OXFORD AQA
INTERNATIONAL QUALIFICATIONS

INTERNATIONAL A-LEVEL
MATHEMATICS

(9660/MA03) Unit P2 Pure Mathematics

Friday 30 May 2025   07:00 GMT   Time allowed: 2 hours 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 120.

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

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

1 (a) Use the mid-ordinate rule with five strips to find an estimate for

$$\int_0^1 1-e^{\left(2x-x^2\right)}\,\mathrm{d}x$$

Give your answer to three decimal places.

[4 marks]

Answer _____

1 (b) The curve with equation $y = 1 - e^{\left(2x - x^2\right)}$ has exactly one stationary point.

Find the coordinates of this stationary point.

Give your answer in an exact form.

[3 marks]

Answer _____

Turn over for the next question

7

2 It is given that for $x > 2$ the curves with equations

$$y = 3\ln x \quad \text{and} \quad y = x^2 - 4x - 5$$

intersect at a single point where $x = \alpha$

2 (a) Show that α lies between 5 and 6

[2 marks]

2 (b) Show that the equation $3\ln x = x^2 - 4x - 5$ can be rearranged into the form

$$x = 2 + \sqrt{3(3 + \ln x)}$$

[2 marks]

2 (c) Use the iterative formula

$$x_{n+1} = 2 + \sqrt{3(3 + \ln x_n)}$$

with $x_1 = 5$ to find the value of x_2 and the value of x_3

Give your values correct to three decimal places.

[2 marks]

$x_2 = $ _____ $x_3 = $ _____

Turn over for the next question

3 (a) Express $8\sin\theta + 15\cos\theta$ in the form $R\sin(\theta+\alpha)$ where $R>0$ and $0° < \alpha < 90°$

Give your value of α in degrees to one decimal place.

[3 marks]

Answer

3 (b) (i) Hence write down the minimum value of $\left| 8\sin\theta + 15\cos\theta \right|$

[1 mark]

Answer

3 (b) (ii) Find the smallest positive value of θ at which the minimum value in **part (b)(i)** occurs.

Give your value in degrees to one decimal place.

[1 mark]

Answer

3 (c) Use a suitable trigonometrical identity to solve the equation

$$\cot^2\left(2x - \frac{\pi}{6}\right) = 5 - \mathrm{cosec}\left(2x - \frac{\pi}{6}\right)$$

Give all values of x in radians to two decimal places in the interval $0 < x < \pi$

[5 marks]

Answer _____

10

Turn over ▶

4 A curve has equation

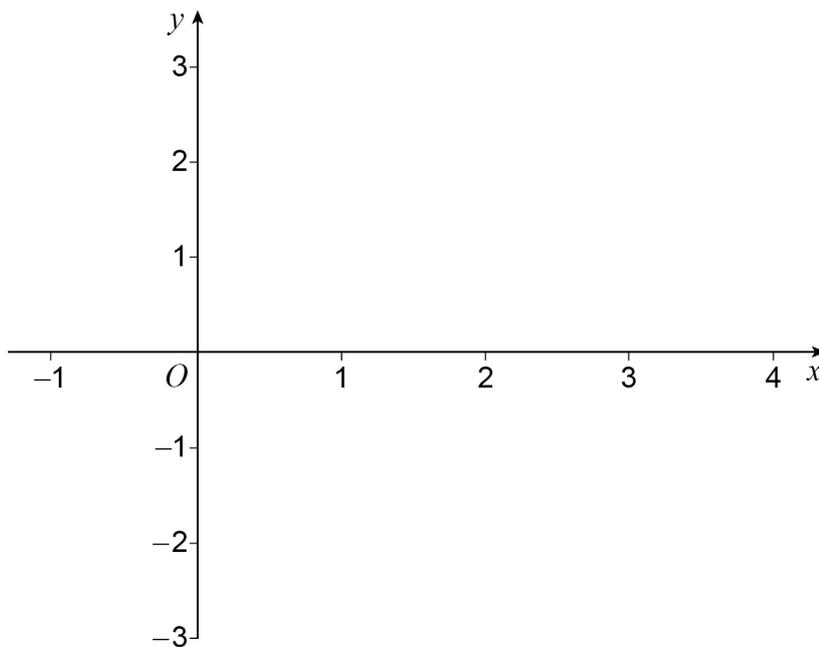$$y = 2 - \left| x^2 - 3x \right|$$

4 (a) (i) Find the exact coordinates of the points where the curve crosses the x-axis.

[3 marks]

Answer _____

4 (a) (ii) Sketch the curve on the axes below.

[2 marks]

4 (b) Solve the inequality $2 - \left| x^2 - 3x \right| \leq 0$

[2 marks]

Answer

4 (c) Describe a single geometrical transformation that maps the graph of $y = \left| x^2 - 3x \right|$ onto the graph of $y = -\left| x^2 - 3x \right|$

[2 marks]

Turn over for the next question

5 The polynomials $f(x)$ and $g(x)$ are defined by

$$f(x) = (2x-3)(kx^2 + x - 5) \quad \text{and} \quad g(x) = (2x+3)(2x^2 + kx + 3)$$

where k is a constant.

When $f(x)$ is divided by $(2x-1)$ the remainder is R

When $g(x)$ is divided by $(2x-1)$ the remainder is also R

5 (a) Find the value of k and the value of R

[4 marks]

$k =$ _____ $R =$ _____

5 (b) Simplify $\dfrac{g(x) - R}{2x - 1}$

[4 marks]

Answer

8

Turn over for the next question

Turn over ▶

6 A curve C has the equation $y = f(x)$

The curve C maps on to the curve D by the following sequence of two transformations:

- a stretch with scale factor 2 parallel to the y-axis

followed by

- a translation by $\begin{bmatrix} -1 \\ -4 \end{bmatrix}$

Find an equation of curve D

[3 marks]

Answer _____

3

1 2

7   Solve the differential equation

$$\cos^2 x \, \frac{dy}{dx} \;=\; 2 - 5y \qquad \text{for} \quad y < 0.4$$

given that $y = 0$ when $x = 0$

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

[5 marks]

Answer _____

5

Turn over ▶

8 The curve C has equation

$$2x^2 + 3y^3 = xy$$

The point $D(-4, -2)$ lies on C

8 (a) Find an equation of the tangent to C at D

Give your answer in the form $px + qy = r$ where p, q and r are integers.

[6 marks]

Answer _____

8 (b) The tangent to C at D intersects the x-axis at A and the y-axis at B

Find the exact area of triangle OAB where O is the origin.

[2 marks]

Answer

8

Turn over for the next question

Turn over ▶

9 Use integration by parts twice to find the exact value of

$$\int_0^{\frac{\pi}{2}} e^{2x} \sin 3x \, dx$$

Give your answer in the form $a + be^c$ where a, b and c are constants.

[9 marks]

Answer

Turn over for the next question

Turn over ▶

10 (a) It is given that $y = \dfrac{\cos x}{\sin x}$

Use the quotient rule to show that

$$\frac{dy}{dx} = -\text{cosec}^2 x$$

[2 marks]

10 (b) It is given that $y = \ln(\text{cosec}\, x - \cot x)$

Show that

$$\frac{dy}{dx} = \text{cosec}\, x$$

[2 marks]

10 (c) The region R is bounded by the curve $y = 2 - \operatorname{cosec} 2x$, the lines $x = 0.5$ and $x = 1$, and the x-axis.

Use **part (a)** and **part (b)** to find the volume of the solid formed by rotating R through 2π radians about the x-axis.

Give your answer to three decimal places.

[6 marks]

Answer _____

10

Turn over ▶

11 A curve is defined by the parametric equations

$$x = 3 - \sin t \quad \text{and} \quad y = 2 - \tan t$$

11 (a) Find a Cartesian equation of the curve.

[3 marks]

Answer

11 (b) Find in terms of t an expression for $\dfrac{\mathrm{d}y}{\mathrm{d}x}$

[3 marks]

Answer

11 (c) Find the equation of the normal to the curve at the point where $t = \dfrac{\pi}{4}$

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

[4 marks]

Answer

10

12 (a) Express $\dfrac{28x^2 - 60x + 50}{(5+4x)(5-2x)^2}$ in the form $\dfrac{A}{5+4x} + \dfrac{B}{5-2x} + \dfrac{C}{(5-2x)^2}$

[4 marks]

Answer _____

12 (b) (i) Find the binomial expansion of $(5-2x)^{-1}$ up to and including the term in x^2

[2 marks]

Answer _____

12 (b) (ii) State the values of x for which the full binomial expansion of $\left(5-2x\right)^{-1}$ is valid.

[1 mark]

Answer _____

12 (c) Use your answers to **part (a)** and **part (b)** to show that

$$\frac{28x^2 - 60x + 50}{\left(5+4x\right)\left(5-2x\right)^2} = D + Ex + Fx^2$$

for small values of x, stating the rational values of D, E and F

[4 marks]

Turn over ▶

13 (a)   Find $\displaystyle\int \frac{x}{x^2 - x - 6}\, \mathrm{d}x$

Give your answer in the form $k\ln\big(\mathrm{f}(x)\big)$ where k is a constant.

[5 marks]

Answer _____

13 (b) Use the substitution $u = 1 - 2x$ to evaluate $\displaystyle\int_0^{0.5} x^2 (1-2x)^{0.5}\, dx$

Give your answer as a fraction.

[7 marks]

Answer _____

12

Turn over ▶

14 (a) Find a vector equation of the line l_1 which passes through the point $A\,(8, -1, 4)$ and the point $B\,(6, -2, 2)$

[1 mark]

Answer _____

14 (b) The line l_2 has equation $\mathbf{r} = \begin{bmatrix} 7 \\ 3 \\ -3 \end{bmatrix} + \mu \begin{bmatrix} 1 \\ 2 \\ -1 \end{bmatrix}$

14 (b) (i) The lines l_1 and l_2 intersect.

Find the coordinates of the point of intersection.

[3 marks]

Answer _____

14 (b) (ii) Find the acute angle between line l_1 and line l_2

Give your answer in degrees to one decimal place.

[3 marks]

Answer

14 (c) Find the shortest distance from the point C (14, −11, −6) to the line l_2

Give your answer in an exact form.

[5 marks]

Answer

END OF QUESTIONS

12

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