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 15 May 2025

Afternoon (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 15 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.
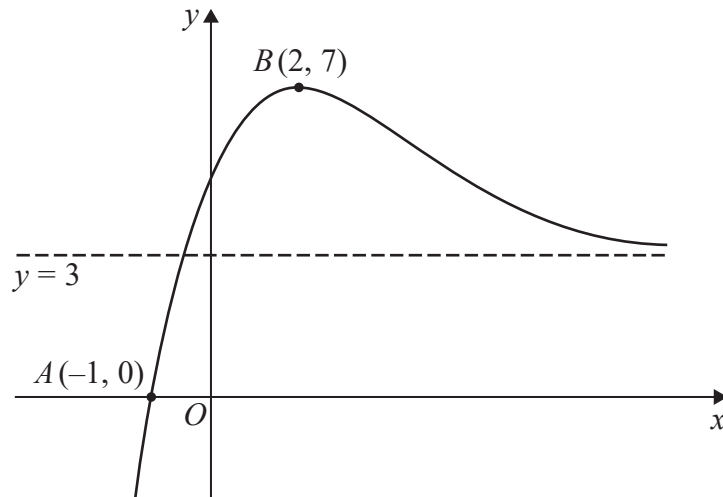- Check your answers if you have time at the end.

Turn over ▶

1.

Figure 1

Figure 1 shows a curve with equation $y = f(x)$

The curve

- passes through the point $A(-1, 0)$

- has a maximum turning point at $B(2, 7)$

- has a horizontal asymptote with equation $y = 3$

On separate diagrams, sketch the curve with equation

(i) $y = f(x + 2)$

(3)

(ii) $y = -f(x)$

(3)

On each diagram, show clearly the coordinates of the points to which A and B are transformed and the equation of the asymptote.

Question 1 continued

2. The line l passes through the points $A(-3, 0)$ and $B\left(\dfrac{5}{2}, 22\right)$

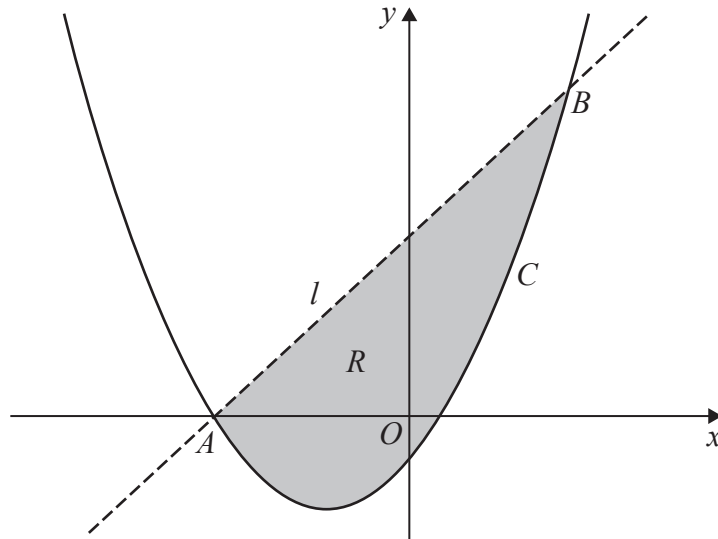(a) Find the equation of l giving your answer in the form $y = mx + c$ where m and c are constants.

(3)

Figure 2

Figure 2 shows the line l and the curve C, which intersect at A and B.

Given that

- C has equation $y = 2x^2 + 5x - 3$

- the region R, shown shaded in Figure 2, is bounded by l and C

(b) use inequalities to define R.

(2)

Question 2 continued

(Total for Question 2 is 5 marks)

3. Relative to a fixed origin O

- the point A has coordinates $(3, -8)$

- the point B is such that $\overrightarrow{AB} = -5\mathbf{i} + 2\mathbf{j}$

(a) Find the exact value of $\left|\overrightarrow{OB}\right|$

(3)

(b) Find the size of angle OAB, giving your answer in degrees to one decimal place.

(3)

Question 3 continued

(Total for Question 3 is 6 marks)

4. The circle C has equation

$$x^2 + y^2 + 10x - 4y + 1 = 0$$

(a) Find

(i) the coordinates of the centre of C

(ii) the exact radius of C

(3)

The line with equation $y = k$, where k is a constant, cuts C at two distinct points.

(b) Find the range of values for k, giving your answer in set notation.

(3)

Question 4 continued

(Total for Question 4 is 6 marks)

5.

$$f(x) = \frac{x^5 - 12x^{\frac{1}{2}}}{4x}$$

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

$$ax^p + bx^q$$

where a, b, p and q are simplified constants.

(3)

(b) Hence find

$$\int f(x)\,dx$$

giving your answer in simplest form.

(3)

Question 5 continued

(Total for Question 5 is 6 marks)

6.
$$f(x) = ax^3 + bx^2 + 18x + 9$$

where a and b are constants.

Given that $(x + 3)$ is a factor of $f(x)$

(a) show that

$$-3a + b = 5$$

(2)

Given also that $f'(2) = 14$

(b) find the value of a and the value of b.

(5)

Question 6 continued

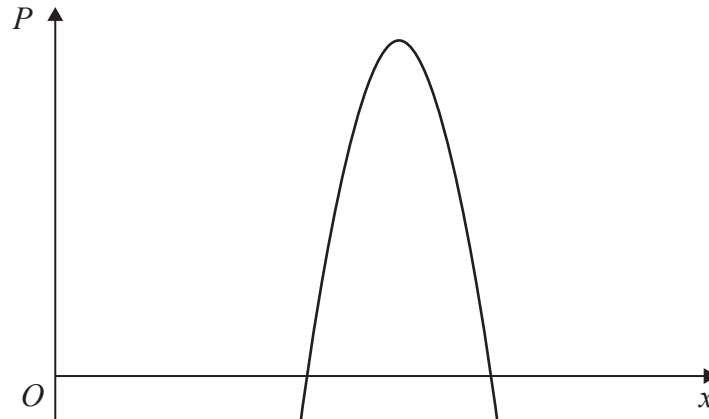**(Total for Question 6 is 7 marks)**

7.

Figure 3

A company makes a particular type of chair.

The annual profit made by the company is modelled by the equation

$$P = -x^2 + 260x - 16450$$

where P is the profit measured in **thousands** of pounds and x is the selling price of the chair in pounds.

The graph of P against x is shown in Figure 3.

Using the model,

(a) explain why £175 is not a sensible selling price for the chair.

(2)

Given that the company made an annual profit of more than £200 000

(b) find, according to the model, the highest possible selling price for the chair.

You must show your working clearly.

(3)

(c) Show that

$$P = a + b(x + c)^2$$

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

(3)

The company wishes to maximise its annual profit.

State, according to the model,

(d) (i) the maximum possible annual profit,

(ii) the selling price of the chair that maximises the annual profit.

(2)

Question 7 continued

Question 7 continued

Question 7 continued

(Total for Question 7 is 10 marks)

8.

In this question you must show all stages of your working.
Solutions relying entirely on calculator technology are not acceptable.

Solve, for $0 \leqslant x \leqslant 90°$, the equation

$$\sin^2 3x = 4\cos^2 3x$$

giving your answers, in degrees, to one decimal place.

(5)

Question 8 continued

(Total for Question 8 is 5 marks)

9. An equation

$$x^2 - 3px + 5q + 4 = 0$$

where p and q are constants, has equal roots.

Show that

$$q = \frac{1}{20}(3p+4)(3p-4)$$

(3)

Question 9 continued

(Total for Question 9 is 3 marks)

10. **In this question you must show all stages of your working.**
Solutions relying entirely on calculator technology are not acceptable.

Solve the equation

$$2 \log_3(x + 1) = 1 + \log_3(x + 7)$$

(5)

Question 10 continued

(Total for Question 10 is 5 marks)

11. **In this question you must show all stages of your working.**
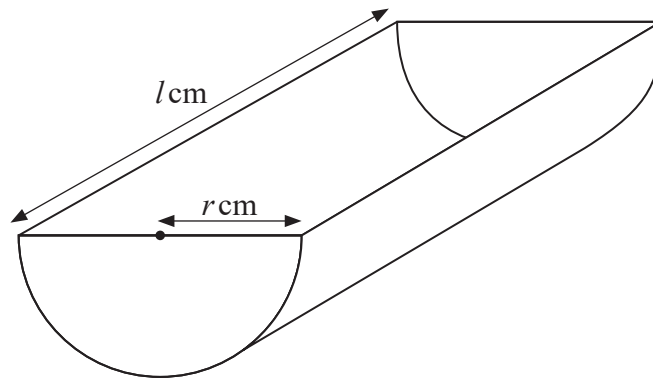**Solutions relying entirely on calculator technology are not acceptable.**

Figure 4

Figure 4 shows a design for a feeding trough.

The trough is modelled as a hollow, semicircular cylinder of radius r cm and length l cm.

The trough will be made from sheet metal of negligible thickness.

Given that the capacity of the trough will be $90\,000\,\pi\,\text{cm}^3$

(a) show that the total area, $A\,\text{cm}^2$, of sheet metal required to make the trough is given by

$$A = \frac{180\,000\pi}{r} + \pi r^2$$

(4)

(b) Use calculus to find the radius of the trough for which A is a minimum.

(4)

(c) Show that the radius found in part (b) gives the minimum value of A.

(2)

Given that the sheet metal costs £30 per square metre

(d) calculate the minimum cost of sheet metal required to make one trough.

(2)

(e) State one assumption you have made in calculating your answer to part (d).

(1)

Question 11 continued

Question 11 continued

Question 11 continued

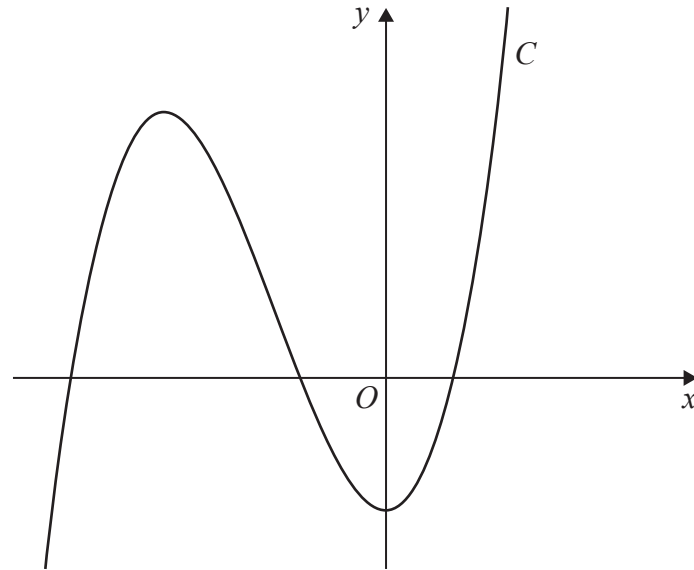**(Total for Question 11 is 13 marks)**

12.

Figure 5

Figure 5 shows a sketch of the curve C.

The curve has a minimum turning point on the y-axis and a maximum turning point in quadrant 2.

(a) On **Diagram 1**, sketch the graph of the gradient function for C.

[A copy of Figure 5 has been included on the next page to help you.]

(3)

The gradient function for C has **one** of the following equations
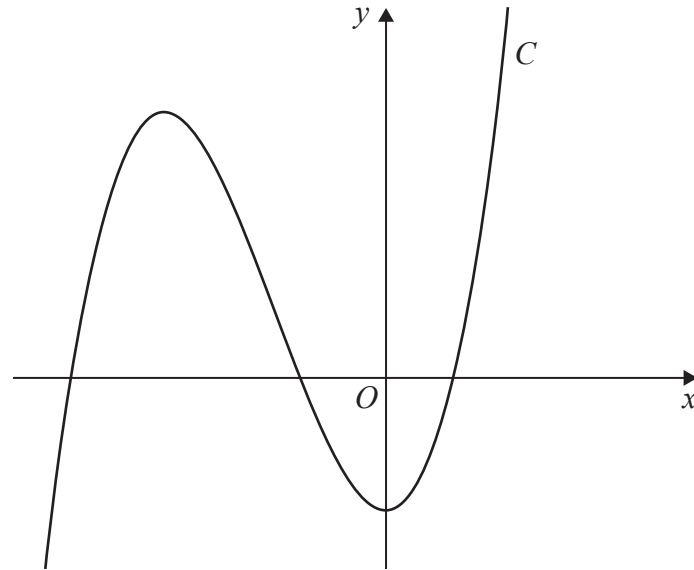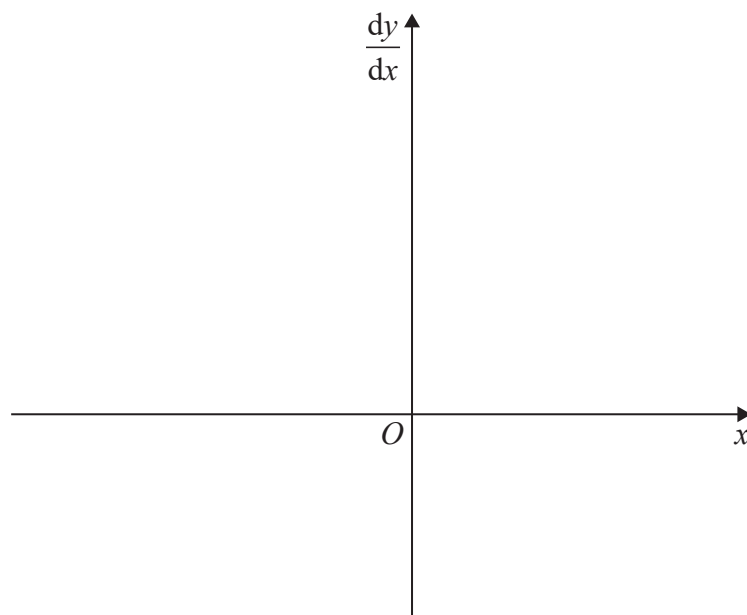
$$\frac{dy}{dx} = (x+1)^2 - 2 \qquad \frac{dy}{dx} = 3x^2 + 9x \qquad \frac{dy}{dx} = -x(x+7) \qquad \frac{dy}{dx} = x^2 - 5x$$

(b) State the correct equation for the gradient function, fully justifying your answer.

(2)

Question 12 continued

Copy of Figure 5

Diagram 1

(Total for Question 12 is 5 marks)

13. **In this question you must show all stages of your working.**
Solutions relying entirely on calculator technology are not acceptable.

The growth of a particular tree is monitored over a period of time.

The height, h metres, of this tree, t years after it was planted, is modelled by the equation

$$h = 31 - Ae^{-kt}$$

where A and k are positive constants.

Given that

- exactly 10 years after it was planted, the height of the tree was 6 m

- exactly 20 years after it was planted, the height of the tree was 11 m

(a) find a complete equation for h in terms of t, giving the value of each of A and k to 3 significant figures.

(4)

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

According to the model, there is a limit to the height to which this tree can grow.

(b) Deduce this limit.

(1)

(c) (i) Find the initial height of the tree.

(ii) Hence explain whether this is a suitable model for the early growth of the tree.

(2)

(d) (i) Find $\dfrac{dh}{dt}$, giving your answer in simplest form.

(2)

(ii) Hence find the value of t for which the height of the tree is increasing at a rate of 30 cm per year.

(3)

Question 13 continued

Question 13 continued

Question 13 continued

(Total for Question 13 is 12 marks)

14. **In this question you must show detailed reasoning.**

$$f(x) = (1 + kx)^8$$

where k is a constant.

Given that the first 3 terms, in ascending powers of x, of the binomial series expansion of $f(x)$ are

$$1 + 8kx + px^2$$

where p is a constant,

(a) find p in terms of k.

(2)

$$g(x) = \left(a - \frac{2}{x} \right) f(x) \qquad x \neq 0$$

where a is a constant.

Given that the first 3 terms, in ascending powers of x, of the series expansion of $g(x)$ are

$$-\frac{2}{x} - 21 - 90x$$

(b) find the possible pairs of values of a and k.

(5)

Question 14 continued

Question 14 continued

Question 14 continued

(Total for Question 14 is 7 marks)

15. $\qquad$ "$n^3 + 4n$ is prime for $n \in \mathbb{N}$" $\qquad$ (I)

(a) Determine whether statement (I) is always true, sometimes true or never true.
You must fully justify your answer.

(2)

"$n^3 + 5n$ is prime for $n \in \mathbb{N}$" $\qquad$ (II)

(b) Determine whether statement (II) is always true, sometimes true or never true.
You must fully justify your answer.

(2)

Question 15 continued

Question 15 continued

(Total for Question 15 is 4 marks)

TOTAL FOR PAPER IS 100 MARKS