A. [3]

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Do **not** write solutions on this page.

Section B

Answer **all** questions in the answer booklet provided. Please start each question on a new page.

7. [Maximum mark: 13]

Consider the function $f(x) = \frac{3x+1}{2x-4}$ where $x \neq 2$.

(a) Write down the equation of

(i) the vertical asymptote of the graph of f;

(ii) the horizontal asymptote of the graph of f. [2]

(b) Find $f'(x)$. [4]

(c) Hence, explain briefly why f is never increasing. [2]

The point $\mathrm{P}(x,\ f(x))$ is on the graph of f such that $x < 2$.

Let d be the distance between the points P and $\mathrm{Q}(3, 5)$.

(d) Find an expression for d in terms of x. [2]

(e) Hence, find the coordinates of P such that d is a minimum. [3]

Do **not** write solutions on this page.

8. [Maximum mark: 14]

A population of frogs, F, in a swamp after t months, can be modelled by the function

$$F(t) = 1850 \times 1.105^t \text{ where } t \geq 0.$$

(a) Find the population of frogs after one year. [2]

(b) After x complete months, the population will be at least $35\,000$ frogs. Find the value of x. [3]

The function F can be written in the form $F(t) = 1850\mathrm{e}^{kt}$.

(c) Find the exact value of k. [2]

(d) Find the rate at which the population of frogs is growing after 15 months. [2]

A more realistic model describing the population of frogs, G, after t months is given by

$$G(t) = \frac{35\,000}{1 + A\mathrm{e}^{-0.0998t}} \text{ where } t \geq 0.$$

(e) After 15 months, this model predicts a population of 6995 frogs. Find the value of A. [2]

(f) Find the value of t when the rate of population growth is the greatest. [2]

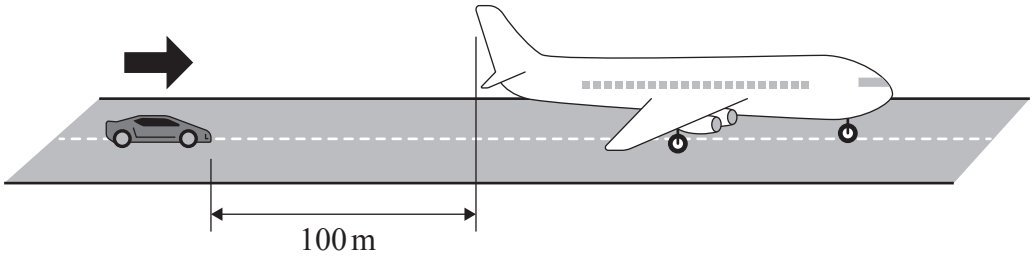
(g) By considering the graph of G or otherwise, state one reason why $G(t)$ is a more appropriate long-term model than $F(t)$. [1]

Do **not** write solutions on this page.

9. [Maximum mark: 17]

An airplane lands on a runway 100 metres in front of a stationary car. At the instant the airplane lands, the car begins to travel in the same direction towards the airplane.

diagram not to scale



Let t represent the number of seconds after the airplane lands. For $t \geq 0$, the velocities of the airplane and the car in m s^{-1}, can be modelled by the following equations:

$$v_{air} = 60\text{e}^{-0.1t}$$

$$v_{car} = 5t$$

(a) When the airplane lands, write down the speed of

(i) the airplane;

(ii) the car. [2]

(b) Find

(i) the value of t when the airplane and the car have the same speed;

(ii) the speed at this time. [3]

Let $d(t)$ represent the distance, in metres, between the car and the back of the airplane after t seconds.

(c) If $d(0) = 100$, find $d(t)$. [7]

(d) Hence, find how long it takes for the car to reach the back of the airplane. [2]

(e) Find the distance travelled by the car when it reaches the back of the airplane. [3]

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