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**Pearson Edexcel**  
**International**  
**Advanced Level**

Centre Number

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Candidate Number

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# Core Mathematics C34

## Advanced

Tuesday 19 June 2018 – Afternoon  
**Time: 2 hours 30 minutes**

Paper Reference  
**WMA02/01**

**You must have:**  
Mathematical Formulae and Statistical Tables (Blue)

Total Marks

**Candidates may use any calculator allowed by the regulations of the Joint Council for Qualifications. 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). Coloured pencils and highlighter pens must not be used.
- **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.
- When a calculator is used, the answer should be given to an appropriate degree of accuracy.

### Information

- The total mark for this paper is 125.
- 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.

Turn over ►

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1. (i) Find

$$\int \frac{2x^2 + 5x + 1}{x^2} dx, \quad x > 0$$

(3)

(ii) Find

$$\int x \cos 2x dx$$

(3)

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Question 1 continued

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Q1

(Total 6 marks)



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2. A curve  $C$  has parametric equations

$$x = \frac{3}{2}t - 5, \quad y = 4 - \frac{6}{t} \quad t \neq 0$$

(a) Find the value of  $\frac{dy}{dx}$  at  $t = 3$ , giving your answer as a fraction in its simplest form. **(3)**

(b) Show that a cartesian equation of  $C$  can be expressed in the form

$$y = \frac{ax + b}{x + 5} \quad x \neq k$$

where  $a$ ,  $b$  and  $k$  are integers to be found. **(4)**

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3.  $f(x) = 2^{x-1} - 4 + 1.5x \quad x \in \mathbb{R}$

(a) Show that the equation  $f(x) = 0$  can be written as

$$x = \frac{1}{3}(8 - 2^x) \tag{2}$$

The equation  $f(x) = 0$  has a root  $\alpha$ , where  $\alpha = 1.6$  to one decimal place.

(b) Starting with  $x_0 = 1.6$ , use the iteration formula

$$x_{n+1} = \frac{1}{3}(8 - 2^{x_n})$$

to calculate the values of  $x_1, x_2$  and  $x_3$ , giving your answers to 3 decimal places. (3)

(c) By choosing a suitable interval, prove that  $\alpha = 1.633$  to 3 decimal places. (2)

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**Question 3 continued**

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**(Total 7 marks)**

**Q3**



4. (a) Find the binomial expansion of

$$(1 + px)^{-4}, \quad |px| < 1$$

in ascending powers of  $x$ , up to and including the term in  $x^3$ , giving each coefficient as simply as possible in terms of the constant  $p$ .

**(3)**

$$f(x) = \frac{3 + 4x}{(1 + px)^4} \quad |px| < 1$$

where  $p$  is a positive constant.

In the series expansion of  $f(x)$ , the coefficient of  $x^2$  is twice the coefficient of  $x$ .

- (b) Find the value of  $p$ .

**(5)**

- (c) Hence find the coefficient of  $x^3$  in the series expansion of  $f(x)$ , giving your answer as a simplified fraction.

**(2)**

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Question 4 continued

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Question 4 continued

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Q4

Mark boxes

(Total 10 marks)



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5. (i) The functions  $f$  and  $g$  are defined by

$$f : x \rightarrow e^{2x} - 5, \quad x \in \mathbb{R}$$

$$g : x \rightarrow \ln(3x - 1), \quad x \in \mathbb{R}, x > \frac{1}{3}$$

(a) Find  $f^{-1}$  and state its domain.

(3)

(b) Find  $fg(3)$ , giving your answer in its simplest form.

(2)

(ii) (a) Sketch the graph with equation

$$y = |4x - a|$$

where  $a$  is a positive constant. State the coordinates of each point where the graph cuts or meets the coordinate axes.

(2)

Given that

$$|4x - a| = 9a$$

where  $a$  is a positive constant,

(b) find the possible values of

$$|x - 6a| + 3|x|$$

giving your answers, in terms of  $a$ , in their simplest form.

(5)

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Question 5 continued

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6. (a) Express  $\sqrt{5} \cos \theta - 2 \sin \theta$  in the form  $R \cos(\theta + \alpha)$ , where  $R > 0$  and  $0 < \alpha < \frac{\pi}{2}$

State the value of  $R$  and give the value of  $\alpha$  to 4 significant figures.

(3)

- (b) Solve, for  $-\pi < \theta < \pi$ ,

$$\sqrt{5} \cos \theta - 2 \sin \theta = 0.5$$

giving your answers to 3 significant figures.

[Solutions based entirely on graphical or numerical methods are not acceptable.]

(4)

$$f(x) = A(\sqrt{5} \cos \theta - 2 \sin \theta) + B \quad \theta \in \mathbb{R}$$

where  $A$  and  $B$  are constants.

Given that the range of  $f$  is

$$-15 \leq f(x) \leq 33$$

- (c) find the value of  $B$  and the possible values of  $A$ .

(4)

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Question 6 continued

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Q6

(Total 11 marks)



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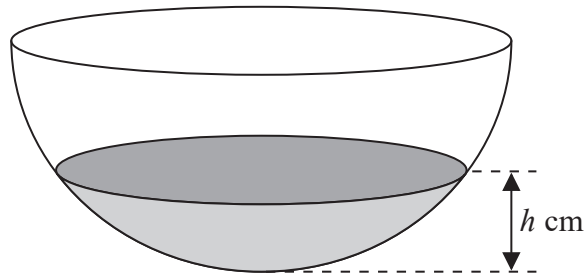


Figure 1

Figure 1 shows a hemispherical bowl.

Water is flowing into the bowl at a constant rate of  $180\text{ cm}^3\text{ s}^{-1}$ .

When the height of the water is  $h\text{ cm}$ , the volume of water  $V\text{ cm}^3$  is given by

$$V = \frac{1}{3} \pi h^2 (90 - h), \quad 0 \leq h \leq 30$$

Find the rate of change of the height of the water, in  $\text{cm s}^{-1}$ , when  $h = 15$

Give your answer to 2 significant figures.

(5)

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**Question 7 continued**

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**(Total 5 marks)**

Q7



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8. With respect to a fixed origin  $O$ , the lines  $l_1$  and  $l_2$  are given by the equations

$$l_1 : \mathbf{r} = \begin{pmatrix} 1 \\ -3 \\ 2 \end{pmatrix} + \lambda \begin{pmatrix} 1 \\ 2 \\ 3 \end{pmatrix}, \quad l_2 : \mathbf{r} = \begin{pmatrix} 6 \\ 4 \\ 1 \end{pmatrix} + \mu \begin{pmatrix} 1 \\ 1 \\ -1 \end{pmatrix}$$

where  $\lambda$  and  $\mu$  are scalar parameters.

- (a) Show that  $l_1$  and  $l_2$  do not meet. (4)

The point  $P$  is on  $l_1$  where  $\lambda = 0$ , and the point  $Q$  is on  $l_2$  where  $\mu = -1$

- (b) Find the acute angle between the line segment  $PQ$  and  $l_1$ , giving your answer in degrees to 2 decimal places. (5)

- (c) Find the shortest distance from the point  $Q$  to the line  $l_1$ , giving your answer to 3 significant figures. (2)

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Question 8 continued

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**Question 8 continued**

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Question 8 continued

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(Total 11 marks)

Q8



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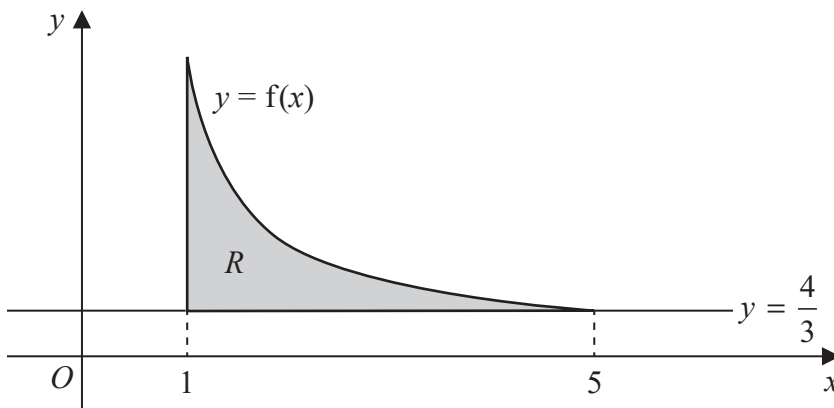


Diagram not drawn to scale

Figure 2

(a) Find

$$\int \frac{1}{(2x - 1)^2} dx$$

(2)

Figure 2 shows a sketch of the curve with equation  $y = f(x)$  where

$$f(x) = \frac{12}{(2x - 1)^2} \quad 1 \leq x \leq 5$$

The finite region  $R$ , shown shaded in Figure 2, is bounded by the line with equation  $x = 1$ , the curve with equation  $y = f(x)$  and the line with equation  $y = \frac{4}{3}$ .

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

(b) Find the exact value of the volume of the solid generated, giving your answer in its simplest form.

(6)

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Question 9 continued

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(Total 8 marks)

Q9

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Question 11 continued

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(Total 9 marks)

Q11

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12. (a) Show that

$$\cot x - \tan x \equiv 2 \cot 2x, \quad x \neq 90n^\circ, n \in \mathbb{Z} \tag{4}$$

(b) Hence, or otherwise, solve, for  $0 \leq \theta < 180^\circ$

$$5 + \cot(\theta - 15^\circ) - \tan(\theta - 15^\circ) = 0$$

giving your answers to one decimal place.

[Solutions based entirely on graphical or numerical methods are not acceptable.] (5)

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Question 12 continued

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(Total 9 marks)

Q12



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14. Given that

$$y = \frac{(x^2 - 4)^{\frac{1}{2}}}{x^3} \quad x > 2$$

(a) show that

$$\frac{dy}{dx} = \frac{Ax^2 + 12}{x^4(x^2 - 4)^{\frac{1}{2}}} \quad x > 2$$

where  $A$  is a constant to be found.

(6)

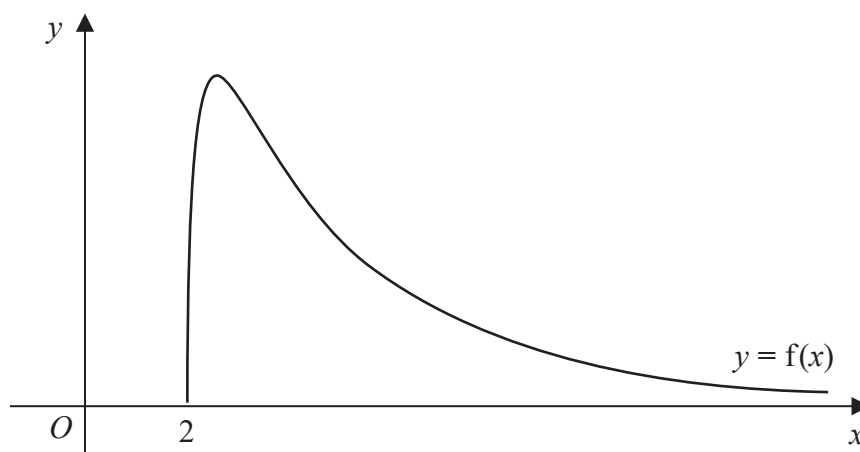


Figure 4

Figure 4 shows a sketch of part of the curve with equation  $y = f(x)$  where

$$f(x) = \frac{24(x^2 - 4)^{\frac{1}{2}}}{x^3} \quad x > 2$$

(b) Use your answer to part (a) to find the range of  $f$ .

(5)

(c) State a reason why  $f^{-1}$  does not exist.

(1)

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Question 14 continued

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**Question 14 continued**

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Q14

(Total 12 marks)

**TOTAL FOR PAPER: 125 MARKS**

**END**

