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I declare this is my own work.

INTERNATIONAL A-LEVEL MATHEMATICS

(9660/MA03) Unit P2 Pure Mathematics

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 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 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	
13	
TOTAL	



- 1 (b)** A curve has equation $y = \sin(e^x)$
The curve intersects the line $y = 3x - 2$ at a single point where $x = \alpha$

- 1 (b) (i)** Show that α lies between 0.8 and 0.9

[2 marks]

- 1 (b) (ii)** The equation $\sin(e^x) = 3x - 2$ can be rearranged into the form $x = \frac{\sin(e^x) + 2}{3}$
Use the iterative formula

$$x_{n+1} = \frac{\sin(e^{x_n}) + 2}{3}$$

with $x_1 = 0.8$ to find the values of x_2 and x_3

Give your answers to three decimal places.

[2 marks]

$$x_2 = \underline{\hspace{2cm}} \qquad x_3 = \underline{\hspace{2cm}}$$

8

Turn over ►



4 (a) (ii) Show that

$$f(x) = (2x+1)(px+q)(px-q)$$

where p and q are constants.

[2 marks]

4 (b) Hence show that

$$\frac{f(x)}{(3x+2)(x^2-2)} = k + \frac{g(x)}{x^2-2}$$

where k is a constant and g is a linear function.

[2 marks]

Turn over ►



6 (a) Find the binomial expansion of $(1-x)^{-\frac{1}{3}}$ up to and including the term in x^3

[3 marks]

Answer _____

6 (b) (i) Find the binomial expansion of $\frac{1}{\sqrt[3]{1-2x}}$ up to and including the term in x^3

[2 marks]

Answer _____



6 (b) (ii) State the values of x for which the binomial expansion of $\frac{1}{\sqrt[3]{1-2x}}$ is valid.

[2 marks]

Answer _____

6 (c) Use your binomial expansion in **part (b)(i)** with $x = 0.1$ to find an estimate for $\sqrt[3]{10}$ giving your answer to three decimal places.

[3 marks]

Answer _____

10

Turn over ►



8 (a) (i) Show that

$$\frac{6}{x^3 + x} = \frac{a}{x} + \frac{bx}{x^2 + 1}$$

where a and b are constants.

[2 marks]

8 (a) (ii) Using part (a)(i), show that

$$\int_1^2 \frac{6}{x^3 + x} dx = \ln k$$

where k is a rational number.

[4 marks]



8 (b) (i) By writing $\sec y$ as $(\cos y)^{-1}$ use the chain rule to show that $\frac{d(\sec y)}{dy} = \sec y \tan y$

[2 marks]

8 (b) (ii) Use the substitution $u = \sin x$ to find the exact value of

$$\int_0^{0.5} \frac{u}{\sqrt{(1-u^2)^3}} du$$

You may use $\sin \frac{\pi}{6} = \frac{1}{2}$ and $\cos \frac{\pi}{6} = \frac{\sqrt{3}}{2}$

[5 marks]

Answer _____

Turn over ►



9 (a) Express $\frac{1}{(30-x)(10-x)}$ in partial fractions.

[2 marks]

Answer _____

9 (b) A chemical experiment produces a substance.

The mass of the substance is x grams after time t minutes.

The mass of the substance increases at a rate directly proportional to $(30-x)(10-x)$

When $t = 0$, $x = 0$

When $t = 2$, $x = 6$

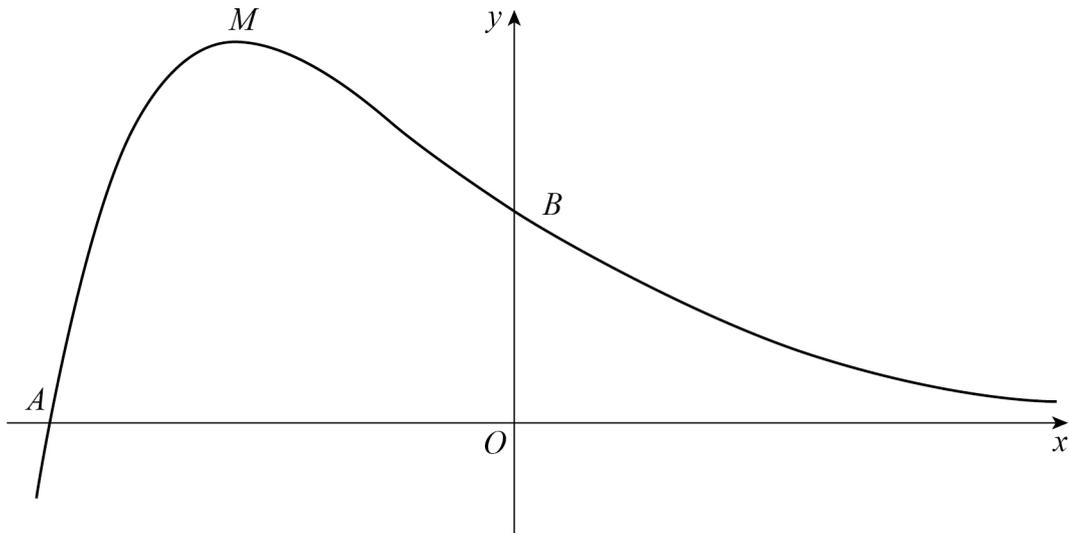
Find an expression for x in terms of t

[9 marks]



11

The diagram shows a sketch of the curve with equation $y = (5 + 2x)e^{-x}$



The curve crosses the axes at A and B and has a stationary point at M

11 (a) Find the coordinates of A and the coordinates of B

[1 mark]

Answer _____

11 (b) The curve $y = (5 + 2x)e^{-x}$ has a stationary point at M

11 (b) (i) Find $\frac{dy}{dx}$

[2 marks]

Answer _____



13 (a) The point A has coordinates $(2, -3, 7)$. The point B has coordinates $(16, -1, -1)$.

Find the distance AB

[2 marks]

Answer _____

13 (b) The line l has equation $\mathbf{r} = \begin{bmatrix} 9 \\ -2 \\ q \end{bmatrix} + \mu \begin{bmatrix} 5 \\ -4 \\ 5 \end{bmatrix}$

13 (b) (i) The line l intersects the line AB

Find the value of q , where q is an integer.

[3 marks]

Answer _____



- 13 (b) (ii)** Find the acute angle between the line l and the line AB , giving your answer in degrees to three significant figures.

[4 marks]

Answer _____

- 13 (c)** The point D has coordinates $(-1, 2, 3)$.

The perpendicular from D to the line l meets l at the point C

Show that ABC is a right-angled triangle.

[6 marks]

Turn over ►



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