Please check the examination details bel	ow before ente	ering your candidate in	formation
Candidate surname		Other names	
Centre Number Candidate N	umber		
Pearson Edexcel Inter	nation	al Advanc	ed Level
<b>Time</b> 1 hour 30 minutes	Paper reference	WMA <sup>1</sup>	14/01
Mathematics			•
International Advanced Le	aval		
	evei		
Pure Mathematics P4			
You must have: Mathematical Formulae and Statistica	al Tables (Ye	llow), calculator	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. The curve C has equation

$$xy^2 = x^2y + 6 \qquad x \neq 0 \quad y \neq 0$$

Find an equation for the tangent to C at the point P(2, 3), giving your answer in the form ax + by + c = 0 where a, b and c are integers.

**(6)** 


Question 1 continued	blank
Question 1 continued	
	Q1
(Total 6 marks)	
( Total o marks)	



2. (a) Find, in ascending powers of x, the first three non-zero terms of the binomial series expansion of

$$\sqrt[3]{1+4x^3}$$
  $|x| < \frac{1}{\sqrt[3]{4}}$ 

giving each coefficient as a simplified fraction.

**(4)** 

(b) Use the expansion from part (a) with  $x = \frac{1}{3}$  to find a rational approximation to  $\sqrt[3]{31}$ 

(3)


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Question 2 continued	
	<b>Q2</b>
(Total 7 marks)	
(Total / marks)	-



3. The curve C has parametric equations

$$x = 3 + 2\sin t \qquad \qquad y = \frac{6}{7 + \cos 2t} \qquad \qquad -\frac{\pi}{2} \leqslant t \leqslant \frac{\pi}{2}$$

(a) Show that C has Cartesian equation

$$y = \frac{12}{(7-x)(1+x)} \qquad p \leqslant x \leqslant q$$

where p and q are constants to be found.

(6)

(b) Hence, find a Cartesian equation for C in the form

$$y = \frac{a}{x+b} + \frac{c}{x+d} \qquad p \leqslant x \leqslant q$$

where a, b, c and d are constants.

**(3)** 



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(Total 9 marks)	<b>Q3</b>



4.

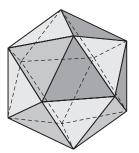


Figure 1

A regular icosahedron of side length x cm, shown in Figure 1, is expanding uniformly.

The icosahedron consists of 20 congruent equilateral triangular faces of side length  $x \, \text{cm}$ .

(a) Show that the surface area,  $A \text{ cm}^2$ , of the icosahedron is given by

$$A = 5\sqrt{3}x^2$$

**(2)** 

Given that the volume,  $V \text{cm}^3$ , of the icosahedron is given by

$$V = \frac{5}{12} \left( 3 + \sqrt{5} \right) x^3$$

(b) show that 
$$\frac{dV}{dA} = \frac{(3 + \sqrt{5})x}{8\sqrt{3}}$$

**(3)** 

The surface area of the icosahedron is increasing at a constant rate of 0.025 cm<sup>2</sup> s<sup>-1</sup>

(c) Find the rate of change of the volume of the icosahedron when x = 2, giving your answer to 2 significant figures.



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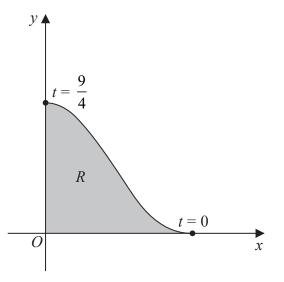


Figure 2

Figure 2 shows a sketch of the curve with parametric equations

$$x = \sqrt{9 - 4t} \qquad \qquad y = \frac{t^3}{\sqrt{9 + 4t}} \qquad \qquad 0 \leqslant t \leqslant \frac{9}{4}$$

The curve touches the x-axis when t = 0 and meets the y-axis when  $t = \frac{9}{4}$ 

The region R, shown shaded in Figure 2, is bounded by the curve, the x-axis and the y-axis.

(a) Show that the area of R is given by

$$K \int_{0}^{\frac{9}{4}} \frac{t^3}{\sqrt{81 - 16t^2}} \, \mathrm{d}t$$

where K is a constant to be found.

**(4)** 

(b) Using the substitution  $u = 81 - 16t^2$ , or otherwise, find the exact area of R.

(Solutions relying on calculator technology are not acceptable.)

**(6)** 

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Question 5 continued	



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Question 5 continued		

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6.	Three <b>consecutive</b> term	is in a sec	guence of real	numbers are	given	bv
<b>U</b> •	Timee consecutive term	is in a sec	quence or rear	mambers are	51 1011	U y

$$k$$
,  $1 + 2k$  and  $3 + 3k$ 

where k is a constant.

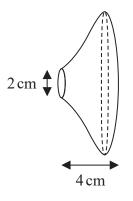
Use proof by contradiction to show that this sequence is not a geometric sequence.

(5)
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	<b>Q6</b>
(Total 5 marks)	



7.



 $f(x) = \frac{1}{4} (4 - x)e^{x}$ 

Figure 3

Figure 4

Figure 3 shows the design of a doorknob.

The shape of the doorknob is formed by rotating the curve shown in Figure 4 through  $360^{\circ}$  about the *x*-axis, where the units are centimetres.

The equation of the curve is given by

$$f(x) = \frac{1}{4} (4 - x)e^x$$
  $0 \le x \le 4$ 

(a) Show that the volume,  $V \text{cm}^3$ , of the doorknob is given by

$$V = K \int_{0}^{4} (x^{2} - 8x + 16) e^{2x} dx$$

where K is a constant to be found.

(3)

(b) Hence, find the exact value of the volume of the doorknob.

Give your answer in the form  $p\pi(e^q + r)$  cm<sup>3</sup> where p, q and r are simplified rational numbers to be found.

**(5)** 



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Question 7 continued	

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	<b>Q7</b>
(Total 8 marks)	



8. With respect to a fixed origin O the points A and B have position vectors

$$\begin{pmatrix} 6 \\ 6 \\ 2 \end{pmatrix} \text{ and } \begin{pmatrix} 6 \\ 0 \\ 7 \end{pmatrix}$$

respectively.

The line  $l_1$  passes through the points A and B.

(a) Write down an equation for  $l_1$ 

Give your answer in the form  $\mathbf{r} = \mathbf{p} + \lambda \mathbf{q}$ , where  $\lambda$  is a scalar parameter.

**(2)** 

The line  $l_2$  has equation

$$\mathbf{r} = \begin{pmatrix} 3 \\ 1 \\ 4 \end{pmatrix} + \mu \begin{pmatrix} 1 \\ 5 \\ 9 \end{pmatrix}$$

where  $\mu$  is a scalar parameter.

(b) Show that  $l_1$  and  $l_2$  do **not** meet.

**(4)** 

The point C is on  $l_2$  where  $\mu = -1$ 

(c) Find the acute angle between AC and  $l_2$ 

Give your answer in degrees to one decimal place.

**(5)** 



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Question 8 continued

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(Total 11 marks)	



9. (a) Find the derivative with respect to y of

$$\frac{1}{\left(1+2\ln y\right)^2}$$

**(2)** 

(b) Hence find a general solution to the differential equation

$$3\csc(2x)\frac{dy}{dx} = y(1+2\ln y)^3$$
  $y > 0$   $-\frac{\pi}{2} < x < \frac{\pi}{2}$ 

**(4)** 

(c) Show that the particular solution of this differential equation for which y = 1 at  $x = \frac{\pi}{6}$  is given by

$$y = e^{A\sec x - \frac{1}{2}}$$

where A is an irrational number to be found.

**(5)** 



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Question 9 continued		

	b
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TOTAL FOR PAPER IS 75 MARKS