Centre No.						Paper Reference							Surname	Initial(s)
Candidate No.						6	6	7	4	/	0	1	Signature	

Paper Reference(s)

6674/01

Edexcel GCE

Further Pure Mathematics FP1

Advanced/Advanced Subsidiary

Friday 30 January 2009 – Afternoon

Time: 1 hour 30 minutes

Examiner's use only

Team Leader's use only

Question Number	Leave Blank
1	
2	
3	
4	
5	
6	
7	
8	
Total	

Materials required for examination	Items included with question papers
Mathematical Formulae (Green)	Nil

Candidates may use any calculator allowed by the regulations of the Joint Council for Qualifications. Calculators must not have the facility for symbolic algebra manipulation, differentiation and integration, or have retrievable mathematical formulae stored in them.

Instructions to Candidates

In the boxes above, write your centre number, candidate number, your surname, initials and signature.
Check that you have the correct question paper.
Answer ALL the questions.
You must write your answer for each question in the space following the question.
When a calculator is used, the answer should be given to an appropriate degree of accuracy.

Information for Candidates

A booklet 'Mathematical Formulae and Statistical Tables' is provided.
Full marks may be obtained for answers to ALL questions.
The marks for individual questions and the parts of questions are shown in round brackets: e.g. **(2)**.
There are 8 questions in this question paper. The total mark for this paper is 75.
There are 28 pages in this question paper. Any blank pages are indicated.

Advice to Candidates

You must ensure that your answers to parts of questions are clearly labelled.
You should show sufficient working to make your methods clear to the Examiner.
Answers without working may not gain full credit.

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1. (a) Show that $\sum_{r=1}^{n}(r^2 - r - 1) = \frac{1}{3}n(n^2 - 4)$.

(4)

(b) Hence, or otherwise, find the value of $\sum_{r=10}^{20}(r^2 - r - 1)$.

(2)

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Question 1 continued

Q1

(Total 6 marks)

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2. $$f(x) = 2x^4 - 14x^3 + 33x^2 - 26x + 10.$$

Given that $x = 3 + i$ is a solution of the equation $f(x) = 0$, solve $f(x) = 0$ completely.

(6)

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Question 2 continued

Q2

(Total 6 marks)

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3. Find the set of values of x for which

$$\frac{x^3 + 5x - 12}{x - 3} > 4.$$

(6)

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Question 3 continued

Q3

(Total 6 marks)

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4.

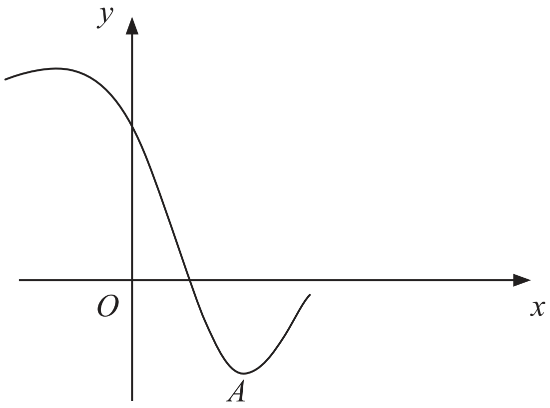

Figure 1

Figure 1 shows part of the curve with equation $y = f(x)$, where

$$f(x) = 1 - x - \sin(x^2).$$

The point A, with x-coordinate p, is a stationary point on the curve.

The equation $f(x) = 0$ has a root α in the interval $0.6 < \alpha < 0.7$.

(a) Explain why $x_0 = p$ is not suitable to use as a first approximation to α when applying the Newton-Raphson procedure to $f(x)$.
(1)

(b) Using $x_0 = 0.6$ as a first approximation to α, apply the Newton-Raphson procedure once to $f(x)$ to find a second approximation to α, giving your answer to 3 decimal places.
(5)

(c) By considering the change of sign of $f(x)$ over an appropriate interval, show that your answer to part (b) is accurate to 3 decimal places.
(2)

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Question 4 continued

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Question 4 continued

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Question 4 continued

Q4

(Total 8 marks)

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5. Given that $z_1 = 3 + 2\text{i}$ and $z_2 = \dfrac{12 - 5\text{i}}{z_1}$,

(a) find z_2 in the form $a + \text{i}b$, where a and b are real. **(2)**

(b) Show, on an Argand diagram, the point P representing z_1 and the point Q representing z_2. **(2)**

(c) Given that O is the origin, show that $\angle POQ = \dfrac{\pi}{2}$. **(2)**

The circle passing through the points O, P and Q has centre C. Find

(d) the complex number represented by C, **(2)**

(e) the exact value of the radius of the circle. **(2)**

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Question 5 continued

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Question 5 continued

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Question 5 continued

(Total 10 marks)

Q5

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6. The curve C_1 has polar equation $r = 6\sin\theta$.

(a) Find a cartesian equation of C_1.

(2)

The curve C_2 has polar equation $r = (9\sqrt{6})\cos 2\theta$, $0 \leqslant \theta \leqslant \frac{\pi}{4}$.

(b) Express the polar equation of C_2 in terms of $\sin\theta$ only.

(1)

The tangent to C_2 at the point P is parallel to the initial line.

(c) Use differentiation to show that, at P, $\sin\theta = \frac{1}{\sqrt{6}}$.

(4)

(d) Find the value of r at P.

(2)

(e) Hence, or otherwise, show that C_1 and C_2 have a common tangent parallel to the initial line.

(3)

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Question 6 continued

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Question 6 continued

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Question 6 continued

Q6

(Total 12 marks)

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7.

$$\frac{d^2y}{dx^2} + 4\frac{dy}{dx} - 5y = 4e^x.$$

(a) Show that λxe^x is a particular integral of the differential equation, where λ is a constant to be found.

(4)

(b) Find the general solution of the differential equation.

(4)

(c) Find the particular solution for which $y = -\frac{2}{3}$ and $\frac{dy}{dx} = -\frac{4}{3}$ at $x = 0$.

(5)

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Question 7 continued

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Question 7 continued

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Question 7 continued

(Total 13 marks)

Q7

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8. (a) Show that the substitution $y = \frac{1}{t}$ transforms the differential equation

$$\sin x \frac{\mathrm{d}y}{\mathrm{d}x} + y\cos x = y^2, \quad 0 < x < \pi \qquad \text{(I)}$$

into the differential equation

$$\frac{\mathrm{d}t}{\mathrm{d}x} - t\cot x = -\operatorname{cosec} x, \quad 0 < x < \pi. \qquad \text{(II)}$$

(4)

(b) Solve the differential equation (II).

(5)

(c) Hence show that

$$y = \frac{1}{\cos x + c\sin x},$$

where c is an arbitrary constant, is a general solution of the differential equation (I).

(2)

Given that $y = \frac{\sqrt{2}}{3}$ at $x = \frac{\pi}{4}$,

(d) find the value of y at $x = \frac{\pi}{2}$.

(3)

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Question 8 continued

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Question 8 continued

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Question 8 continued

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Question 8 continued

Q8

(Total 14 marks)

TOTAL FOR PAPER: 75 MARKS

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