PMT

| Centre No. | | | | | | Paper Reference | | | | | | | Surname | Initial(s) |
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| 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

Examiner's use only

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Team Leader's use only

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| Question Number | Leave Blank |
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**Materials required for examination**
Mathematical Formulae (Orange)

**Items included with question papers**
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 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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***Turn over***

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**1.** The complex numbers $z_1$ and $z_2$ are given by

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

(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) $\frac{z_2}{z_1}$ in the form $a + bi$, where $a$ and $b$ are real.

**(3)**

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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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**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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**4.** Given that $\alpha$ 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 $\alpha$, apply the Newton-Raphson procedure once to $f(x) = x^3 - x^2 - 6$ to obtain a second approximation to $\alpha$, 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 $\alpha$, giving your answer to 3 decimal places.

**(3)**

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**5.** $\mathbf{R} = \begin{pmatrix} a & 2 \\ a & b \end{pmatrix}$, where $a$ and $b$ 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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**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)**

Leave blank

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

(a) Find the value of $a$ for which the matrix $\mathbf{A}$ is singular.

**(2)**

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

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

**(3)**

The transformation represented by $\mathbf{B}$ 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)**

PMT

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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)**