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

Monday 1 February 2010 – Afternoon

Time: 1 hour 30 minutes

Examiner's use only

Team Leader's use only

Question Number	Leave Blank
1	
2	
3	
4	
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6	
7	
8	
9	
Total	

Materials required for examination
Mathematical Formulae (Pink)

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 9 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

$$z_1 = 2 + 8\text{i} \quad \text{and} \quad z_2 = 1 - \text{i}$$

Find, showing your working,

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

(3)

(b) the value of $\left|\dfrac{z_1}{z_2}\right|$,

(2)

(c) the value of $\arg \dfrac{z_1}{z_2}$, giving your answer in radians to 2 decimal places.

(2)

Leave blank

2. $$f(x) = 3x^2 - \frac{11}{x^2}$$

(a) Write down, to 3 decimal places, the value of f(1.3) and the value of f(1.4).

(1)

The equation $f(x) = 0$ has a root α between 1.3 and 1.4

(b) Starting with the interval [1.3, 1.4], use interval bisection to find an interval of width 0.025 which contains α.

(3)

(c) Taking 1.4 as a first approximation to α, apply the Newton-Raphson procedure once to $f(x)$ to obtain a second approximation to α, giving your answer to 3 decimal places.

(5)

PMT

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3. A sequence of numbers is defined by

$$u_1 = 2,$$
$$u_{n+1} = 5u_n - 4, \qquad n \geqslant 1.$$

Prove by induction that, for $n \in \mathbb{Z}^+$, $u_n = 5^{n-1} + 1$.

(4)

Leave blank

4.

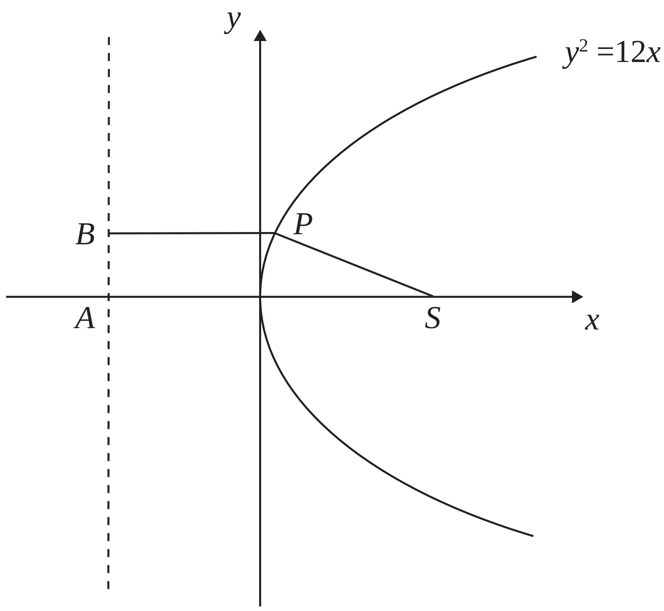

Figure 1

Figure 1 shows a sketch of part of the parabola with equation $y^2 = 12x$.

The point P on the parabola has x-coordinate $\dfrac{1}{3}$.

The point S is the focus of the parabola.

(a) Write down the coordinates of S.

(1)

The points A and B lie on the directrix of the parabola.
The point A is on the x-axis and the y-coordinate of B is positive.

Given that $ABPS$ is a trapezium,

(b) calculate the perimeter of $ABPS$.

(5)

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5. $\mathbf{A} = \begin{pmatrix} a & -5 \\ 2 & a+4 \end{pmatrix}$, where a is real.

(a) Find det **A** in terms of a.

(2)

(b) Show that the matrix **A** is non-singular for all values of a.

(3)

Given that $a = 0$,

(c) find $\mathbf{A}^{-1}$.

(3)

Leave blank

6. Given that 2 and 5 + 2i are roots of the equation

$$x^3 - 12x^2 + cx + d = 0, \qquad c, d \in \mathbb{R},$$

(a) write down the other complex root of the equation.

(1)

(b) Find the value of c and the value of d.

(5)

(c) Show the three roots of this equation on a single Argand diagram.

(2)

Leave blank

7. The rectangular hyperbola H has equation $xy = c^2$, where c is a constant.

The point $P\left(ct, \dfrac{c}{t}\right)$ is a general point on H.

(a) Show that the tangent to H at P has equation

$$t^2 y + x = 2ct$$

(4)

The tangents to H at the points A and B meet at the point $(15c, -c)$.

(b) Find, in terms of c, the coordinates of A and B.

(5)

Leave blank

8. (a) Prove by induction that, for any positive integer *n*,

$$\sum_{r=1}^{n} r^3 = \frac{1}{4}n^2(n+1)^2$$

(5)

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

$$\sum_{r=1}^{n} (r^3 + 3r + 2) = \frac{1}{4}n(n+2)(n^2+7)$$

(5)

(c) Hence evaluate $\sum_{r=15}^{25} (r^3 + 3r + 2)$

(2)

Leave blank

9.

$$\mathbf{M} = \begin{pmatrix} \frac{1}{\sqrt{2}} & -\frac{1}{\sqrt{2}} \\ \frac{1}{\sqrt{2}} & \frac{1}{\sqrt{2}} \end{pmatrix}$$

(a) Describe fully the geometrical transformation represented by the matrix **M**.
(2)

The transformation represented by **M** maps the point *A* with coordinates (p, q) onto the point *B* with coordinates $(3\sqrt{2}, 4\sqrt{2})$.

(b) Find the value of *p* and the value of *q*.
(4)

(c) Find, in its simplest surd form, the length *OA*, where *O* is the origin.
(2)

(d) Find $\mathbf{M}^2$.
(2)

The point *B* is mapped onto the point *C* by the transformation represented by $\mathbf{M}^2$.

(e) Find the coordinates of *C*.
(2)