

Please write clearly in block capitals.

Centre number

Candidate number

Surname \_\_\_\_\_

Forename(s) \_\_\_\_\_

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I declare this is my own work.

# INTERNATIONAL A-LEVEL MATHEMATICS

(9660/MA03) Unit P2 Pure Mathematics

Tuesday 10 January 2023 07:00 GMT Time allowed: 2 hours 30 minutes

## Materials

- For this paper you must have the Oxford International AQA 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 120.

## 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	
11	
12	
<b>TOTAL</b>	







- 2 (a) Express  $8\cos\theta + 15\sin\theta$  in the form  $R\cos(\theta - \alpha)$ , where  $R > 0$  and  $0^\circ < \alpha < 90^\circ$ , giving the value of  $\alpha$  to the nearest degree.

[3 marks]

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Answer \_\_\_\_\_

- 2 (b) (i) Hence write down the minimum value of

$$|8\cos\theta + 15\sin\theta|$$

[1 mark]

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Answer \_\_\_\_\_

- 2 (b) (ii) Hence find a value of  $\theta$  at which the minimum value in **part (b)(i)** occurs, giving your answer to the nearest degree.

[1 mark]

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Answer \_\_\_\_\_







3 (a) (ii) Express  $f(x)$  as a product of three linear factors.

[2 marks]

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Answer \_\_\_\_\_

3 (b) Hence express  $\frac{f(x)}{16x^2 - 9}$  in the form

$$px + q + \frac{r}{mx + n}$$

where  $p$ ,  $q$ ,  $r$ ,  $m$  and  $n$  are constants.

[3 marks]

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Answer \_\_\_\_\_

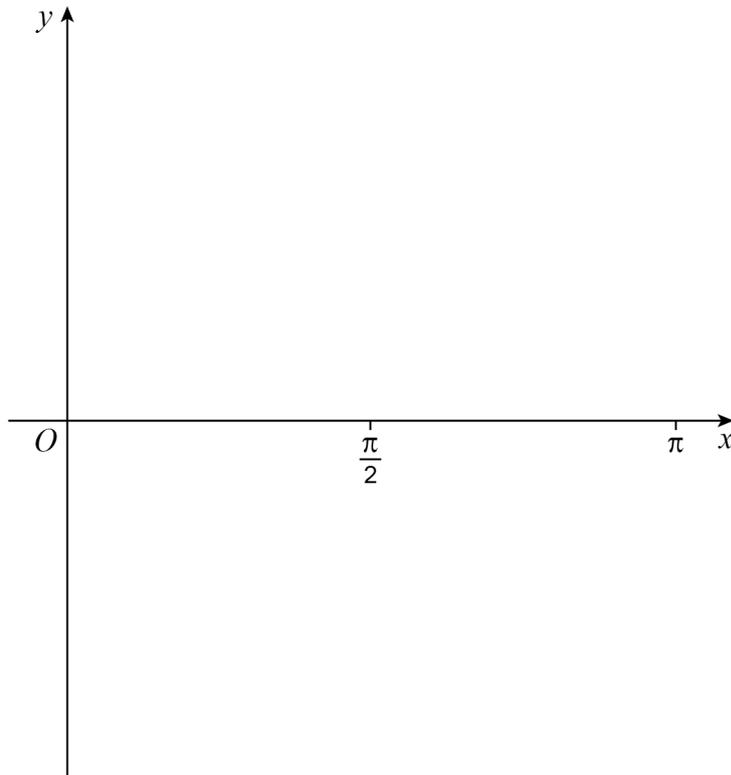
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- 4 (a) Sketch on the axes below the graph of the curve that has equation

$$y = \sec x \text{ for } 0 \leq x \leq \pi$$

[2 marks]



- 4 (b) A curve has equation  $y = \sec x$  where  $0 \leq x \leq \frac{\pi}{4}$

This curve intersects the line  $y = 10x - 5$  at a single point where  $x = \alpha$

- 4 (b) (i) Show that  $\alpha$  lies between 0.6 and 0.7

[2 marks]

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- 5 (a)** Show that the binomial expansion of  $(1 - px)^{-\frac{1}{2}}$  up to and including the term in  $x^3$  where  $p$  is a constant is

$$1 + \frac{1}{2}px + \frac{3}{8}p^2x^2 + \frac{5}{16}p^3x^3$$

**[2 marks]**


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- 5 (b)** Find the binomial expansion of  $\sqrt{4 + px}$  up to and including the term in  $x^3$ .  
Give all numerical coefficients as simplified fractions.

**[3 marks]**


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Answer \_\_\_\_\_

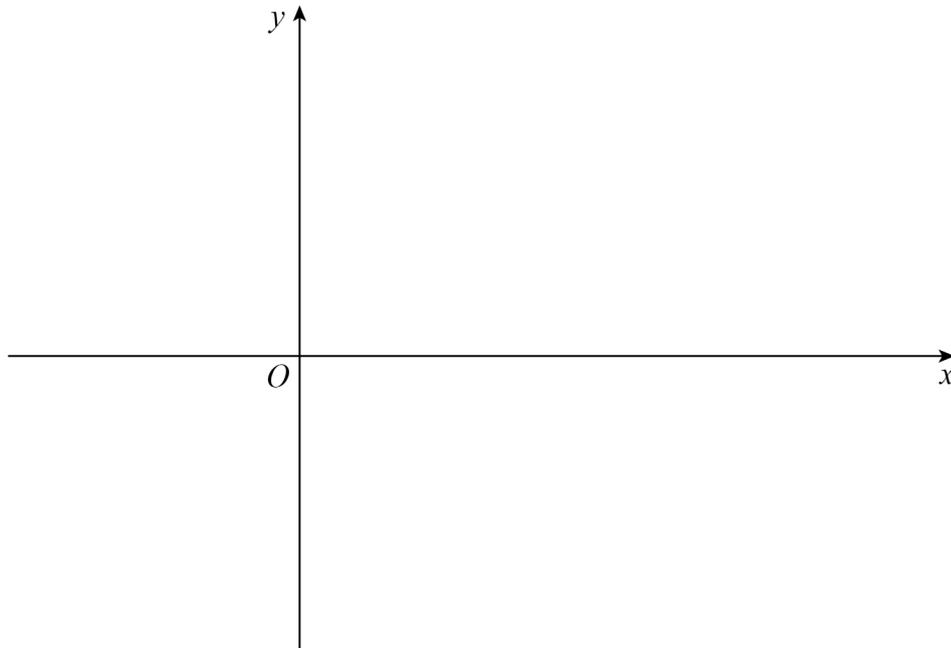




6 A curve  $C$  has equation  $y = |e^{0.5x} - 4|$

6 (a) Sketch on the axes below the graph of  $C$  indicating the coordinates of any points where the curve meets or cuts the axes.

[3 marks]



6 (b) Find an equation of the normal to  $C$  at the point  $P$  where  $x = \ln 25$

Give your answer in the form  $ax + by = k$  where  $a$ ,  $b$  and  $k$  are constants.

[5 marks]

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- 7 The coordinates of the points  $A$  and  $B$  are  $(1, 5, -3)$  and  $(-2, 3, 4)$  respectively.

The line  $l$  has equation  $\mathbf{r} = \begin{bmatrix} 4 \\ -1 \\ c \end{bmatrix} + \lambda \begin{bmatrix} 1 \\ -2 \\ -3 \end{bmatrix}$  where  $c$  is a constant.

- 7 (a) (i) Find the vector  $\vec{AB}$

[1 mark]

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Answer \_\_\_\_\_

- 7 (a) (ii) Find  $|\vec{AB}|$

[2 marks]

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Answer \_\_\_\_\_

- 7 (a) (iii) Calculate the acute angle between  $\vec{AB}$  and the line  $l$ , giving your answer to the nearest  $0.1^\circ$

[3 marks]

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Answer \_\_\_\_\_



7 (a) (iv) The line  $AB$  intersects the line  $l$

Find the value of  $c$

[3 marks]

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Answer \_\_\_\_\_

7 (b) (i) Find the shortest distance from  $l$  to the origin.

[4 marks]

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Answer \_\_\_\_\_

7 (b) (ii) Explain which of the line  $l$  or the line  $AB$ , is nearest to the origin.

[2 marks]

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Turn over ►





- 9 (a) Describe a single geometrical transformation that maps the graph of  $y = \ln x$  onto the graph of  $y = \ln(2x)$

[2 marks]

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- 9 (b) The region bounded by the curve  $y = \ln(2x)$ , the line  $x = 4$  and the  $x$ -axis from  $x = 0.5$  to  $x = 4$  is rotated through  $2\pi$  radians about the  $x$ -axis to form a solid.

Find the value of the volume of the solid generated, giving your answer in an exact form.

[9 marks]

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Answer \_\_\_\_\_

Turn over ►











**12** A curve  $C$  is defined by the parametric equations

$$x = 2\cos\theta \quad \text{and} \quad y = 3\sin\theta \quad \text{for } 0 \leq \theta \leq 2\pi$$

**12 (a)** Find a Cartesian equation of  $C$

**[2 marks]**

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Answer \_\_\_\_\_

**12 (b)** Find the equation of the tangent to the curve at the point where  $\theta = \frac{\pi}{6}$   
Give your answer in the form  $y + ax + b = 0$  where  $a$  and  $b$  are constants.

$$\left[ \text{You are given } \sin\left(\frac{\pi}{6}\right) = \frac{1}{2} \quad \text{and} \quad \cos\left(\frac{\pi}{6}\right) = \frac{\sqrt{3}}{2} \right]$$

**[4 marks]**

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Answer \_\_\_\_\_





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