

Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										



General Certificate of Education
Advanced Level Examination
June 2010

Mathematics

MFP3

Unit Further Pure 3

Friday 11 June 2010 9.00 am to 10.30 am

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.

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



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

1 The function $y(x)$ satisfies the differential equation

$$\frac{dy}{dx} = f(x, y)$$

where $f(x, y) = x + 3 + \sin y$

and $y(1) = 1$

(a) Use the Euler formula

$$y_{r+1} = y_r + hf(x_r, y_r)$$

with $h = 0.1$, to obtain an approximation to $y(1.1)$, giving your answer to four decimal places. (3 marks)

(b) Use the formula

$$y_{r+1} = y_{r-1} + 2hf(x_r, y_r)$$

with your answer to part **(a)**, to obtain an approximation to $y(1.2)$, giving your answer to three decimal places. (3 marks)

QUESTION
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QUESTION
PART
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Turn over ►



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$$\frac{d^2y}{dx^2} + y = \sin 2x \quad (3 \text{ marks})$$

(b) Hence find the general solution of this differential equation. (4 marks)

QUESTION	PART	REFERENCE
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QUESTION
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4

By using an integrating factor, find the solution of the differential equation

$$\frac{dy}{dx} + \frac{3}{x}y = (x^4 + 3)^{\frac{3}{2}}$$

given that $y = \frac{1}{5}$ when $x = 1$.

(9 marks)

QUESTION
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Turn over ►



5 (a) Write down the expansion of $\cos 4x$ in ascending powers of x up to and including the term in x^4 . Give your answer in its simplest form. (2 marks)

(b) (i) Given that $y = \ln(2 - e^x)$, find $\frac{dy}{dx}$, $\frac{d^2y}{dx^2}$ and $\frac{d^3y}{dx^3}$.

(You may leave your expression for $\frac{d^3y}{dx^3}$ unsimplified.) (6 marks)

(ii) Hence, by using Maclaurin's theorem, show that the first three non-zero terms in the expansion, in ascending powers of x , of $\ln(2 - e^x)$ are

$$-x - x^2 - x^3 \quad (2 \text{ marks})$$

(c) Find

$$\lim_{x \rightarrow 0} \left[\frac{x \ln(2 - e^x)}{1 - \cos 4x} \right] \quad (3 \text{ marks})$$

QUESTION
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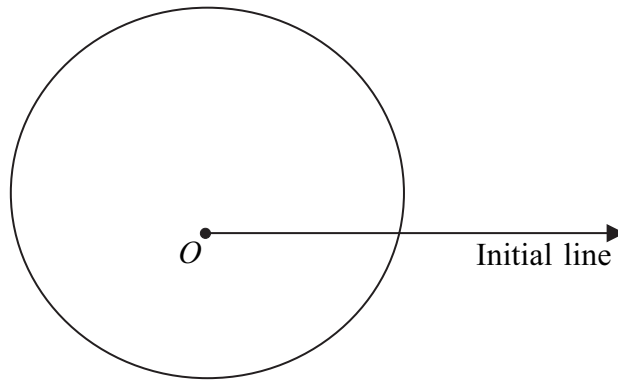
6

$$r = 2(\cos \theta - \sin \theta), \quad 0 \leq \theta \leq 2\pi$$

- (a) (i)** Find the cartesian equation of C_1 . (4 marks)
- (ii)** Deduce that C_1 is a circle and find its radius and the cartesian coordinates of its centre. (3 marks)

- (b)** The diagram shows the curve C_2 with polar equation

$$r = 4 + \sin \theta, \quad 0 \leq \theta \leq 2\pi$$



- (i) Find the area of the region that is bounded by C_2 . (6 marks)
- (ii) Prove that the curves C_1 and C_2 do not intersect. (4 marks)
- (iii) Find the area of the region that is outside C_1 but inside C_2 . (2 marks)

QUESTION	PART	REFERENCE
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