Please check the examination details below before entering your candidate information

Candidate surname	Other names

Pearson Edexcel Level 3 GCE

Centre Number	Candidate Number

Mock Paper Set 1

Time: 2 hours | Paper Reference **8MA0/01**

Mathematics

Advanced Subsidiary
Paper 1: Pure Mathematics

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 ▶

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Pearson

1. Find

$$\int \frac{2x^3 + 3}{x^2} \, dx$$

writing your answer in simplest form.

(4)

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Question 1 continued

(Total for Question 1 is 4 marks)

2. The triangle ABC is such that

- $AC = 12\,\text{cm}$
- $AB = 8\,\text{cm}$
- area $ABC = 30\,\text{cm}^2$

Find the two possible sizes of angle BAC, giving your answers in degrees to one decimal place.

(4)

Question 2 continued

(Total for Question 2 is 4 marks)

3. By taking logarithms of both sides, solve the equation

$$2^{5k+3} = 3^{550}$$

giving the value of k to one decimal place.

(3)

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Question 3 continued

(Total for Question 3 is 3 marks)

4. In the binomial expansion of

$$\left(k + \frac{1}{2}x\right)^9 \quad \text{where } k \text{ is a positive constant}$$

the coefficient of x^3 is 70

Find the value of k, giving your answer to 2 decimal places.

(3)

Question 4 continued

(Total for Question 4 is 3 marks)

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

Solutions relying on calculator technology are not acceptable.

(a) By letting $p = 2^x$, show that the equation

$$2 \times 4^x + 2^{x+3} = 1 + 2^{x-2}$$

can be rewritten in the form

$$8p^2 + 31p - 4 = 0$$

(3)

(b) Hence solve

$$2 \times 4^x + 2^{x+3} = 1 + 2^{x-2}$$

(3)

Question 5 continued

(Total for Question 5 is 6 marks)

6. The points P, Q and R have coordinates $(-5, -5)$, $(7, 1)$ and $(9, -3)$ respectively.

(a) Show that angle $PQR = 90°$

(3)

Given that P, Q and R each lie on a circle C

(b) find an equation for C

(3)

Question 6 continued

(Total for Question 6 is 6 marks)

7.

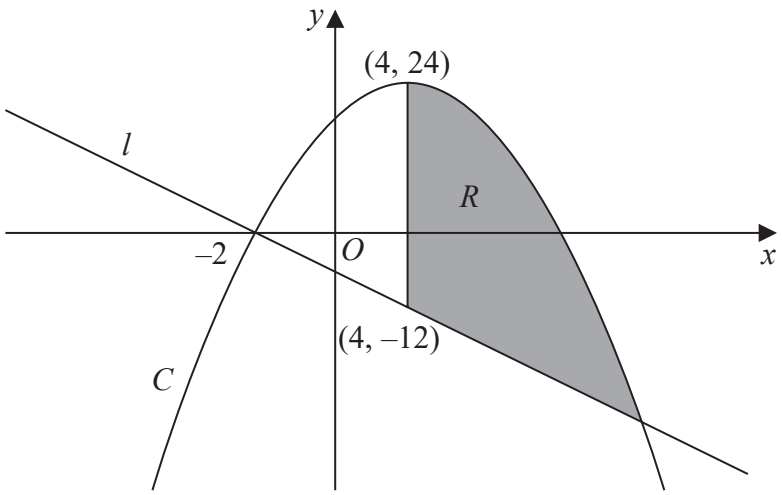

Figure 1

Figure 1 shows a sketch of the curve C with equation $y = f(x)$ where

- $f(x)$ is a quadratic expression
- C has a maximum turning point at (4, 24)
- C cuts the negative x-axis at –2

(a) (i) Deduce the coordinates of the point at which C cuts the positive x-axis.

(ii) Hence, or otherwise, find $f(x)$.

(3)

The straight line l, also shown in Figure 1, passes through the points (–2, 0) and (4, –12)

(b) Find an equation for l, writing your answer in the form $y = mx + c$, where m and c are constants to be found.

(3)

A shaded region R is shown in Figure 1.

(c) Use inequalities to define R.

(3)

Question 7 continued

Question 7 continued

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Question 7 continued

(Total for Question 7 is 9 marks)

8. A curve C has equation $y = g(x)$.

Given that

- $g'(x) = 6x^2 + 5x + k$ where k is a constant
- the graph of C cuts the y-axis at $(0, -10)$
- $(x + 4)$ is a factor of $g(x)$

find $g(x)$ in simplest form.

(6)

Question 8 continued

(Total for Question 8 is 6 marks)

9. A student studies two sets of data, y and x.

The student plots a graph of the values of $\log_{10} y$ against the values of $\log_{10} x$

The points on the graph lie on the straight line with equation

$$\log_{10} y = \frac{2}{3} \log_{10} x - 1$$

(a) Show that the relationship linking x and y may be written in the form

$$y = px^q$$

where p and q are constants to be found.

(4)

(b) Hence, or otherwise, find the exact value of y when $x = 100$

Write your answer in the form 10^k where k is a constant.

(2)

Question 9 continued

(Total for Question 9 is 6 marks)

10.

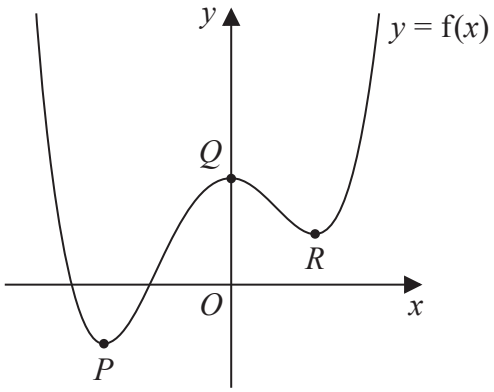

Figure 2

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

The curve has exactly three stationary points

- a minimum turning point P at $(-3, -7)$
- a maximum turning point Q at $(0, 10)$
- a minimum turning point R at $(2, 5)$

(a) Deduce the values of x for which $f'(x) < 0$. Write your answer in set notation.

(2)

Given that the value of $f''(x)$ is -5 at one of the stationary points,

(b) explain why this must be point Q.

(1)

Given that the equation $f(x) = k$, where k is a constant, has **exactly** 3 roots,

(c) write down the two possible values for k.

(2)

On the next page there is an unlabelled copy of Figure 2 called Diagram 1.

(d) On Diagram 1 sketch a graph of the curve with equation $y = f'(x)$.

(3)

Question 10 continued

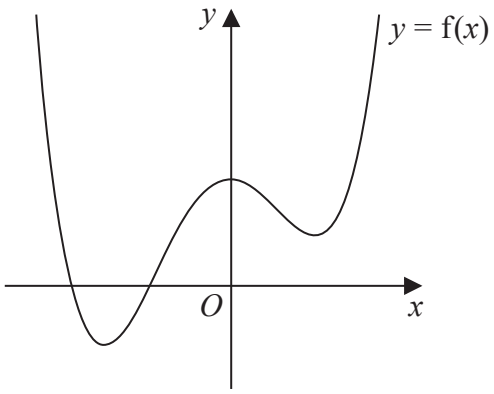

Diagram 1

(Total for Question 10 is 8 marks)

11. [*In this question the unit vectors* **i** *and* **j** *are due east and due north respectively*.]

A boat travels in a straight line at constant speed.

Initially the boat has position $(-11\mathbf{i} - 2\mathbf{j})$ km relative to a fixed origin O

After 90 minutes the boat has position $(\mathbf{i} + 6\mathbf{j})$ km relative to O

(a) Show that the speed of the boat is $p\sqrt{13}\,\text{km h}^{-1}$, where p is a constant to be found.

(3)

The boat continues in the same direction until it reaches point X

Given that X is due north east of O

(b) find the position vector of X, making your method clear.

(4)

Question 11 continued

(Total for Question 11 is 7 marks)

12. (i) A student states that

" $n^2 - n + 5$ is a prime number for all $n \in \mathbb{N}$ "

Show, by counter example, that the student's statement is **not** true.

(1)

(ii) Prove that

$$\tan\theta + \frac{1}{\tan\theta} \equiv \frac{1}{\sin\theta\cos\theta} \qquad \theta \neq (90n)^\circ \quad n \in \mathbb{N}$$

(3)

Question 12 continued

(Total for Question 12 is 4 marks)

13. A treatment is used to reduce the concentration of nitrate in the water in a pond.

The concentration of nitrate in the pond water, N ppm (parts per million), is modelled by the equation

$$N = 65 - 3e^{0.1t} \qquad t \in \mathbb{R} \quad t \geqslant 0$$

where t hours is the time after the treatment was applied.

Use the equation of the model to answer parts (a) and (b).

(a) Calculate the **reduction** in the concentration of nitrate in the pond water in the first 8 hours after the treatment was applied.

(3)

For fish to survive in the pond, the concentration of nitrate in the water must be no more than 20 ppm.

(b) Calculate the minimum time, after the treatment is applied, before fish can be safely introduced into the pond.
Give your answer in hours to one decimal place.

(3)

(c) State a limitation of this model.

(1)

Question 13 continued

(Total for Question 13 is 7 marks)

14.

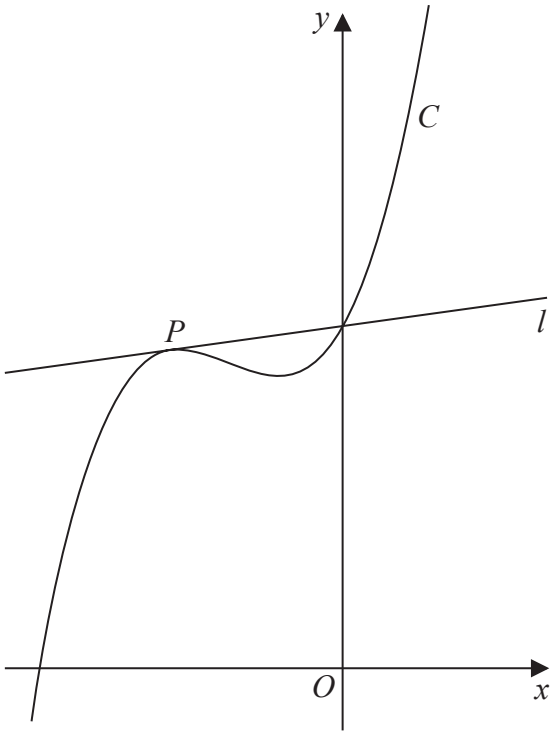

Figure 3

Figure 3 shows a sketch of part of the curve C with equation $y = f(x)$, where

$$f(x) = (x + 4)(2x^2 + x + 7)$$

(a) Use the given information to state the values of x for which

$$f(x) > 0$$

(1)

(b) Expand $(x + 4)(2x^2 + x + 7)$ writing your answer as a polynomial in simplest form.

(2)

The straight line l, also shown in Figure 3, has gradient k.

Given that

- l intersects C on the y-axis
- l is a tangent to C at a point P, as shown in Figure 3

(c) find the value of k.

(5)

Question 14 continued

Question 14 continued

Question 14 continued

(Total for Question 14 is 8 marks)

15.

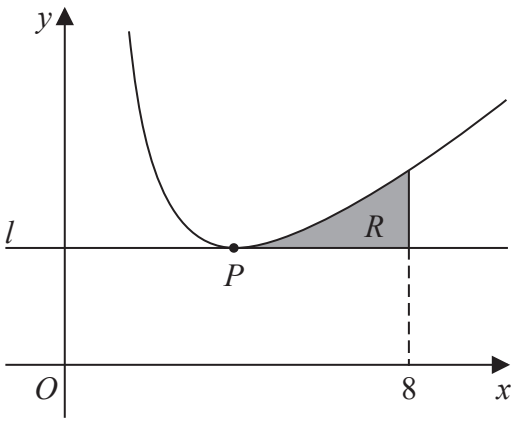

Figure 4

Figure 4 shows a sketch of the curve with equation

$$y = \frac{3x}{2} + \frac{32}{\sqrt{x^3}} \qquad x > 0$$

The point P is the only stationary point on the curve.

(a) Show that the x coordinate of P is 4

(4)

The line l is parallel to the x-axis and passes through the point P

The region R, shown shaded in Figure 4, is bounded by the curve, the line l and the line with equation $x = 8$

(b) Use algebraic integration to find the exact area of R, writing your answer in the form $a + b\sqrt{2}$ where a and b are integers to be found.

(5)

Question 15 continued

Question 15 continued

Question 15 continued

(Total for Question 15 is 9 marks)

16.

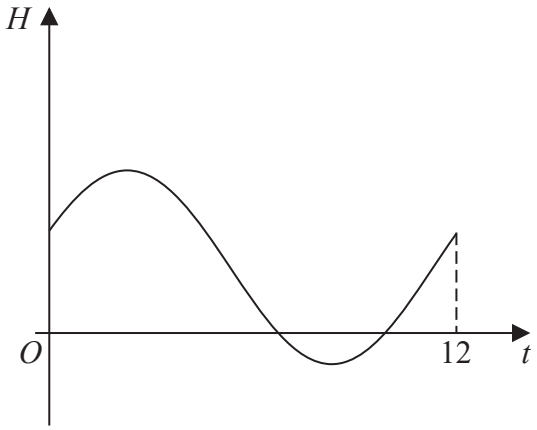

Figure 5

A horizontal path connects an island to the mainland.

On a particular morning, the height of the sea relative to the path, H m, is modelled by the equation

$$H = 0.8 + k\cos(30t - 70)°$$

where k is a constant and t is number of hours after midnight.

Figure 5 shows a sketch of the graph of H against t.

Use the equation of the model to answer parts (a), (b) and (c).

(a) Find the time of day at which the height of the sea is at its maximum.

(2)

Given that the maximum height of the sea relative to the path is 2 m,

(b) (i) find a complete equation for the model,

(ii) state the minimum height of the sea relative to the path.

(3)

It is safe to use the path when the sea is 10 centimetres or more **below** the path.

(c) Find the times between which it is safe to use the path.

(*Solutions relying entirely on calculator technology are not acceptable.*)

(5)

Question 16 continued

Question 16 continued

(Total for Question 16 is 10 marks)

(TOTAL FOR PAPER IS 100 MARKS)