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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]**.

8825–7120

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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

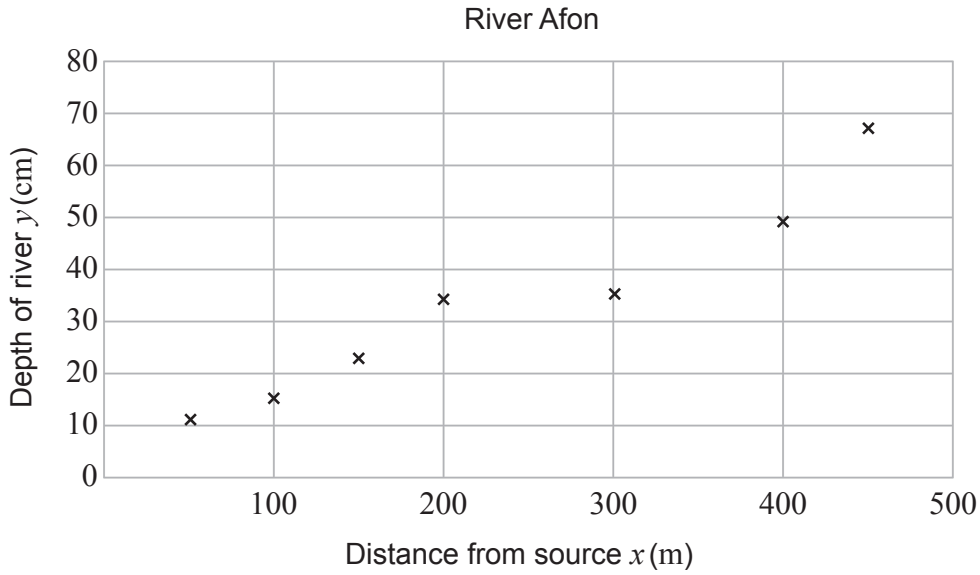
Answer **all** questions. Answers must be written within the answer boxes provided. Working may be continued below the lines, if necessary.

1. [Maximum mark: 7]

Kiran and Logan collect the following data about the river Afon, where x is the distance in metres from the source and y is the depth in centimetres.

Distance from the source x (m)	50	100	150	200	300	400	450
Depth y (cm)	11	15	23	34	35	49	67

This data is represented in the following scatter diagram.



(This question continues on the following page)

(Question 1 continued)

Kiran knows that the depth of the river is $0\,\text{cm}$ at the source.

Kiran calculates $\bar{x}$ and $\bar{y}$ for the seven points given in the table on page 2 and draws a line on the scatter diagram through the mean point $(\bar{x}, \bar{y})$ and the point $(0, 0)$.

(a) Find

(i) the value of $\bar{x}$ and the value of $\bar{y}$;

(ii) the equation of Kiran's line. [3]

For the seven points given in the table Logan finds the regression line of y on x with equation $y = ax + b$, where $a, b \in \mathbb{R}$.

(b) Determine the value of a and the value of b. [2]

(c) By using the equation of Logan's regression line, estimate the depth of the river $350\,\text{m}$ from its source. [2]

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2. [Maximum mark: 5]

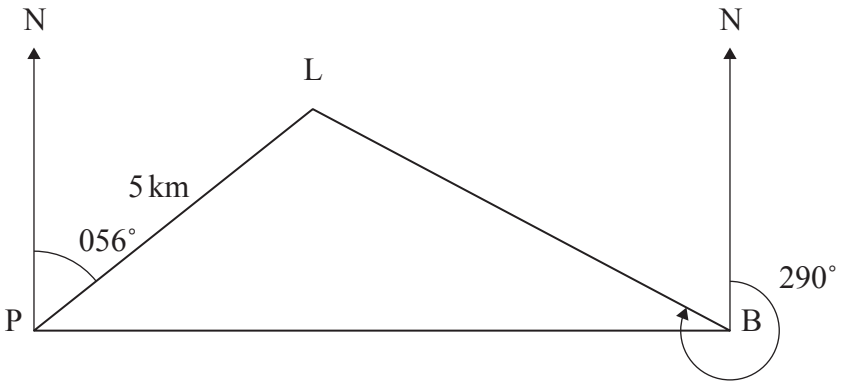
A boat sets off from a port P and travels on a bearing of $090°$ until reaching point B.

A lighthouse L is $5\,\mathrm{km}$ from P on a bearing of $056°$.

The bearing of the lighthouse from B is $290°$.

This is shown in the following diagram.

diagram not to scale



(a) Find the angle $\mathrm{L\hat{P}B}$. [1]

(b) Find LB, the distance from point L to point B. [4]

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3. [Maximum mark: 5]

(a) Show that $3\cos 2x + 11\sin x = 3 + 11\sin x - 6\sin^2 x$. [2]

(b) Hence, or otherwise, solve the equation $3\cos 2x + 11\sin x - 6 = 0$ for $0° \leq x \leq 180°$. [3]

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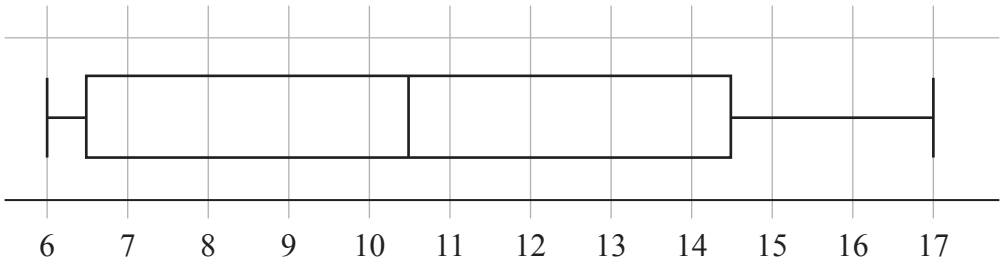
4. [Maximum mark: 6]

A teacher sets her class of 30 pupils a quiz.

Aiden and Brett were absent on the day of the quiz.

The following box and whisker diagram shows the results of the 28 pupils who took the quiz on the day.



quiz score

Aiden and Brett take the quiz when they return.

Aiden scores less than 6.

Brett scores more than 17.

(a) Explain, briefly, why the median score for all 30 pupils would still be 10.5. [1]

The mean score of the 28 pupils was 10.5.

The mean score for all 30 pupils is now 10.6.

The range of scores for all 30 pupils is 14.

(b) Determine Aiden's score and Brett's score. [5]

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5. [Maximum mark: 6]

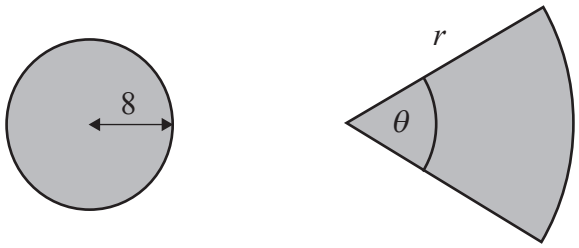
Consider a circle and a sector.

The radius of the circle is $8\,\text{mm}$.

The radius of the sector is $r\,\text{mm}$ and the acute angle at the centre is θ radians.

This is shown in the following diagram.

diagram not to scale



The perimeter of the sector is 1.5 times the circumference of the circle.

(a) Show that $r = \dfrac{24\pi}{2+\theta}$. [3]

It is given that the area of the circle is the same as the area of the sector.

(b) Determine the value of θ. [3]

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will not be marked.

6. [Maximum mark: 7]

A garden centre sells seeds for two varieties of sunflowers: large and giant.

The heights of large sunflowers are normally distributed with mean μ and standard deviation σ.

It is known that $25\,\%$ of large sunflowers have a height of over $180\,\text{cm}$.

(a) Given that $\mu + A\sigma = 180$, where $A \in \mathbb{R}$, find the value of A. [3]

The heights of giant sunflowers are also normally distributed.

The giant sunflowers have a mean height that is $35\,\text{cm}$ more than that of the large sunflowers and a standard deviation that is double that of the large sunflowers.

It is known that $98\,\%$ of giant sunflowers have a height greater than $180\,\text{cm}$.

(b) Determine μ and σ. [4]

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Section B

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

7. [Maximum mark: 12]

Andy and Jess each have $\$5000$.

Andy invests the money in a new savings plan that will pay interest at the end of each month.

Andy will receive a fixed amount of interest each month. The amount received is 0.315% of the initial investment.

(a) (i) Determine the amount of interest Andy will receive at the end of each month. Give this answer correct to two decimal places.

(ii) Hence, determine the amount of interest Andy will receive each year.

(iii) Write down an expression in the form $5000 + pn$, where $p \in \mathbb{Z}^+$, for the amount of money Andy will have in his savings plan at the end of n years.

(iv) Hence, show that Andy will have $\$5945$ in his savings plan at the end of 5 years. [4]

In this part, where appropriate, give all answers to the nearest dollar.

Jess invests her $\$5000$ in a new account that pays 3% interest compounded annually.

(b) (i) Determine the amount of money that will be in Jess's account at the end of 5 years.

(ii) Hence, find the amount of interest Jess will receive in the 5 years. [3]

(c) (i) Write an expression in the form $5000 \times q^n$, where $q \in \mathbb{R}^+$, for the amount of money that Jess will have in her account at the end of n years.

(ii) Hence, determine the smallest number of complete years that it will take for Jess to have more money in her account than Andy has in his savings plan. [5]

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

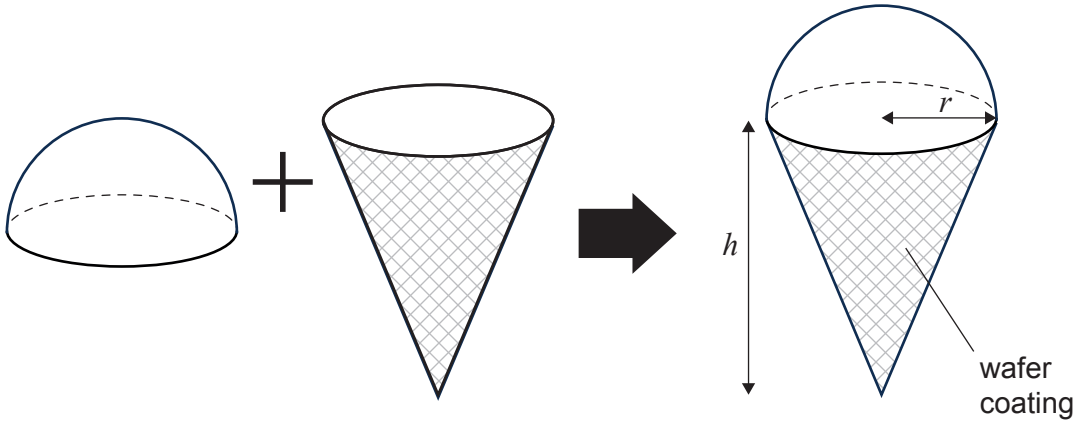
8. [Maximum mark: 15]

A manufacturer creates an ice cream model consisting of two parts.

The top part consists of a hemisphere of ice cream with radius $r\,\text{cm}$.

The bottom part consists of a cone of ice cream with radius $r\,\text{cm}$ and height $h\,\text{cm}$, which is wrapped in a wafer coating.

This is shown in the following diagram.



(a) Consider the case where $r = 3$ and $h = 8$.

(i) Show that the total volume, V, of ice cream is $132\,\text{cm}^3$, correct to 3 significant figures.

(ii) Determine the curved surface area, S, of the wafer coating. [7]

The manufacturer changes the dimensions of the model to ensure that the total volume, V, of ice cream is $120\,\text{cm}^3$.

(b) Show that $h = \dfrac{360 - 2\pi r^3}{\pi r^2}$. [3]

(c) Hence, show that the curved surface area of the wafer coating is given by

$$S = \pi r\sqrt{r^2 + \left(\frac{360 - 2\pi r^3}{\pi r^2}\right)^2}\ .$$ [2]

The manufacturer wants to use the minimum possible value of S.

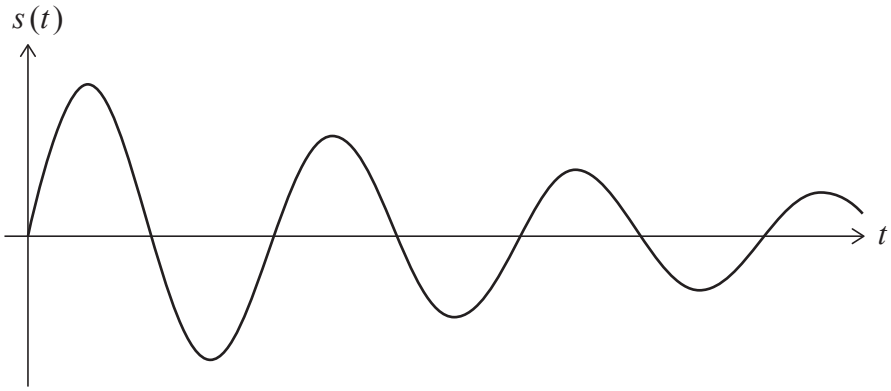
(d) Determine the minimum value of S and the corresponding value of r. [3]

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

9. [Maximum mark: 17]

A particle P moves in a straight line so that its displacement, $s\,\text{cm}$, from a fixed point O at time t seconds is given by $s(t) = 2^{\left(1-\frac{t}{5}\right)} \sin\left(\frac{2\pi t}{3}\right)$, where $t \geq 0$.

The following diagram shows part of the graph of $y = s(t)$.



(a) Find

(i) the maximum displacement of P from O;

(ii) the maximum velocity of P. [5]

(b) Find

(i) the minimum value of the displacement function $s(t)$;

(ii) the displacement of P from O when $t = 3.5$. [3]

(c) Hence, determine the **total distance** travelled by P in the first 3.5 seconds. [3]

The first time that P returns and passes through O is when $t = T$.

(d) Write down the value of T. [1]

(This question continues on the following page)

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

(Question 9 continued)

The particle passes through O every T seconds.

A sequence $u_1, u_2, u_3 \ldots$ is formed where $u_1, u_2, u_3 \ldots$ are the largest **distances** from O in each of the intervals $0 < t < T,\ T < t < 2T,\ 2T < t < 3T \ldots$ respectively.

It is known that $u_1, u_2, u_3 \ldots$ form a geometric sequence.

(e) (i) Determine the value of the common ratio r of this geometric sequence.

(ii) Calculate the **total distance** travelled by the particle if it were to continue to move in this way indefinitely. [5]

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