

Please check the examination details below before entering your candidate information

Candidate surname

Other names

**Pearson Edexcel  
Level 3 GCE**

Centre Number

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Candidate Number

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**Mock Paper**

(Time: 2 hours)

Paper Reference **9MA0/01**

**Mathematics**

**Advanced**

**Paper 1: Pure Mathematics 1**

**You must have:**

Mathematical Formulae and Statistical Tables, calculator

Total Marks

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**Candidates may use any calculator allowed 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 15 questions in this question paper. The total mark for this paper is 100.
- 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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**Pearson**

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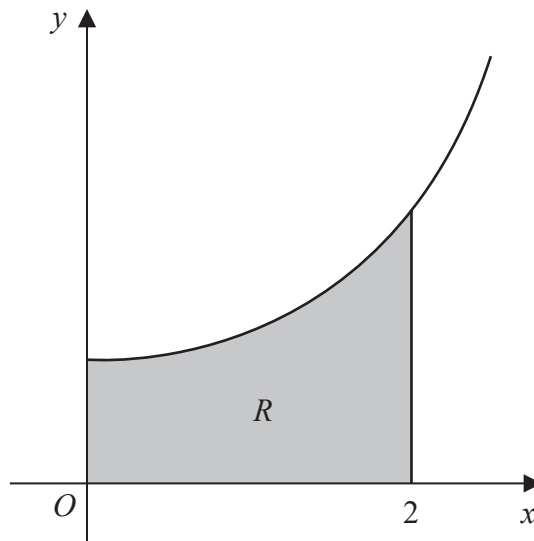


Figure 1

Figure 1 shows part of the curve with equation  $y = e^{\frac{1}{5}x^2}$  for  $x \geq 0$

The finite region  $R$ , shown shaded in Figure 1, is bounded by the curve, the  $y$ -axis, the  $x$ -axis, and the line with equation  $x = 2$

The table below shows corresponding values of  $x$  and  $y$  for  $y = e^{\frac{1}{5}x^2}$

$x$	0	0.5	1	1.5	2
$y$	1	$e^{0.05}$	$e^{0.2}$	$e^{0.45}$	$e^{0.8}$

(a) Use the trapezium rule, with all the values of  $y$  in the table, to find an estimate for the area of  $R$ , giving your answer to 2 decimal places.

(3)

(b) Use your answer to part (a) to deduce an estimate for

(i)  $\int_0^2 (4 + e^{\frac{1}{5}x^2}) dx$

(ii)  $\int_1^3 e^{\frac{1}{5}(x-1)^2} dx$

giving your answers to 2 decimal places.

(2)

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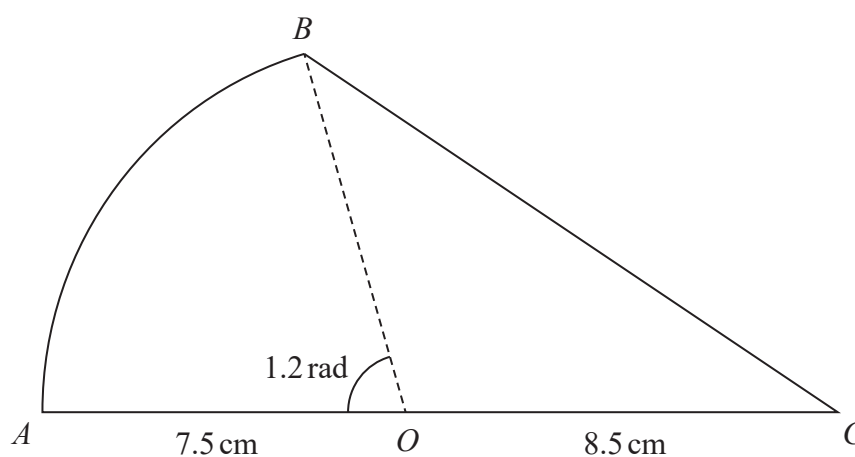


Figure 2

The shape  $AOCBA$ , shown in Figure 2, consists of a sector  $AOB$  of a circle centre  $O$  joined to a triangle  $BOC$ .

The points  $A$ ,  $O$  and  $C$  lie on a straight line with  $AO = 7.5$  cm and  $OC = 8.5$  cm.

The size of angle  $AOB$  is 1.2 radians.

Find, in cm, the perimeter of the shape  $AOCBA$ , giving your answer to one decimal place.

(5)

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Question 2 continued

Lined writing area for the answer to Question 2.

(Total for Question 2 is 5 marks)

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Question 4 continued

Lined writing area for the answer to Question 4.

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Question 4 continued

Lined area for writing the answer to Question 4.

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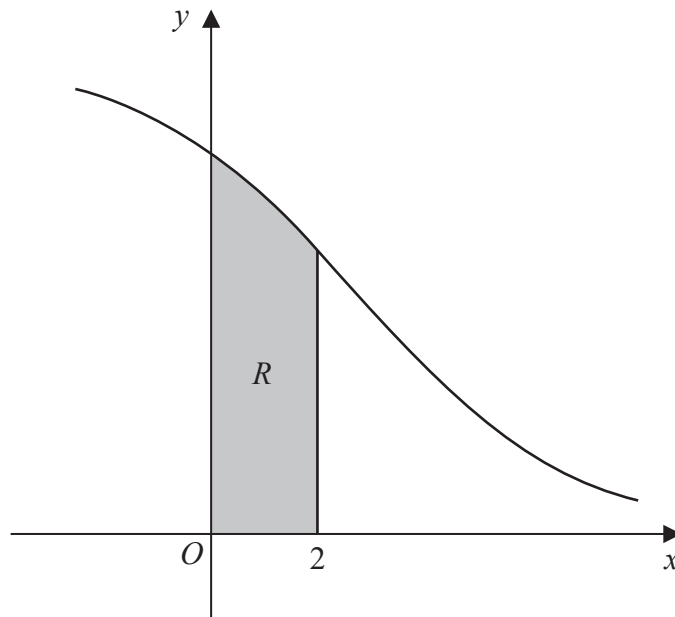


Figure 3

Figure 3 shows a sketch of part of the curve with equation

$$y = \frac{6}{e^{\frac{1}{2}x} + 4} \quad x \in \mathbb{R}$$

The finite region  $R$ , shown shaded in Figure 3, is bounded by the curve, the  $y$ -axis, the  $x$ -axis, and the line with equation  $x = 2$

(a) Use the substitution  $u = e^{\frac{1}{2}x}$  to show that the area of  $R$  can be given by

$$\int_a^b \frac{12}{u(u+4)} du$$

where  $a$  and  $b$  are constants to be found.

(3)

(b) Hence use algebraic integration to show that the exact area of  $R$  is  $3 \ln \left( \frac{5e}{e+4} \right)$

(5)

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Question 6 continued

Ruled writing area for the question.

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**Question 6 continued**

Lined writing area for the response to Question 6.

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Question 6 continued

Lined writing area for the answer to Question 6. The area contains 25 horizontal lines for writing.

(Total for Question 6 is 8 marks)



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7. (a) Express  $3 \sin \theta - 4 \cos \theta$  in the form  $R \sin(\theta - \alpha)$ , where  $R > 0$  and  $0 < \alpha < 90^\circ$   
State the value of  $R$  and give the value of  $\alpha$  to 2 decimal places. (3)

The temperature in a greenhouse,  $G^\circ\text{C}$ , is modelled by the equation

$$G = 17 + 3 \sin(15t)^\circ - 4 \cos(15t)^\circ \quad 0 \leq t \leq 17$$

where  $t$  is the time in hours after 5 a.m.

(b) Find, according to this model,

- (i) the maximum temperature in the greenhouse, (1)

- (ii) the time, after midday, when the temperature in the greenhouse is  $20^\circ\text{C}$ .  
Give your answer to the nearest minute.  
(Solutions based entirely on graphical or numerical methods are not acceptable.) (4)

Handwriting practice area consisting of 20 horizontal lines.

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Question 7 continued

Lined writing area for the answer to Question 7.

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**Question 7 continued**

Handwriting practice area with horizontal lines.

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Question 7 continued

Lined writing area for the answer.

(Total for Question 7 is 8 marks)



8. (i) Show that  $y^2 - 4y + 7$  is positive for all real values of  $y$ . (2)

(ii) Bobby claims that

$$e^{3x} \geq e^{2x} \quad x \in \mathbb{R}$$

Determine whether Bobby's claim is always true, sometimes true or never true, justifying your answer. (2)

(iii) Elsa claims that

'for  $n \in \mathbb{Z}^+$ , if  $n^2$  is even, then  $n$  must be even'

Use proof by contradiction to show that Elsa's claim is true. (2)

(iv) Ying claims that

'the sum of two different irrational numbers is irrational'

Determine whether Ying's claim is always true, sometimes true or never true, justifying your answer. (2)

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**Question 8 continued**

A large rectangular area containing numerous horizontal lines for writing answers.

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9. (a) Show that

$$\frac{\sin x}{1 - \cos x} + \frac{1 - \cos x}{\sin x} \equiv k \operatorname{cosec} x \quad x \neq n\pi, \quad n \in \mathbb{Z}$$

where  $k$  is a constant to be found.

(4)

(b) Hence explain why the equation

$$\frac{\sin x}{1 - \cos x} + \frac{1 - \cos x}{\sin x} = 1.6$$

has no real solutions.

(1)

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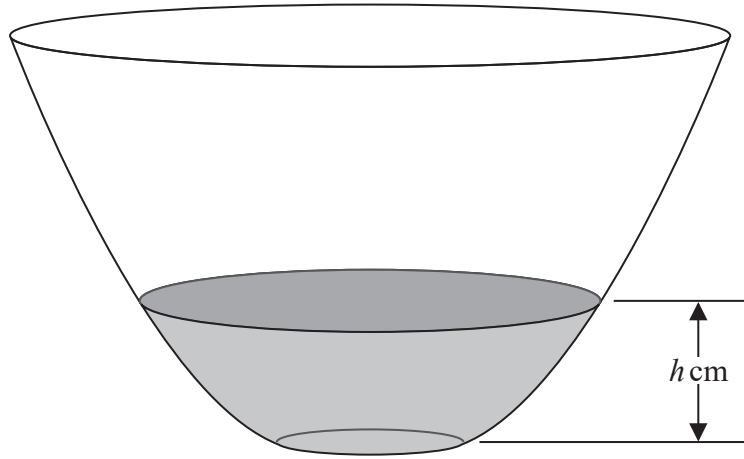


Figure 4

Figure 4 shows a bowl with a circular cross-section.

Initially the bowl is empty. Water begins to flow into the bowl.

At time  $t$  seconds after the water begins to flow into the bowl, the height of the water in the bowl is  $h$  cm.

The volume of water,  $V$  cm<sup>3</sup>, in the bowl is modelled as

$$V = 4\pi h(h + 6) \quad 0 \leq h \leq 25$$

The water flows into the bowl at a constant rate of  $80\pi$  cm<sup>3</sup> s<sup>-1</sup>

- (a) Show that, according to the model, it takes 36 seconds to fill the bowl with water from empty to a height of 24 cm. (1)
- (b) Find, according to the model, the rate of change of the height of the water, in cm s<sup>-1</sup>, when  $t = 8$ . (8)

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Question 10 continued

A large rectangular area with horizontal lines for writing the answer to Question 10.

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Question 10 continued

Lined area for writing the answer to Question 10.

(Total for Question 10 is 9 marks)

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11. (i) Given that

$$y = a^x$$

where  $a$  is a positive constant, show that

$$\frac{dy}{dx} = a^x \ln a \quad (2)$$

(ii) Given that

$$x = 2 \tan y \quad -\frac{\pi}{2} < y < \frac{\pi}{2}$$

show that

$$\frac{dy}{dx} = \frac{k}{4 + x^2} \quad (4)$$

where  $k$  is a constant to be found.

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Question 11 continued

Lined writing area for question 11.

(Total for Question 11 is 6 marks)

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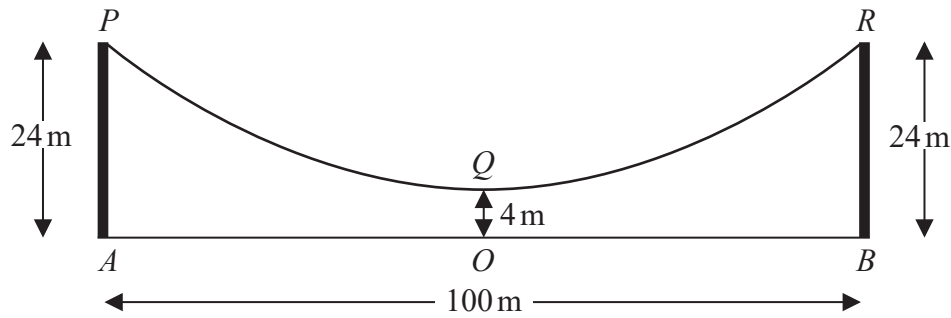


Figure 5

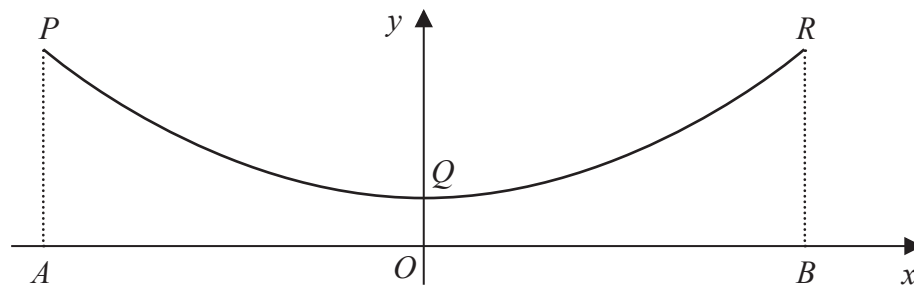


Figure 6

A suspension bridge cable  $PQR$  hangs between the tops of two vertical towers,  $AP$  and  $BR$ , as shown in Figure 5.

A walkway  $AOB$  runs between the bases of the towers, directly under the cable.

The towers are 100m apart and each tower is 24m high.

At the point  $O$ , midway between the towers, the cable is 4m above the walkway.

The points  $P$ ,  $Q$ ,  $R$ ,  $A$ ,  $O$  and  $B$  are assumed to lie in the same vertical plane and  $AOB$  is assumed to be horizontal.

Figure 6 shows a symmetric quadratic curve  $PQR$  used to model this cable.

Given that  $O$  is the origin,

(a) find an equation for the curve  $PQR$ . (3)

Lee can safely inspect the cable up to a height of 12m above the walkway.

A defect is reported on the cable at a location 19m horizontally **from one of the towers**.

(b) Determine whether, according to the model, Lee can safely inspect this defect. (2)

(c) Give a reason why this model may not be suitable to determine whether Lee can safely inspect this defect. (1)

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Question 12 continued

Lined area for writing the answer to Question 12.

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Question 12 continued

Lined writing area for the answer to Question 12.

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**Question 12 continued**

Lined writing area for the response to Question 12. The area contains 22 horizontal lines for writing.

(Total for Question 12 is 6 marks)

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13. Given that  $p$  is a positive constant,

(a) show that

$$\sum_{n=1}^{11} \ln(p^n) = k \ln p$$

where  $k$  is a constant to be found,

(2)

(b) show that

$$\sum_{n=1}^{11} \ln(8p^n) = 33 \ln(2p^2)$$

(2)

(c) Hence find the set of values of  $p$  for which

$$\sum_{n=1}^{11} \ln(8p^n) < 0$$

giving your answer in set notation.

(2)

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**Question 13 continued**

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**Question 13 continued**

Lined writing area for the question response.

(Total for Question 13 is 6 marks)



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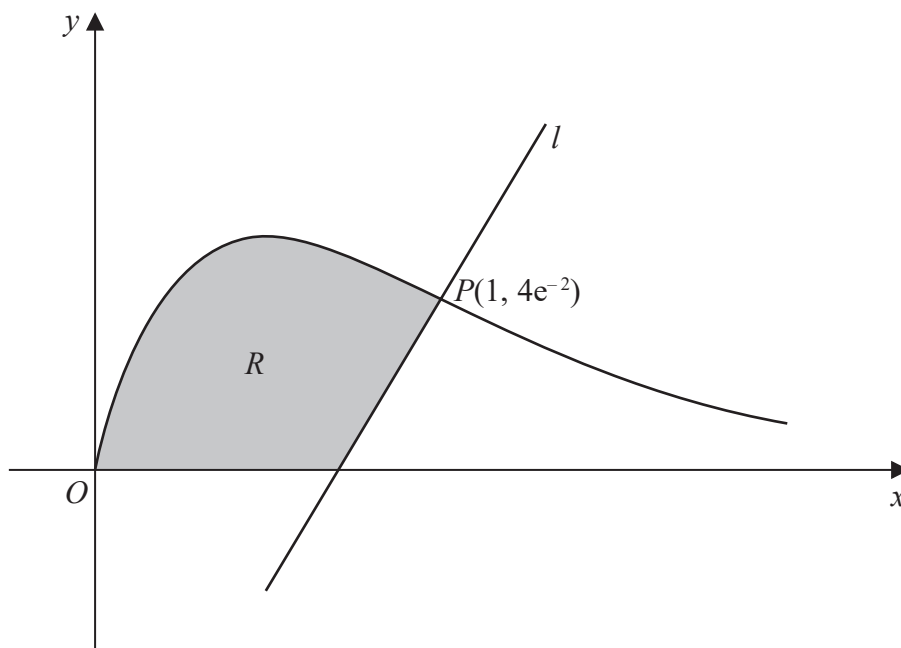


Figure 7

Figure 7 shows a sketch of the curve with equation

$$y = 4xe^{-2x} \quad x \geq 0$$

The line  $l$  is the normal to the curve at the point  $P(1, 4e^{-2})$

The finite region  $R$ , shown shaded in Figure 7, is bounded by the curve, the line  $l$ , and the  $x$ -axis.

Find the exact value of the area of  $R$ .

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

(10)

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Question 14 continued

Lined writing area for the answer to Question 14.

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**Question 14 continued**

Lined area for student response.

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15. Relative to a fixed origin  $O$ , the points  $A$  and  $B$  are such that

$$\vec{OA} = \begin{pmatrix} -3 \\ 2 \\ 7 \end{pmatrix} \text{ and } \vec{OB} = \begin{pmatrix} 3 \\ -1 \\ p \end{pmatrix}, \text{ where } p \text{ is a constant}$$

and the points  $C$  and  $D$  are such that

$$\vec{BC} = \begin{pmatrix} 0 \\ 6 \\ -7 \end{pmatrix} \text{ and } \vec{AD} = \begin{pmatrix} 2 \\ 5 \\ -4 \end{pmatrix}$$

(a) Find the position vector of the point  $D$ .

(1)

Given that  $ABCD$  is a trapezium,

(b) find the value of  $p$ .

(4)

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Question 15 continued

Lined writing area for the answer to Question 15.

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