

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.

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.

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.

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.

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)

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

(2 marks)

(Total for Question 1 is 4 marks)

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)

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)

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)

(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)

5. (a) Express

$$\lim_{\delta x \rightarrow 0} \sum_{x=1.44}^{2.89} \frac{2}{\sqrt{x}} \delta x \text{ as an integral.}$$

(1 mark)

(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)

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.

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)

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)

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 $x = 2$

(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)

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)

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)

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

(4 marks)

(Total for Question 8 is 5 marks)

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.

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)

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)

10. Given that

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

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

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

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

(Total for Question 10 is 6 marks)

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.

Given that

- the initial value of the car was $\pounds 20\,000$
- the value of the car was $\pounds 12\,000$ when it was 2.5 years old

(continued on the next page)

11. continued.

- (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)

- (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)

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)

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)

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)

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)

- (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)

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 $OBCD$

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)

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)

- (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

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

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 $x = \sqrt{3}$

- (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)

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