AQA

Please write clearly in block capitals.

Centre number	
Candidate number	
Surname	
Forename(s)	
Candidate signature	I declare this is my own work.

A-level
MATHEMATICS
Paper 1

Wednesday 3 June 2026 Afternoon Time allowed: 2 hours

Materials
- You must have the AQA Formulae for A-level Mathematics booklet.
- You should have a graphical or scientific calculator that meets the requirements of the specification.

Instructions
- Use black ink or black ball-point pen. Pencil should only be used for drawing.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer each question in the space provided for that question.
- If you need extra space for your answer(s), use the lined pages at the end of this book. Write the question number against your answer(s).
- Do **not** write outside the box around each page or on blank pages.
- Show all necessary working; otherwise marks for method may be lost.
- Do all rough work in this book. Cross through any work that you do not want to be marked.

Information
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 100.

Advice
- Unless stated otherwise, you may quote formulae, without proof, from the booklet.
- You do not necessarily need to use all the space provided.

For Examiner's Use	
Question	Mark
1	
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Section A

Answer **all** questions in the spaces provided.

1 Identify which one of the following is a correct identity.

Tick (✓) **one** box.

[1 mark]

$\cos^2\theta - \sin^2\theta \equiv 1$ ☐

$\cos^2\theta + \sin^2\theta \equiv 1$ ☐

$\tan^2\theta - \sec^2\theta \equiv 1$ ☐

$\tan^2\theta + \sec^2\theta \equiv 1$ ☐

2 The graph with equation

$$y = (x-3)^2 + 7$$

is translated through one of the following vectors.

The translated graph has the x-axis as a tangent.

Determine the vector which describes the translation.

Circle your answer.

[1 mark]

$\begin{bmatrix} 0 \\ -7 \end{bmatrix}$ $\begin{bmatrix} 0 \\ -3 \end{bmatrix}$ $\begin{bmatrix} 0 \\ 3 \end{bmatrix}$ $\begin{bmatrix} 0 \\ 7 \end{bmatrix}$

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3 By rationalising the denominator, simplify

$$\frac{4}{2+\sqrt{n}}$$

where $n \geq 0$ and $n \neq 4$

Circle your answer.

[1 mark]

$\frac{8-4\sqrt{n}}{4-n}$ $\quad\quad$ $\frac{8+4\sqrt{n}}{4-n}$ $\quad\quad$ $\frac{8-4\sqrt{n}}{4+n}$ $\quad\quad$ $\frac{8+4\sqrt{n}}{4+n}$

Turn over for the next question

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4 A sequence is defined by

$$u_1 = 5$$

$$u_{n+1} = \frac{u_n - 5}{u_n - 3}$$

4 (a) Find u_2

Circle your answer.

[1 mark]

0 $\quad\quad$ $\frac{5}{3}$ $\quad\quad$ $\frac{5}{2}$ $\quad\quad$ 5

4 (b) Which one of the words below best describes the sequence?

Circle your answer.

[1 mark]

arithmetic decreasing geometric periodic

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5 The trapezium rule is to be used to find an approximation for

$$\int_{1.1}^{2.3} e^{-x}\sqrt{x+1}\,dx$$

The values required to obtain this approximation are shown in the table.

x	1.1	1.4	1.7	2	2.3
y	0.48238	0.38203	0.30018	0.23441	0.18213

Use the trapezium rule with 5 ordinates (4 strips) to find an approximation for

$$\int_{1.1}^{2.3} e^{-x}\sqrt{x+1}\,dx$$

Give your answer to four decimal places.

[3 marks]

Turn over for the next question

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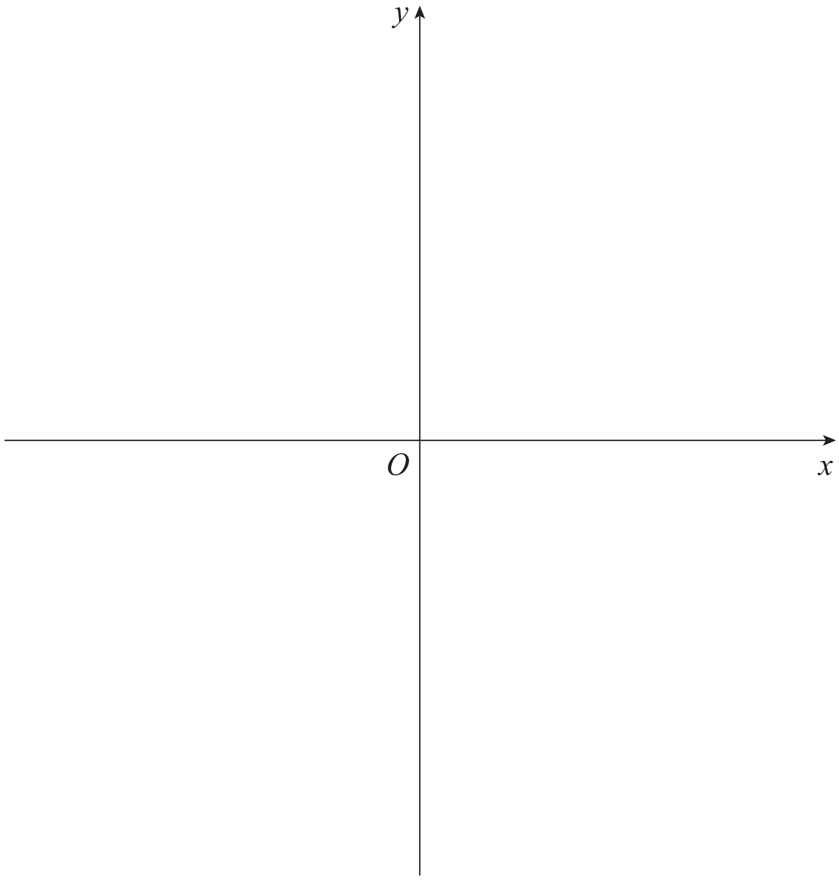
6 On the given axes, sketch the graph of $y = |2x - 5|$

[3 marks]



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7 A curve has equation

$$y = e^{2x} + 3$$

7 (a) Find $\dfrac{dy}{dx}$

[1 mark]

7 (b) Find an equation of the tangent to the curve at the point where $x = 0$

[3 marks]

Turn over for the next question

8 Express

$$8\cos x + 15\sin x$$

in the form

$$R\cos(x - \alpha)$$

where $R > 0$ and $0° < \alpha < 90°$

Give your value of α to the nearest $0.1°$

[3 marks]

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Turn over for the next question

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9 (a) The expression

$$\frac{x+3}{(1-3x)(1-x)}$$

can be written in the form

$$\frac{A}{1-3x}+\frac{B}{1-x}$$

where A and B are constants.

Find the value of A and the value of B

[2 marks]

9 (b) (i) Find the first three terms of the binomial expansion of

$$(1-x)^{-1}$$

[2 marks]

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9 (b) (ii) Hence or otherwise, write down the first three terms of the binomial expansion of

$$\frac{1}{1-3x}$$

[1 mark]

9 (c) (i) Find the first three terms of the binomial expansion of

$$\frac{x+3}{(1-3x)(1-x)}$$

[2 marks]

9 (c) (ii) State the range of values of x for which the answer to **(c)(i)** is valid.

[1 mark]

Turn over ▶

10 David, a conservationist, is studying a population of newts which he released into a newly created lake.

David models the relationship between N, the number of newts in the lake, and t, the number of years after the newts were released, using the formula

$$N = A \times B^t$$

where A and B are constants.

10 (a) According to this model, show algebraically that there is a linear relationship between In N and t

[3 marks]

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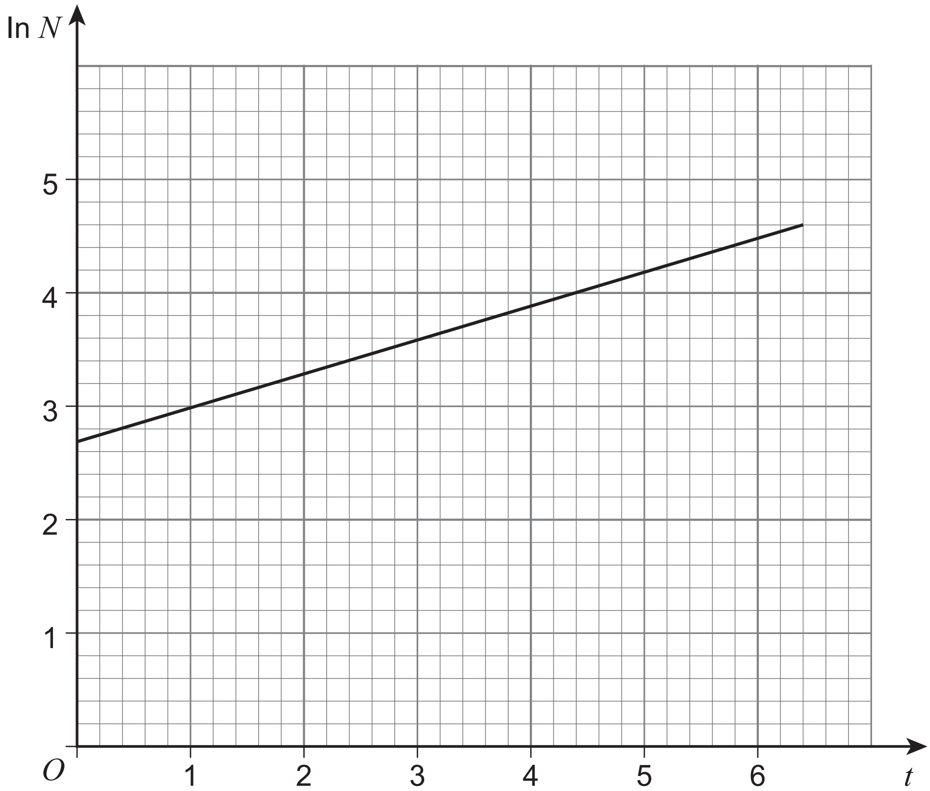
10 (b) David used the data he collected to produce the following graph.



10 (b) (i) Find the gradient of the graph, using the points where $t = 1$ and $t = 5$

[1 mark]

10 (b) (ii) Hence find the value of B

Give your answer to three significant figures.

[2 marks]

Turn over ▶

Do not write outside the box

10 (b) (iii) Find an estimate for the number of newts that were released.

[3 marks]

10 (b) (iv) Use the model to estimate the number of complete years needed for the population of newts to exceed 10 times its initial size.

[2 marks]

10 (c) David's model for exponential growth will become unrealistic in the long term.

State **one** additional factor that David could include in a refined model.

[1 mark]

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11 A curve has equation $y = \mathrm{p}(x)$ where

$$\frac{\mathrm{d}y}{\mathrm{d}x} = 8x^3 - 3x^2 - 10$$

It is given that $(2x - 1)$ is a factor of $\mathrm{p}(x)$

Find an expression for $\mathrm{p}(x)$

[5 marks]

Turn over ▶

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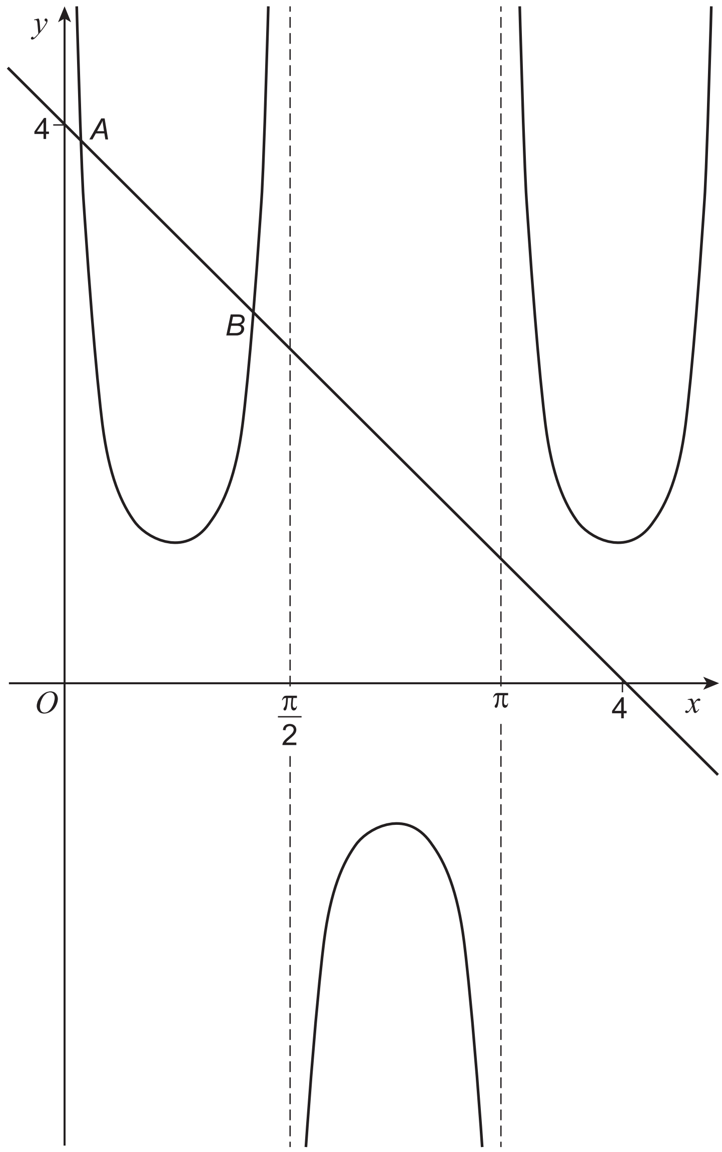
12 The diagram shows parts of the graphs of $y = \operatorname{cosec} 2x$ and $y = 4 - x$



The graphs intersect at the points *A* and *B*

12 (a) A student is trying to solve the equation

$$\operatorname{cosec} 2x = 4 - x$$

The student looks at the graph and states:

"The line $y = 4 - x$ intersects $y = \operatorname{cosec} 2x$ in two places, so the equation $\operatorname{cosec} 2x = 4 - x$ must have exactly two solutions."

Explain the error in the student's reasoning.

[1 mark]

12 (b) The smallest positive solution to the equation

$$\operatorname{cosec} 2x = 4 - x$$

is $x = a$

Using a small angle approximation, show that a satisfies

$$2a^2 - 8a + 1 \approx 0$$

[2 marks]

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12 (c) Using the result from part **(b)**, find an approximate value for a

Give your answer to three significant figures.

[2 marks]

Turn over for the next question

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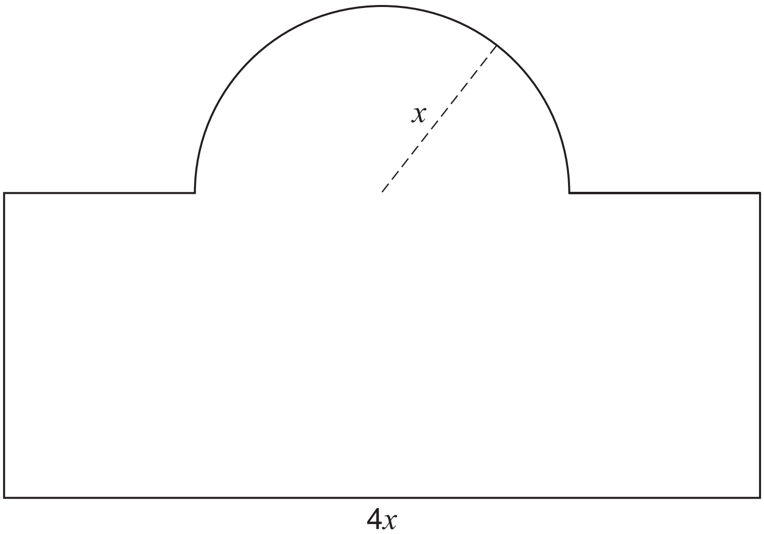
13 A gardener wants to create a symmetrical flowerbed.

The shape of the flowerbed will be constructed from a rectangle and a semi-circle.

The rectangle has length $4x$ metres.

The semi-circle has radius x metres.

These dimensions are shown in the diagram.



13 (a) The total area of the flowerbed will be 100 m^2

13 (a) (i) By considering the total area of the flowerbed, show that the width, w metres, of the rectangular part of the flowerbed is given by

$$w = \frac{200 - \pi x^2}{8x}$$

[2 marks]

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13 (a) (ii) Hence show that the perimeter, P metres, of the flowerbed is given by

$$P = \left(6 + \frac{3\pi}{4}\right)x + \frac{50}{x}$$

[3 marks]

13 (b) The gardener is going to purchase a decorative material to go around the perimeter of the flowerbed.

The decorative material costs £12.75 per metre.

13 (b) (i) Find the minimum total cost of the decorative material.

Fully justify your answer.

[6 marks]

13 (b) (ii) Explain why the cost of the decorative material is likely to be greater than the value you found in part **(b)(i)**.

[1 mark]

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14 Use integration by parts to show that

$$\int_{\frac{1}{2}}^{2} x^3 \ln 2x \, dx = A \ln 2 + \frac{B}{256}$$

where A and B are integers to be found.

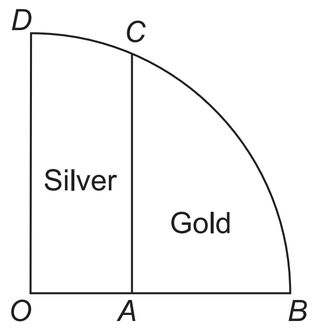
[6 marks]

Turn over ▶

15 A jeweller has been asked to make a pendant in the shape of a quarter-circle.

Half of the area of the pendant is to be made from gold and half from silver as shown in **Figure 1**.

Figure 1

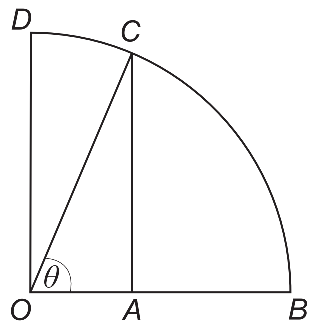


The line AC is parallel to the line OD

To position the line AC correctly, the jeweller needs to find the angle COA

The angle COA is θ radians as shown in **Figure 2**.

Figure 2



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15 (a) Show that

$$4\theta - 2\sin 2\theta = \pi$$

[5 marks]

Turn over ▶

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15 (b) Use a suitable **change of sign** to show that the solution to the equation

$$4\theta - 2\sin 2\theta = \pi$$

lies in the interval $1.1 < \theta < 1.2$

[2 marks]

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15 (c) Apply the Newton-Raphson method once with $\theta_0 = 1.1$ to find an approximate solution θ_1 to the equation

$$4\theta - 2\sin 2\theta = \pi$$

Give your answer to four decimal places.

[3 marks]

Turn over for the next question

16 The nth term of a geometric sequence, u_n, is given by

$$u_n = \frac{e^{1-n}}{2^n}$$

16 (a) Find the value of u_1

[1 mark]

16 (b) (i) Show that

$$\frac{u_{n+1}}{u_n} = \frac{1}{2e}$$

[3 marks]

16 (b) (ii) Explain why the sum to infinity of this sequence exists.

[1 mark]

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16 (c) Show that the sum to infinity of the sequence is

$$\frac{e}{Ae-1}$$

where A is an integer to be found.

[3 marks]

Turn over for the next question

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17 A large bowl is filled with water.

As the water evaporates from the bowl, the rate of change of the depth, h cm, of the water in the bowl is modelled by

$$\frac{\mathrm{d}h}{\mathrm{d}t} = -\frac{h^2}{400}\left(2 + \sin\frac{t}{4}\right)$$

where t is the time in hours since the bowl was filled.

17 (a) Given that the depth of water is initially 10 cm, show that the depth of the water in the bowl at time t is given by

$$h = \frac{200}{At + B - 2\cos\frac{t}{4}}$$

where A and B are integers to be found.

[7 marks]

17 (b) After 4 hours the depth of the water is measured.

It is found that the depth of the water has fallen by just under 2 cm.

Comment on the validity of the model.

[2 marks]

Turn over for the next question

18 (a) Expand and simplify

$$(x^2 + y^2)(x^2 - y^2)$$

[1 mark]

18 (b) Prove the identity

$$\cot^4\theta - \operatorname{cosec}^4\theta \equiv \frac{\cos^2\theta + 1}{\cos^2\theta - 1}$$

where $\theta \neq n\pi,\ n \in \mathbb{Z}$

[4 marks]

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18 (c) Hence show that

$$\cot^4\theta - \operatorname{cosec}^4\theta < 0$$

where $\theta \neq n\pi,\ n \in \mathbb{Z}$

[2 marks]

END OF QUESTIONS

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