

Please check the examination details below before entering your candidate information

Candidate surname

Other names

Centre Number

Candidate Number

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## Pearson Edexcel Level 3 GCE

Time 2 hours

Paper  
reference

**9MA0/01**

### Mathematics

Advanced

**PAPER 1: Pure Mathematics 1**

**You must have:**

Mathematical Formulae and Statistical Tables (Green), calculator

Total Marks

**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 16 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 ►

P69601A

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Q:1/1/1/1/



  
Pearson

1. The point  $P(-2, -5)$  lies on the curve with equation  $y = f(x)$ ,  $x \in \mathbb{R}$

Find the point to which  $P$  is mapped, when the curve with equation  $y = f(x)$  is transformed to the curve with equation

(a)  $y = f(x) + 2$  (1)

(b)  $y = |f(x)|$  (1)

(c)  $y = 3f(x - 2) + 2$  (2)



Question 1 continued

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(Total for Question 1 is 4 marks)



2.

$$f(x) = (x - 4)(x^2 - 3x + k) - 42 \text{ where } k \text{ is a constant}$$

Given that  $(x + 2)$  is a factor of  $f(x)$ , find the value of  $k$ .

(3)

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**Question 2 continued**

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**(Total for Question 2 is 3 marks)**



3. A circle has equation

$$x^2 + y^2 - 10x + 16y = 80$$

(a) Find

(i) the coordinates of the centre of the circle,

(ii) the radius of the circle.

(3)

Given that  $P$  is the point on the circle that is furthest away from the origin  $O$ ,

(b) find the exact length  $OP$

(2)

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**Question 3 continued**

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**(Total for Question 3 is 5 marks)**



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4. (a) Express  $\lim_{\delta x \rightarrow 0} \sum_{x=2.1}^{6.3} \frac{2}{x} \delta x$  as an integral.

(1)

(b) Hence show that

$$\lim_{\delta x \rightarrow 0} \sum_{x=2.1}^{6.3} \frac{2}{x} \delta x = \ln k$$

where  $k$  is a constant to be found.

(2)

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5. The height,  $h$  metres, of a tree,  $t$  years after being planted, is modelled by the equation

$$h^2 = at + b \quad 0 \leq t < 25$$

where  $a$  and  $b$  are constants.

Given that

- the height of the tree was 2.60 m, exactly 2 years after being planted
- the height of the tree was 5.10 m, exactly 10 years after being planted

(a) find a complete equation for the model, giving the values of  $a$  and  $b$  to 3 significant figures. (4)

Given that the height of the tree was 7 m, exactly 20 years after being planted

(b) evaluate the model, giving reasons for your answer. (2)

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Question 5 continued

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**(Total for Question 5 is 6 marks)**



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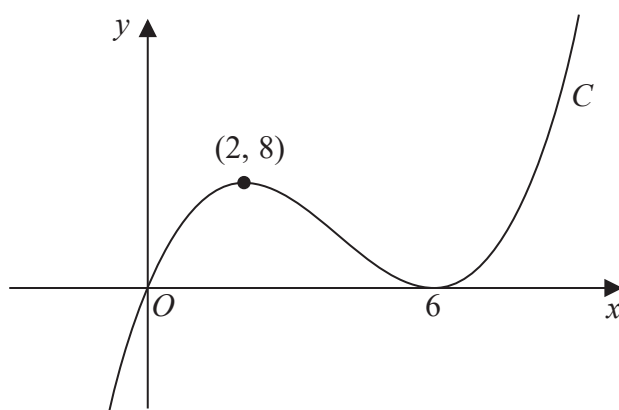


Figure 1

Figure 1 shows a sketch of a curve  $C$  with equation  $y = f(x)$  where  $f(x)$  is a cubic expression in  $x$ .

The curve

- passes through the origin
- has a maximum turning point at  $(2, 8)$
- has a minimum turning point at  $(6, 0)$

(a) Write down the set of values of  $x$  for which

$$f'(x) < 0$$

(1)

The line with equation  $y = k$ , where  $k$  is a constant, intersects  $C$  at only one point.

(b) Find the set of values of  $k$ , giving your answer in set notation.

(2)

(c) Find the equation of  $C$ . You may leave your answer in factorised form.

(3)

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Question 6 continued

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Lined writing area for the answer to Question 6.

(Total for Question 6 is 6 marks)



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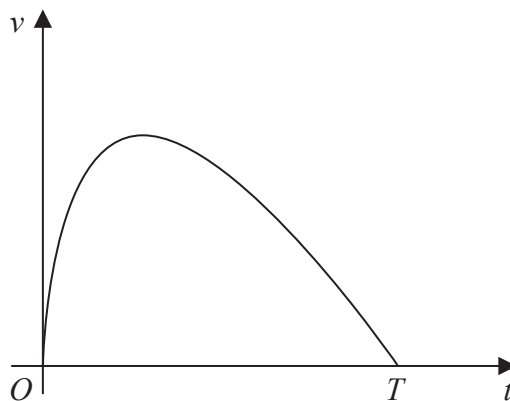


Figure 2

A car stops at two sets of traffic lights.

Figure 2 shows a graph of the speed of the car,  $v \text{ ms}^{-1}$ , as it travels between the two sets of traffic lights.

The car takes  $T$  seconds to travel between the two sets of traffic lights.

The speed of the car is modelled by the equation

$$v = (10 - 0.4t) \ln(t + 1) \quad 0 \leq t \leq T$$

where  $t$  seconds is the time after the car leaves the first set of traffic lights.

According to the model,

(a) find the value of  $T$  (1)

(b) show that the maximum speed of the car occurs when

$$t = \frac{26}{1 + \ln(t + 1)} - 1 \quad (4)$$

Using the iteration formula

$$t_{n+1} = \frac{26}{1 + \ln(t_n + 1)} - 1$$

with  $t_1 = 7$

(c) (i) find the value of  $t_3$  to 3 decimal places,  
 (ii) find, by repeated iteration, the time taken for the car to reach maximum speed. (3)

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**Question 8 continued**

Lined writing area for the answer.

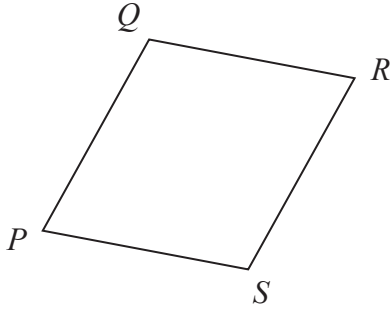
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**(Total for Question 8 is 8 marks)**



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**Figure 3**

Figure 3 shows a sketch of a parallelogram  $PQRS$ .

Given that

- $\vec{PQ} = 2\mathbf{i} + 3\mathbf{j} - 4\mathbf{k}$
- $\vec{QR} = 5\mathbf{i} - 2\mathbf{k}$

(a) show that parallelogram  $PQRS$  is a rhombus. (2)

(b) Find the exact area of the rhombus  $PQRS$ . (4)

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Question 9 continued

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**Question 9 continued**

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Question 9 continued

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(Total for Question 9 is 6 marks)



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10. A scientist is studying the number of bees and the number of wasps on an island.

The number of bees, measured in thousands,  $N_b$ , is modelled by the equation

$$N_b = 45 + 220e^{0.05t}$$

where  $t$  is the number of years from the start of the study.

According to the model,

- (a) find the number of bees at the start of the study, (1)

- (b) show that, exactly 10 years after the start of the study, the number of bees was increasing at a **rate** of approximately 18 thousand per year. (3)

The number of wasps, measured in thousands,  $N_w$ , is modelled by the equation

$$N_w = 10 + 800e^{-0.05t}$$

where  $t$  is the number of years from the start of the study.

When  $t = T$ , according to the models, there are an equal number of bees and wasps.

- (c) Find the value of  $T$  to 2 decimal places. (4)

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Question 10 continued

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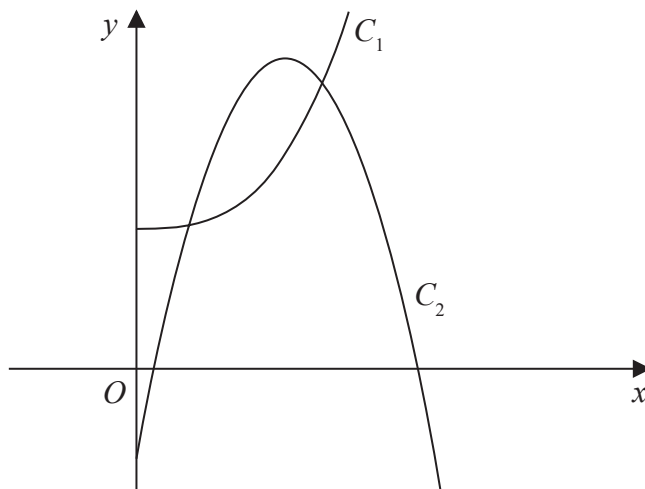


Figure 4

Figure 4 shows a sketch of part of the curve  $C_1$  with equation

$$y = 2x^3 + 10 \quad x > 0$$

and part of the curve  $C_2$  with equation

$$y = 42x - 15x^2 - 7 \quad x > 0$$

- (a) Verify that the curves intersect at  $x = \frac{1}{2}$  (2)

The curves intersect again at the point  $P$

- (b) Using algebra and showing all stages of working, find the exact  $x$  coordinate of  $P$  (5)









12.

In this question you must show all stages of your working.

Solutions relying on calculator technology are not acceptable.

Show that

$$\int_1^{e^2} x^3 \ln x \, dx = ae^8 + b$$

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

(5)

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13. (i) In an arithmetic series, the first term is  $a$  and the common difference is  $d$ .

Show that

$$S_n = \frac{n}{2} [2a + (n - 1)d] \quad (3)$$

(ii) James saves money over a number of weeks to buy a printer that costs £64

He saves £10 in week 1, £9.20 in week 2, £8.40 in week 3 and so on, so that the weekly amounts he saves form an arithmetic sequence.

Given that James takes  $n$  weeks to save exactly £64

(a) show that

$$n^2 - 26n + 160 = 0 \quad (2)$$

(b) Solve the equation

$$n^2 - 26n + 160 = 0 \quad (1)$$

(c) Hence state the number of weeks James takes to save enough money to buy the printer, giving a brief reason for your answer.

(1)

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# Question 13 continued

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Lined writing area for the answer to Question 13 continued.



**Question 13 continued**

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14.

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

(a) Given that

$$2 \sin(x - 60^\circ) = \cos(x - 30^\circ)$$

show that

$$\tan x = 3\sqrt{3} \tag{4}$$

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

$$2 \sin 2\theta = \cos(2\theta + 30^\circ)$$

giving your answers to one decimal place. (4)

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**Question 14 continued**

Lined writing area for the answer.

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Question 14 continued

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(Total for Question 14 is 8 marks)



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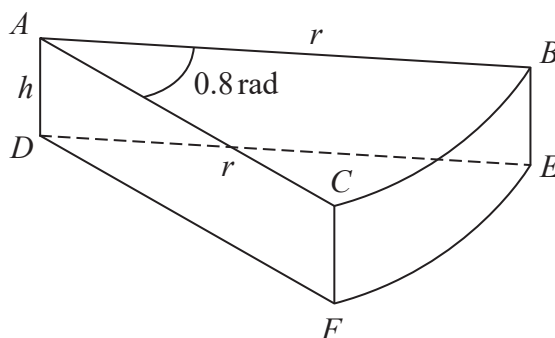


Figure 5

A company makes toys for children.

Figure 5 shows the design for a solid toy that looks like a piece of cheese.

The toy is modelled so that

- face  $ABC$  is a sector of a circle with radius  $r$  cm and centre  $A$
- angle  $BAC = 0.8$  radians
- faces  $ABC$  and  $DEF$  are congruent
- edges  $AD$ ,  $CF$  and  $BE$  are perpendicular to faces  $ABC$  and  $DEF$
- edges  $AD$ ,  $CF$  and  $BE$  have length  $h$  cm

Given that the volume of the toy is  $240 \text{ cm}^3$

(a) show that the surface area of the toy,  $S \text{ cm}^2$ , is given by

$$S = 0.8r^2 + \frac{1680}{r}$$

making your method clear.

(4)

Using algebraic differentiation,

(b) find the value of  $r$  for which  $S$  has a stationary point.

(4)

(c) Prove, by further differentiation, that this value of  $r$  gives the minimum surface area of the toy.

(2)

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### Question 15 continued

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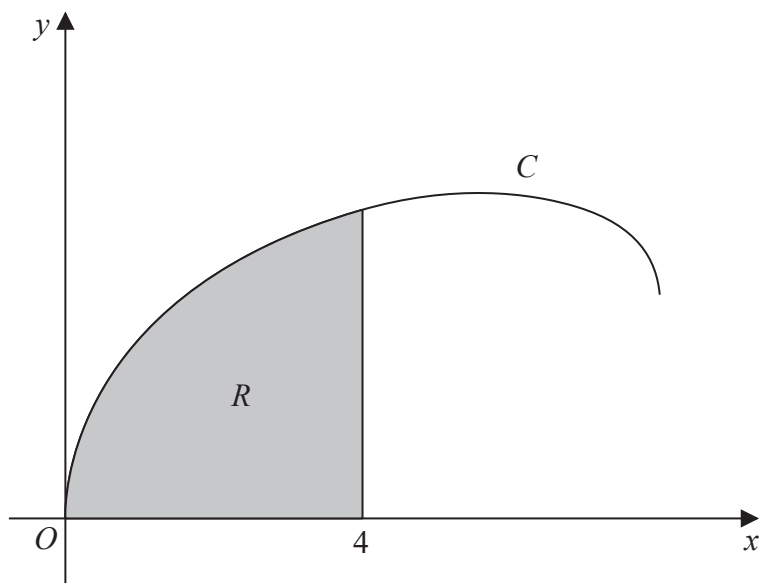


Figure 6

Figure 6 shows a sketch of the curve  $C$  with parametric equations

$$x = 8 \sin^2 t \quad y = 2 \sin 2t + 3 \sin t \quad 0 \leq t \leq \frac{\pi}{2}$$

The region  $R$ , shown shaded in Figure 6, is bounded by  $C$ , the  $x$ -axis and the line with equation  $x = 4$

(a) Show that the area of  $R$  is given by

$$\int_0^a (8 - 8 \cos 4t + 48 \sin^2 t \cos t) dt$$

where  $a$  is a constant to be found.

(5)

(b) Hence, using algebraic integration, find the exact area of  $R$ .

(4)

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Question 16 continued

Lined writing area for the answer to Question 16.

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