AQA

Please write clearly in block capitals.

Centre number | | | | | | Candidate number | | | | |

Surname _____

Forename(s) _____

Candidate signature _____

I declare this is my own work.

AS MATHEMATICS

Paper 1

Thursday 15 May 2025 Afternoon Time allowed: 1 hour 30 minutes

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 80.

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
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TOTAL	

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Section A

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

1 Identify the expression that is equivalent to $\tan x$

Circle your answer.

[1 mark]

$\sin^2 x + \cos^2 x$ $\sin^2 x - \cos^2 x$ $\frac{\cos x}{\sin x}$ $\frac{\sin x}{\cos x}$

2 Find the value of $\log_b \frac{1}{b^2}$

Circle your answer.

[1 mark]

-2 $-\frac{1}{2}$ $\frac{1}{2}$ 2

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3 The polynomial $p(x)$ is given by

$$p(x) = 2x^3 - ax^2 + 6x + 2a$$

It is given that $(x - 2)$ is a factor of $p(x)$

Find the value of a by using the factor theorem.

[3 marks]

Turn over for the next question

Do not write outside the box

4 Solve the equation

$$2\tan 3\theta - 3 = 0$$

for $0° \leq \theta \leq 180°$

Give your answers to the nearest degree.

[3 marks]

5 Jayven claims that for two real numbers a and b

$$\text{if } a > b \text{, then it must be true that } \frac{a}{b} > 1$$

By using a counter example, show that Jayven is **not** correct.

[2 marks]

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6 It is given that $p = \log_2 x$ and $q = \log_2 y$

6 (a) Express

$$\log_2\left(\frac{x^2}{y}\right)$$

in terms of p and q

[2 marks]

6 (b) Express

$$\log_2\left(16x^3\sqrt{y}\right)$$

in terms of p and q

Give your answer in a form not involving logarithms.

[3 marks]

7 A circle has equation

$$(x - a)^2 + (y - b)^2 = 49$$

7 (a) State the radius of the circle.

[1 mark]

7 (b) The circle crosses the x-axis at two distinct points.

Find the range of possible values for b

[2 marks]

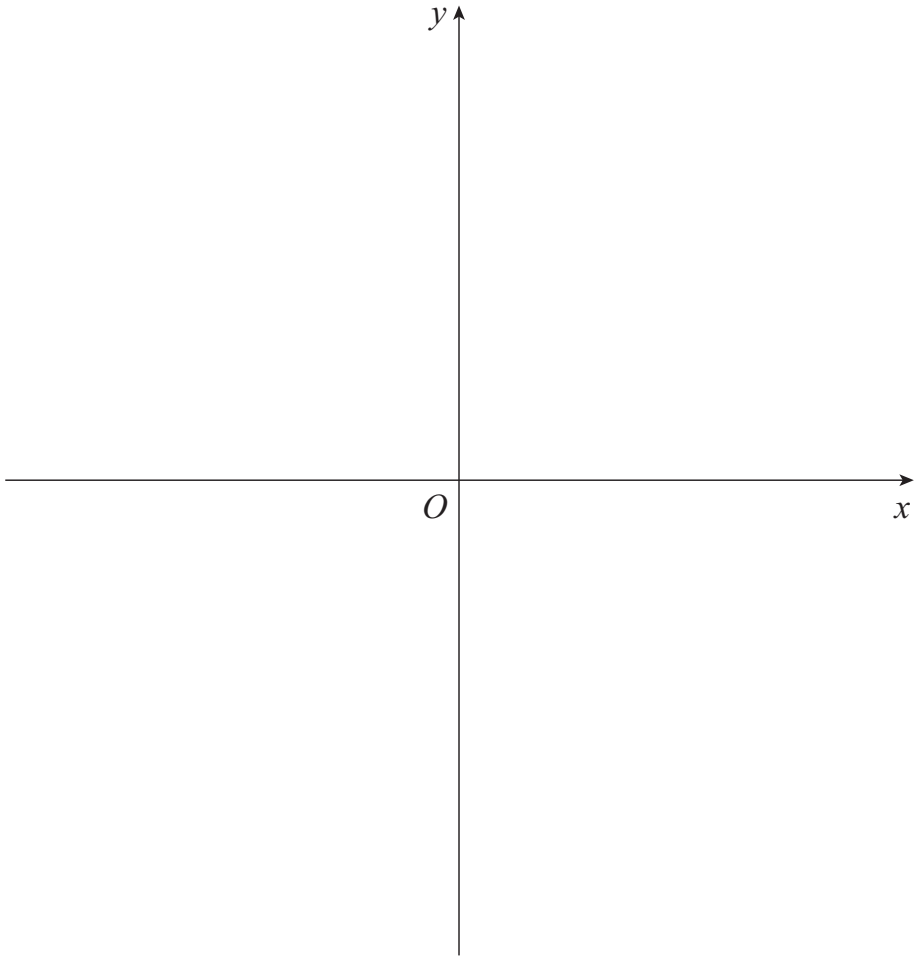
8 Sketch the graph of

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

where k is a positive constant.

Label the coordinates of the points where the graph meets the axes.

[4 marks]



Turn over for the next question

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9 (a) Find, in ascending powers of x, the first three terms in the expansion of

$$(1 - 5x)^7$$

[3 marks]

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9 (b) The coefficient of x^2 in the expansion of

$$(3 + kx)(1 - 5x)^7$$

is 1477

Find the value of k

[3 marks]

Turn over for the next question

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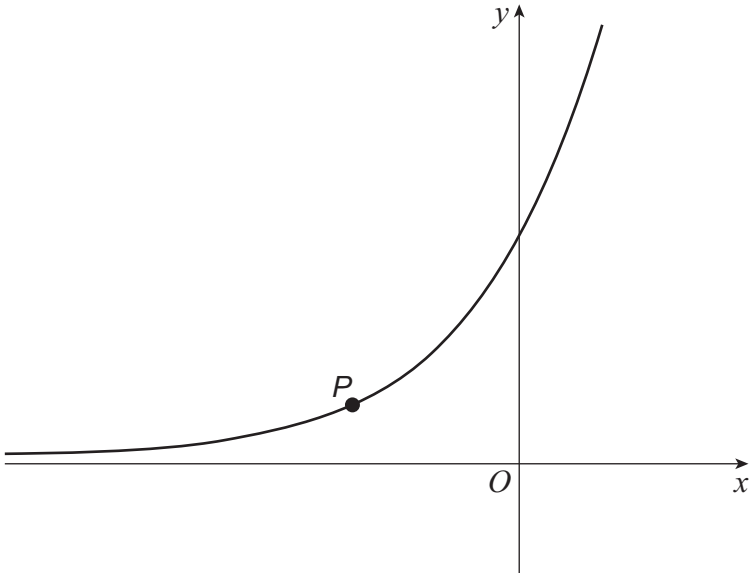
10 A curve has the equation

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

and the point P lies on the curve, as shown in the diagram.



The tangent to the curve at P is parallel to the line with equation $x - 9y = 23$

Find the x-coordinate of P

[5 marks]

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11 (a) Expand $x(x-2)(x+4)$

[1 mark]

11 (b) Show that

$$\int_{-4}^{2} x(x-2)(x+4)\,\mathrm{d}x = 36$$

Fully justify your answer.

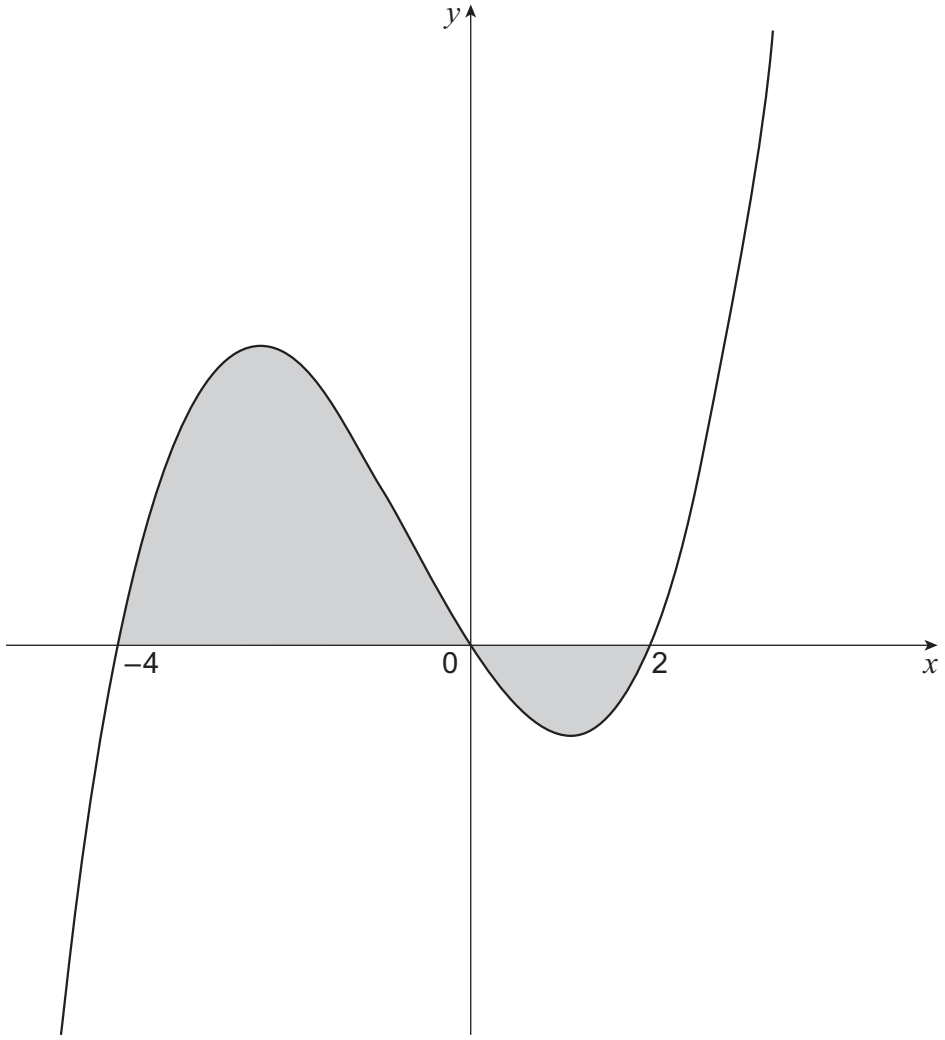
[4 marks]

Question 11 continues on the next page

11 (c) The curve C has equation

$$y = x(x - 2)(x + 4)$$

A sketch of C is shown in the diagram.



11 (c) (i) Explain why your answer to part **(b)** will not give the total area of the shaded region bounded by C and the x-axis.

[1 mark]

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11 (c) (ii) Find the total area of the shaded region bounded by C and the x-axis.

[2 marks]

Turn over for the next question

12 (a) It is given that

$$^{40}C_{18} = \frac{40!}{18!\,p!}$$

Write down the value of p

[1 mark]

12 (b) Use the result from part **(a)** to show that

$$\frac{^{40}C_{18}}{^{40}C_{17}} = \frac{23}{q}$$

where q is an integer to be found.

[2 marks]

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13 A computer game awards points to a player based on the time taken to complete a level.

The points awarded decrease as the time taken to complete a level increases.

Rebekah believes that the points awarded, P, can be modelled by the equation

$$P = A\mathrm{e}^{kt}$$

where t is the time, in seconds, taken to complete the level and A and k are constants.

13 (a) Explain, in context, the meaning of the value of A

[1 mark]

13 (b) Show that

$$\ln P = \ln A + kt$$

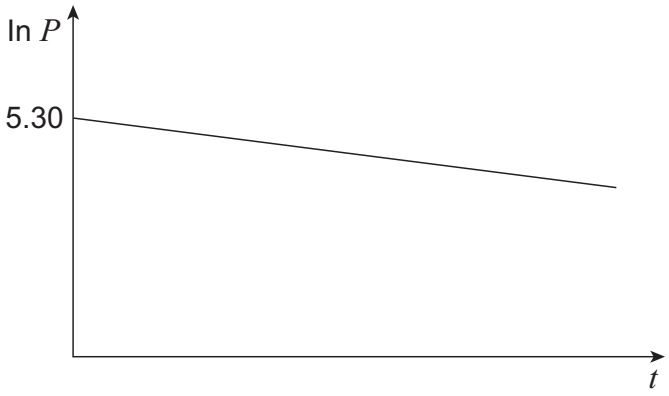
[2 marks]

Question 13 continues on the next page

13 (c) Rebekah records the points and the time taken for her to complete each level.

She plots the values of ln P against t

Rebekah obtains a straight-line graph with a gradient of -0.08 and a vertical intercept of 5.30, as shown in the diagram.



Find the value of A and the value of k

[3 marks]

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13 (d) Rebekah scores 20 points for completing a particular level.

Find, to the nearest second, the time taken to complete this level.

[3 marks]

END OF SECTION A

Turn over for Section B

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Section B

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

14 A particle of mass 2 kg is moving on a smooth horizontal surface under the action of a single horizontal force of 5 N

Find the acceleration of the particle.

Circle your answer.

[1 mark]

$0.4\ m\ s^{-2}$ $2.5\ m\ s^{-2}$ $10\ m\ s^{-2}$ $24.5\ m\ s^{-2}$

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15 Three forces $\mathbf{F}_1$, $\mathbf{F}_2$ and $\mathbf{F}_3$ are given by:

$$\mathbf{F}_1 = (-2\mathbf{i} + 4\mathbf{j})\ \text{N}$$

$$\mathbf{F}_2 = (-3\mathbf{i} + 6\mathbf{j})\ \text{N}$$

$$\mathbf{F}_3 = (-6\mathbf{i} + 9\mathbf{j})\ \text{N}$$

One of the following statements is true.

Identify the correct statement.

Tick (✓) **one** box.

[1 mark]

$\mathbf{F}_1$ and $\mathbf{F}_2$ are parallel forces. ☐

$\mathbf{F}_1$ and $\mathbf{F}_3$ are parallel forces. ☐

$\mathbf{F}_2$ and $\mathbf{F}_3$ are parallel forces. ☐

None of the forces $\mathbf{F}_1$, $\mathbf{F}_2$ and $\mathbf{F}_3$ are parallel. ☐

Turn over for the next question

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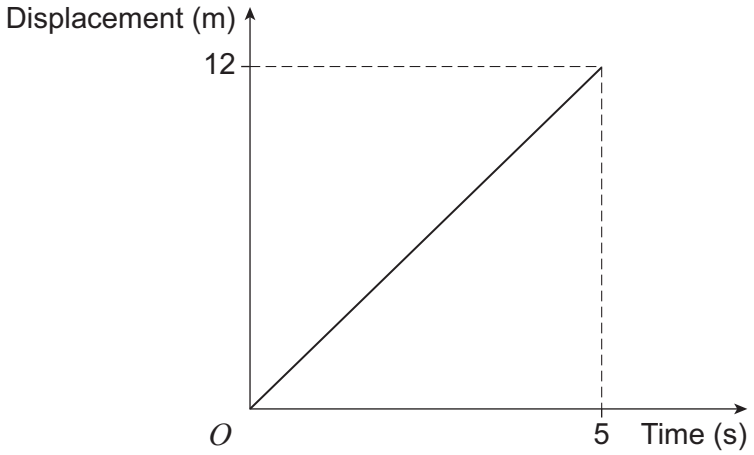
16 The displacement–time graph, **Figure 1**, shows the first 5 seconds of the motion of a car which starts from rest and travels 12 metres.

Figure 1



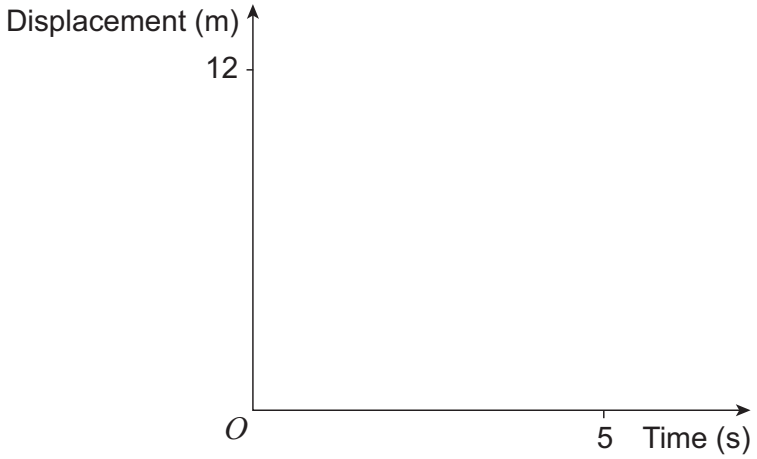
16 (a) Find the speed of the car.

[1 mark]

16 (b) On **Figure 2**, draw a more realistic displacement–time graph to show the first 5 seconds of motion of the car.

[1 mark]

Figure 2



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17 **In this question use $g = 9.8$ m s^{-2}**

Lamic has mass 60 kg.

He is standing on the floor of a lift.

The lift is accelerating upwards at 1.2 m s^{-2}

The reaction of the floor on Lamic is R newtons.

Find the value of R

[2 marks]

Turn over for the next question

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18 **In this question use $g = 10$ m s^{-2}**

A ball is thrown vertically upwards from a height of 1.8 metres above the ground.

The initial velocity of the ball is 12 m s^{-1}

The greatest height reached by the ball above the ground is h metres.

Find the value of h

[3 marks]

Do not write outside the box

19 A force **F** is $\begin{bmatrix} p \\ -0.5 \end{bmatrix}$ newtons, where p is a constant.

Given that the magnitude of **F** is 1.3 newtons, find the possible values of p

[3 marks]

Turn over for the next question

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20 A sports scientist is modelling the speed of an athlete who ran a 100-metre race.

The speed, v m s^{-1}, of the athlete at time t seconds after the start of the 100-metre race is given by

$$v = 1.8 + 3.8t - 0.25t^2$$

20 (a) State the initial speed of the athlete according to the model.

[1 mark]

20 (b) (i) Find an expression, in terms of t, for the acceleration of the athlete.

[2 marks]

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20 (b) (ii) Hence find the maximum speed of the athlete.

Fully justify your answer.

[4 marks]

20 (c) The official maximum speed recorded, by the scientist, for the athlete was 12.4 m s^{-1}

Evaluate the accuracy of the model used by the scientist.

[1 mark]

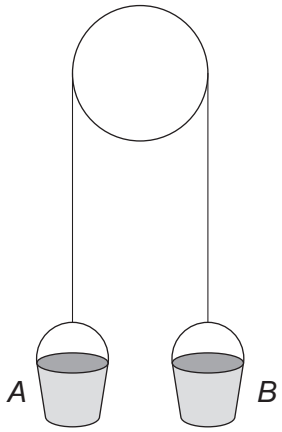
Turn over for the next question

21 Two buckets, *A* and *B*, each have mass 0.5 kg

Each bucket is attached to one end of a light inextensible rope.

The rope is hung over a smooth fixed pulley.

The system is in equilibrium with both buckets hanging freely at rest, as shown in the diagram.



A builder then places a brick of mass 3 kg inside bucket *A*

Bucket *A*, with the brick inside, then moves vertically downwards.

During the subsequent motion, the magnitude of the acceleration of each bucket is a m s^{-2} and the magnitude of the tension in the rope is T N

Assume the buckets and brick can be modelled as particles.

21 (a) Find a and T, leaving your answers in terms of g

Fully justify your answer.

[6 marks]

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21 (b) Explain a limitation of modelling the buckets as particles.

[1 mark]

END OF QUESTIONS

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