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

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	
5	
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 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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PEARSON

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1. The complex numbers z_1 and z_2 are given by

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

where p is an integer.

(a) Find $\dfrac{z_1}{z_2}$ in the form $a + b\text{i}$ where a and b are real. Give your answer in its simplest form in terms of p.

(4)

Given that $\left|\dfrac{z_1}{z_2}\right| = 13$,

(b) find the possible values of p.

(4)

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Question 1 continued

Q1

(Total 8 marks)

P 4 3 1 5 3 A 0 3 2 8

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2.

$$f(x) = x^3 - \frac{5}{2x^{\frac{3}{2}}} + 2x - 3, \quad x > 0$$

(a) Show that the equation $f(x) = 0$ has a root α in the interval [1.1, 1.5].

(2)

(b) Find $f'(x)$.

(2)

(c) Using $x_0 = 1.1$ as a first approximation to α, apply the Newton-Raphson procedure once to $f(x)$ to find a second approximation to α, giving your answer to 3 decimal places.

(3)

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Question 2 continued

Q2

(Total 7 marks)

P 4 3 1 5 3 A 0 5 2 8

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3. Given that 2 and $1 - 5i$ are roots of the equation

$$x^3 + px^2 + 30x + q = 0, \qquad p, q \in \mathbb{R}$$

(a) write down the third root of the equation. **(1)**

(b) Find the value of p and the value of q. **(5)**

(c) Show the three roots of this equation on a single Argand diagram. **(2)**

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Question 3 continued

Q3

(Total 8 marks)

P 4 3 1 5 3 A 0 7 2 8

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4. (i) Given that

$$\mathbf{A} = \begin{pmatrix} 1 & 2 \\ 3 & -1 \\ 4 & 5 \end{pmatrix} \text{ and } \mathbf{B} = \begin{pmatrix} 2 & -1 & 4 \\ 1 & 3 & 1 \end{pmatrix},$$

(a) find **AB**.

(b) Explain why $\mathbf{AB} \neq \mathbf{BA}$.

(4)

(ii) Given that

$$\mathbf{C} = \begin{pmatrix} 2k & -2 \\ 3 & k \end{pmatrix}, \text{ where } k \text{ is a real number}$$

find $\mathbf{C}^{-1}$, giving your answer in terms of k.

(3)

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Question 4 continued

Q4

(Total 7 marks)

P 4 3 1 5 3 A 0 9 2 8

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5. (a) Use the standard results for $\sum_{r=1}^{n} r$ and $\sum_{r=1}^{n} r^2$ to show that

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

(6)

(b) Hence show that

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

where a and b are constants to be found.

(3)

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Question 5 continued

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Question 5 continued

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Question 5 continued

Q5

(Total 9 marks)

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

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6. The rectangular hyperbola H has cartesian equation $xy = c^2$.

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

(a) Show that an equation of the tangent to H at the point P is

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

(4)

An equation of the normal to H at the point P is $t^3x - ty = ct^4 - c$

Given that the normal to H at P meets the x-axis at the point A and the tangent to H at P meets the x-axis at the point B,

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

(2)

Given that $c = 4$,

(c) find, in terms of t, the area of the triangle APB. Give your answer in its simplest form.

(3)

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Question 6 continued

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

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Question 6 continued

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Question 6 continued

Q6

(Total 9 marks)

P 4 3 1 5 3 A 0 1 7 2 8

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7. (i) In each of the following cases, find a 2×2 matrix that represents

(a) a reflection in the line $y = -x$,

(b) a rotation of 135° anticlockwise about (0, 0),

(c) a reflection in the line $y = -x$ followed by a rotation of 135° anticlockwise about (0, 0).

(4)

(ii) The triangle T has vertices at the points $(1, k)$, $(3, 0)$ and $(11, 0)$, where k is a constant.

Triangle T is transformed onto the triangle T' by the matrix

$$\begin{pmatrix} 6 & -2 \\ 1 & 2 \end{pmatrix}$$

Given that the area of triangle T' is 364 square units, find the value of k.

(6)

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Question 7 continued

Turn over

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Question 7 continued

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Question 7 continued

Q7

(Total 10 marks)

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

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8. The points $P(4k^2, 8k)$ and $Q(k^2, 4k)$, where k is a constant, lie on the parabola C with equation $y^2 = 16x$.

The straight line l_1 passes through the points P and Q.

(a) Show that an equation of the line l_1 is given by

$$3ky - 4x = 8k^2$$

(4)

The line l_2 is perpendicular to the line l_1 and passes through the focus of the parabola C. The line l_2 meets the directrix of C at the point R.

(b) Find, in terms of k, the y coordinate of the point R.

(7)

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Question 8 continued

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

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Question 8 continued

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Question 8 continued

Q8

(Total 11 marks)

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

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

$$f(n) = 8^n - 2^n$$

is divisible by 6

(6)

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Question 9 continued

P 4 3 1 5 3 A 0 2 7 2 8

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Question 9 continued

Q9

(Total 6 marks)

TOTAL FOR PAPER: 75 MARKS

END