

Write your name here

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Other names

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

Centre Number

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# Core Mathematics C34

## Advanced

Monday 16 June 2014 – Morning  
**Time: 2 hours 30 minutes**

Paper Reference

**WMA02/01****You must have:**

Mathematical Formulae and Statistical Tables (Blue)

Total Marks

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**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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5/5/11


**PEARSON**

1.  $f(x) = 2x^3 + x - 10$

- (a) Show that the equation  $f(x) = 0$  has a root  $\alpha$  in the interval  $[1.5, 2]$  (2)

The only real root of  $f(x) = 0$  is  $\alpha$

The iterative formula

$$x_{n+1} = \left(5 - \frac{1}{2}x_n\right)^{\frac{1}{3}}, \quad x_0 = 1.5$$

can be used to find an approximate value for  $\alpha$

- (b) Calculate  $x_1, x_2$  and  $x_3$ , giving your answers to 4 decimal places. (3)

- (c) By choosing a suitable interval, show that  $\alpha = 1.6126$  correct to 4 decimal places. (2)

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6. (a) Express  $\frac{5 - 4x}{(2x - 1)(x + 1)}$  in partial fractions. (3)

(b) (i) Find a general solution of the differential equation

$$(2x - 1)(x + 1)\frac{dy}{dx} = (5 - 4x)y, \quad x > \frac{1}{2}$$

Given that  $y = 4$  when  $x = 2$ ,

(ii) find the particular solution of this differential equation.  
Give your answer in the form  $y = f(x)$ . (7)

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7. The function  $f$  is defined by

$$f: x \mapsto \frac{3x - 5}{x + 1}, \quad x \in \mathbb{R}, x \neq -1$$

(a) Find an expression for  $f^{-1}(x)$  **(3)**

(b) Show that

$$ff(x) = \frac{x + a}{x - 1}, \quad x \in \mathbb{R}, x \neq -1, x \neq 1$$

where  $a$  is an integer to be determined. **(4)**

The function  $g$  is defined by

$$g: x \mapsto x^2 - 3x, \quad x \in \mathbb{R}, 0 \leq x \leq 5$$

(c) Find the value of  $fg(2)$  **(2)**

(d) Find the range of  $g$  **(3)**

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8. The volume  $V$  of a spherical balloon is increasing at a constant rate of  $250 \text{ cm}^3 \text{ s}^{-1}$ . Find the rate of increase of the radius of the balloon, in  $\text{cm s}^{-1}$ , at the instant when the volume of the balloon is  $12\,000 \text{ cm}^3$ . Give your answer to 2 significant figures.

(5)

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

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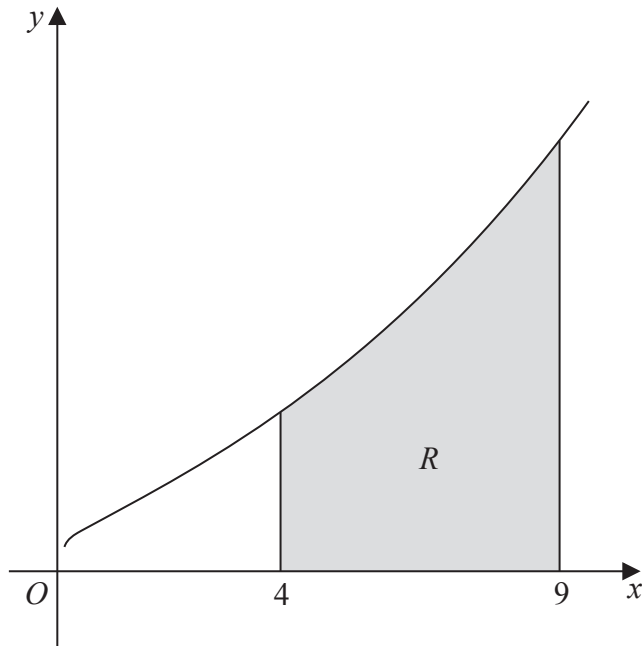








9.



**Figure 1**

Figure 1 shows a sketch of part of the curve with equation  $y = e^{\sqrt{x}}$ ,  $x > 0$

The finite region  $R$ , shown shaded in Figure 1, is bounded by the curve, the  $x$ -axis and the lines  $x = 4$  and  $x = 9$

- (a) Use the trapezium rule, with 5 strips of equal width, to obtain an estimate for the area of  $R$ , giving your answer to 2 decimal places. (4)

- (b) Use the substitution  $u = \sqrt{x}$  to find, by integrating, the exact value for the area of  $R$ . (7)

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10. (a) Use the identity for  $\sin(A + B)$  to prove that

$$\sin 2A \equiv 2 \sin A \cos A \quad (2)$$

(b) Show that

$$\frac{d}{dx} [\ln(\tan(\frac{1}{2}x))] = \operatorname{cosec} x \quad (4)$$

A curve  $C$  has the equation

$$y = \ln(\tan(\frac{1}{2}x)) - 3\sin x, \quad 0 < x < \pi$$

(c) Find the  $x$  coordinates of the points on  $C$  where  $\frac{dy}{dx} = 0$

Give your answers to 3 decimal places.

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

(6)

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11.

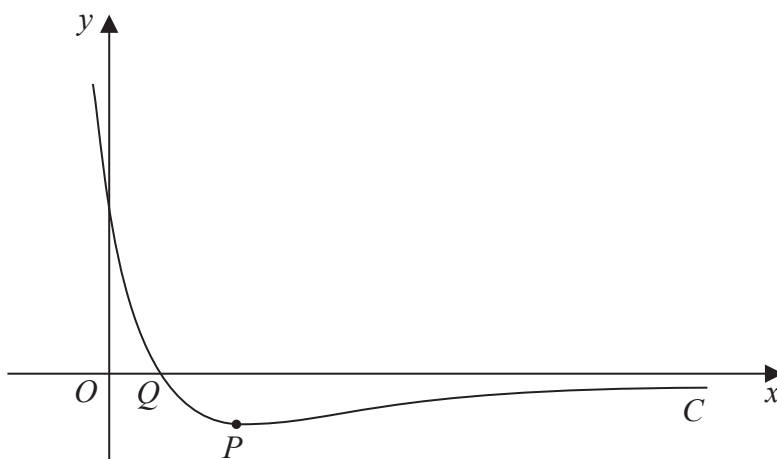


Figure 2

Figure 2 shows a sketch of part of the curve  $C$  with equation

$$y = e^{a-3x} - 3e^{-x}, \quad x \in \mathbb{R}$$

where  $a$  is a constant and  $a > \ln 4$

The curve  $C$  has a turning point  $P$  and crosses the  $x$ -axis at the point  $Q$  as shown in Figure 2.

(a) Find, in terms of  $a$ , the coordinates of the point  $P$ . (6)

(b) Find, in terms of  $a$ , the  $x$  coordinate of the point  $Q$ . (3)

(c) Sketch the curve with equation

$$y = |e^{a-3x} - 3e^{-x}|, \quad x \in \mathbb{R}, \quad a > \ln 4$$

Show on your sketch the exact coordinates, in terms of  $a$ , of the points at which the curve meets or cuts the coordinate axes. (3)

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**Question 11 continued**

**Q11**

**(Total 12 marks)**



12.

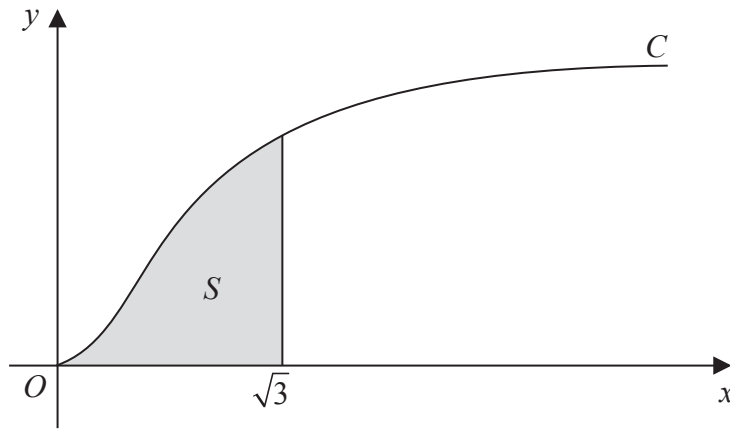


Figure 3

Figure 3 shows a sketch of part of the curve  $C$  with parametric equations

$$x = \tan t, \quad y = 2 \sin^2 t, \quad 0 \leq t < \frac{\pi}{2}$$

The finite region  $S$ , shown shaded in Figure 3, is bounded by the curve  $C$ , the line  $x = \sqrt{3}$  and the  $x$ -axis. This shaded region is rotated through  $2\pi$  radians about the  $x$ -axis to form a solid of revolution.

(a) Show that the volume of the solid of revolution formed is given by

$$4\pi \int_0^{\frac{\pi}{3}} (\tan^2 t - \sin^2 t) dt \tag{6}$$

(b) Hence use integration to find the exact value for this volume. (6)

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13. (a) Express  $2 \sin \theta + \cos \theta$  in the form  $R \sin (\theta + \alpha)$ , where  $R$  and  $\alpha$  are constants,  $R > 0$  and  $0 < \alpha < 90^\circ$ . Give your value of  $\alpha$  to 2 decimal places. (3)

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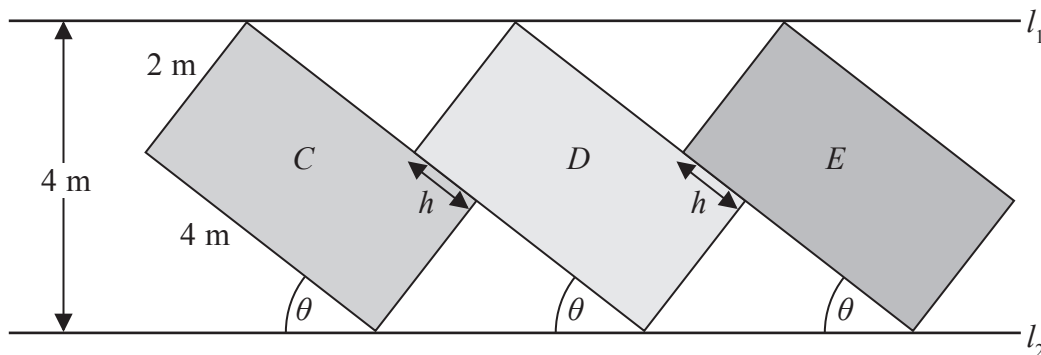


Figure 4

Figure 4 shows the design for a logo that is to be displayed on the side of a large building. The logo consists of three rectangles,  $C$ ,  $D$  and  $E$ , each of which is in contact with two horizontal parallel lines  $l_1$  and  $l_2$ . Rectangle  $D$  touches rectangles  $C$  and  $E$  as shown in Figure 4.

Rectangles  $C$ ,  $D$  and  $E$  each have length 4 m and width 2 m. The acute angle  $\theta$  between the line  $l_2$  and the longer edge of each rectangle is shown in Figure 4.

Given that  $l_1$  and  $l_2$  are 4 m apart,

(b) show that

$$2 \sin \theta + \cos \theta = 2 \quad (2)$$

Given also that  $0 < \theta < 45^\circ$ ,

(c) solve the equation

$$2 \sin \theta + \cos \theta = 2$$

giving the value of  $\theta$  to 1 decimal place. (3)

Rectangles  $C$  and  $D$  and rectangles  $D$  and  $E$  touch for a distance  $h$  m as shown in Figure 4.

Using your answer to part (c), or otherwise,

(d) find the value of  $h$ , giving your answer to 2 significant figures. (3)











14. Relative to a fixed origin  $O$ , the line  $l$  has vector equation

$$\mathbf{r} = \begin{pmatrix} -1 \\ -4 \\ 6 \end{pmatrix} + \lambda \begin{pmatrix} 2 \\ 1 \\ -1 \end{pmatrix}$$

where  $\lambda$  is a scalar parameter.

Points  $A$  and  $B$  lie on the line  $l$ , where  $A$  has coordinates  $(1, a, 5)$  and  $B$  has coordinates  $(b, -1, 3)$ .

(a) Find the value of the constant  $a$  and the value of the constant  $b$ . (3)

(b) Find the vector  $\overrightarrow{AB}$ . (2)

The point  $C$  has coordinates  $(4, -3, 2)$

(c) Show that the size of the angle  $CAB$  is  $30^\circ$  (3)

(d) Find the exact area of the triangle  $CAB$ , giving your answer in the form  $k\sqrt{3}$ , where  $k$  is a constant to be determined. (2)

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

(e) Find the coordinates of the two possible positions of  $D$ . (4)

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### Question 14 continued

Lined area for writing the answer to Question 14.



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