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

Thursday 14 May 2015 – 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	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 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.

Printer's Log. No.
P44829RA
5/1/5/1/1/1/
P 4 4 8 2 9 R A 0 1 2 8

Turn over

PEARSON

Leave blank

1. $$f(x) = 9x^3 - 33x^2 - 55x - 25$$

Given that $x = 5$ is a solution of the equation $f(x) = 0$, use an algebraic method to solve $f(x) = 0$ completely.

(5)

Leave blank

Question 1 continued

(Total 5 marks)

Q1

P 4 4 8 2 9 R A 0 3 2 8

Turn over

Leave blank

2. In the interval $13 < x < 14$, the equation

$$3 + x\sin\left(\frac{x}{4}\right) = 0, \text{ where } x \text{ is measured in radians,}$$

has exactly one root, α.

(a) Starting with the interval [13, 14], use interval bisection twice to find an interval of width 0.25 which contains α.

(3)

(b) Use linear interpolation once on the interval [13, 14] to find an approximate value for α. Give your answer to 3 decimal places.

(4)

Leave blank

Question 2 continued

Q2

(Total 7 marks)

P 4 4 8 2 9 R A 0 5 2 8

Turn over

Leave blank

3. (a) Using the formulae for $\sum_{r=1}^{n} r$ and $\sum_{r=1}^{n} r^2$, show that

$$\sum_{r=1}^{n}(r + 1)(r + 4) = \frac{n}{3}(n + 4)(n + 5)$$

for all positive integers n.

(5)

(b) Hence show that

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

where a and b are integers to be found.

(3)

Leave blank

Question 3 continued

Leave blank

Question 3 continued

Leave blank

Question 3 continued

(Total 8 marks)

Q3

P 4 4 8 2 9 R A 0 9 2 8

Turn over

Leave blank

4.

$$z_1 = 3\text{i} \text{ and } z_2 = \frac{6}{1 + \text{i}\sqrt{3}}$$

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

(2)

(b) Find the modulus and the argument of z_2, giving the argument in radians in terms of π.

(4)

(c) Show the three points representing z_1, z_2 and $(z_1 + z_2)$ respectively, on a single Argand diagram.

(2)

Leave blank

Question 4 continued

Q4

(Total 8 marks)

P 4 4 8 2 9 R A 0 1 1 2 8

Turn over

Leave blank

5. The rectangular hyperbola H has equation $xy = 9$

The point A on H has coordinates $\left(6, \frac{3}{2}\right)$.

(a) Show that the normal to H at the point A has equation

$$2y - 8x + 45 = 0$$

(5)

The normal at A meets H again at the point B.

(b) Find the coordinates of B.

(4)

Leave blank

Question 5 continued

Leave blank

Question 5 continued

Leave blank

Question 5 continued

Q5

(Total 9 marks)

P 4 4 8 2 9 R A 0 1 5 2 8

Turn over

Leave blank

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

$$\begin{pmatrix} 1 & 0 \\ -1 & 5 \end{pmatrix}^n = \begin{pmatrix} 1 & 0 \\ -\frac{1}{4}\left(5^n - 1\right) & 5^n \end{pmatrix}$$

(6)

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

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

(6)

Leave blank

Question 6 continued

P 4 4 8 2 9 R A 0 1 7 2 8

Leave blank

Question 6 continued

Leave blank

Question 6 continued

Q6

(Total 12 marks)

P 4 4 8 2 9 R A 0 1 9 2 8

Turn over

7. (i)

$$\mathbf{A} = \begin{pmatrix} 5k & 3k-1 \\ -3 & k+1 \end{pmatrix}, \text{ where } k \text{ is a real constant.}$$

Given that **A** is a singular matrix, find the possible values of k.

(4)

(ii)

$$\mathbf{B} = \begin{pmatrix} 10 & 5 \\ -3 & 3 \end{pmatrix}$$

A triangle T is transformed onto a triangle T' by the transformation represented by the matrix **B**.

The vertices of triangle T' have coordinates (0, 0), (–20, 6) and ($10c$, $6c$), where c is a positive constant.

The area of triangle T' is 135 square units.

(a) Find the matrix $\mathbf{B}^{-1}$

(2)

(b) Find the coordinates of the vertices of the triangle T, in terms of c where necessary.

(3)

(c) Find the value of c.

(3)

Leave blank

Question 7 continued

Leave blank

Question 7 continued

Leave blank

Question 7 continued

Q7

(Total 12 marks)

P 4 4 8 2 9 R A 0 2 3 2 8

Turn over

Leave blank

8. The point $P(3p^2, 6p)$ lies on the parabola with equation $y^2 = 12x$ and the point S is the focus of this parabola.

(a) Prove that $SP = 3(1 + p^2)$

(3)

The point $Q(3q^2, 6q)$, $p \neq q$, also lies on this parabola.

The tangent to the parabola at the point P and the tangent to the parabola at the point Q meet at the point R.

(b) Find the equations of these two tangents and hence find the coordinates of the point R, giving the coordinates in their simplest form.

(8)

(c) Prove that $SR^2 = SP.SQ$

(3)

P 4 4 8 2 9 R A 0 2 4 2 8

Leave blank

Question 8 continued

Turn over

Leave blank

Question 8 continued

Leave blank

Question 8 continued

Turn over

Leave blank

Question 8 continued

Q8

(Total 14 marks)

TOTAL FOR PAPER: 75 MARKS

END