

Paper Reference 9MA0/01

Pearson Edexcel

Level 3 GCE

Mathematics

Advanced

PAPER 1: Pure Mathematics 1

Wednesday 4 June 2025 – Afternoon

Time: 2 hours

Question Paper

**THIS DOCUMENT MUST BE
RETURNED TO PEARSON AT THE END
OF THE EXAMINATION.**

In the boxes below, write your name,
centre number and candidate number.

Surname					
Other names					
Centre Number					
Candidate Number					

YOU MUST HAVE

**Mathematical Formulae and Statistical
Tables (Green), calculator**

YOU WILL BE GIVEN

Diagram Booklet

Answer Booklet

**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.**

Turn over

INSTRUCTIONS

Answer ALL questions and ensure that your answers to parts of questions are clearly labelled.

Answer the questions in the Answer Booklet or in the separate Diagram Booklet – 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.

Turn over

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.

There may be spare copies of some diagrams.

Turn over

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

1. The point $P(6, -4)$ lies on the curve with equation $y = f(x)$, $x \in \mathbb{R}$

Find the point to which P is mapped when the curve with equation $y = f(x)$ is transformed to the curve with equation

(a) $y = f(x + 2)$
(1 mark)

(b) $y = f^{-1}(x)$
(1 mark)

(continued on the next page)

Turn over

1. continued.

Find the point to which **P** is mapped when the curve with equation $y = f(x)$ is transformed to the curve with equation

$$(c) \quad y = 2|f(x)| - 3$$

(2 marks)

(Total for Question 1 is 4 marks)

Turn over

2. The circle C has equation

$$(x + 3)^2 + (y - 4)^2 = 24$$

(a) (i) State the coordinates of the centre of C

(ii) Find the radius of C writing your answer as a fully simplified surd.

(3 marks)

(b) Determine, giving a reason, whether or not the origin lies inside the circle C

(2 marks)

(Total for Question 2 is 5 marks)

Turn over

- 3. The first three terms of an arithmetic sequence are**

$6k$, 10 and $2k$

where k is a constant.

- (a) Find the value of k
(2 marks)**

- (b) Hence find the value of the sum
of the first 50 terms of this
sequence.
(3 marks)**

(Total for Question 3 is 5 marks)

Turn over

4. Given that

- $f(x) = 2x^3 + 3x^2 - 16x + 16$

- $f(-4) = 0$

(a) write $f(x)$ in the form

$$(x + p)Q(x)$$

where p is a constant and $Q(x)$ is a quadratic expression.

(3 marks)

(continued on the next page)

Turn over

4. continued.

Remember:

- $f(x) = 2x^3 + 3x^2 - 16x + 16$

- $f(-4) = 0$

(b) Hence prove that -4 is the only real root of the equation

$$f(x) = 0$$

(Solutions relying on calculator technology are not acceptable.)

(2 marks)

(Total for Question 4 is 5 marks)

Turn over

5. (a) Express

$$\lim_{\delta x \rightarrow 0} \sum_{x=1.44}^{2.89} \frac{2}{\sqrt{x}} \delta x$$

as an integral.

(1 mark)

(continued on the next page)

5. continued.

(b) Hence show that

$$\lim_{\delta x \rightarrow 0} \sum_{x=1.44}^{2.89} \frac{2}{\sqrt{x}} \delta x = k$$

where k is an integer to be found.

(Solutions relying on calculator technology are not acceptable.)

(2 marks)

(Total for Question 5 is 3 marks)

Turn over

6. A scientist is monitoring the flight of sea birds after they leave their nests on a cliff.

The height above the sea, h metres, of one of the birds is modelled by the equation

$$h = A - B t^{1.5} \quad h \geq 0 \quad 0 \leq t \leq T$$

where t seconds is the time after the bird leaves its nest and A , B and T are positive constants.

(continued on the next page)

Turn over

6. continued.

Given that

- the bird was **17.6** metres above the sea exactly **4** seconds after leaving its nest
- the bird was **11.9** metres above the sea exactly **9** seconds after leaving its nest

(a) find a complete equation for the model.

(4 marks)

(continued on the next page)

Turn over

6. continued.

Find, according to the model,

**(b) the height of the bird's nest
above the sea,
(1 mark)**

**(c) the limitation on the value of T
(2 marks)**

(Total for Question 6 is 7 marks)

Turn over

7. Refer to the diagram for Question 7 in the Diagram Booklet.

It shows a sketch of a curve C with equation

$y = f(x)$, where $f(x)$ is a quartic expression in x

The curve

- has maximum turning points at $(-1, 0)$ and $(5, 0)$**
- crosses the y -axis at $(0, -75)$**
- has a minimum turning point at $x = 2$**

(continued on the next page)

Turn over

7. continued.

(a) Find the set of values of x for which

$$f'(x) \geq 0$$

writing your answer in set notation.

(2 marks)

(continued on the next page)

Turn over

7. continued.

(b) Find the equation of C

**You may leave your answer in
factorised form.**

(3 marks)

The curve C_1 has equation

$y = f(x) + k$, where k is a constant.

**Given that the graph of C_1 intersects
the X -axis at exactly four places,**

**(c) find the range of possible values
for k**

(2 marks)

(Total for Question 7 is 7 marks)

Turn over

- 8. Refer to the information for Question 8 in the Diagram Booklet. A student was asked to prove that the square of any number can be expressed in the form $5n$ or $5n \pm 1$ where $n \in \mathbb{N}$**

The start of the student's proof is shown in the Diagram Booklet.

- (a) Identify and correct an algebraic error in the proof shown in the Diagram Booklet.
(1 mark)**

(continued on the next page)

8. continued.

(b) Show the calculations and statements that are required to complete the proof.

(4 marks)

(Total for Question 8 is 5 marks)

Turn over

- 9. Refer to the diagram for Question 9 in the Diagram Booklet.**

A racing car is driven along a straight road.

The diagram shows a graph of the speed of the car as it travels along the road.

The car starts from rest and is driven for T seconds before stopping.

(continued on the next page)

Turn over

9. continued.

The speed of the car is modelled by the equation

$$v = 15t - te^{0.2t} \quad 0 \leq t \leq T$$

where t seconds is the time after the car starts to move.

According to the model,

- (a) find the value of T , giving your answer to one decimal place,
(2 marks)**

(continued on the next page)

Turn over

9. continued.

(b) show that the maximum speed of the car occurs when

$$t = 5 \ln \left(\frac{75}{t + 5} \right)$$

(4 marks)

(continued on the next page)

Turn over

9. continued.

Using the iteration formula

$$t_{n+1} = 5 \ln \left(\frac{75}{t_n + 5} \right) \quad \text{with } t_1 = 8$$

**(c) (i) find the value of t_3 to
3 decimal places,**

**(ii) find, by repeated iteration,
the time taken for the car
to reach maximum speed.**

(3 marks)

(Total for Question 9 is 9 marks)

Turn over

10. Given that

$$\bullet \vec{PQ} = 2\mathbf{i} + 8\mathbf{j} - 2\mathbf{k}$$

$$\bullet \vec{QR} = 6\mathbf{i} + 6\mathbf{k}$$

(a) find $\vec{PR}$
(2 marks)

(b) Hence show that triangle PQR is
both right-angled and isosceles.
(4 marks)

(Total for Question 10 is 6 marks)

Turn over

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

Solutions relying entirely on calculator technology are not acceptable.

The value of a car, $\pounds V$, is modelled by the equation

$$V = 1500 + Ae^{-kt}$$

where A and k are positive constants and t is the age of the car in years.

(continued on the next page)

Turn over

11. continued.

Given that

- **the initial value of the car was
£20 000**
- **the value of the car was £12 000
when it was 2.5 years old**

- (a) find a complete equation for the
model, giving the exact value
of A and the value of k to
3 significant figures.
(4 marks)**

(continued on the next page)

Turn over

11. continued.

- (b) Show that the rate of change in the value of the car can be expressed in the form**

$$-k(V - 1500)$$

(3 marks)

- (c) State a limitation of this model.**
(1 mark)

(Total for Question 11 is 8 marks)

Turn over

12. Refer to the diagram for Question 12 in the Diagram Booklet.

It shows a sketch of the curve **C with equation**

$$y = \frac{15x}{(2x + 3)(x - 3)} \quad x \neq -\frac{3}{2} \quad x \neq 3$$

and the straight line **L with equation**

$$y = 2x - 10$$

- (a) Verify that **C** and **L** intersect where $x = 6$**
(2 marks)

(continued on the next page)

Turn over

12. continued.

The curve and line also intersect at the point **Q shown in the diagram.**

(b) Show that the **x coordinate of **Q** is a solution of**

$$4x^3 - 26x^2 - 3x + 90 = 0$$

(2 marks)

(c) Using algebra and showing all stages of working, find the exact **x coordinate of **Q****

(4 marks)

(Total for Question 12 is 8 marks)

Turn over

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

Solutions relying on calculator technology are not acceptable.

Show that

$$\int_0^2 \frac{x}{(2x+1)^3} dx = \frac{2}{25}$$

(Total for Question 13 is 5 marks)

Turn over

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

Solutions relying on calculator technology are not acceptable.

(a) Show that

$$\sin(x + 30^\circ) + \sqrt{3} \cos(x + 30^\circ) \\ \equiv 2 \cos x$$

(3 marks)

(continued on the next page)

Turn over

14. continued.

(b) Hence solve, for $0 \leq \theta < 180^\circ$

$$\sin(\theta + 30^\circ) + \sqrt{3} \cos(\theta + 30^\circ) = 3 \sin 2\theta$$

giving your answers to one decimal place, where appropriate.

(4 marks)

(Total for Question 14 is 7 marks)

Turn over

15. Refer to the diagram for Question 15 in the Diagram Booklet.

It shows the plan view for the design of a stage.

The shape of this design consists of a sector of a circle AOB joined to a rectangle $OBCD$

(continued on the next page)

15. continued.

Given that

- the radius of the sector is r metres
and angle **AOB** is θ radians
- the length and width of the rectangle
are r metres and $\frac{1}{10}r$ metres
respectively
- the total area of the stage is 240 m^2

(continued on the next page)

Turn over

15. continued.

- (a) show that the perimeter of the stage, P metres, is given by**

$$P = 2r + \frac{480}{r}$$

You must make your method clear.

(4 marks)

Using algebraic differentiation,

- (b) find the value of r for which P has a stationary value.**

(3 marks)

(continued on the next page)

Turn over

15. continued.

- (c) Prove, by further differentiation, that this value of r gives the minimum perimeter of the stage.
(2 marks)**

(Total for Question 15 is 9 marks)

16. Refer to the diagram for Question 16 in the Diagram Booklet.

It shows a sketch of the curve **C** with equation

$$y = \frac{1}{x^2 \sqrt{4 - x^2}} \qquad 0 < x < 2$$

The region **R**, shown shaded in the diagram, is bounded by **C**, the line with equation $x = 1$, the x -axis and the line with equation $x = \sqrt{3}$

(continued on the next page)

16. continued.

- (a) Use the substitution $x = 2 \sin u$ to show that the area of R is given by**

$$\int_a^b k \operatorname{cosec}^2 u \, du$$

where a , b and k are constants to be found.

(4 marks)

(continued on the next page)

Turn over

16. continued.

(b) Hence, using algebraic integration, find the exact area of R

Give your answer in simplest form.

(3 marks)

(Total for Question 16 is 7 marks)

TOTAL FOR PAPER IS 100 MARKS

END OF PAPER