Please check the examination details bel	low before ente	ering your candidate information
Candidate surname		Other names
Centre Number Candidate N	umber	
Pearson Edexcel Inter	nation	al Advanced Level
Time 1 hour 30 minutes	Paper reference	WFM01/01
Mathematics		00
International Advanced So	uhsidiar	v/Advanced Level
	,	y/Advanced Level
Further Pure Mathematics	5 F1	
You must have: Mathematical Formulae and Statistical	al Tables (Ye	ellow), calculator

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 guestion 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.

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2. The complex numbers z_1 and z_2 are given by

$$z_1 = 3 + 5i$$
 and $z_2 = -2 + 6i$

(a) Show z_1 and z_2 on a single Argand diagram.

(2)

- (b) Without using your calculator and showing all stages of your working,
 - (i) determine the value of $|z_1|$

(1)

(ii) express $\frac{z_1}{z_2}$ in the form a + bi, where a and b are fully simplified fractions.

(3)

(c) Hence determine the value of $\arg \frac{z_1}{z_2}$

Give your answer in radians to 2 decimal places.

(2)



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3.	The parabola C has equation $y^2 = 18x$	
	The point S is the focus of C	
	(a) Write down the coordinates of S	
		(1)
	The point P , with $y > 0$, lies on C	
	The shortest distance from P to the directrix of C is 9 units.	
	(b) Determine the exact perimeter of the triangle <i>OPS</i> , where <i>O</i> is the origin.	
	Give your answer in simplest form.	
	Give your answer in simplest form.	(4)

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4. The equation

$$x^4 + Ax^3 + Bx^2 + Cx + 225 = 0$$

where A, B and C are real constants, has

- a complex root 4 + 3i
- a repeated positive real root
- (a) Write down the other complex root of this equation.

(1)

(b) Hence determine a quadratic factor of $x^4 + Ax^3 + Bx^2 + Cx + 225$

(2)

(c) Deduce the real root of the equation.

(2)

(d) Hence determine the value of each of the constants A, B and C

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5.
$$\mathbf{P} = \begin{pmatrix} \frac{1}{2} & -\frac{\sqrt{3}}{2} \\ \frac{\sqrt{3}}{2} & \frac{1}{2} \end{pmatrix}$$

The matrix \mathbf{P} represents the transformation U

(a) Give a full description of \boldsymbol{U} as a single geometrical transformation.

(2)

The transformation V, represented by the 2×2 matrix **Q**, is a reflection in the line y = -x

(b) Write down the matrix \mathbf{Q}

(1)

The transformation U followed by the transformation V is represented by the matrix \mathbf{R}

(c) Determine the matrix \mathbf{R}

(2)

The transformation W is represented by the matrix $3\mathbf{R}$

The transformation W maps a triangle T to a triangle T'

The transformation W' maps the triangle T' back to the original triangle T

(d) Determine the matrix that represents W'

(3)





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6. The quadratic equation

$$Ax^2 + 5x - 12 = 0$$

where A is a constant, has roots α and β

- (a) Write down an expression in terms of A for
 - (i) $\alpha + \beta$
 - (ii) $\alpha\beta$

(2)

The equation

$$4x^2 - 5x + B = 0$$

where *B* is a constant, has roots $\alpha - \frac{3}{\beta}$ and $\beta - \frac{3}{\alpha}$

(b) Determine the value of A

(3)

(c) Determine the value of B

(3)

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7. In this question you must show all stages of your working.

Solutions relying entirely on calculator technology are not acceptable.

The rectangular hyperbola H has equation xy = 36

The point P(4, 9) lies on H

(a) Show, using calculus, that the normal to H at P has equation

$$4x - 9y + 65 = 0$$

(4)

The normal to H at P crosses H again at the point Q

(b)	Determine	an equation	for the	tangent	to H	at Q ,	giving	your	answer	in	the	form
	y = mx + c	where m and	d c are r	ational c	onsta	nts.						

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 $f(x) = 2x^{-\frac{2}{3}} + \frac{1}{2}x - \frac{1}{3x - 5} - \frac{5}{2}$ $x \neq \frac{5}{3}$ 8.

The table below shows values of f(x) for some values of x, with values of f(x) given to 4 decimal places where appropriate.

X	1	2	3	4	5
f(x)	0.5		-0.2885		0.5834

(a) Complete the table giving the values to 4 decimal places.

(2)

The equation f(x) = 0 has exactly one positive root, α .

Using the values in the completed table and explaining your reasoning,

(b) determine an interval of width one that contains α .

(2)

(c) Hence use interval bisection twice to obtain an interval of width 0.25 that contains α .

Given also that the equation f(x) = 0 has a negative root, β , in the interval [-1, -0.5]

(d) use linear interpolation once on this interval to find an approximation for β .

Give your answer to 3 significant figures.

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

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

(5)

(b) Using the standard summation formulae, show that

$$\sum_{r=1}^{n} r(r+1)(r-1) = \frac{1}{4} n(n+A)(n+B)(n+C)$$

where A, B and C are constants to be determined.

(4)

(c) Determine the value of n for which

$$3\sum_{r=1}^{n} r(r+1)(r-1) = 17\sum_{r=n}^{2n} r^{2}$$

(5)



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