

Paper Reference 8MA0/01
Pearson Edexcel
Level 3 GCE

Mathematics
Advanced Subsidiary
Paper 1: Pure Mathematics

Wednesday 15 May 2019 – Morning

Time: 2 hours plus your additional time allowance.

**MATERIALS REQUIRED FOR
EXAMINATION**

**Mathematical Formulae and Statistical
Tables, calculator**

**ITEMS INCLUDED WITH QUESTION
PAPER**

Diagram Book
Answer Book

Y58351A

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

INSTRUCTIONS

In the boxes on the Answer Book and on the Diagram Book, write 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 Answer Book or on the separate diagrams – there may be more space than you need.

Do NOT write on the Question Paper.

You should show sufficient working to make your methods clear. Answers without working may not gain full credit.

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.

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 line L_1 has equation
 $2x + 4y - 3 = 0$

The line L_2 has equation $y = mx + 7$,
where m is a constant.

Given that L_1 and L_2 are
perpendicular,

- (a) find the value of m
(2 marks)

(continued on the next page)

1. continued.

The lines L_1 and L_2 meet at the point P

**(b) Find the x coordinate of P
(2 marks)**

(Total for Question 1 is 4 marks)

Turn over

- 2. Find, using algebra, all real solutions to the equation**

(i) $16a^2 = 2\sqrt{a}$

(4 marks)

(ii) $b^4 + 7b^2 - 18 = 0$

(4 marks)

(Total for Question 2 is 8 marks)

3. (a) Given that k is a constant, find

$$\int \left(\frac{4}{x^3} + kx \right) dx$$

simplifying your answer.

(3 marks)

- (b) Hence find the value of k such that

$$\int_{0.5}^2 \left(\frac{4}{x^3} + kx \right) dx = 8$$

(3 marks)

(Total for Question 3 is 6 marks)

Turn over

4. A tree was planted in the ground.
Its height, H metres, was measured
 t years after planting.

Exactly 3 years after planting, the
height of the tree was 2.35 metres.

Exactly 6 years after planting, the
height of the tree was 3.28 metres.

Using a linear model,

- (a) find an equation linking H with t
(3 marks)

(continued on the next page)

Turn over

4. continued.

The height of the tree was approximately 140 cm when it was planted.

(b) Explain whether or not this fact supports the use of the linear model in part (a)
(2 marks)

(Total for Question 4 is 5 marks)

Turn over

5. A curve has equation

$$y = 3x^2 + \frac{24}{x} + 2 \quad x > 0$$

(a) Find, in simplest form, $\frac{dy}{dx}$
(3 marks)

(b) Hence find the exact range of values of x for which the curve is increasing.
(2 marks)

(Total for Question 5 is 5 marks)

Turn over

6. Refer to the diagram for Question 6 in the Diagram Book.

It shows a sketch of a triangle **ABC** with **$AB = 3x$ cm**, **$AC = 2x$ cm** and angle **$CAB = 60^\circ$**

Given that the area of triangle **ABC** is **$18\sqrt{3}$ cm²**

- (a) show that **$x = 2\sqrt{3}$**
(3 marks)

(continued on the next page)

6. continued.

(b) Hence find the exact length of BC, giving your answer as a simplified surd.

(3 marks)

(Total for Question 6 is 6 marks)

Turn over

7. The curve **C** has equation

$$y = \frac{k^2}{x} + 1 \quad x \in \mathbb{R}, x \neq 0$$

where **k** is a constant.

(a) Sketch **C** stating the equation of the horizontal asymptote.

(3 marks)

(continued on the next page)

Turn over

7. continued.

The line L has equation $y = -2x + 5$

(b) Show that the X coordinate of any point of intersection of L with C is given by a solution of the equation

$$2x^2 - 4x + k^2 = 0$$

(2 marks)

(continued on the next page)

Turn over

7. continued.

- (c) Hence find the exact values of k
for which L is a tangent to C
(3 marks)**

(Total for Question 7 is 8 marks)

Turn over

8. (a) Find the first 3 terms, in ascending powers of x , of the binomial expansion of

$$\left(2 + \frac{3x}{4}\right)^6$$

giving each term in its simplest form.

(4 marks)

(continued on the next page)

8. continued.

(b) Explain how you could use your expansion to estimate the value of 1.925^6

You do not need to perform the calculation.

(1 mark)

(Total for Question 8 is 5 marks)

Turn over

9. A company started mining tin in Riverdale on 1st January 2019

A model to find the total mass of tin that will be mined by the company in Riverdale is given by the equation

$$T = 1200 - 3(n - 20)^2$$

where T tonnes is the total mass of tin mined in the n years after the start of mining.

(continued on the next page)

9. continued.

Using this model,

**(a) calculate the mass of tin
that will be mined up to
1st January 2020,
(1 mark)**

**(b) deduce the maximum total mass
of tin that could be mined,
(1 mark)**

**(c) calculate the mass of tin that will
be mined in 2023
(2 marks)**

(continued on the next page)

Turn over

9. continued.

- (d) State, giving reasons, the
limitation on the values of n
(2 marks)**

(Total for Question 9 is 6 marks)

Turn over

10. A circle **C** has equation

$$x^2 + y^2 - 4x + 8y - 8 = 0$$

(a) Find

(i) the coordinates of the centre of **C**,

(ii) the exact radius of **C**

(3 marks)

(continued on the next page)

Turn over

10. continued.

**The straight line with equation $x = k$,
where k is a constant, is a tangent
to C**

**(b) Find the possible values for k
(2 marks)**

(Total for Question 10 is 5 marks)

Turn over

11.

$$f(x) = 2x^3 - 13x^2 + 8x + 48$$

(a) Prove that $(x - 4)$ is a factor of $f(x)$

(2 marks)

(b) Hence, using algebra, show that the equation $f(x) = 0$ has only two distinct roots.

(4 marks)

(continued on the next page)

Turn over

11. continued.

Refer to the diagram for

Question 11(c) in the Diagram Book.

**It shows a sketch of part of the curve
with equation $y = f(x)$**

**(c) Deduce, giving reasons for your
answer, the number of real roots
of the equation**

$$2x^3 - 13x^2 + 8x + 46 = 0$$

(2 marks)

(continued on the next page)

Turn over

11. continued.

Given that k is a constant and the curve with equation $y = f(x + k)$ passes through the origin,

**(d) find the two possible values of k
(2 marks)**

(Total for Question 11 is 10 marks)

Turn over

12. (a) Show that

$$\frac{10\sin^2\theta - 7\cos\theta + 2}{3 + 2\cos\theta} \equiv 4 - 5\cos\theta$$

(4 marks)

(b) Hence, or otherwise, solve,
for $0 \leq x < 360^\circ$, the equation

$$\frac{10\sin^2 x - 7\cos x + 2}{3 + 2\cos x} = 4 + 3\sin x$$

(3 marks)

(Total for Question 12 is 7 marks)

Turn over

13. Refer to the diagram for Question 13 in the Diagram Book.

It shows a sketch of part of the curve with equation

$$y = 2x^3 - 17x^2 + 40x$$

The curve has a minimum turning point at $x = k$

(continued on the next page)

13. continued.

The region R , shown shaded in the diagram, is bounded by the curve, the x -axis and the line with equation $x = k$

Show that the area of R is $\frac{256}{3}$

(Solutions based entirely on graphical or numerical methods are not acceptable.)
(7 marks)

(Total for Question 13 is 7 marks)

Turn over

14. The value of a car, £ V , can be modelled by the equation

$$V = 15700e^{-0.25t} + 2300$$

$$t \in \mathbb{R}, t \geq 0$$

where the age of the car is t years.

Using the model,

- (a) find the initial value of the car.

(1 mark)

(continued on the next page)

Turn over

14. continued.

Given the model predicts that the value of the car is decreasing at a rate of £500 per year at the instant when $t = T$,

(b) (i) show that

$$3925e^{-0.25T} = 500$$

(continued on the next page)

Turn over

14. (b) continued.

(ii) Hence find the age of the car at this instant, giving your answer in years and months to the nearest month.

(Solutions based entirely on graphical or numerical methods are not acceptable.)

(6 marks)

(continued on the next page)

Turn over

14. continued.

The model predicts that the value of the car approaches, but does not fall below, £A

(c) State the value of A
(1 mark)

(d) State a limitation of this model.
(1 mark)

(Total for Question 14 is 9 marks)

Turn over

15. Given $n \in \mathbb{N}$, prove that $n^3 + 2$ is not divisible by 8
(4 marks)

(Total for Question 15 is 4 marks)

16. (i) Two non-zero vectors, **a** and **b**, are such that

$$| \underline{\mathbf{a}} + \underline{\mathbf{b}} | = | \underline{\mathbf{a}} | + | \underline{\mathbf{b}} |$$

Explain, geometrically, the significance of this statement.

(1 mark)

(continued on the next page)

16. continued.

- (ii) Two different vectors, $\underline{\mathbf{m}}$ and $\underline{\mathbf{n}}$, are such that

$$|\underline{\mathbf{m}}| = 3 \text{ and } |\underline{\mathbf{m}} - \underline{\mathbf{n}}| = 6$$

The angle between vector $\underline{\mathbf{m}}$ and vector $\underline{\mathbf{n}}$ is 30°

Find the angle between vector $\underline{\mathbf{m}}$ and vector $\underline{\mathbf{m}} - \underline{\mathbf{n}}$, giving your answer, in degrees, to one decimal place.

(4 marks)

(Total for Question 16 is 5 marks)

Turn over

(TOTAL FOR PAPER IS 100 MARKS)

END OF PAPER
