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# Pearson Edexcel International Advanced Level

## Thursday 18 January 2024

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.** Find, in ascending powers of $x$ up to and including the term in $x^3$, the binomial expansion of

$$(1 - 4x)^{-3} \qquad |x| < \frac{1}{4}$$

fully simplifying each term.

**(4)**

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**Question 1 continued**

**(Total for Question 1 is 4 marks)**

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**2.** Given that

$$\frac{3x+4}{(x-2)(2x+1)^2} \equiv \frac{A}{x-2} + \frac{B}{2x+1} + \frac{C}{(2x+1)^2}$$

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

**(4)**

(b) Hence find the exact value of

$$\int_7^{12} \frac{3x+4}{(x-2)(2x+1)^2}\,\mathrm{d}x$$

giving your answer in the form $p\ln q + r$ where $p$, $q$ and $r$ are rational numbers.

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**Question 2 continued**

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**Question 2 continued**

**(Total for Question 2 is 10 marks)**

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**3.**

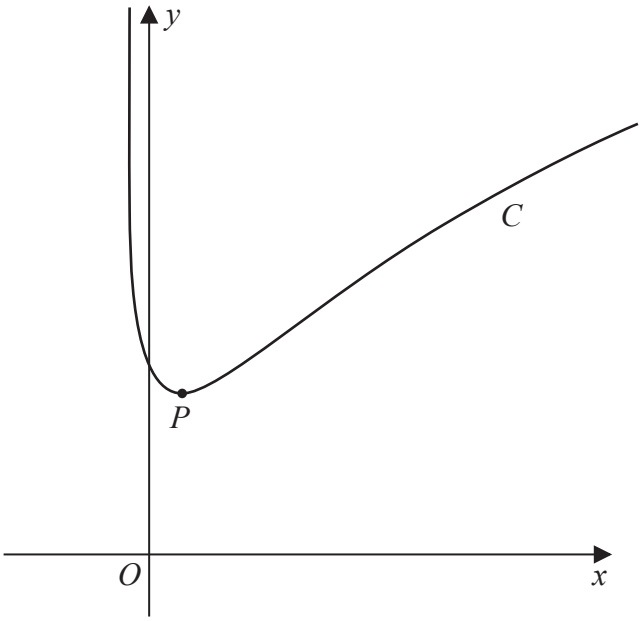


**Figure 1**

The curve $C$, shown in Figure 1, has equation

$$y^2x + 3y = 4x^2 + k \qquad y > 0$$

where $k$ is a constant.

(a) Find $\dfrac{dy}{dx}$ in terms of $x$ and $y$

**(5)**

The point $P(p, 2)$, where $p$ is a constant, lies on $C$.

Given that $P$ is the minimum turning point on $C$,

(b) find

(i) the value of $p$

(ii) the value of $k$

**(4)**

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**Question 3 continued**

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**Question 3 continued**

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**Question 3 continued**

**(Total for Question 3 is 9 marks)**

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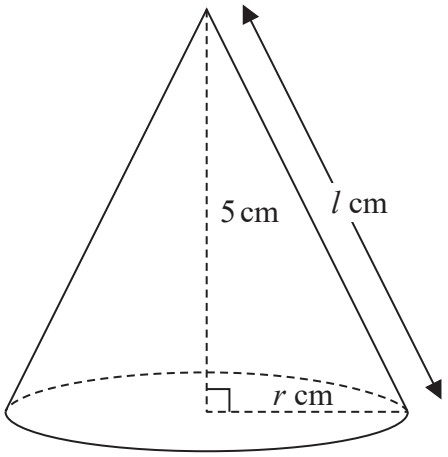


**Figure 2**

A cone, shown in Figure 2, has

- fixed height 5 cm
- base radius $r$ cm
- slant height $l$ cm

(a) Find an expression for $l$ in terms of $r$

**(1)**

Given that the base radius is increasing at a constant rate of 3 cm per minute,

(b) find the rate at which the total surface area of the cone is changing when the radius of the cone is 1.5 cm. Give your answer in $cm^2$ per minute to one decimal place.

[*The total surface area, S, of a cone is given by the formula* $S = \pi r^2 + \pi rl$]

**(4)**

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**Question 4 continued**

**(Total for Question 4 is 5 marks)**

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**5.** (a) Find $\int x^2 \cos 2x \, \mathrm{d}x$

**(4)**

(b) Hence solve the differential equation

$$\frac{\mathrm{d}y}{\mathrm{d}t} = \left( \frac{t \cos t}{y} \right)^2$$

giving your answer in the form $y^n = \mathrm{f}(t)$ where $n$ is an integer.

**(5)**

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**Question 5 continued**

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**Question 5 continued**

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**Question 5 continued**

**(Total for Question 5 is 9 marks)**

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**6.** Relative to a fixed origin $O$, the lines $l_1$ and $l_2$ are given by the equations

$$l_1 : \mathbf{r} = (3\mathbf{i} + p\mathbf{j} + 7\mathbf{k}) + \lambda(2\mathbf{i} - 5\mathbf{j} + 4\mathbf{k})$$

$$l_2 : \mathbf{r} = (8\mathbf{i} - 2\mathbf{j} + 5\mathbf{k}) + \mu(4\mathbf{i} + \mathbf{j} + 2\mathbf{k})$$

where $\lambda$ and $\mu$ are scalar parameters and $p$ is a constant.

Given that $l_1$ and $l_2$ intersect,

(a) find the value of $p$,

**(4)**

(b) find the position vector of the point of intersection.

**(2)**

(c) Find the acute angle between $l_1$ and $l_2$

Give your answer in degrees to one decimal place.

**(3)**

The point $A$ lies on $l_1$ with parameter $\lambda = 2$

The point $B$ lies on $l_2$ with $\overrightarrow{AB}$ perpendicular to $l_2$

(d) Find the coordinates of $B$

**(5)**

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**Question 6 continued**

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**Question 6 continued**

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**Question 6 continued**

**(Total for Question 6 is 14 marks)**

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**7.** (a) Using the substitution $u = 4x + 2\sin 2x$, or otherwise, show that

$$\int_0^{\frac{\pi}{2}} e^{4x+2\sin 2x} \cos^2 x \, dx = \frac{1}{8}(e^{2\pi} - 1)$$

**(5)**

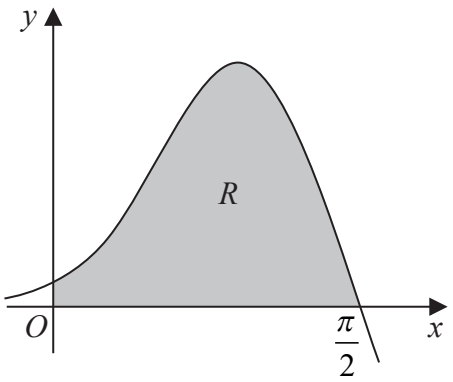


**Figure 3**

The curve shown in Figure 3, has equation

$$y = 6e^{2x+\sin 2x} \cos x$$

The region $R$, shown shaded in Figure 3, is bounded by the positive $x$-axis, the positive $y$-axis and the curve.

The region $R$ is rotated through $2\pi$ radians about the $x$-axis to form a solid.

(b) Use the answer to part (a) to find the volume of the solid formed, giving the answer in simplest form.

**(3)**

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**Question 7 continued**

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**Question 7 continued**

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**Question 7 continued**

**(Total for Question 7 is 8 marks)**

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**8.** Use proof by contradiction to prove that the curve with equation

$$y = 2x + x^3 + \cos x$$

has no stationary points.

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**9.**

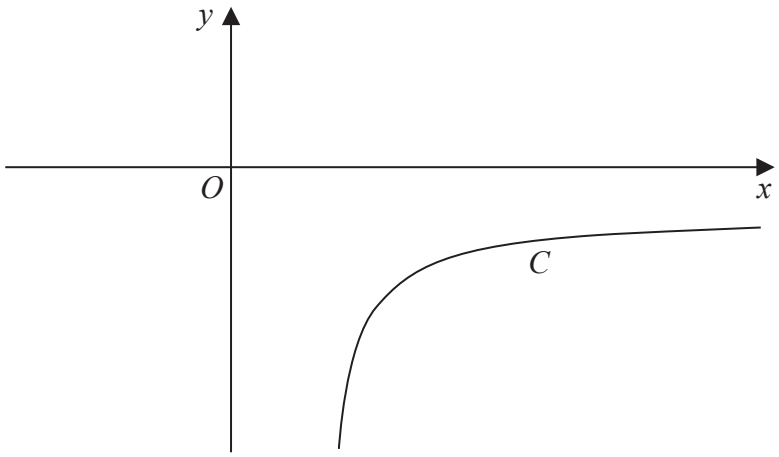


**Figure 4**

Figure 4 shows a sketch of the curve $C$ with parametric equations

$$x = \sec t \qquad y = \sqrt{3}\tan\left(t + \frac{\pi}{3}\right) \qquad \frac{\pi}{6} < t < \frac{\pi}{2}$$

(a) Find $\dfrac{\mathrm{d}y}{\mathrm{d}x}$ in terms of $t$

**(3)**

(b) Find an equation for the tangent to $C$ at the point where $t = \dfrac{\pi}{3}$

Give your answer in the form $y = mx + c$, where $m$ and $c$ are constants.

**(4)**

(c) Show that all points on $C$ satisfy the equation

$$y = \frac{Ax^2 + B\sqrt{3x^2 - 3}}{4 - 3x^2}$$

where $A$ and $B$ are constants to be found.

**(5)**

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**Question 9 continued**

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**Question 9 continued**

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**(Total for Question 9 is 12 marks)**

**TOTAL FOR PAPER IS 75 MARKS**