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

Paper Reference(s)

6667/01R

Edexcel GCE

Further Pure Mathematics FP1

Advanced/Advanced Subsidiary

Tuesday 10 June 2014 – Morning

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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7	
8	
9	
Total	

Materials required for examination	Items included with question papers
Mathematical Formulae (Pink)	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 or symbolic differentiation/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 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. The roots of the equation

$$2z^3 - 3z^2 + 8z + 5 = 0$$

are z_1, z_2 and z_3

Given that $z_1 = 1 + 2\text{i}$, find z_2 and z_3

(5)

Leave blank

Question 1 continued

Q1

(Total 5 marks)

Leave blank

2.

$$f(x) = 3\cos 2x + x - 2, \qquad -\pi \leqslant x < \pi$$

(a) Show that the equation $f(x) = 0$ has a root α in the interval [2, 3].

(2)

(b) Use linear interpolation once on the interval [2, 3] to find an approximation to α.

Give your answer to 3 decimal places.

(3)

(c) The equation $f(x) = 0$ has another root β in the interval [–1, 0]. Starting with this interval, use interval bisection to find an interval of width 0.25 which contains β.

(4)

Leave blank

Question 2 continued

Q2

(Total 9 marks)

Leave blank

3. (i)

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

(a) Describe fully the single transformation represented by the matrix **A**.

(2)

The matrix **B** represents an enlargement, scale factor –2, with centre the origin.

(b) Write down the matrix **B**.

(1)

(ii)

$$\mathbf{M} = \begin{pmatrix} 3 & k \\ -2 & 3 \end{pmatrix},$$ where k is a positive constant.

Triangle T has an area of 16 square units.

Triangle T is transformed onto the triangle T' by the transformation represented by the matrix **M**.

Given that the area of the triangle T' is 224 square units, find the value of k.

(3)

Leave blank

Question 3 continued

(Total 6 marks)

Q3

Leave blank

4. The complex number z is given by

$$z = \frac{p + 2\mathrm{i}}{3 + p\mathrm{i}}$$

where p is an integer.

(a) Express z in the form $a + b\mathrm{i}$ where a and b are real. Give your answer in its simplest form in terms of p.

(4)

(b) Given that $\arg(z) = \theta$, where $\tan\theta = 1$ find the possible values of p.

(5)

Leave blank

Question 4 continued

Leave blank

Question 4 continued

Leave blank

Question 4 continued

Q4

(Total 9 marks)

Leave blank

5. (a) Use the standard results for $\sum_{r=1}^{n} r$ and $\sum_{r=1}^{n} r^3$ to show that

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

(5)

(b) Calculate the value of $\sum_{r=10}^{50} r(r^2 - 3)$

(3)

P 4 3 1 5 2 A 0 1 2 2 8

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Question 5 continued

(Total 8 marks)

Q5

Leave blank

6. $$\mathbf{A} = \begin{pmatrix} 2 & 1 \\ -1 & 0 \end{pmatrix} \text{ and } \mathbf{B} = \begin{pmatrix} -1 & 1 \\ 0 & 1 \end{pmatrix}$$

Given that $\mathbf{M} = (\mathbf{A} + \mathbf{B})(2\mathbf{A} - \mathbf{B})$,

(a) calculate the matrix **M**,

(6)

(b) find the matrix **C** such that $\mathbf{MC} = \mathbf{A}$.

(4)

Leave blank

Question 6 continued

Q6

(Total 10 marks)

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7. The parabola C has cartesian equation $y^2 = 4ax,\ \ a > 0$

The points $P(ap^2, 2ap)$ and $P'(ap^2, -2ap)$ lie on C.

(a) Show that an equation of the normal to C at the point P is

$$y + px = 2ap + ap^3$$

(5)

(b) Write down an equation of the normal to C at the point P'.

(1)

The normal to C at P meets the normal to C at P' at the point Q.

(c) Find, in terms of a and p, the coordinates of Q.

(2)

Given that S is the focus of the parabola,

(d) find the area of the quadrilateral $SPQP'$.

(3)

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Question 7 continued

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Question 7 continued

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Question 7 continued

Q7

(Total 11 marks)

Leave blank

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

The point $P\left(ct, \frac{c}{t}\right)$, $t \neq 0$, is a general point on H.

An equation for the tangent to H at P is given by

$$y = -\frac{1}{t^2}x + \frac{2c}{t}$$

The points A and B lie on H.

The tangent to H at A and the tangent to H at B meet at the point $\left(-\frac{6}{7}c, \frac{12}{7}c\right)$.

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

(5)

Leave blank

Question 8 continued

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Question 8 continued

Leave blank

Question 8 continued

Q8

(Total 5 marks)

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9. (a) Prove by induction that, for $n \in \mathbb{Z}^+$,

$$\sum_{r=1}^{n}(r+1)2^{r-1} = n2^n$$

(5)

(b) A sequence of numbers is defined by

$$u_1 = 0, \qquad u_2 = 32,$$

$$u_{n+2} = 6u_{n+1} - 8u_n \qquad n \geqslant 1$$

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

$$u_n = 4^{n+1} - 2^{n+3}$$

(7)

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Question 9 continued

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Question 9 continued

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Question 9 continued

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Question 9 continued

Q9

(Total 12 marks)

TOTAL FOR PAPER: 75 MARKS

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