| 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

Wednesday 17 June 2009 – Morning

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**
Mathematical Formulae (Green)

**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. Write your answers in the spaces provided in this question paper.
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.** Given that $x = \mathrm{i}$ is a complex solution of the equation

$$x^4 + 6x^3 + 26x^2 + 6x + 25 = 0 ,$$

(a) express $x^4 + 6x^3 + 26x^2 + 6x + 25$ as a product of two quadratic factors.

**(4)**

(b) Hence solve completely the equation $x^4 + 6x^3 + 26x^2 + 6x + 25 = 0$ .

**(2)**



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**Question 1 continued**

**Q1**

**(Total 6 marks)**



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**2.** Find the general solution of the differential equation

$$\frac{d^2x}{dt^2} + 6\frac{dx}{dt} + 10x = e^{-4t}.$$

**(8)**



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**Question 2 continued**

**(Total 8 marks)**

Q2



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**3.** (a) Show that

$$\sum_{r=1}^{n} r(r+2)(r+4) = \frac{1}{4}n(n+1)(n+4)(n+5).$$

**(5)**

(b) Hence evaluate $\sum_{r=21}^{30} r(r+2)(r+4)$.

**(2)**



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**Question 3 continued**

**Q3**

**(Total 7 marks)**



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**4.** The complex numbers $z_1$ and $z_2$ are such that

$$z_1 = 5 + 2p\mathrm{i} \quad \text{and} \quad \frac{z_1}{z_2} = 1 - \mathrm{i},$$

where $p$ is a real constant.

(a) Find $z_2$ in the form $a + b\mathrm{i}$, giving the real numbers $a$ and $b$ in terms of $p$.
**(3)**

Given that $\arg z_2 = \arctan 4$,

(b) find the value of $p$.
**(2)**

(c) Find the value of $|z_2|$.
**(2)**

(d) Show $z_1$, $z_2$ and $\frac{z_1}{z_2}$ on a single Argand diagram.
**(2)**



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**Question 4 continued**



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**Question 4 continued**



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**Question 4 continued**

Q4

**(Total 9 marks)**



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**5.** Given that $\alpha$ is the only real root of the equation

$$\sin 2x - \ln 3x = 0,$$

(a) show that $0.8 < \alpha < 0.9$

**(2)**

(b) Taking 0.9 as a first approximation to $\alpha$, apply the Newton-Raphson procedure once to $f(x) = \sin 2x - \ln 3x$ to obtain a second approximation to $\alpha$, giving your answer to 3 decimal places.

**(5)**

(c) Use linear interpolation once on the interval [0.8, 0.9] to find another approximation to $\alpha$, giving your answer to 3 decimal places.

**(3)**



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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.** (a) Find, in the form $y = \mathrm{f}(x)$, the general solution of the equation

$$\frac{\mathrm{d}y}{\mathrm{d}x} + y\cot x = \sin x, \quad 0 < x < \pi .$$

**(6)**

Given that $y = 1$ at $x = \frac{\pi}{2}$,

(b) show that, at $x = \frac{\pi}{4}$,

$$y = \frac{(6-\pi)\sqrt{2}}{8}$$

**(4)**



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**Question 6 continued**



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**Question 6 continued**



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**Question 6 continued**

**Q6**

**(Total 10 marks)**



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**7.** (a) On the same diagram, sketch the graph of $y = x + 2$ and the graph of $y = \left|\frac{1}{x-2}\right|$.

Indicate on your sketch the coordinates of any points at which the graphs cross the axes, and state the equations of any asymptotes.

**(6)**

(b) Find the set of values of $x$ for which

$$x + 2 < \left|\frac{1}{x-2}\right|$$

**(6)**



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**Question 7 continued**



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**Question 7 continued**



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**Question 7 continued**

**Q7**

**(Total 12 marks)**



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**8.**

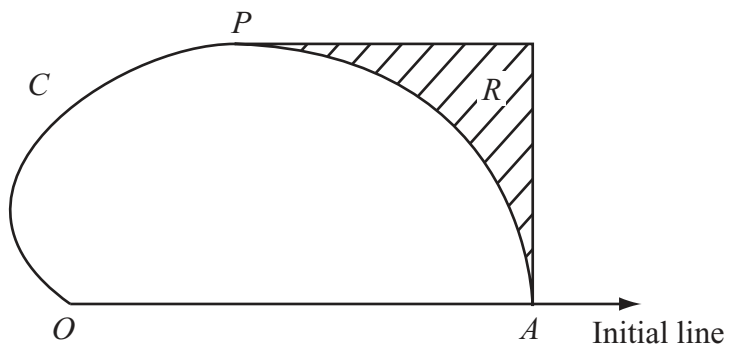


**Figure 1**

The curve $C$ shown in Figure 1 has polar equation

$$r = 1 + \cos\theta, \qquad 0 \leqslant \theta < \pi .$$

At the point $P$ on $C$, the tangent to $C$ is parallel to the initial line.

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

**(4)**

The point $A$ on $C$ has polar coordinates (2, 0).

The finite region $R$, shown shaded in Figure 1, is bounded by the arc $AP$ of $C$, the tangent to $C$ at $P$ and the line through $A$ parallel to $\theta = \frac{\pi}{2}$.

(b) Find the exact area of $R$.

**(9)**



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**Question 8 continued**



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**Question 8 continued**



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**Question 8 continued**

Q8

**(Total 13 marks)**

**TOTAL FOR PAPER: 75 MARKS**

**END**



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