OXFORD AQA
INTERNATIONAL QUALIFICATIONS

INTERNATIONAL AS
MATHEMATICS

(9660/MA01) Unit P1 Pure Mathematics

Thursday 4 January 2024   07:00 GMT   Time allowed: 1 hour 30 minutes

Materials
- For this paper you must have the OxfordAQA Booklet of Formulae and Statistical Tables (enclosed).
- You may use a graphical calculator.

Instructions
- Use black ink or black ball-point pen. Pencil should only be used for drawing.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- If you need extra space for your answer(s), use the lined pages at the end of this book. Write the question number against your answer(s).
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 80.

Advice
- Unless stated otherwise, you may quote formulae, without proof, from the booklet.
- Show all necessary working; otherwise marks may be lost.

For Examiner's Use	
Question	Mark
1	
2	
3	
4	
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6	
7	
8	
9	
TOTAL	

MA01

Answer **all** questions in the spaces provided.

1 The function f is defined by

$$f(x) = 2x^2 - 14x + 8$$

1 (a) It is given that $f(x)$ can be expressed in the form $2(x+a)^2 + b$ where a and b are constants.

1 (a) (i) Find the value of a

Circle your answer.

[1 mark]

$$-7 \qquad\qquad -\frac{7}{2} \qquad\qquad \frac{7}{2} \qquad\qquad 7$$

1 (a) (ii) Find the value of b

Circle your answer.

[1 mark]

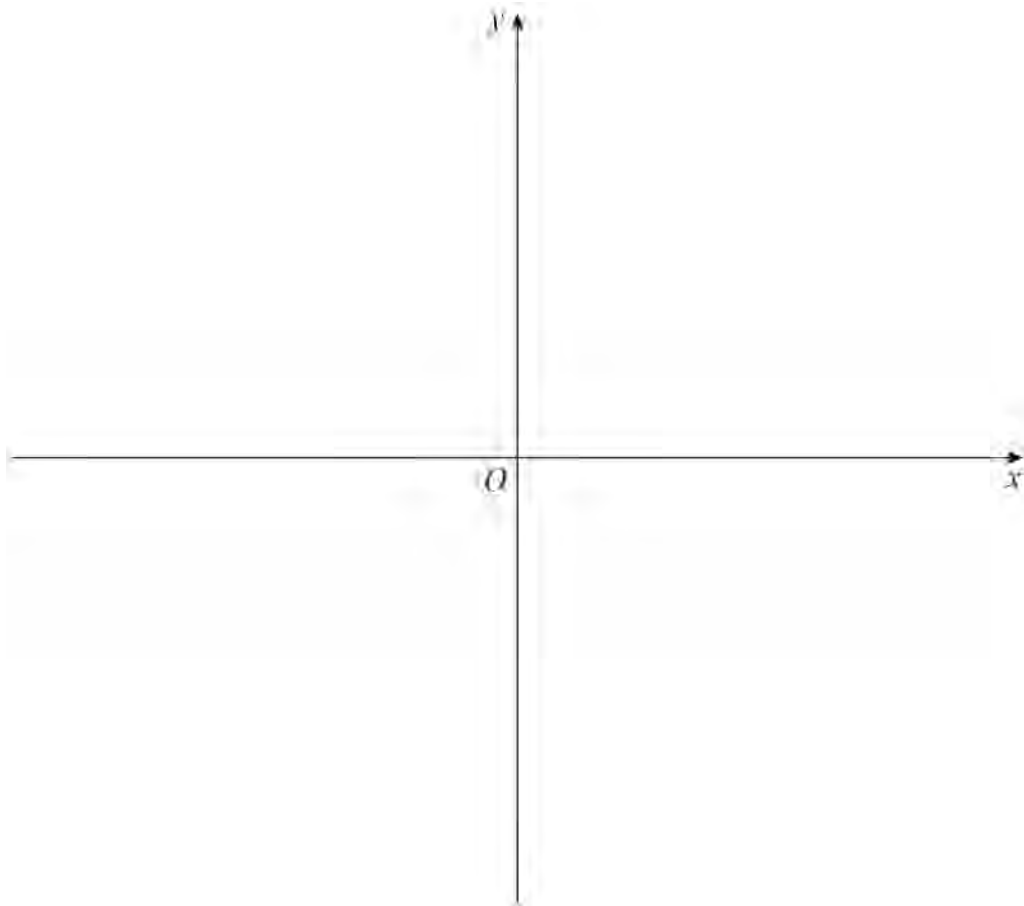$$-41 \qquad\qquad -\frac{33}{2} \qquad\qquad -\frac{33}{4} \qquad\qquad -\frac{17}{4}$$

1 (b) Sketch the curve with equation $y = f(x)$ on the axes below, showing the coordinates of the y-intercept and the coordinates of the vertex.
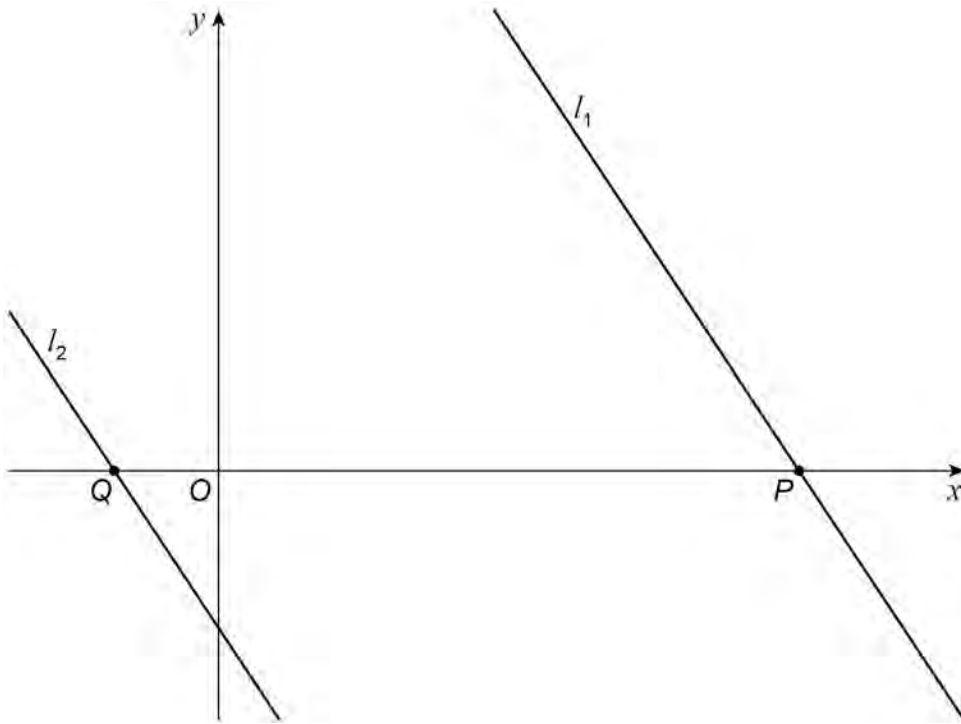
[3 marks]

Turn over for the next question

Turn over ▶

2   The diagram shows the lines l_1 and l_2 and the points P and Q

The line l_1 has equation $3x + 2y - 66 = 0$ and intersects the x-axis at P

The line l_2 intersects the x-axis at Q

2 (a)   Find the coordinates of P

[1 mark]

Answer _____

2 (b)   The line l_2 is parallel to the line l_1 and intersects the y-axis at the point $(0, -6)$

Find the coordinates of Q

[2 marks]

Answer _____

2 (c) The point R lies on l_1 such that the line segment QR is perpendicular to l_1

2 (c) (i) Find the coordinates of R

[4 marks]

Answer _____

2 (c) (ii) Find the area of the triangle PQR

[2 marks]

Answer _____

9

Turn over ▶

3 (a) The equation of a curve is

$$y = kx^{\frac{1}{2}} - 12x^{-\frac{3}{2}}$$

where $x > 0$ and k is a constant.

The curve passes through the point $\left(2p, \ \dfrac{8}{p}\sqrt{2p}\right)$ where p is a positive constant.

Show that $k = \dfrac{mp + n}{p^2}$ where m and n are integers.

[3 marks]

3 (b) It is given that

$$10t^2 + 29t - 28 + 2w = w\sqrt{5t} + 2t \qquad \text{for } t \neq 0.8$$

Show that

$$w = (at + b)\left(\sqrt{ct} + d\right)$$

where a, b, c and d are integers.

[4 marks]

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7

Turn over ▶

4 The nth term of a sequence is u_n

The sequence is defined by

$$u_{n+1} = k - \frac{18}{u_n}$$

The first term $u_1 = 2$

It is given that $u_3 = 5u_2 - 9$

4 (a) Show that one possible value of k is 12 and find the other possible value.

[5 marks]

Answer _____

4 (b) In the case when $k = 12$ find the exact value of u_4

[2 marks]

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Answer _____

7

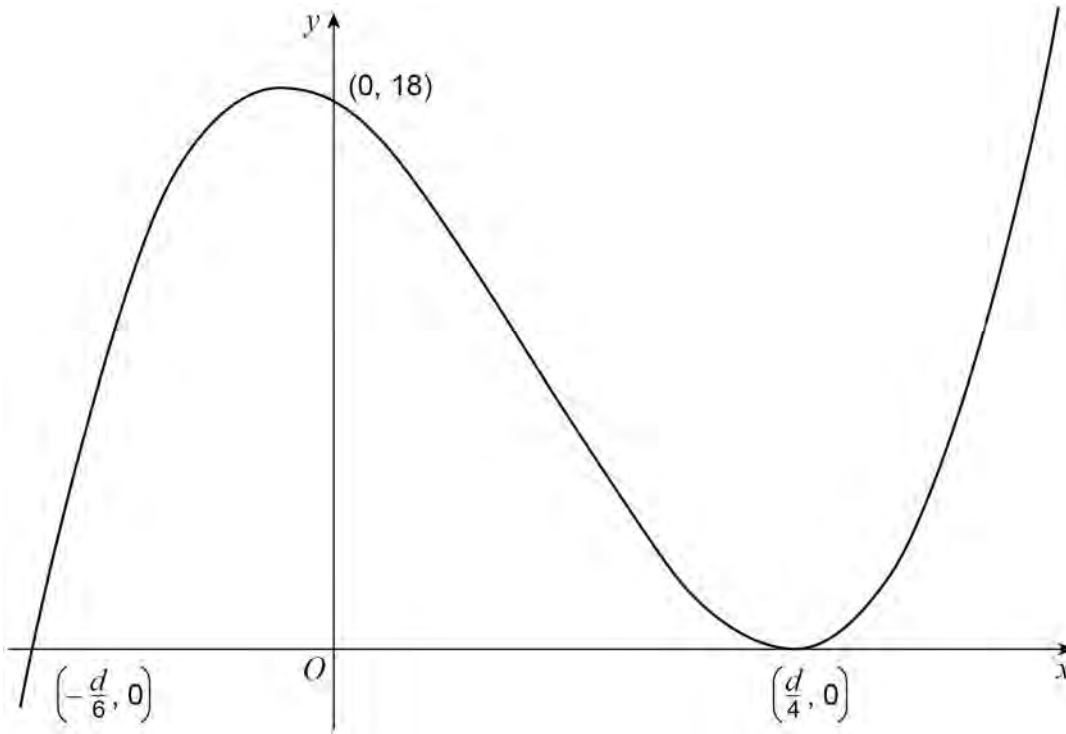**Turn over for the next question**

Turn over ▶

5   The graph with equation $y = f(x)$ where

$$f(x) = x^3 + bx^2 + cx + 18$$

and b and c are constants is shown in the diagram below.

The graph:

   intersects the x-axis at the point $\left(-\dfrac{d}{6}, 0\right)$ where d is a positive constant

   touches the x-axis at the point $\left(\dfrac{d}{4}, 0\right)$

   intersects the y-axis at the point $(0, 18)$

5 (a)   Show that $d = 12$

[2 marks]

5 (b) By writing $f(x)$ as a product of linear factors prove that

$$f(x) = x^3 - 4x^2 - 3x + 18$$

[3 marks]

Question 5 continues on the next page

Turn over ▶

5 (c) The graph with equation $y = x^3 - 4x^2 - 3x + 18$ is mapped onto the graph with equation $y = g(x)$ by the translation $\begin{bmatrix} 5 \\ -3 \end{bmatrix}$

Find an expression for $g(x)$

Give your answer in the form

$$g(x) = x^3 + px^2 + qx + r$$

where p, q and r are non-zero integers.

[3 marks]

$g(x) =$ _____

5 (d) Use the Factor Theorem to determine whether $(x-5)$ is a factor of $g(x)$

[2 marks]

10

Turn over for the next question

Turn over ▶

6 The diagram shows a rectangle *ABCD* and a triangle *AEF* where *AB* = 6 cm, *AD* = 8 cm, *BE* = *x* cm and *DF* = *y* cm

The point *B* lies on *AE*, the point *C* lies on *EF* and the point *D* lies on *AF*
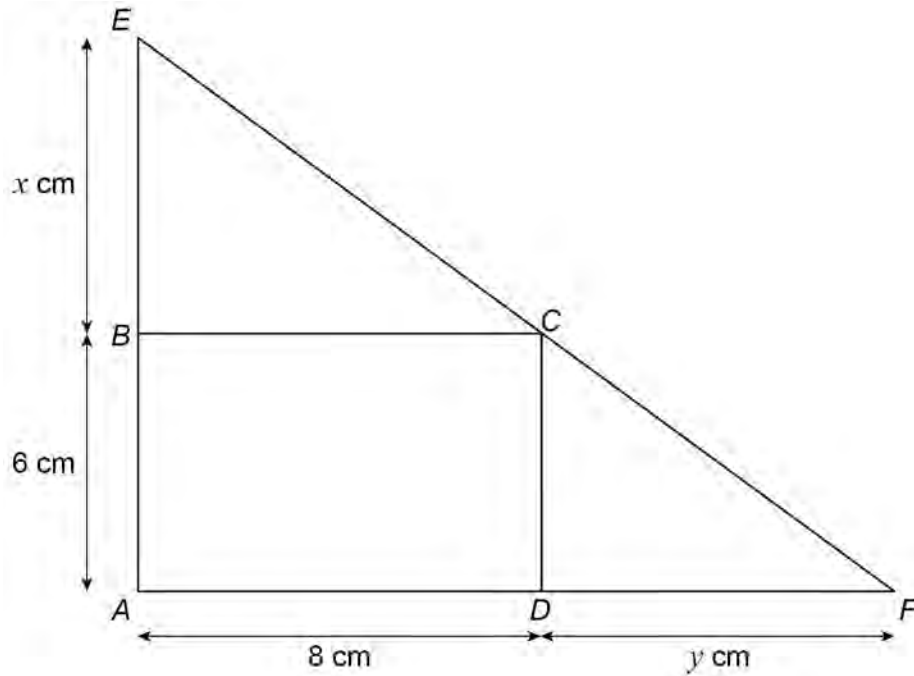
6 (a) Show that the area *T* cm² of the triangle *AEF* is given by

$$T = 48 + 4x + \frac{144}{x}$$

[3 marks]

6 (b) (i) Use the result given in **part (a)** to find the minimum value of T

[4 marks]

$T =$ _____

6 (b) (ii) Use $\dfrac{\mathrm{d}^2 T}{\mathrm{d}x^2}$ to prove that your value of T is a minimum.
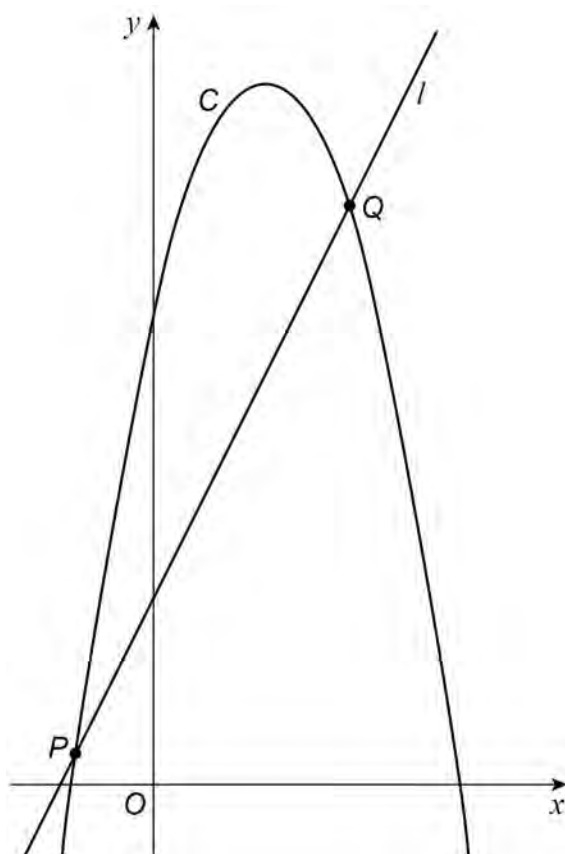
[2 marks]

9

Turn over ▶

7 The curve C and the line l are shown in the diagram below.

The line l intersects C at the points P and Q

The equation of C is $y = 35 + 4x - \dfrac{1}{4}x^2$

7 (a) The tangent to C at the point where $x = 4$ is parallel to l

The line l passes through the point $(5, 24)$

Show that the x-coordinates of P and Q satisfy the equation

$$x^2 - 8x - 84 = 0$$

[5 marks]

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7 (b) Find the values of x for which the curve C is above the line l

[2 marks]

Answer _____

Question 7 continues on the next page

Turn over ▶

7 (c) (i) Find $\displaystyle\int\left(35+4x-\frac{1}{4}x^2\right)\mathrm{d}x$

[2 marks]

Answer

7 (c) (ii) Find the area of the finite region bounded by C and l

Show clearly each step of your working.

[5 marks]

Answer _____

14

Turn over for the next question

Turn over ▶

8 (a) Expand $(1-w)^3$

[1 mark]

Answer

8 (b) Show that

$$4\left(1-\sqrt{x}\right)^3 + \left(1+\sqrt{x}\right)^3$$

can be expressed as

$$5 + a\sqrt{x} + 15x + bx\sqrt{x}$$

where a and b are integers.

[4 marks]

8 (c) The curve C is such that any point (x, y) on C satisfies the equation

$$\frac{dy}{dx} = 4\left(1 - \sqrt{x}\right)^3 + \left(1 + \sqrt{x}\right)^3$$

The curve C passes through the point $(4, 20)$

Find the equation of C

Give your answer in the form $y = f(x)$

[5 marks]

Answer _____

10

Turn over ▶

9 (a) The first three terms of a geometric series are

$$a, \ b \text{ and } c$$

where a, b and c are real numbers.

It is given that $b = 27c^2$

Find b in terms of a

[4 marks]

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Answer _____

9 (b) It is given that $k > 3$

Show that

$$\sum_{n=1}^{\infty} \frac{5 - 4 \times (-3)^{n-1}}{k^n} = \frac{(k+p)}{(k+q)(k+r)}$$

where p, q and r are integers.

[5 marks]

9

END OF QUESTIONS

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