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

Paper Reference(s)

6667/01

Edexcel GCE

Further Pure Mathematics FP1

Advanced/Advanced Subsidiary

Wednesday 17 June 2009 – Morning

Time: 1 hour 30 minutes

Materials required for examination	Items included with question papers
Mathematical Formulae (Orange)	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.

Examiner's use only

Team Leader's use only

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

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 to 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 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. The complex numbers z_1 and z_2 are given by

$$z_1 = 2 - \mathrm{i} \quad \text{and} \quad z_2 = -8 + 9\mathrm{i}$$

(a) Show z_1 and z_2 on a single Argand diagram.

(1)

Find, showing your working,

(b) the value of $|z_1|$,

(2)

(c) the value of arg z_1, giving your answer in radians to 2 decimal places,

(2)

(d) $\dfrac{z_2}{z_1}$ in the form $a + b\mathrm{i}$, where a and b are real.

(3)

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Question 1 continued

Q1

(Total 8 marks)

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2. (a) Using the formulae for $\sum_{r=1}^{n} r$, $\sum_{r=1}^{n} r^2$ and $\sum_{r=1}^{n} r^3$, show that

$$\sum_{r=1}^{n} r(r+1)(r+3) = \frac{1}{12}n(n+1)(n+2)(3n+k),$$

where k is a constant to be found.

(7)

(b) Hence evaluate $\sum_{r=21}^{40} r(r+1)(r+3)$.

(2)

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Question 2 continued

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Question 2 continued

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Question 2 continued

Q2

(Total 9 marks)

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3. $$f(x) = (x^2 + 4)(x^2 + 8x + 25)$$

(a) Find the four roots of $f(x) = 0$.

(5)

(b) Find the sum of these four roots.

(2)

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Question 3 continued

Q3

(Total 7 marks)

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4. Given that α is the only real root of the equation

$$x^3 - x^2 - 6 = 0$$

(a) show that $2.2 < \alpha < 2.3$

(2)

(b) Taking 2.2 as a first approximation to α, apply the Newton-Raphson procedure once to $f(x) = x^3 - x^2 - 6$ to obtain a second approximation to α, giving your answer to 3 decimal places.

(5)

(c) Use linear interpolation once on the interval [2.2, 2.3] to find another approximation to α, giving your answer to 3 decimal places.

(3)

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Question 4 continued

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Question 4 continued

Question 4 continued

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(Total 10 marks)

Q4

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5. $$\mathbf{R} = \begin{pmatrix} a & 2 \\ a & b \end{pmatrix}, \text{ where } a \text{ and } b \text{ are constants and } a > 0.$$

(a) Find $\mathbf{R}^2$ in terms of a and b.

(3)

Given that $\mathbf{R}^2$ represents an enlargement with centre (0, 0) and scale factor 15,

(b) find the value of a and the value of b.

(5)

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Question 5 continued

Q5

(Total 8 marks)

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6. The parabola C has equation $y^2 = 16x$.

(a) Verify that the point $P(4t^2, 8t)$ is a general point on C.
(1)

(b) Write down the coordinates of the focus S of C.
(1)

(c) Show that the normal to C at P has equation

$$y + tx = 8t + 4t^3$$
(5)

The normal to C at P meets the x-axis at the point N.

(d) Find the area of triangle PSN in terms of t, giving your answer in its simplest form.
(4)

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Question 6 continued

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Question 6 continued

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Question 6 continued

Q6

(Total 11 marks)

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7.
$$\mathbf{A} = \begin{pmatrix} a & -2 \\ -1 & 4 \end{pmatrix}, \text{ where } a \text{ is a constant.}$$

(a) Find the value of a for which the matrix **A** is singular.

(2)

$$\mathbf{B} = \begin{pmatrix} 3 & -2 \\ -1 & 4 \end{pmatrix}$$

(b) Find $\mathbf{B}^{-1}$.

(3)

The transformation represented by **B** maps the point P onto the point Q.

Given that Q has coordinates $(k - 6, 3k + 12)$, where k is a constant,

(c) show that P lies on the line with equation $y = x + 3$.

(3)

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Question 7 continued

Q7

(Total 8 marks)

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8. Prove by induction that, for $n \in \mathbb{Z}^+$,

(a) $f(n) = 5^n + 8n + 3$ is divisible by 4,

(7)

(b) $\begin{pmatrix} 3 & -2 \\ 2 & -1 \end{pmatrix}^n = \begin{pmatrix} 2n+1 & -2n \\ 2n & 1-2n \end{pmatrix}$

(7)

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Question 8 continued

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Question 8 continued

Q8

(Total 14 marks)

TOTAL FOR PAPER: 75 MARKS

END

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