

Please check the examination details below before entering your candidate information

Candidate surname

Other names

Centre Number

Candidate Number

--	--	--	--	--

--	--	--	--	--

Pearson Edexcel Level 3 GCE

Thursday 12 June 2025

Afternoon (Time: 2 hours)

Paper
reference

9MA0/02

Mathematics

Advanced

PAPER 2: Pure Mathematics 2

You must have:

Mathematical Formulae and Statistical Tables (Green), calculator

Total Marks

Candidates may use any calculator allowed by Pearson regulations. Calculators must not have the facility for symbolic algebra manipulation, differentiation and integration, or have retrievable mathematical formulae stored in them.

Instructions

- Use **black** ink or ball-point pen.
- If pencil is used for diagrams/sketches/graphs it must be dark (HB or B).
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions and ensure that your answers to parts of questions are clearly labelled.
- Answer the questions in the spaces provided
– *there may be more space than you need.*
- You should show sufficient working to make your methods clear. Answers without working may not gain full credit.
- Inexact answers should be given to three significant figures unless otherwise stated.

Information

- A booklet 'Mathematical Formulae and Statistical Tables' is provided.
- There are 16 questions in this question paper. The total mark for this paper is 100.
- The marks for **each** question are shown in brackets
– *use this as a guide as to how much time to spend on each question.*

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ►

P74091A

©2025 Pearson Education Ltd.
Y:1/1/1/1/1/1/1/



DO NOT WRITE IN THIS AREA



DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

- DO NOT WRITE IN THIS AREA**

DO NOT WRITE IN THIS AREA

- DO NOT WRITE IN THIS AREA**

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



Question 1 continued

Lined area for writing the answer to Question 1.

(Total for Question 1 is 4 marks)



P 7 4 0 9 1 A 0 3 4 8

2. (a) Sketch the curve with equation

$$y = 2^{-3x}$$

stating the coordinates of any points of intersection with the coordinate axes.

(2)

- (b) By writing $\frac{1}{32}\sqrt{2}$ as a power of 2, solve the equation

$$2^{-3x} = \frac{1}{32}\sqrt{2}$$

(2)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



Question 2 continued

Lined area for writing the answer to Question 2.

(Total for Question 2 is 4 marks)



3. A sequence of terms $a_1, a_2, a_3, \dots$ is defined by

$$a_1 = 4$$

$$a_{n+1} = ka_n + 3$$

where k is a constant.

Given that

- $\sum_{n=1}^3 a_n = 12$
- all terms of the sequence are different

find the value of k

(4)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



Question 3 continued

Lined area for writing the answer to Question 3.

(Total for Question 3 is 4 marks)



P 7 4 0 9 1 A 0 7 4 8

4.

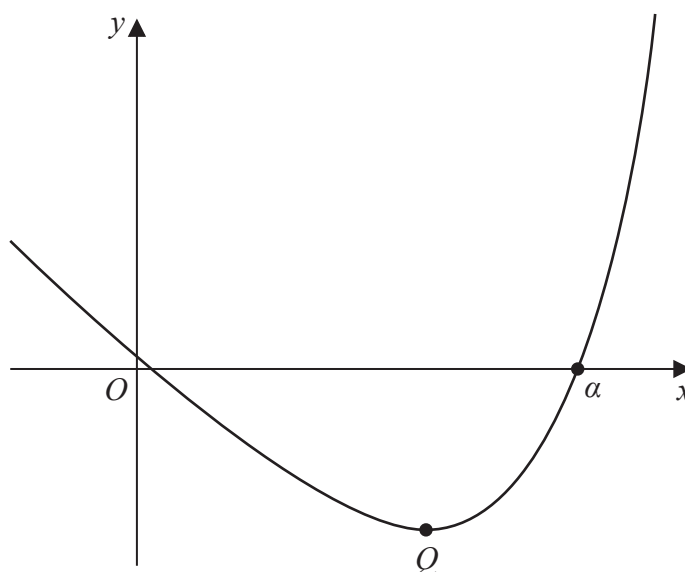


Figure 2

Figure 2 shows a sketch of the curve with equation $y = f(x)$, where

$$f(x) = 2^x - 10x$$

The curve crosses the x -axis at $x = \alpha$, $\alpha > 1$, as shown in Figure 2.

- (a) Show that α lies in the interval $[5, 6]$ (2)

Given that $f'(x) = p \times 2^x - 10$

- (b) state the value of the constant p (1)

- (c) Taking $x_0 = 6$ as a first approximation to α , apply the Newton-Raphson method once to $f(x)$ to obtain a second approximation to α .
Show your method and give your answer to 3 significant figures. (2)

The curve has a minimum turning point at Q , shown in Figure 2.

- (d) Use the answer to part (b) to find the x coordinate of Q .
Show your working and give your answer to 3 significant figures. (2)



Question 4 continued

Lined area for writing the answer to Question 4.

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



P 7 4 0 9 1 A 0 9 4 8

Question 4 continued

Lined area for writing the answer to Question 4.

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



Question 4 continued

Lined area for writing the answer to Question 4.

(Total for Question 4 is 7 marks)



5. The table below shows corresponding values of x and y for $y = e^{-x^2}$

The values of y are given to 4 decimal places as appropriate.

x	0	0.25	0.5	0.75	1	1.25	1.5
y	1	0.9394	0.7788	0.5698	0.3679	0.2096	0.1054

- (a) Using the trapezium rule with all the values of y in the table, find an estimate for

$$\int_0^{1.5} e^{-x^2} dx$$

giving your answer to 3 significant figures.

(3)

Using your answer to part (a) and making your method clear, estimate

(b) (i) $\int_{-1.5}^{1.5} e^{-x^2} dx$

(ii) $\int_0^{1.5} (e^{-x^2} + 7) dx$

(3)



Question 5 continued

Lined area for writing the answer to Question 5.

(Total for Question 5 is 6 marks)



6. (a) Find the first four terms, in ascending powers of x , of the binomial expansion of

$$\frac{4}{(2+3x)^2}$$

writing each term in simplest form.

(4)

(b) Find the range of values of x for which this expansion is valid.

(1)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



Question 6 continued

Lined area for writing the answer to Question 6.

(Total for Question 6 is 5 marks)



7. The functions f and g are defined by

$$f(x) = \frac{3}{2} \ln x \quad x > 0$$

$$g(x) = \frac{4x+3}{2x+1} \quad x > 0$$

(a) Find $gf(e^2)$ writing your answer in simplest form.

(2)

(b) Prove that g is a decreasing function.

(3)

(c) Find the range of the function fg

(2)

Handwritten area with horizontal lines for working.

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



Question 7 continued

Handwriting practice area with 20 horizontal lines.



Question 7 continued

Handwriting practice area with 25 horizontal lines.

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



Question 7 continued

Lined area for writing the answer to Question 7.

(Total for Question 7 is 7 marks)



8.

In this question you must show all stages of your working.

Solutions relying entirely on calculator technology are not acceptable.

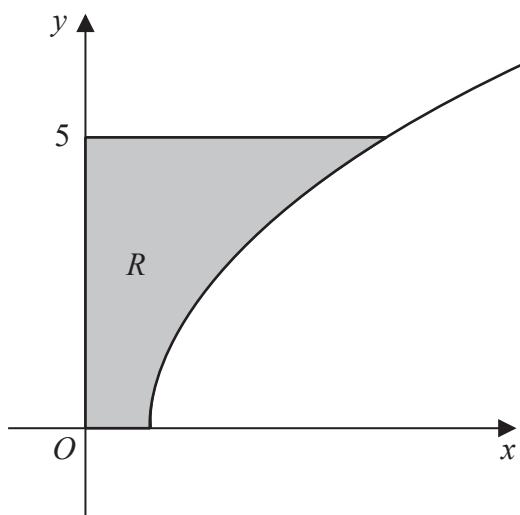


Figure 3

Figure 3 shows a sketch of part of the curve with equation

$$y = \sqrt{2x - 7}$$

The region R , shown shaded in Figure 3, is bounded by the curve, the x -axis, the y -axis and the line with equation $y = 5$

Find the exact area of R

(6)



Question 8 continued

Lined area for writing the answer to Question 8.

(Total for Question 8 is 6 marks)



9. (a) Prove that the difference of the squares of two consecutive **odd** numbers is always a multiple of 8

(3)

(b) Show that the difference of the squares of two consecutive **even** numbers is **not** always a multiple of 8

(1)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



Question 9 continued

Lined area for writing the answer to Question 9.

(Total for Question 9 is 4 marks)



DO NOT WRITE IN THIS AREA



DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



Question 10 continued

Lined area for writing the answer to Question 10.



Question 10 continued

Handwriting practice area with 20 horizontal lines.

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



Question 10 continued

Lined area for writing the answer to Question 10.

(Total for Question 10 is 8 marks)



11. Given that θ is measured in radians, prove, from first principles, that the derivative of $\sin \theta$ is $\cos \theta$

$$\left(\text{You may assume that as } h \rightarrow 0, \frac{\sin h}{h} \rightarrow 1 \text{ and } \frac{\cos h - 1}{h} \rightarrow 0 \right) \quad (5)$$

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



Question 11 continued

Lined area for writing the answer to Question 11.

(Total for Question 11 is 5 marks)



12.

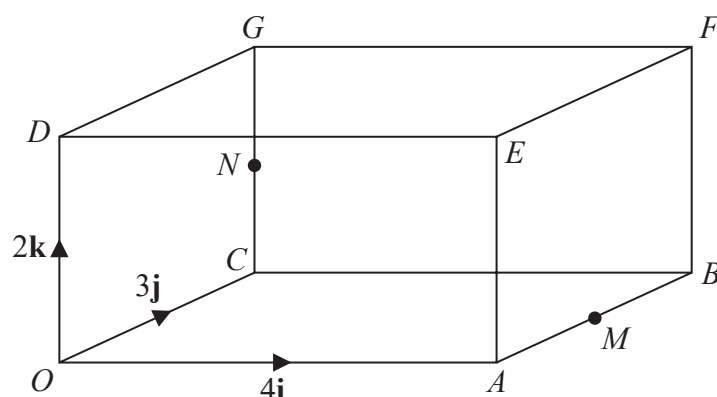


Figure 5

Figure 5 shows a sketch of the cuboid $OABCGDEF$

Unit vectors $\mathbf{i}$, $\mathbf{j}$ and $\mathbf{k}$ lie on the lines OA , OC and OD respectively where O is the origin.

Given that

- $\vec{OA} = 4\mathbf{i}$ and $\vec{OC} = 3\mathbf{j}$ and $\vec{OD} = 2\mathbf{k}$
- the points M and N are the midpoints of AB and CG respectively
- the point P lies on MN such that $\vec{MP} = 3\vec{PN}$

(a) show that

$$\vec{OP} = \mathbf{i} + \frac{21}{8}\mathbf{j} + \frac{3}{4}\mathbf{k} \quad (4)$$

The straight line through O and P meets the face $BFGC$ at the point Q

(b) Find the coordinates of Q (2)



Question 12 continued

Lined area for writing the answer to Question 12.



Question 12 continued

Handwriting practice area with 30 horizontal lines.

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



Question 12 continued

Lined area for writing the answer to Question 12.

(Total for Question 12 is 6 marks)



13.

In this question you must show all stages of your working.

Given that the first three terms of a geometric sequence are

$$8 \sin \theta \qquad 3 \sin 2\theta \qquad 2 + 2 \cos 2\theta$$

and $0 < \theta < \frac{\pi}{2}$

(a) show that

$$\sin \theta = \frac{8}{9} \quad (4)$$

Hence, or otherwise

(b) prove that S_∞ exists (2)

(c) find the value of $S_\infty - S_{10}$ giving your answer to 2 significant figures. (3)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



Question 13 continued

Handwriting practice area with 20 horizontal lines.



Question 13 continued

Handwriting practice area with 28 horizontal lines.

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



Question 13 continued

Lined area for writing the answer to Question 13.

(Total for Question 13 is 9 marks)



14.

In this question you must show detailed reasoning.

The height of the tide, H m, in a harbour, is measured t hours after midnight.

The rate of change of H is modelled by the differential equation

$$\frac{dH}{dt} = A \cos(bt)$$

where A and b are constants and t is measured in radians.

Given that

- the largest value of this rate of change is 2 metres per hour
- the time between consecutive tides of maximum height, in the harbour, is 12 hours
- the maximum height of the tide, in the harbour, is $\frac{30}{\pi}$ metres

find a complete equation for the model, giving H in terms of t

(5)



Question 14 continued

Lined area for writing the answer to Question 14.

(Total for Question 14 is 5 marks)



15. The number of mice on an island is being monitored.

When monitoring began there were 4000 mice on the island.

In a simple model, the number of mice x , in thousands, is modelled by the equation

$$x = \frac{k(3t+2)}{4t+5}$$

where k is a constant and t is the number of years after monitoring began.

- (a) Find a complete equation for this model.

(2)

- (b) Hence calculate the long-term population of mice predicted by this model.

(1)

In a second model, the number of mice x , in thousands, is modelled by the differential equation

$$4 \frac{dx}{dt} = 6x - x^2$$

where t is the number of years after monitoring began.

- (c) Write $\frac{4}{6x - x^2}$ in partial fraction form.

(3)

- (d) Solve the differential equation with the given initial condition to show that

$$x = \frac{12e^{\frac{3}{2}t}}{1+2e^{\frac{3}{2}t}}$$

(5)

- (e) Hence find the long-term population of mice predicted by this **second** model.

(1)



Question 15 continued

Lined area for writing the answer to Question 15.



P 7 4 0 9 1 A 0 4 1 4 8

Question 15 continued

Handwriting practice area with 30 horizontal lines.

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



Question 15 continued

Lined area for writing the answer to Question 15.

(Total for Question 15 is 12 marks)



In this question you must show all stages of your working.

DO NOT WRITE IN THIS AREA



DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

(2)

(6)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



Question 16 continued

Lined area for writing the answer to Question 16.



Question 16 continued

Handwriting practice area with 25 horizontal lines.

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



Question 16 continued

Lined area for writing the answer to Question 16.



P 7 4 0 9 1 A 0 4 7 4 8

Question 16 continued

Handwriting practice area with horizontal lines.

(Total for Question 16 is 8 marks)

TOTAL FOR PAPER IS 100 MARKS

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

