Please write clearly in block capitals.

Centre number ☐☐☐☐☐   Candidate number ☐☐☐☐

Surname _____

Forename(s) _____

Candidate signature _____

I declare this is my own work.

INTERNATIONAL AS
MATHEMATICS

(9660/MA01) Unit P1 Pure Mathematics

Time allowed: 1 hour 30 minutes

Materials
- For this paper you must have the Oxford International AQA Booklet of Formulae and Statistical Tables (enclosed).
- You may use a graphic 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	
5	
6	
7	
8	
9	
10	
TOTAL	

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

1 (a) The line *L* has equation

$$ax + 6y = 6$$

where a is a constant.

1 (a) (i) Find the value of a for which *L* passes through the point $(2, -2)$

Circle your answer.

[1 mark]

–9	–3	3	9

1 (a) (ii) Find the value of a for which *L* does not intersect the line with equation $5x + 2y = 6$

Circle your answer.

[1 mark]

–15	–5	5	15

1 (b) The line with equation $5x + 2y = 6$ is translated onto the line K by the vector $\begin{bmatrix} 7 \\ -2 \end{bmatrix}$

Find the equation of K

Give your answer in the form $bx + cy = d$, where b, c and d are constants.

[2 marks]

Answer

Turn over for the next question

Turn over ▶

2 The line J passes through the points $(-2, 1)$ and $(4, 13)$

2 (a) Find the equation of J

Give your answer in the form $y = mx + c$ where m and c are integers.

[3 marks]

$y =$ _____

2 (b) (i) Determine the number of distinct real solutions of the equation

$$3x^2 - 4x + 8 = 2x + 5$$

Justify your answer.

[3 marks]

Answer _____

2 (b) (ii) Describe the relationship between J and the curve with equation

$$y = 3x^2 - 4x + 8$$

[1 mark]

7

3 Under a stretch parallel to the y-axis, the curve with equation $y = \mathrm{f}(x)$ is mapped to the curve with equation $y = a\,\mathrm{f}(x)$, where a is a constant.

Under this transformation, the point $\left(2, 3 - \sqrt{7}\right)$ on $y = \mathrm{f}(x)$ is mapped to the point $\left(2, 9 + 5\sqrt{7}\right)$

Show that the value of a can be written in the form $b + c\sqrt{7}$, where b and c are integers.

Full marks will not be awarded for calculator-only working in this question.

[5 marks]

4 It is given that

$$f(x) = 4x^2 + 12x + 23$$

4 (a) Express $f(x)$ in the form $a(x+b)^2 + c$ where a, b and c are constants.

[3 marks]

Answer _____

4 (b) Sketch the curve with equation $y = f(x)$ on the axes below, showing the coordinates of the vertex and the coordinates of any points where the curve crosses the axes.

[3 marks]
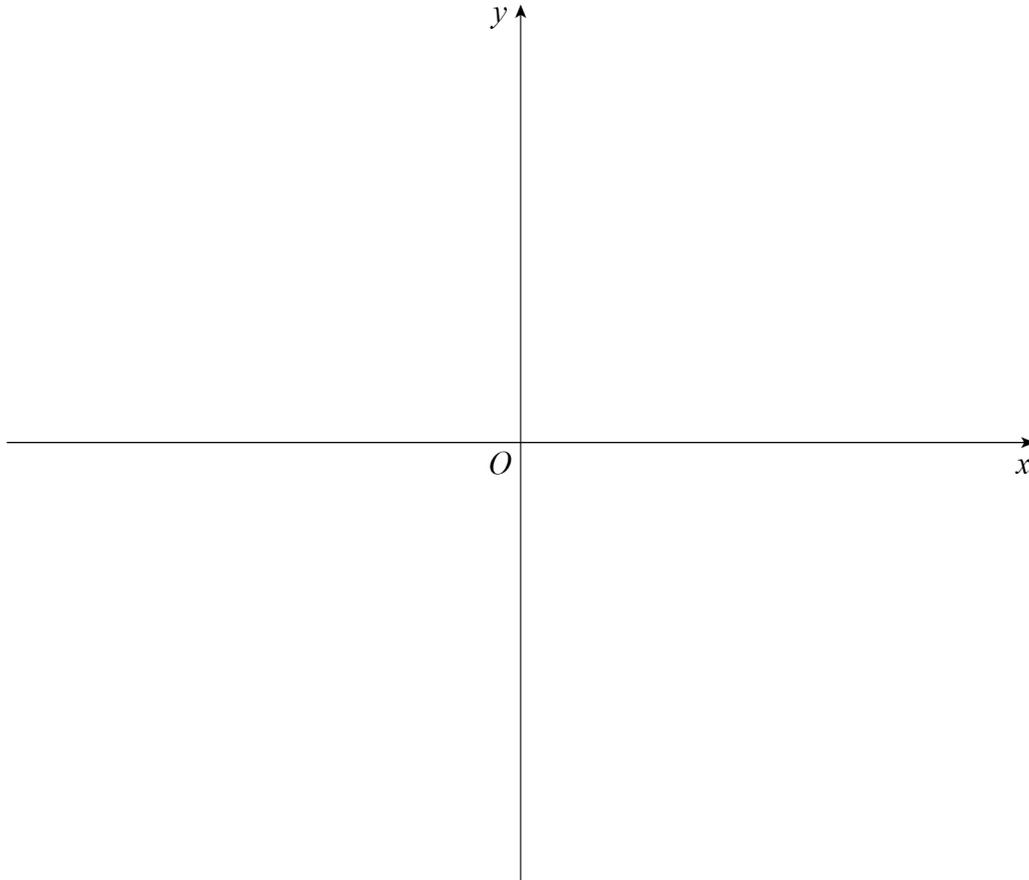
4 (c) State the range of values of k for which the equation $f(x) = k$ has no real roots.

[1 mark]

Answer

4 (d) Find the shortest distance between the curves with equations $y = f(x)$ and $y = -f(x)$

[1 mark]

Answer

Turn over ▶

8

5   The nth term of a sequence is u_n

The sequence is defined by

$$u_{n+1} = k\,u_n + 15$$

where k is a non-zero constant.

The first term $u_1 = 25$

5 (a)   Show that

$$u_3 = 25k^2 + 15k + 15$$

[3 marks]

_____

_____

_____

_____

_____

_____

5 (b)   The third term $u_3 = 33$

5 (b) (i)   Find the possible values of k

[2 marks]

_____

_____

_____

_____

_____

Answer _____

5 (b) (ii) It is given that the sequence has only positive terms and converges to a limit T

Find the value of T

[2 marks]

_____

_____

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_____

_____

_____

_____

_____

_____

$T = $ _____

7

Turn over for the next question

Turn over ▶

6 The polynomial $p(x)$ is given by

$$p(x) = x^3 + 8x^2 + 14x - 8$$

6 (a) The remainder when $p(x)$ is divided by $(x - 2m)$ is four times the remainder when

$p(x)$ is divided by $(x - m)$, where m is a constant.

Show that

$$m^3 - 7m + 6 = 0$$

[4 marks]

6 (b) (i) Use the Factor Theorem to show that $(m-2)$ is a factor of $m^3 - 7m + 6$

[2 marks]

6 (b) (ii) Hence, by writing $m^3 - 7m + 6$ as the product of a linear factor and a quadratic factor, find the values of m for which

$$m^3 - 7m + 6 = 0$$

[3 marks]

Answer _____

9

Turn over ▶

7   In the diagram below, curves C_1 and C_2 intersect at the points $P(1, 8)$ and $Q(3, 14)$

The equation of C_1 is $y = 2 + 7x - x^2$

The equation of C_2 is $y = 6 + 2^x$
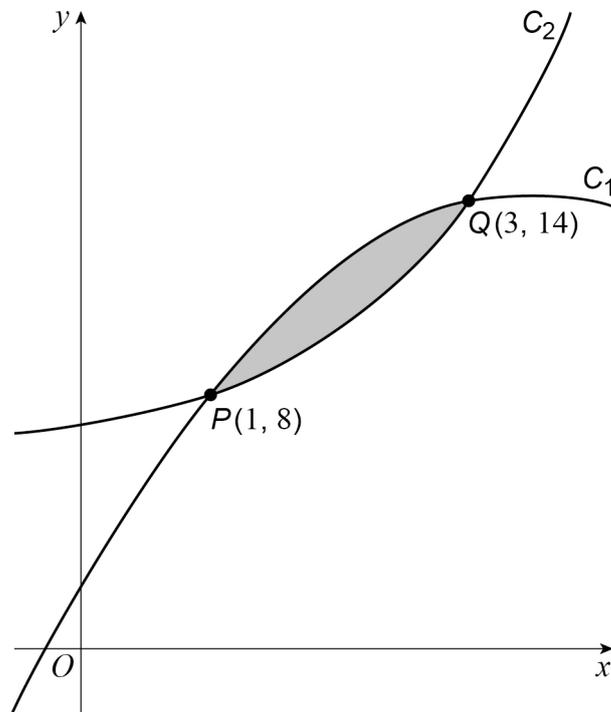
7   (a) (i)   Find $\int \left(2 + 7x - x^2\right) dx$

[2 marks]

Answer _____

7   (a) (ii)   Show that $\int\limits_{1}^{3} \left(2 + 7x - x^2\right) dx = 23\dfrac{1}{3}$

[2 marks]

7 (b) Use the trapezium rule with four strips to find an approximate value for

$$\int_1^3 \left(6 + 2^x\right) dx$$

Give your answer to three decimal places.

[4 marks]

Answer

7 (c) (i) Using your answers to **parts (a)** and **(b)**, find an approximate value for the area of the shaded region.

Give your answer to two decimal places.

[2 marks]

Answer

7 (c) (ii) State, with a reason, whether your answer to **part (c)(i)** is an overestimate or an underestimate for the value of the area of the shaded region.

[2 marks]

12

Turn over ▶

8 The curve with equation

$$y = 3x^{\frac{2}{3}}\left(x^2 - bx^{\frac{2}{3}} + 4x^{-\frac{2}{3}} \right)$$

where b is a constant, has a stationary point P at $x = 8$

8 (a) Find the value of b

[5 marks]

$b =$ _____

8 (b) The tangent to the curve at *P* intersects the y-axis at the point $(0, c)$

Find the value of c

[2 marks]

$c =$ _____

7

Turn over for the next question

Turn over ▶

9 The curve *C* has equation $y = 2x^2 - 10x + 13$

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

9 (a) (i) Show that the *y*-coordinates of the points of intersection of *L* and *C* satisfy the equation

$$8y^2 - 21y + 13 = 0$$

[3 marks]

9 (a) (ii) Hence find the coordinates of the points of intersection of *L* and *C*

[3 marks]

Answer _____

9 (b) Show that *L* is a normal to *C* at one of the points of intersection.

[4 marks]

9 (c) The point *Q* lies on *C*

The tangent to *C* at *Q* is parallel to *L*

Find the value of the x-coordinate of *Q*

[2 marks]

$x =$ _____

12

Turn over ▶

10 The diagram below shows a pattern consisting of an infinite number of circles whose centres lie on a straight line.

Each circle touches the next one at a single point.
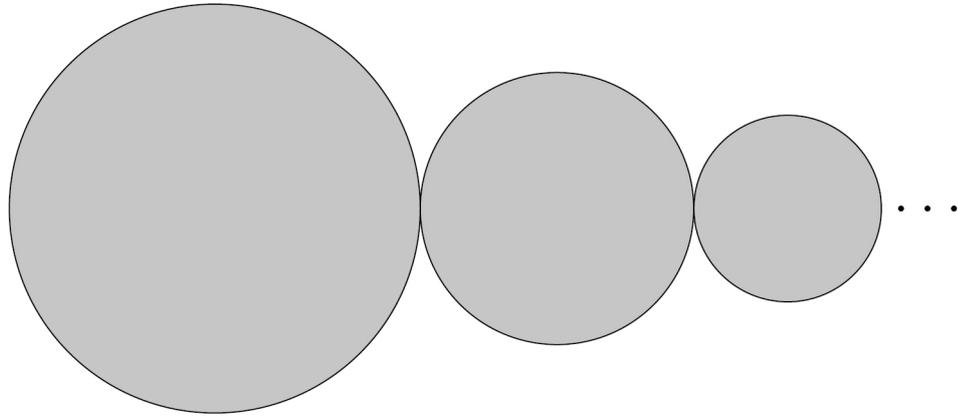
The lengths of the diameters of successive circles form the terms of a geometric series with common ratio r

The sum to infinity of the lengths of the diameters of the circles is S

The diameter of the largest circle is the first term.

10 (a) Find the diameter of the largest circle when the common ratio $r = \dfrac{3}{5}$ and $S = 20$

[2 marks]

Answer _____

10 (b) When the diameter of the largest circle is $x^2 +1$ the diameter of the next circle in the pattern is $7x^2 +8x+3$

10 (b) (i) Find the values of x for which the common ratio $r = \dfrac{3}{5}$

[3 marks]

Answer

10 (b) (ii) Find the range of values of x for which S has a finite value.

[4 marks]

Answer

END OF QUESTIONS

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Question number	**Additional page, if required.** **Write the question numbers in the left-hand margin.**

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