Please check the examination details be	low before ente	ering your candidate	information
Candidate surname		Other names	
Centre Number Candidate N	umber		
Pearson Edexcel Inter	nation	al Advan	ced Level
Time 1 hour 30 minutes	Paper reference	WFM	01/01
Mathematics			
International Advanced Subsidiary/Advanced Level			
Further Pure Mathematics	,	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	
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You must have: Mathematical Formulae and Statistic	al Tables (Ye	llow), calculato	Total Marks

Candidates may use any calculator permitted 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 ▶



1.

Given that
$$|z_1z_2| = 15\sqrt{2}$$

(a) determine $|z_2|$

(2)

Given also that p = -4

(b) determine the possible values of q

(2)

(c) Show z_1 and the possible positions for z_2 on the same Argand diagram.

 $z_1 = 3 + 3i$ $z_2 = p + qi$ $p, q \in \mathbb{R}$

(2)



Question 1 continued



Question 1 continued

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- 2. $f(x) = 10 2x \frac{1}{2\sqrt{x}} \frac{1}{x^3} \qquad x > 0$
 - (a) Show that the equation f(x) = 0 has a root α in the interval [0.4, 0.5] (2)
 - (b) Determine f'(x).

(3)

(c) Using $x_0 = 0.5$ 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.

(2)

The equation f(x) = 0 has another root β in the interval [4.8, 4.9]

(d) Use linear interpolation once on the interval [4.8, 4.9] to find an approximation to β , giving your answer to 3 decimal places.

(2)

Question 2 continued



Question 2 continued

Question 2 continued	
(Total for Onestion 2 is 0 ma	wlra)
(Total for Question 2 is 9 ma	rks)



- 3. $\mathbf{M} = \begin{pmatrix} k & k \\ 3 & 5 \end{pmatrix}$ where k is a non-zero constant
 - (a) Determine \mathbf{M}^{-1} , giving your answer in simplest form in terms of k.

(2)

Hence, given that $N^{-1} = \begin{pmatrix} k & k \\ 4 & -1 \end{pmatrix}$

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

(2)

Question 3 continued
(Total for Question 3 is 4 marks)



where A and B are constants.

The complex number 5 - i is a root of the equation f(z) = 0

(a) Write down another complex root of this equation.

(1)

(b) Solve the equation f(z) = 0 completely.

(5)

(c) Determine the value of A and the value of B.

(2)



Question 4 continued



Question 4 continued

Question 4 continued	
(Tota	l for Question 4 is 8 marks)



5. The quadratic equation

$$2x^2 - 3x + 5 = 0$$

has roots α and β

Without solving the equation,

(a) write down the value of $(\alpha + \beta)$ and the value of $\alpha\beta$

(1)

- (b) determine the value of
 - (i) $\alpha^2 + \beta^2$
 - (ii) $\alpha^3 + \beta^3$

(4)

(c) find a quadratic equation which has roots

$$(\alpha^3 - \beta)$$
 and $(\beta^3 - \alpha)$

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

(5)

Question 5 continued



Question 5 continued	
	Total for Question 5 is 10 marks)



6. The parabola C has equation $y^2 = 36x$

The point $P(9t^2, 18t)$, where $t \neq 0$, lies on C

(a) Use calculus to show that the normal to C at P has equation

$$y + tx = 9t^3 + 18t$$

(4)

(b) Hence find the equations of the two normals to C which pass through the point (54, 0), giving your answers in the form y = px + q where p and q are constants to be determined.

(4)

Given that

- the normals found in part (b) intersect the directrix of C at the points A and B
- the point F is the focus of C
- (c) determine the area of triangle AFB

(3)





Question 6 continued

Question 6 continued	
(To	tal for Question 6 is 11 marks)
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$$\mathbf{A} = \begin{pmatrix} -\frac{\sqrt{3}}{2} & -\frac{1}{2} \\ \frac{1}{2} & -\frac{\sqrt{3}}{2} \end{pmatrix}$$

(a) Determine the matrix A^2

(1)

(b) Describe fully the single geometrical transformation represented by the matrix \mathbf{A}^2

(2)

(c) Hence determine the smallest positive integer value of n for which $A^n = I$

(1)

The matrix **B** represents a stretch scale factor 4 parallel to the x-axis.

(d) Write down the matrix **B**

(1)

The transformation represented by matrix ${\bf A}$ followed by the transformation represented by matrix ${\bf B}$ is represented by the matrix ${\bf C}$

(e) Determine the matrix **C**

(2)

The parallelogram P is transformed onto the parallelogram P' by the matrix \mathbb{C}

(f) Given that the area of parallelogram P' is 20 square units, determine the area of parallelogram P

(2)

Question 7 continued



Question 7 continued

Question 7 continued	
(To	otal for Question 7 is 9 marks)
(20	



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

$$\sum_{r=0}^{n} (r+1)(r+2) = \frac{1}{3} (n+1)(n+2)(n+3)$$
(5)

(b) Hence determine the value of

$$10 \times 11 + 11 \times 12 + 12 \times 13 + ... + 100 \times 101$$

(3)



Question 8 continued	



Question 8 continued

Question 8 continued	
(Tai	tal for Question 8 is 8 marks)
(100	with Angular o is a marks)



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

$$u_1 = 3$$

$$u_{n+1} = 2u_n - 2^{n+1}$$
 $n \geqslant 1$

Prove by induction that, for $n \in \mathbb{N}$

$$u_n = 5 \times 2^{n-1} - n \times 2^n$$

(5)

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

$$f(n) = 5^{n+2} - 4n - 9$$

is divisible by 16

(5)



Question 9 continued



Question 9 continued

Question 9 continued



Question 9 continued
(Total for Question 9 is 10 marks)
TOTAL FOR PAPER: 75 MARKS END

