



Rewarding Learning

ADVANCED  
General Certificate of Education  
2025

Centre Number

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Candidate Number

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## Mathematics

Assessment Unit A2 1

*assessing*

Pure Mathematics

**MV24**

[AMT11]

THURSDAY 29 MAY, MORNING

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### Time

2 hours 30 minutes, plus your additional time allowance.

### Instructions to Candidates

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.

You must answer **all twelve** questions in the spaces provided.

**Do not write on blank pages or tracing paper.**  
Complete in black ink only.

**Do not write with a gel pen.**

Questions which require drawing or sketching

should be completed using an HB pencil. Show clearly the full development of your answers. **Answers without working may not gain full credit.**

Answers should be given to three significant figures unless otherwise stated.

You are permitted to use a graphic or scientific calculator in this paper.

## **Information for Candidates**

The total mark for this paper is 150

Figures in brackets printed at the end of each question indicate the marks awarded to each question or part question.

A copy of the **Mathematical Formulae and Tables booklet** is provided.

Throughout the paper the logarithmic notation used is  $\ln z$  where it is noted that  $\ln z \equiv \log_e z$

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**(Questions start overleaf)**











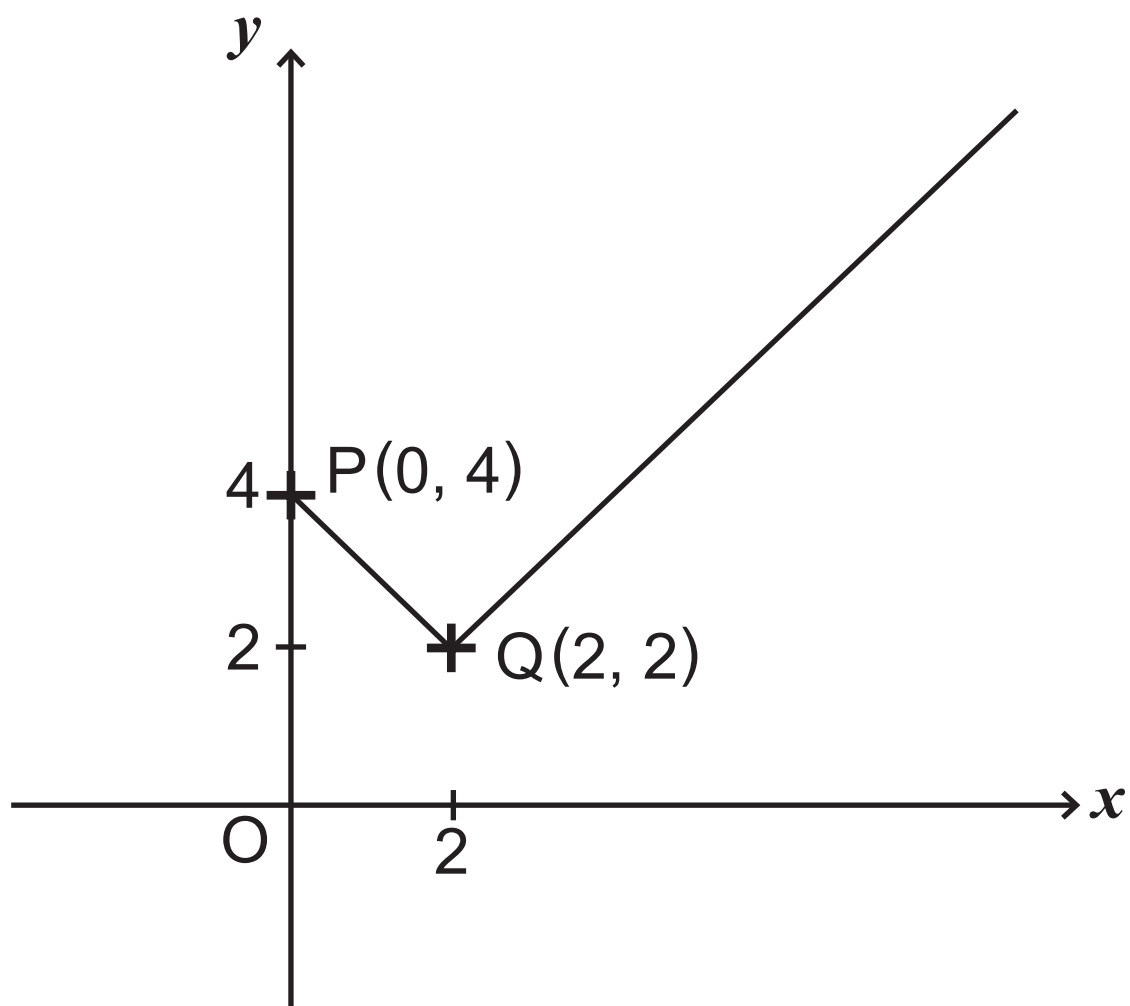
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**(Questions continue overleaf)**

**3 Fig. 1** below shows the graph of  $y = f(x)$

The points  $P(0, 4)$  and  $Q(2, 2)$  are labelled as shown.

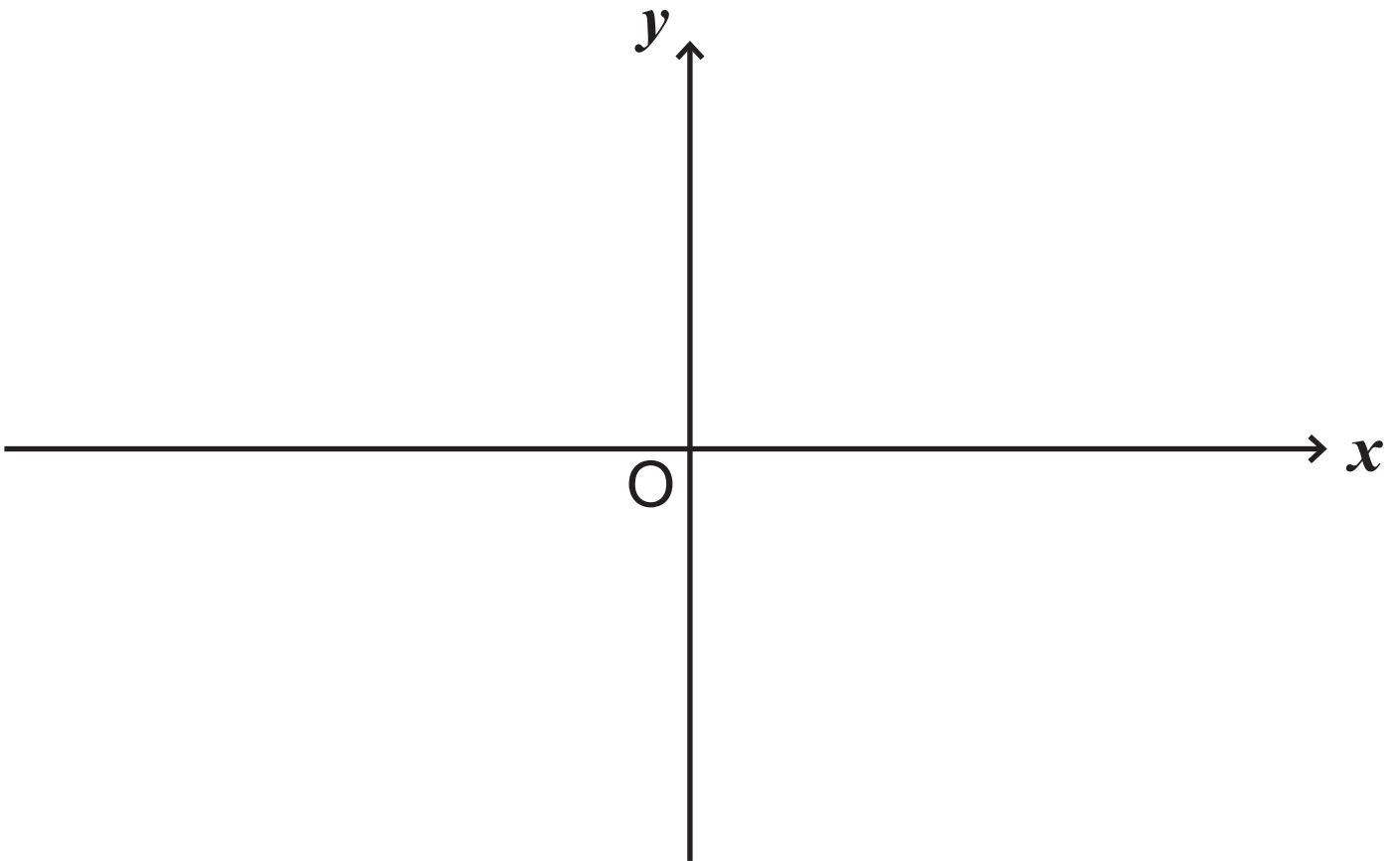
**Fig. 1**



(i) On the axes below, sketch the graph of

$$y = 1 + f\left(\frac{x}{2}\right)$$

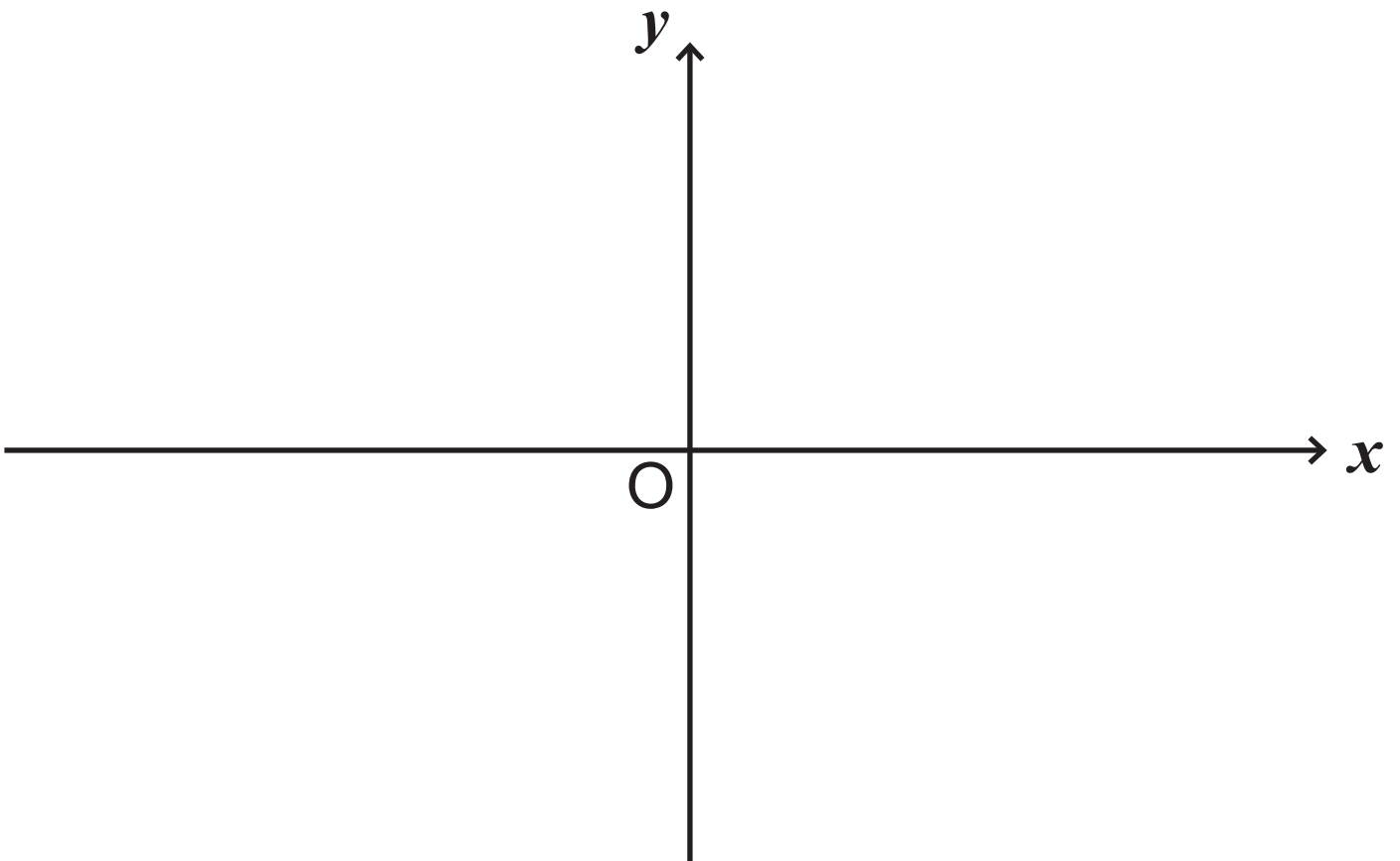
Clearly label the images of the points P and Q. [3 marks]



(ii) On the axes below, sketch the graph of

$$y = 4 - f(x)$$

Clearly label the images of the points P and Q. [3 marks]



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**(Questions continue overleaf)**

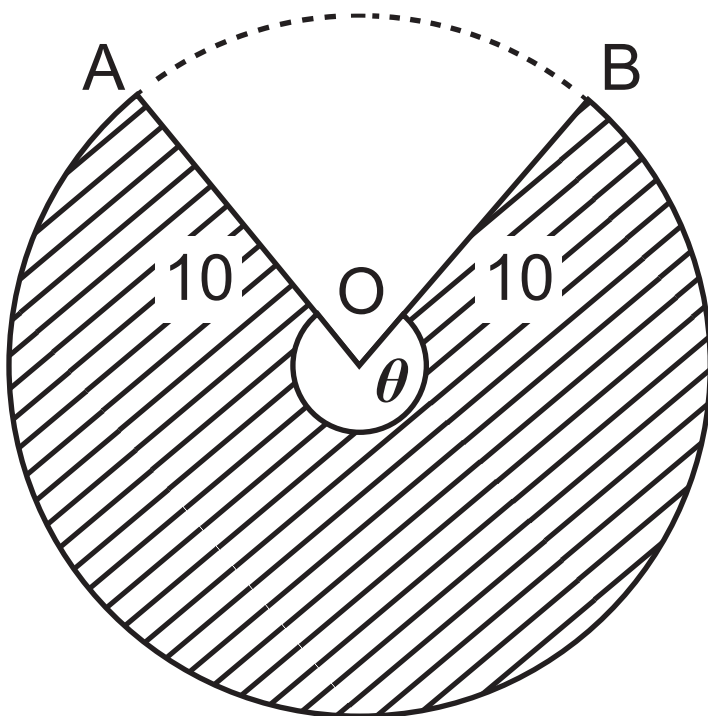
- 4 Ella wants to make party hats for her son's birthday party.

She creates a template by cutting a major sector AOB from circular card.

The card has centre O and radius 10 cm.

The major arc AB subtends an angle  $\theta$  radians at O, as shown in **Fig. 2** below.

**Fig. 2**



She will then fold the cards into cones before decorating them.

The template must have a major arc length of  $14\pi$  cm.

- (i) Find the exact value of  $\theta$  that Ella should use when creating her sector template.  
[2 marks]

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- 5 (a) On the axes below, sketch the graph of  $y = \cot \theta$  for  $0^\circ \leq \theta \leq 360^\circ$   
[3 marks]



- (b) (i) Prove the identity [4 marks]

$$2 \cot 2\theta \equiv \cot \theta - \tan \theta$$

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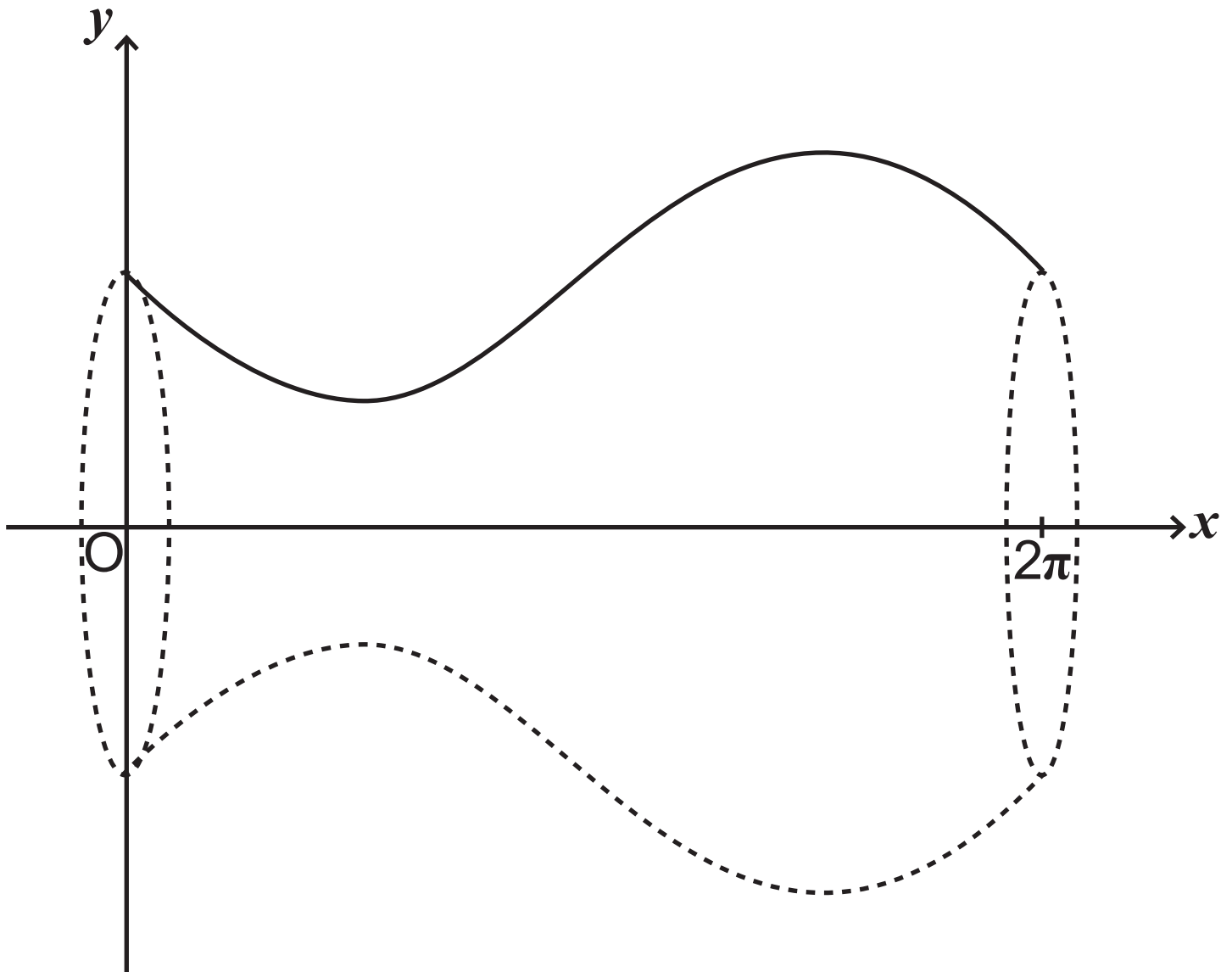
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(ii) A vase is modelled by rotating the curve

$$y = 2 - \sin x$$

between the lines  $x = 0$  and  $x = 2\pi$  through  $2\pi$  radians about the  $x$ -axis, as shown in **Fig. 3** below.

**Fig. 3**





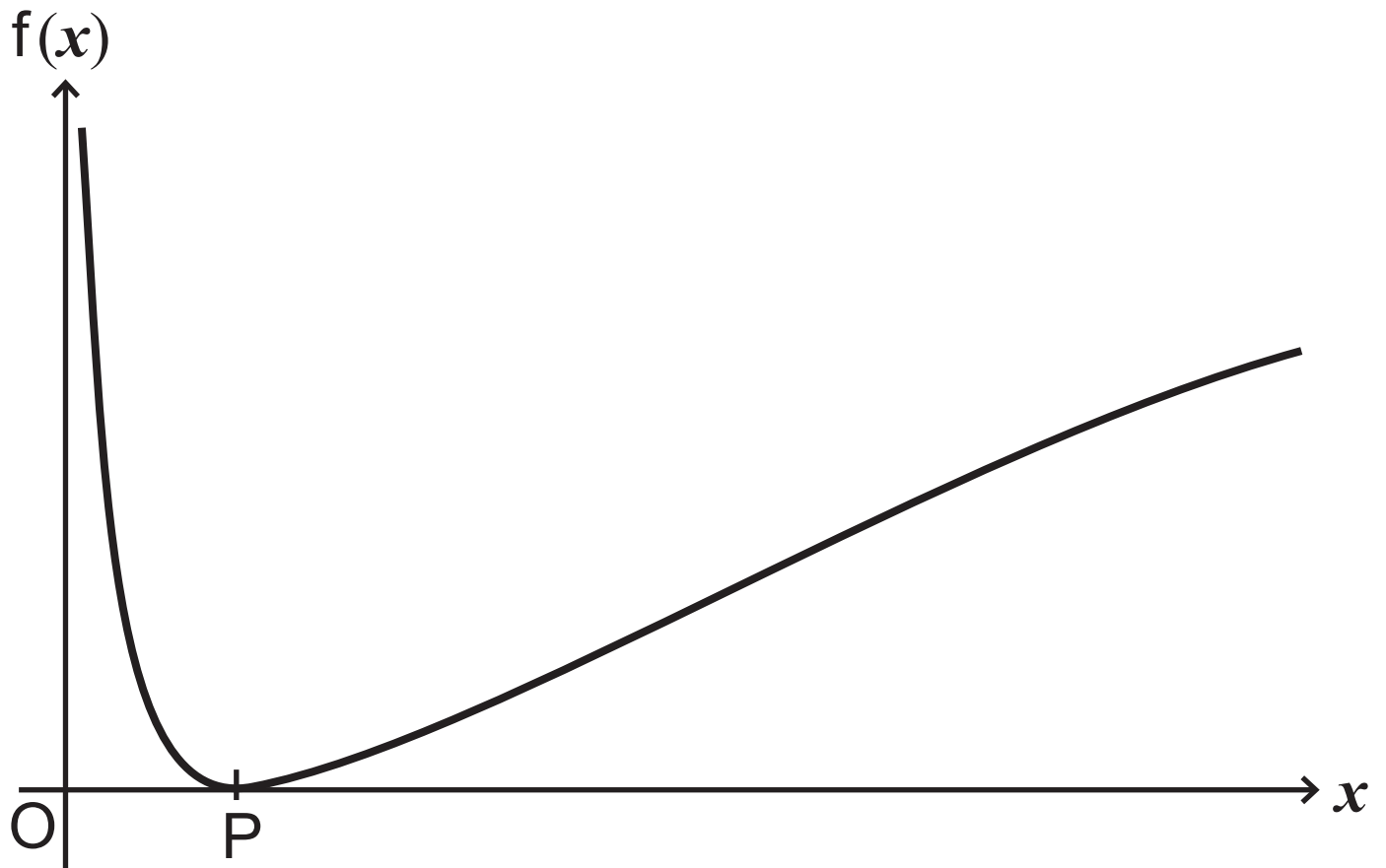


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**(Questions continue overleaf)**

- 8 The graph of the function  $f(x) = 3(1 + \ln x)^2$  is shown in **Fig. 4** below.

**Fig. 4**







**(ii)** State the equation of the vertical asymptote of the function  $f(x)$ .  
[1 mark]

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**(iii)** State the domain and range of the function  $f(x)$ . [2 marks]

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**(b)** A toy car is moving around a circular track such that its coordinates relative to a fixed origin  $O$  are given parametrically by

$$x = 3 \cos t + 4 \sin t + 2$$

and

$$y = 4 \cos t - 3 \sin t - 1$$

where  $t$  is the time in seconds.

**(i)** By using parametric differentiation, show that

$$\frac{dy}{dx} = \frac{2-x}{y+1} \quad [5 \text{ marks}]$$

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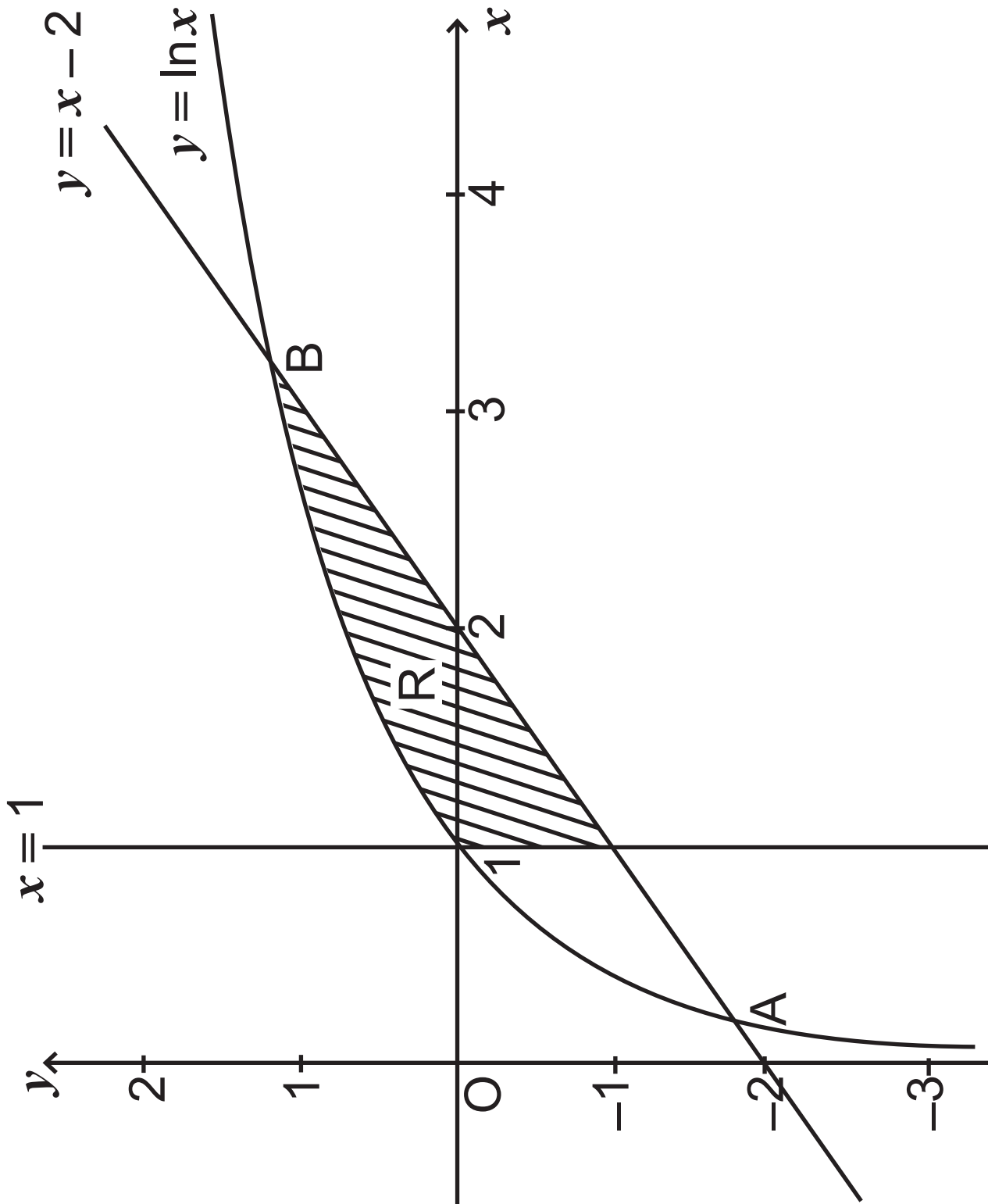
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**(Questions continue overleaf)**

**12** The graphs of

$y = \ln x$ ,  $y = x - 2$  and  $x = 1$   
are shown in **Fig. 5** below.

**Fig. 5**



The graphs of  $y = \ln x$  and  $y = x - 2$  intersect at the points A and B.

Point B has an  $x$  coordinate close to 3

(i) Show that the  $x$  coordinate of B lies between  $x = 3$  and  $x = 4$  [4 marks]

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(ii) Starting with  $x_0 = 3$ , use the Newton-Raphson method once to find a better approximation for the  $x$  coordinate of B.

Give your answer correct to three decimal places. [5 marks]

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The shaded region  $R$ , as shown in **Fig. 5**, is the area enclosed between the two lines and the curve.

**(iii)** Using the approximation you have found in **(ii)**, find the area of  $R$ . [10 marks]

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question paper**

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## SOURCES

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For Examiner's use only	
Question Number	Marks
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
<b>Total Marks</b>	

Examiner Number

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