Write your name here

Surname	Other names

Pearson Edexcel International Advanced Level

Centre Number	Candidate Number

Further Pure Mathematics F1

Advanced/Advanced Subsidiary

Tuesday 27 January 2015 – Morning
Time: 1 hour 30 minutes

Paper Reference **WFM01/01**

You must have:
Mathematical Formulae and Statistical Tables (Blue)

Total Marks

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

- Use **black** ink or ball-point pen.
- If pencil is used for diagrams/sketches/graphs it must be dark (HB or B). Coloured pencils and highlighter pens must not be used.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions and ensure that your answers to parts of questions are clearly labelled.
- Answer the questions in the spaces provided – *there may be more space than you need.*
- You should show sufficient working to make your methods clear. Answers without working may not gain full credit.
- When a calculator is used, the answer should be given to an appropriate degree of accuracy.

Information

- The total mark for this paper is 75.
- The marks for **each** question are shown in brackets – *use this as a guide as to how much time to spend on each question.*

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

PEARSON

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1. $$f(x) = x^4 - x^3 - 9x^2 + 29x - 60$$

Given that $x = 1 + 2i$ is a root of the equation $f(x) = 0$, use algebra to find the three other roots of the equation $f(x) = 0$

(7)

Leave blank

Question 1 continued

(Total 7 marks)

Q1

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2.

$$f(x) = x^3 - 3x^2 + \frac{1}{2\sqrt{x^5}} + 2, \quad x > 0$$

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

(2)

(b) Taking 3 as a first approximation to α, apply the Newton-Raphson process once to $f(x)$ to find a second approximation to α. Give your answer to 3 decimal places.

(5)

Leave blank

Question 2 continued

(Total 7 marks)

Q2

Leave blank

3. Given that $z = x + iy$, where x and y are real numbers, solve the equation

$$(z - 2i)(z^* - 2i) = 21 - 12i$$

where z^* is the complex conjugate of z.

(6)

Leave blank

Question 3 continued

Q3

(Total 6 marks)

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4. The parabola C has cartesian equation $y^2 = 12x$

The point $P(3p^2, 6p)$ lies on C, where $p \neq 0$

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

$$y + px = 6p + 3p^3$$

(5)

This normal crosses the curve C again at the point Q.

Given that $p = 2$ and that S is the focus of the parabola, find

(b) the coordinates of the point Q,

(5)

(c) the area of the triangle PQS.

(4)

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Question 4 continued

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Question 4 continued

Leave blank

Question 4 continued

(Total 14 marks)

Q4

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5. The quadratic equation

$$4x^2 + 3x + 1 = 0$$

has roots α and β.

(a) Write down the value of $(\alpha + \beta)$ and the value of $\alpha\beta$.
(2)

(b) Find the value of $(\alpha^2 + \beta^2)$.
(2)

(c) Find a quadratic equation which has roots

$$(4\alpha - \beta) \text{ and } (4\beta - \alpha)$$

giving your answer in the form $px^2 + qx + r = 0$ where p, q and r are integers to be determined.
(4)

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Question 5 continued

Leave blank

Question 5 continued

Leave blank

Question 5 continued

Q5

(Total 8 marks)

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6.

(i) $\mathbf{A} = \begin{pmatrix} 3 & 0 \\ 0 & 1 \end{pmatrix}$ $\mathbf{B} = \begin{pmatrix} -\frac{\sqrt{3}}{2} & \frac{1}{2} \\ -\frac{1}{2} & -\frac{\sqrt{3}}{2} \end{pmatrix}$

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

(2)

(b) Describe fully the single transformation represented by the matrix **B**.

(2)

The transformation represented by **A** followed by the transformation represented by **B** is equivalent to the transformation represented by the matrix **C**.

(c) Find **C**.

(2)

(ii) $\mathbf{M} = \begin{pmatrix} 2k+5 & -4 \\ 1 & k \end{pmatrix}$, where k is a real number.

Show that det $\mathbf{M} \neq 0$ for all values of k.

(4)

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Question 6 continued

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Question 6 continued

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Question 6 continued

(Total 10 marks)

Q6

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7. Given that, for all positive integers n,

$$\sum_{r=1}^{n}(r + a)(r + b) = \frac{1}{6}n(2n + 11)(n - 1)$$

where a and b are constants and $a > b$,

(a) find the value of a and the value of b.

(8)

(b) Find the value of

$$\sum_{r=9}^{20}(r + a)(r + b)$$

(3)

Leave blank

Question 7 continued

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Question 7 continued

Leave blank

Question 7 continued

(Total 11 marks)

Q7

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8. (i) A sequence of numbers is defined by

$$u_1 = 5 \qquad u_2 = 13$$

$$u_{n+2} = 5u_{n+1} - 6u_n \qquad n \geqslant 1$$

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

$$u_n = 2^n + 3^n$$

(6)

(ii) Prove by induction that for $n \geqslant 2$, where $n \in \mathbb{Z}$,

$$\text{f}(n) = 7^{2n} - 48n - 1$$

is divisible by 2304

(6)

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Question 8 continued

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Question 8 continued

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Question 8 continued

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Question 8 continued

Q8

(Total 12 marks)

TOTAL FOR PAPER: 75 MARKS

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