



Please write clearly in block capitals.

Centre number

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Candidate number

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Surname

Forename(s)

Candidate signature

I declare this is my own work.

A-level MATHEMATICS

Paper 1

Wednesday 4 June 2025

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

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outside the
box

- 1** The equation of a curve is given by

$$y = 3e^x$$

Find an expression for $\frac{dy}{dx}$

Circle your answer.

[1 mark]

$3e^{-x}$

$3e^1$

$3e^x$

$3xe^{x-1}$

- 2** A sequence is defined by

$$x_{n+1} = -\frac{1}{4}x_n \text{ with } x_1 = 32$$

The first four terms of the sequence are

$$32, -8, 2, -0.5$$

Which **one** of the following can be used to describe this sequence?

Circle your answer.

[1 mark]

Convergent

Decreasing

Increasing

Periodic



3 Express

$$\log_3 2x - \log_3 x$$

as a single logarithm.

Circle your answer.

[1 mark]

$$\log_3 \frac{1}{2}$$

$$\log_3 2$$

$$\log_3 x$$

$$\log_3 2x^2$$

Turn over for the next question

Turn over ►



- 4** The first three terms, in ascending powers of x , of the binomial expansion of $(1 - 8x)^{\frac{1}{2}}$ are

$$1 + nx - 8x^2$$

where n is a constant.

- 4 (a)** State the range of values of x for which the expansion is valid.

Circle your answer.

[1 mark]

$$|x| > -8 \qquad |x| > -\frac{1}{8} \qquad |x| < \frac{1}{8} \qquad |x| < 8$$

- 4 (b)** State the value of the constant n

Circle your answer.

[1 mark]

$$-16 \qquad -4 \qquad \frac{1}{2} \qquad 4$$



5

Find $\int \left(4x - 3 + x^{-\frac{1}{2}} \right) dx$

[3 marks]

6

An arithmetic series has first term 3 and common difference -0.5

Find the sum of the first 250 terms.

[2 marks]

Turn over ►

7

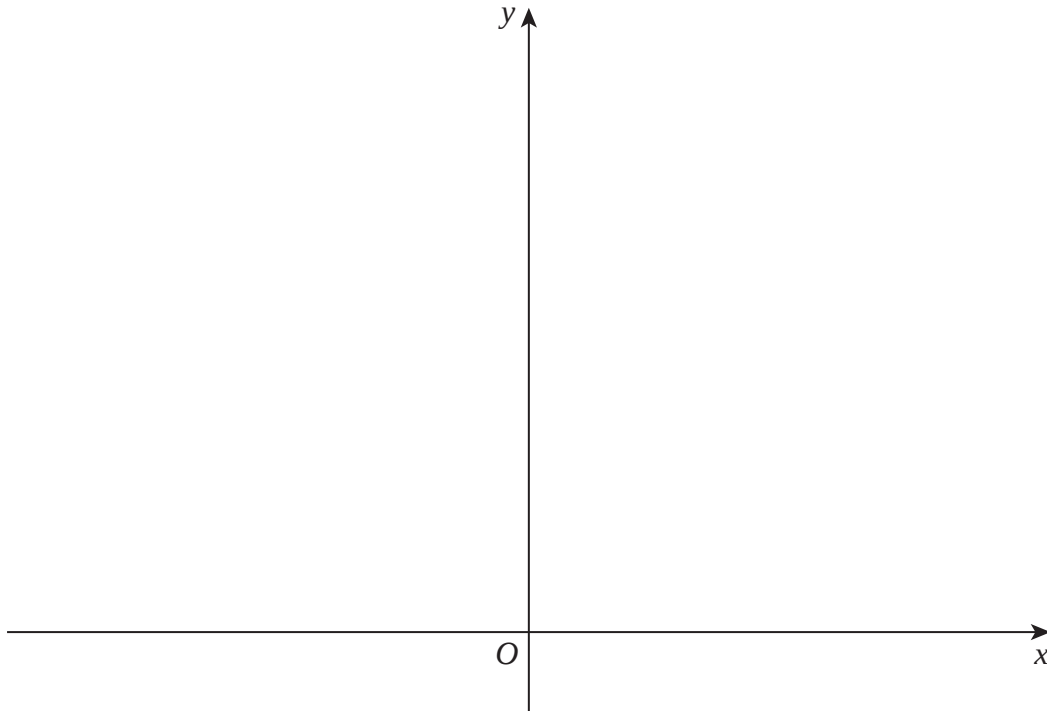
It is given that $0 < a < 1$

Sketch the graph with equation

$$y = a^x$$

on the axes below.

[2 marks]



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9 (b) (ii) Find the maximum value of $r - r^2$

[2 marks]

9 (b) (iii) Hence find the range of possible values of T_{∞}

Fully justify your answer.

[2 marks]

Turn over ►



10 A researcher working for a frozen-food manufacturer uses the formula

$$\theta = 21 - Ae^{-kt}$$

to model the temperature of a dessert once it is taken out of a freezer.

In this model:

- θ is the temperature of the dessert in $^{\circ}\text{C}$
- t is the time in hours since the dessert was removed from the freezer
- A and k are positive constants.

10 (a) Show how

$$\theta = 21 - Ae^{-kt}$$

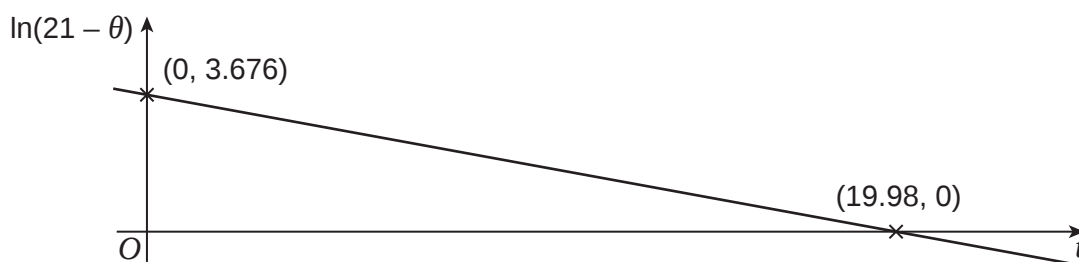
can be rearranged to obtain

$$\ln(21 - \theta) = -kt + \ln A$$

[3 marks]



- 10 (b)** The researcher uses measurements they have recorded to plot the graph of $\ln(21 - \theta)$ against t as shown in the diagram below.



- 10 (b) (i)** Use the information on the graph to find the value of A

Give your answer to **three** significant figures.

[2 marks]

- 10 (b) (ii)** Use the information on the graph to find the value of k

Give your answer to **three** significant figures.

[2 marks]

Turn over ►



10 (b) (iii) Find the temperature of the dessert when it is initially removed from the freezer.

Give your answer to **three** significant figures.

[2 marks]

10 (c) The dessert is ready to be eaten when its temperature reaches 4°C

Use the model to determine the time, after being removed from the freezer, for the dessert to reach this temperature.

Give your answer to the nearest 10 minutes.

[3 marks]



11 The equation of a curve is

$$x^2y + 4y^3 = 8x$$

The curve has two stationary points.

11 (a) Use implicit differentiation to show that at the stationary points $y = \frac{4}{x}$

[4 marks]

11 (b) Hence show that the x -coordinates of the stationary points can be written in the form $\pm\sqrt{n}$ where n is an integer to be found.

[3 marks]

Turn over ►



12 Functions f and g are defined by

$$f(x) = x^2 + 5 \quad x \in \mathbb{R}$$

$$g(x) = \sqrt{x} \quad x \geq 0$$

12 (a) Using set notation, state the range of f

[2 marks]

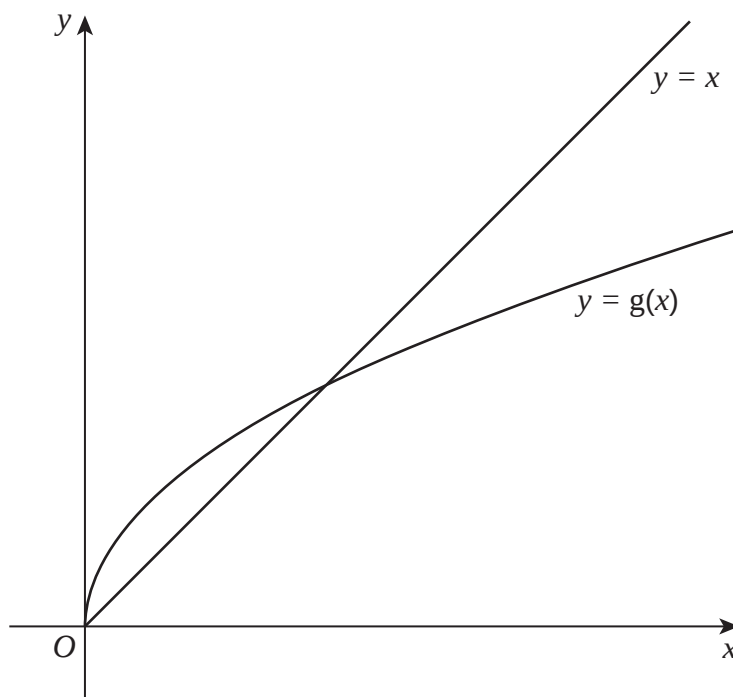
12 (b) Determine whether f has an inverse.

Fully justify your answer.

[2 marks]



- 12 (c)** The graph of $y = g(x)$, and the line with equation $y = x$, are shown on the diagram below.



Sketch the graph of $y = g^{-1}(x)$ on the diagram.

[2 marks]

- 12 (d)** The composite function gf is denoted by h

- 12 (d) (i)** Write down an expression for $h(x)$

[1 mark]

- 12 (d) (ii)** State the range of h

[1 mark]

Turn over ►



13 A curve C has parametric equations

$$x = 4(4t + 1)^2$$

$$y = e^{-4t}$$

for $-\frac{1}{4} \leq t \leq 0$

13 (a) Find $\frac{dy}{dx}$ in terms of t

[3 marks]

13 (b) Find an equation of the tangent to C at the point where $t = 0$

[3 marks]



13 (c) Find a Cartesian equation for C in the form $y = f(x)$

Fully justify your answer.

[3 marks]

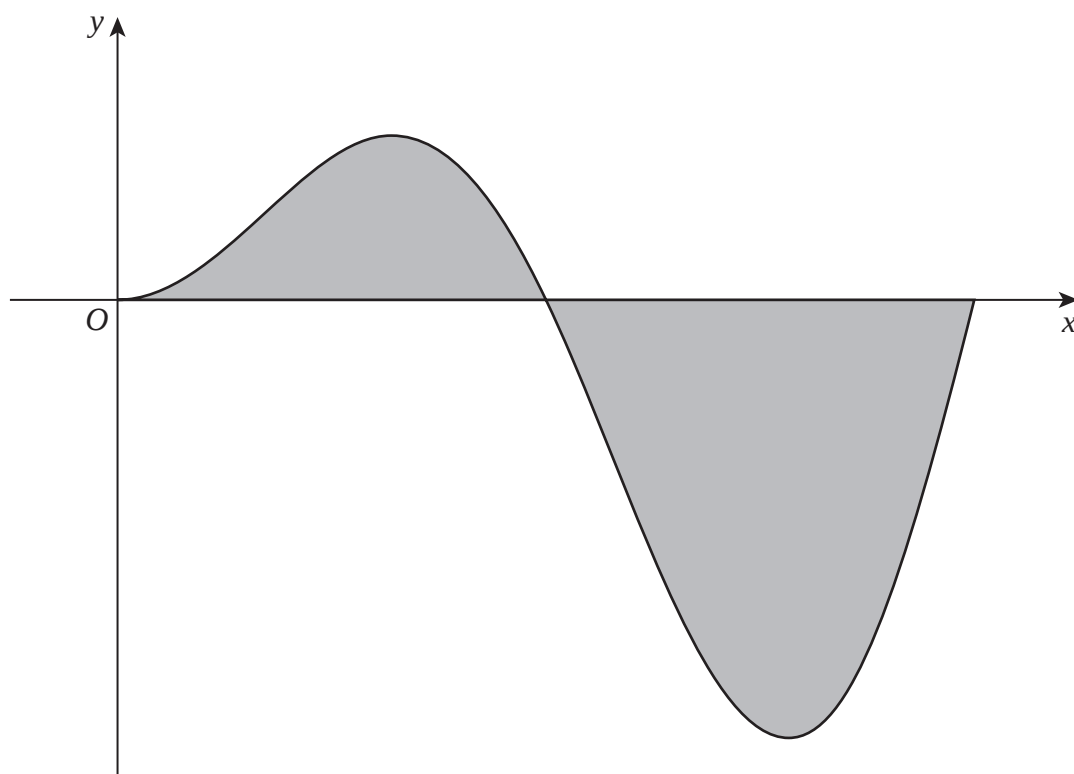
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14

The graph of $y = 4x \sin 2x$ for $0 \leq x \leq \pi$ is shown below.



Show that the shaded area enclosed by the x -axis and the curve is $k\pi$, where k is an integer to be found.

Fully justify your answer.

[8 marks]

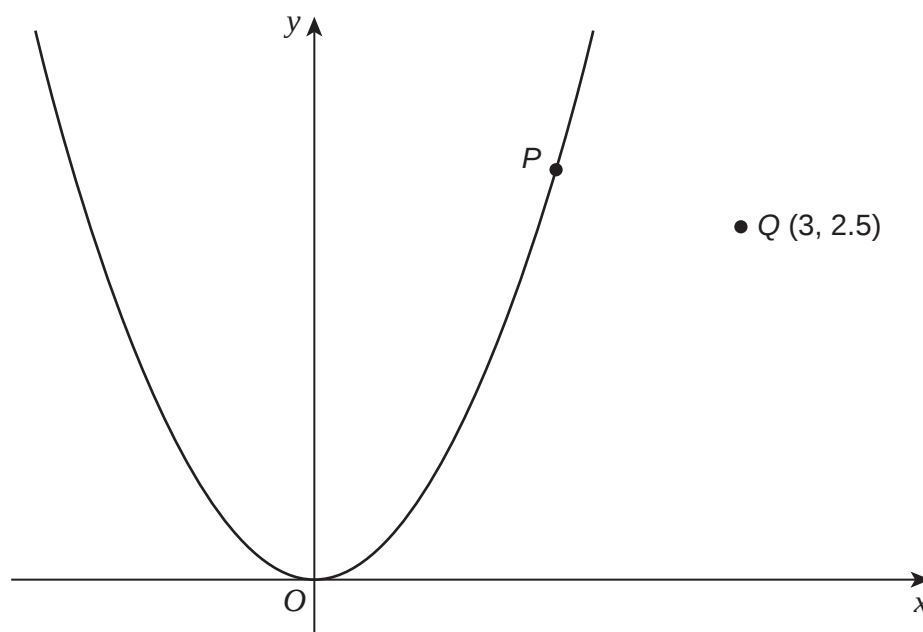


15 A curve has equation

$$y = x^2$$

The point Q has coordinates $(3, 2.5)$

The point P on the curve which is closest to the point Q is shown on the diagram below.



15 (a) Show that the x -coordinate of P satisfies the equation

$$2x^3 - 4x - 3 = 0$$

[4 marks]



- 15 (c)** Starting with $x_0 = 3$, use the iterative formula given in part **(b)** to find the value of x_3
Give your answer to **three** decimal places.

[2 marks]

- 15 (d)** Hence find the distance PQ
Give your answer to **two** decimal places.

[2 marks]

Turn over for the next question

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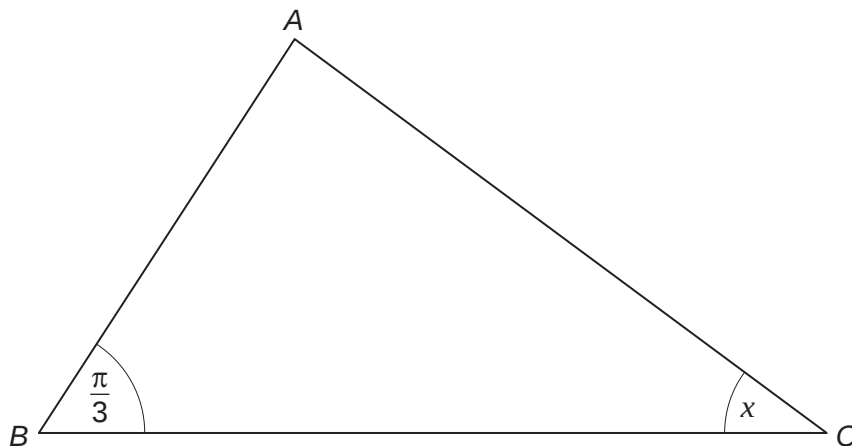


16

The triangle ABC is shown in the diagram below.

The angle ABC is $\frac{\pi}{3}$ radians.

The angle BCA is x radians.

**16 (a)**

Explain why angle $BAC = \frac{2\pi}{3} - x$

[1 mark]



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3 2



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