Please check the examination details below before entering your candidate information

Candidate surname	Other names

Centre Number | Candidate Number

Pearson Edexcel International Advanced Level

Tuesday 21 January 2025

Morning (Time: 1 hour 30 minutes)

Paper reference **WMA14/01**

Mathematics

International Advanced Level
Pure Mathematics P4

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

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1.

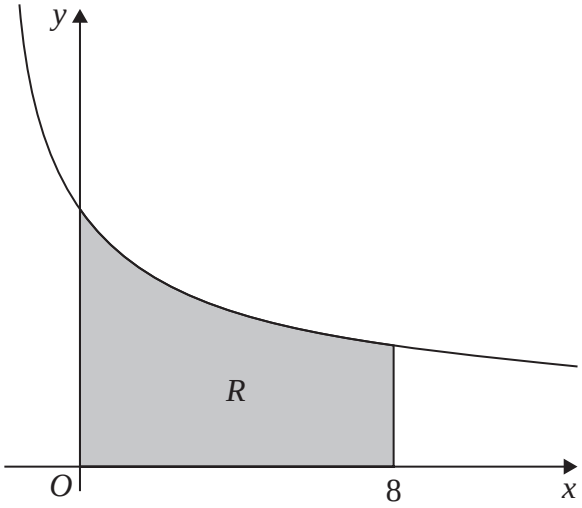

Figure 1

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

The curve shown in Figure 1 has equation

$$y = \frac{4}{x+2} \qquad x > -2$$

The region R, bounded by the curve, the y-axis, the x-axis and the line with equation $x = 8$ is shown shaded in Figure 1

Region R is rotated through 360 degrees about the x-axis.

Use calculus to find the exact value of the volume of the solid generated, writing your answer in simplest form.

(5)

Question 1 continued

(Total for Question 1 is 5 marks)

2. The curve C has equation

$$3x + 5y^2 + 4x^2y = 10(2^x) + 35 \qquad y > 0$$

(a) Find an expression for $\frac{dy}{dx}$ in terms of x and y

(6)

Curve C cuts the y-axis at the point P

(b) Find the exact value of the gradient of the tangent to C at P

(2)

Question 2 continued

(Total for Question 2 is 8 marks)

3. Given that the binomial expansion, in ascending powers of x, of

$$6\left(4+Ax\right)^{-\frac{1}{2}}$$

is $$B-\frac{1}{4}x+Cx^2+\ldots$$

(a) find the values of the constants A, B and C.

(5)

(b) State the range of values of x for which this expansion is valid.

(1)

For the expansion,

(c) find the coefficient of the term in x^3

(2)

Question 3 continued

(Total for Question 3 is 8 marks)

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

(i) The volume, V, of a spherical balloon is increasing at a constant rate of $70\pi\,\text{cm}^3\,\text{s}^{-1}$

Find the rate of increase of the radius of the balloon, in $\text{cm}\,\text{s}^{-1}$, at the instant when the radius of the balloon is 5 cm.

[The volume V of a sphere of radius r is given by the formula $V = \frac{4}{3}\pi r^3$]

(4)

(ii) The depth of water in a cave is being monitored.

The rate of increase in the depth of water, h cm, at a particular point in the cave is modelled by the differential equation

$$\frac{\mathrm{d}h}{\mathrm{d}t} = \frac{k}{h^3}$$

where k is a constant and t hours is the time after monitoring began.

Given that

- initially the depth of water was 4 cm
- 5 hours after monitoring began, the depth of water was 6 cm
- T hours after monitoring began, the depth of water was 10 cm

solve the differential equation to find the value of T.

Give your answer to one decimal place.

(6)

Question 4 continued

Question 4 continued

Question 4 continued

(Total for Question 4 is 10 marks)

5. (i) Find

$$\int x^2 e^{4x} dx$$

writing the answer in simplest form.

(4)

(ii) Use partial fractions and algebraic integration to show that

$$\int_4^7 \frac{2x+11}{(2x+1)(2-x)} dx = \ln k$$

where k is a fully simplified rational constant to be found.

(6)

Question 5 continued

Question 5 continued

Question 5 continued

(Total for Question 5 is 10 marks)

6. Given that $n \in \mathbb{N}$, use algebra to prove by contradiction that

" if $n^2 - 4n + 5$ is even then n is odd"

(4)

Question 6 continued

(Total for Question 6 is 4 marks)

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

Use the substitution $x = 4\sin\theta$ to find the exact value of

$$\int_{2}^{2\sqrt{3}} \frac{1}{\left(16-x^2\right)^{\frac{3}{2}}}\,\mathrm{d}x$$

(6)

Question 7 continued

(Total for Question 7 is 6 marks)

8. Relative to a fixed origin O, the line l has equation

$$\mathbf{r} = \begin{pmatrix} 2 \\ -1 \\ 3 \end{pmatrix} + \lambda \begin{pmatrix} 4 \\ 2 \\ -1 \end{pmatrix}$$

where λ is a scalar parameter.

The point A and the point B lie on line l

Given that

- A has coordinates $(-2, a, 4)$
- B has coordinates $(b, 3, 1)$

(a) find the value of the constant a and the value of the constant b.

(2)

(b) Hence find vector $\overrightarrow{AB}$

(2)

The point C has coordinates $(4, 7, -2)$.

(c) Find the size of angle CAB, giving your answer in degrees to one decimal place.

(4)

The point D lies on the line l so that the area of triangle CAD is twice the area of triangle CAB.

(d) Find the coordinates of the two possible positions of D.

(4)

Question 8 continued

Question 8 continued

Question 8 continued

(Total for Question 8 is 12 marks)

9.

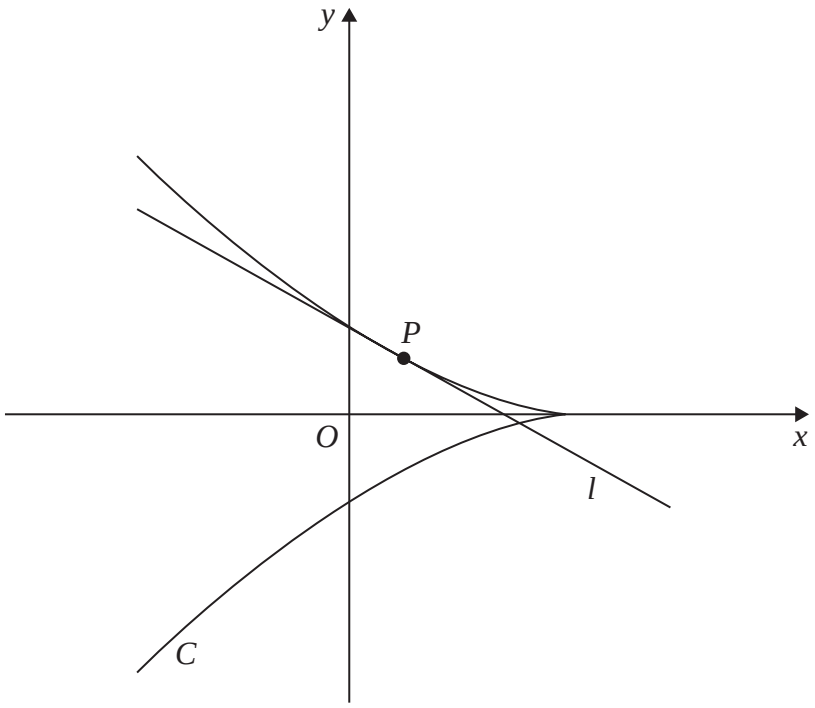

Figure 2

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

Figure 2 shows a sketch of the curve C with parametric equations

$$x = 2\cos 2t \qquad y = \sin^3 t \qquad -\frac{\pi}{2} < t < \frac{\pi}{2}$$

where t is a parameter.

The point P lies on C where $t = \frac{\pi}{6}$

The line l, shown in Figure 2, is the tangent to C at P.

(a) Use parametric differentiation to show that

(i) $\frac{dy}{dx} = k\sin t$ where k is a constant to be found

(ii) an equation for l is $3x + 16y - 5 = 0$

(6)

The line l intersects the curve C again at the point Q.

(b) Using algebra and showing detailed reasoning, find the exact coordinates of Q.

(6)

Question 9 continued

Question 9 continued

Question 9 continued

Question 9 continued

(Total for Question 9 is 12 marks)

TOTAL FOR PAPER IS 75 MARKS