

Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

For Examiner's Use	
Examiner's Initials	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
8	
TOTAL	



General Certificate of Education
Advanced Level Examination
January 2011

Mathematics

MPC3

Unit Pure Core 3

Wednesday 19 January 2011 1.30 pm to 3.00 pm

For this paper you must have:

- the blue AQA booklet of formulae and statistical tables.

You may use a graphics calculator.

Time allowed

- 1 hour 30 minutes

- 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.
 - Write the question part reference (eg (a), (b)(i) etc) in the left-hand margin.
 - You must answer the questions in the spaces provided. Do not write outside the box around each page.
 - Show all necessary working; otherwise marks for method may be lost.
 - Do all rough work in this book. Cross through any work that you do not want to be marked.

- Information**
- The marks for questions are shown in brackets.
 - The maximum mark for this paper is 75.

- Advice**
- Unless stated otherwise, you may quote formulae, without proof, from the booklet.



J A N 1 1 M P C 3 0 1

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

1 (a) Find $\frac{dy}{dx}$ when $y = (x^3 - 1)^6$. *(2 marks)*

(b) A curve has equation $y = x \ln x$.

(i) Find $\frac{dy}{dx}$. *(2 marks)*

(ii) Find an equation of the tangent to the curve $y = x \ln x$ at the point on the curve where $x = e$. *(3 marks)*

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Turn over ►



2 A curve is defined by the equation $y = (x^2 - 4) \ln(x + 2)$ for $x \geq 3$.

The curve intersects the line $y = 15$ at a single point, where $x = \alpha$.

(a) Show that α lies between 3.5 and 3.6. (2 marks)

(b) Show that the equation $(x^2 - 4) \ln(x + 2) = 15$ can be arranged into the form

$$x = \pm \sqrt{4 + \frac{15}{\ln(x + 2)}} \quad (2 \text{ marks})$$

(c) Use the iteration

$$x_{n+1} = \sqrt{4 + \frac{15}{\ln(x_n + 2)}}$$

with $x_1 = 3.5$ to find the values of x_2 and x_3 , giving your answers to three decimal places. (2 marks)

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3 (a) Given that $x = \tan(3y + 1)$:

(i) find $\frac{dx}{dy}$ in terms of y ; (2 marks)

(ii) find the value of $\frac{dy}{dx}$ when $y = -\frac{1}{3}$. (2 marks)

(b) Sketch the graph of $y = \tan^{-1} x$. (2 marks)

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4 The functions f and g are defined with their respective domains by

$$f(x) = 3 \cos \frac{1}{2}x, \quad \text{for } 0 \leq x \leq 2\pi$$

$$g(x) = |x|, \quad \text{for all real values of } x$$

(a) Find the range of f . *(2 marks)*

(b) The inverse of f is f^{-1} .

(i) Find $f^{-1}(x)$. *(3 marks)*

(ii) Solve the equation $f^{-1}(x) = 1$, giving your answer in an exact form. *(2 marks)*

(c) (i) Write down an expression for $gf(x)$. *(1 mark)*

(ii) Sketch the graph of $y = gf(x)$ for $0 \leq x \leq 2\pi$. *(3 marks)*

(d) Describe a sequence of two geometrical transformations that maps the graph of $y = \cos x$ onto the graph of $y = 3 \cos \frac{1}{2}x$. *(3 marks)*

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5 (a) Find $\int \frac{1}{3+2x} dx$. (2 marks)

(b) By using integration by parts, find $\int x \sin \frac{x}{2} dx$. (4 marks)

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7 (a) Solve the equation $\sec x = -5$, giving all values of x in radians to two decimal places in the interval $0 < x < 2\pi$. *(3 marks)*

(b) Show that the equation

$$\frac{\operatorname{cosec} x}{1 + \operatorname{cosec} x} - \frac{\operatorname{cosec} x}{1 - \operatorname{cosec} x} = 50$$

can be written in the form

$$\sec^2 x = 25 \tag{4 marks}$$

(c) Hence, or otherwise, solve the equation

$$\frac{\operatorname{cosec} x}{1 + \operatorname{cosec} x} - \frac{\operatorname{cosec} x}{1 - \operatorname{cosec} x} = 50$$

giving all values of x in radians to two decimal places in the interval $0 < x < 2\pi$. *(3 marks)*

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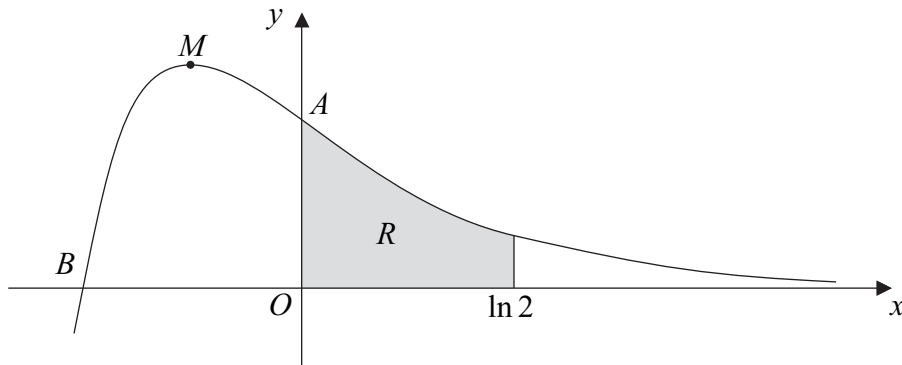
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8 (a) Given that $e^{-2x} = 4$, find the exact value of x . (2 marks)

(b) The diagram shows the curve $y = 4e^{-2x} - e^{-4x}$.



The curve crosses the y -axis at the point A , the x -axis at the point B , and has a stationary point at M .

(i) State the y -coordinate of A . (1 mark)

(ii) Find the x -coordinate of B , giving your answer in an exact form. (3 marks)

(iii) Find the x -coordinate of the stationary point, M , giving your answer in an exact form. (3 marks)

(iv) The shaded region R is bounded by the curve $y = 4e^{-2x} - e^{-4x}$, the lines $x = 0$ and $x = \ln 2$ and the x -axis.

Find the volume of the solid generated when the region R is rotated through 360° about the x -axis, giving your answer in the form $\frac{p}{q}\pi$, where p and q are integers.

(7 marks)

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END OF QUESTIONS

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