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 26 January 2007 – 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	

ND004000139

Materials required for examination
Mathematical Formulae (Green)

Items included with question papers
Nil

Candidates may use any calculator EXCEPT those with the facility for symbolic algebra, differentiation and/or integration. Thus candidates may NOT use calculators such as the Texas Instruments TI 89, TI 92, Casio CFX 9970G, Hewlett Packard HP 48G.

Instructions to Candidates

In the boxes above, write your centre number, candidate number, your surname, initial(s) and signature.
Check that you have the correct question paper.
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 24 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 must show sufficient working to make your methods clear to the examiner. Answers without working may gain no credit.

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1. (a) Find the roots of the equation

$$z^2 + 2z + 17 = 0,$$

giving your answers in the form $a + ib$, where a and b are integers.

(3)

(b) Show these roots on an Argand diagram.

(1)

(Total 4 marks)

Q1

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2. Obtain the general solution of the differential equation

$$x\frac{dy}{dx}+2y=\cos x, \quad x>0,$$

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

(8)

Leave blank

Question 2 continued

Q2

(Total 8 marks)

N 2 3 5 6 8 A 0 5 2 4

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3. The complex numbers z_1 and z_2 are given by

$$z_1 = 5 + 3\text{i},$$
$$z_2 = 1 + p\text{i},$$

where p is an integer.

(a) Find $\frac{z_2}{z_1}$ in the form $a + \text{i}b$, where a and b are expressed in terms of p.

(3)

Given that $\arg\left(\frac{z_2}{z_1}\right) = \frac{\pi}{4}$,

(b) find the value of p.

(2)

Leave blank

Question 3 continued

Q3

(Total 5 marks)

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4. (a) Show that

$$\frac{r^3 - r + 1}{r(r+1)} \equiv r - 1 + \frac{1}{r} - \frac{1}{r+1}, \quad \text{for } r \neq 0, -1.$$

(3)

(b) Find $\sum_{r=1}^{n} \frac{r^3 - r + 1}{r(r+1)}$, expressing your answer as a single fraction in its simplest form.

(6)

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Question 4 continued

Q4

(Total 9 marks)

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5.

Figure 1

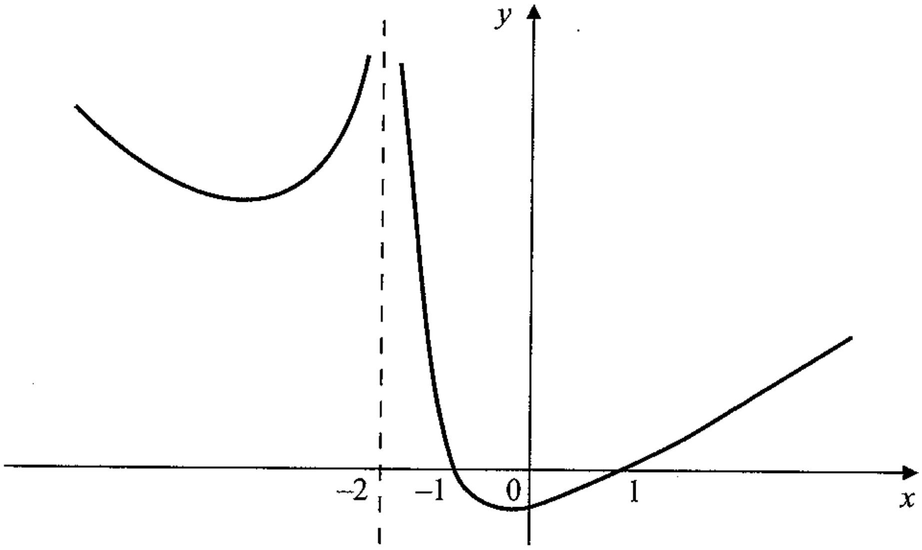

Figure 1 shows a sketch of the curve with equation

$$y = \frac{x^2 - 1}{|x+2|}, \quad x \neq -2.$$

The curve crosses the x-axis at $x = 1$ and $x = -1$ and the line $x = -2$ is an asymptote of the curve.

(a) Use algebra to solve the equation $\dfrac{x^2 - 1}{|x+2|} = 3(1 - x)$.

(6)

(b) Hence, or otherwise, find the set of values of x for which

$$\frac{x^2 - 1}{|x+2|} < 3(1 - x).$$

(3)

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Question 5 continued

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Question 5 continued

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Question 5 continued

Q5

(Total 9 marks)

N 2 3 5 6 8 A 0 1 3 2 4

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6. $$f(x) = \ln x + x - 3, \ x > 0.$$

(a) Find f(2.0) and f(2.5), each to 4 decimal places, and show that the root α of the equation $f(x) = 0$ satisfies $2.0 < \alpha < 2.5$.

(3)

(b) Use linear interpolation with your values of f(2.0) and f(2.5) to estimate α, giving your answer to 3 decimal places.

(2)

(c) Taking 2.25 as a first approximation to α, apply the Newton-Raphson process once to f(x) to obtain a second approximation to α, giving your answer to 3 decimal places.

(5)

(d) Show that your answer in part (c) gives α correct to 3 decimal places.

(2)

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Question 6 continued

Q6

(Total 12 marks)

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7. A scientist is modelling the amount of a chemical in the human bloodstream. The amount x of the chemical, measured in mg l^{-1}, at time t hours satisfies the differential equation

$$2x\frac{d^2x}{dt^2} - 6\left(\frac{dx}{dt}\right)^2 = x^2 - 3x^4, \quad x > 0.$$

(a) Show that the substitution $y = \frac{1}{x^2}$ transforms this differential equation into

$$\frac{d^2y}{dt^2} + y = 3. \qquad \boxed{\text{I}}$$

(5)

(b) Find the general solution of differential equation $\boxed{\text{I}}$.

(4)

Given that at time $t = 0$, $x = \frac{1}{2}$ and $\frac{dx}{dt} = 0$,

(c) find an expression for x in terms of t,

(4)

(d) write down the maximum value of x as t varies.

(1)

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Question 7 continued

N 2 3 5 6 8 A 0 1 7 2 4

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Question 7 continued

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Question 7 continued

Q7

(Total 14 marks)

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8.

Figure 2

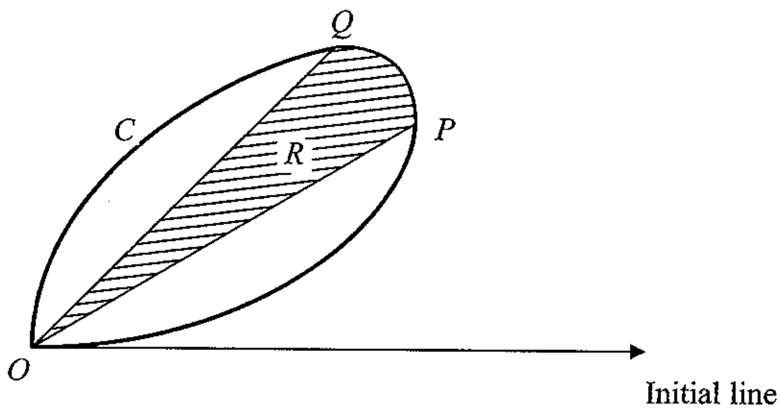

Figure 2 shows a sketch of the curve C with polar equation

$$r = 4\sin\theta\cos^2\theta, \qquad 0 \leqslant \theta < \frac{\pi}{2}.$$

The tangent to C at the point P is perpendicular to the initial line.

(a) Show that P has polar coordinates $\left(\frac{3}{2}, \frac{\pi}{6}\right)$.

(6)

The point Q on C has polar coordinates $\left(\sqrt{2}, \frac{\pi}{4}\right)$.

The shaded region R is bounded by OP, OQ and C, as shown in Figure 2.

(b) Show that the area of R is given by

$$\int_{\frac{\pi}{6}}^{\frac{\pi}{4}} \left(\sin^2 2\theta\cos 2\theta + \frac{1}{2} - \frac{1}{2}\cos 4\theta\right) \mathrm{d}\theta.$$

(3)

(c) Hence, or otherwise, find the area of R, giving your answer in the form $a + b\pi$, where a and b are rational numbers.

(5)

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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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