

Please check the examination details below before entering your candidate information

Candidate surname					Other names				
Centre Number					Candidate Number				

Pearson Edexcel International Advanced Level

Thursday 23 May 2024

Morning (Time: 1 hour 30 minutes)

Paper reference **WFM01/01**

Mathematics

International Advanced Subsidiary/ Advanced Level

Further Pure Mathematics F1

You must have:
Mathematical Formulae and Statistical Tables (Yellow), calculator

Total Marks

Candidates may use any calculator allowed by Pearson regulations. 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).
- **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.
- Inexact answers should be given to three significant figures unless otherwise stated.

Information

- A booklet 'Mathematical Formulae and Statistical Tables' is provided.
- There are 9 questions in this question paper. 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.
- If you change your mind about an answer, cross it out and put your new answer and any working underneath.

Turn over ►

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1. (i) The matrix **A** is defined by

$$\mathbf{A} = \begin{pmatrix} 3k & 4k - 1 \\ 2 & 6 \end{pmatrix}$$

where k is a constant.

- (a) Determine the value of k for which **A** is singular.

(2)

Given that **A** is non-singular,

- (b) determine \mathbf{A}^{-1} in terms of k , giving your answer in simplest form.

(2)

- (ii) The matrix **B** is defined by

$$\mathbf{B} = \begin{pmatrix} p & 0 \\ 0 & q \end{pmatrix}$$

where p and q are integers.

State the value of p and the value of q when **B** represents

- (a) an enlargement about the origin with scale factor -2

- (b) a reflection in the y -axis.

(2)



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Question 1 continued

Lined area for writing the answer to Question 1.

(Total for Question 1 is 6 marks)



2.

In this question you must show all stages of your working.**Solutions relying entirely on calculator technology are not acceptable.**

$$f(z) = z^3 - 13z^2 + 59z + p \quad p \in \mathbb{Z}$$

Given that $z = 3$ is a root of the equation $f(z) = 0$

(a) show that $p = -87$ (2)

(b) Use algebra to determine the other roots of $f(z) = 0$, giving your answers in simplest form. (4)

On an Argand diagram

- the root $z = 3$ is represented by the point P
- the other roots of $f(z) = 0$ are represented by the points Q and R
- the number $z = -9$ is represented by the point S

(c) Show on a single Argand diagram the positions of P , Q , R and S (1)

(d) Determine the perimeter of the quadrilateral $PQSR$, giving your answer as a simplified surd. (2)



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Question 2 continued

Lined area for writing the answer to Question 2.



Question 2 continued

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Question 2 continued

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(Total for Question 2 is 9 marks)



3. $f(x) = x^3 - 5\sqrt{x} - 4x + 7 \quad x \geq 0$

The equation $f(x) = 0$ has a root α in the interval $[0.25, 1]$

- (a) Use linear interpolation once on the interval $[0.25, 1]$ to determine an approximation to α , giving your answer to 3 decimal places.

(3)

The equation $f(x) = 0$ has another root β in the interval $[1.5, 2.5]$

- (b) Determine $f'(x)$

(2)

- (c) Hence, using $x_0 = 1.75$ as a first approximation to β , apply the Newton–Raphson process once to $f(x)$ to determine a second approximation to β , giving your answer to 3 decimal places.

(2)



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Question 3 continued

Lined area for writing answers.

(Total for Question 3 is 7 marks)



4.

In this question you must show all stages of your working.**Solutions relying entirely on calculator technology are not acceptable.**The complex number z is defined by

$$z = -3 + 4i$$

(a) Determine $|z^2 - 3|$ (3)

(b) Express $\frac{50}{z^*}$ in the form kz , where k is a positive integer.

(c) Hence find the value of $\arg\left(\frac{50}{z^*}\right)$ (3)

Give your answer in radians to 3 significant figures.

(2)



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Question 4 continued

Lined area for writing answers.

(Total for Question 4 is 8 marks)



5. The equation $5x^2 - 4x + 2 = 0$ has roots $\frac{1}{p}$ and $\frac{1}{q}$

(a) Without solving the equation,

(i) show that $pq = \frac{5}{2}$

(ii) determine the value of $p + q$

(4)

(b) Hence, without finding the values of p and q , determine a quadratic equation with roots

$$\frac{p}{p^2 + 1} \text{ and } \frac{q}{q^2 + 1}$$

giving your answer in the form $ax^2 + bx + c = 0$ where a , b and c are integers.

(5)



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Question 5 continued

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Question 5 continued

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Question 5 continued

Lined area for writing the answer to Question 5.

(Total for Question 5 is 9 marks)

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Question 6 continued

Lined area for writing the answer to Question 6.



Question 6 continued

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Question 6 continued

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(Total for Question 6 is 9 marks)



7.

In this question use the standard results for summations.(a) Show that for all positive integers n

$$\sum_{r=1}^n (12r^2 + 2r - 3) = An^3 + Bn^2$$

where A and B are integers to be determined.

(4)

(b) Hence determine the value of n for which

$$\sum_{r=1}^{2n} r^3 - \sum_{r=1}^n (12r^2 + 2r - 3) = 270$$

(4)



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Question 7 continued

Lined area for writing the answer to Question 7.

(Total for Question 7 is 8 marks)



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

$$f(n) = 7^{n-1} + 8^{2n+1}$$

is divisible by 57

(6)



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Question 8 continued

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(Total for Question 8 is 6 marks)



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Question 9 continued

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Question 9 continued

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Question 9 continued

Lined area for writing the answer to Question 9.



Question 9 continued

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(Total for Question 9 is 13 marks)

TOTAL FOR PAPER IS 75 MARKS

