Candidate surname		before enter	ng your candidate Other names	e information
Pearson Edexcel International Advanced Level	Centre	Number	Can	didate Number
Friday 15 Jan	uai	ry 20	21	
Morning (Time: 1 hour 30 minute	s)	Paper Re	ference WFN	/ 102/01
Mathematics				
International Advanced Further Pure Mathema		•	/Advance	d Level

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 8 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 ▶







The transformation T from the z-plane, where z = x + iy, to the w-plane, where w = u + iv, is given by

$$w = \frac{z + pi}{iz + 3} \qquad z \neq 3i \quad p \in \mathbb{Z}$$

The point representing $i(1 + \sqrt{3})$ is invariant under T.

Determine the value of p .	(3

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2. (a) Show that, for r > 0

$$\frac{r+2}{r(r+1)} - \frac{r+3}{(r+1)(r+2)} = \frac{r+4}{r(r+1)(r+2)}$$

(2)

(b) Hence show that

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

where a, b and c are integers to be determined.

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4. (a) Show that the substitution $y^2 = \frac{1}{z}$ transforms the differential equation

$$\frac{\mathrm{d}y}{\mathrm{d}x} + 2y = 3xy^3 \qquad y \neq 0 \tag{I}$$

into the differential equation

$$\frac{\mathrm{d}z}{\mathrm{d}x} - 4z = -6x \tag{II}$$

(3)

(b) Obtain the general solution of differential equation (II).

(5)

(c) Hence obtain the general solution of differential equation (I), giving your answer in the form $y^2 = f(x)$





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5. Given that

$$(2 - x^2)\frac{\mathrm{d}^2 y}{\mathrm{d}x^2} + 5x \left(\frac{\mathrm{d}y}{\mathrm{d}x}\right)^2 = 3y$$

(a) show that

$$\frac{d^{3}y}{dx^{3}} = \frac{1}{(2-x^{2})} \left(2x \frac{d^{2}y}{dx^{2}} \left(1 - 5 \frac{dy}{dx} \right) - 5 \left(\frac{dy}{dx} \right)^{2} + 3 \frac{dy}{dx} \right)$$
 (5)

Given also that y = 3 and $\frac{dy}{dx} = \frac{1}{4}$ at x = 0

(b) obtain a series solution for y in ascending powers of x with simplified coefficients, up to and including the term in x^3 (4)

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6.	(a)	Determine the	general	solution	of the	differential	equation
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$$\frac{\mathrm{d}^2 y}{\mathrm{d}x^2} + 2\frac{\mathrm{d}y}{\mathrm{d}x} + 5y = 6\cos x$$

(7)

(b)	Find the particular solution for which	y = 0	and	$\frac{\mathrm{d}y}{\mathrm{d}x} = 0$	at $x = 0$
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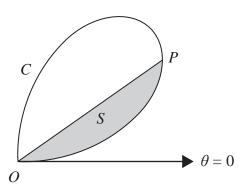


Figure 1

Figure 1 shows a sketch of curve C with polar equation

$$r = 3\sin 2\theta$$
 $0 \leqslant \theta \leqslant \frac{\pi}{2}$

The point P on C has polar coordinates (R, ϕ) . The tangent to C at P is perpendicular to the initial line.

(a) Show that $\tan \phi = \frac{1}{\sqrt{2}}$

(4)

(b) Determine the exact value of R.

(2)

The region S, shown shaded in Figure 1, is bounded by C and the line OP, where O is the pole.

(c) Use calculus to show that the exact area of S is

$$p \arctan \frac{1}{\sqrt{2}} + q \sqrt{2}$$

where p and q are constants to be determined.

Solutions relying entirely on calculator technology are not acceptable.

(7)

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(Total 13 marks)	Q7
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8. Given that $z = e^{i\theta}$

(a) show that
$$z^n + \frac{1}{z^n} = 2\cos n\theta$$

where n is a positive integer.

(2)

(b) Show that

$$\cos^6\theta = \frac{1}{32} \left(\cos 6\theta + 6\cos 4\theta + 15\cos 2\theta + 10\right)$$

(5)

(c) Hence solve the equation

$$\cos 6\theta + 6\cos 4\theta + 15\cos 2\theta = 0$$
 $0 \leqslant \theta \leqslant \pi$

Give your answers to 3 significant figures.

(4)

(d) Use calculus to determine the exact value of

$$\int_0^{\frac{\pi}{3}} (32\cos^6\theta - 4\cos^2\theta) d\theta$$

Solutions relying entirely on calculator technology are not acceptable.

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