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Maths

**AQA
AS & A LEVEL**

Topic Questions

3.10 I: Numerical methods

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- 2 Use Simpson's rule with 5 ordinates (4 strips) to find an approximation to

$$\int_1^3 \frac{1}{\sqrt{1+x^3}} dx$$

giving your answer to three significant figures.

(4 marks)

- 6 [Figure 1, printed on the insert, is provided for use in this question.]

The curve $y = x^3 + 4x - 3$ intersects the x -axis at the point A where $x = \alpha$.

- (a) Show that α lies between 0.5 and 1.0.

(2 marks)

- (b) Show that the equation $x^3 + 4x - 3 = 0$ can be rearranged into the form $x = \frac{3 - x^3}{4}$.

(1 mark)

- (c) (i) Use the iteration $x_{n+1} = \frac{3 - x_n^3}{4}$ with $x_1 = 0.5$ to find x_3 , giving your answer to two decimal places.

(3 marks)

- (ii) The sketch on **Figure 1** shows parts of the graphs of $y = \frac{3 - x^3}{4}$ and $y = x$, and the position of x_1 .

On **Figure 1**, draw a cobweb or staircase diagram to show how convergence takes place, indicating the positions of x_2 and x_3 on the x -axis. (3 marks)

- 1 The curve $y = x^3 - x - 7$ intersects the x -axis at the point where $x = \alpha$.

- (a) Show that α lies between 2.0 and 2.1.

(2 marks)

- (b) Show that the equation $x^3 - x - 7 = 0$ can be rearranged in the form $x = \sqrt[3]{x + 7}$.

(1 mark)

- (c) Use the iteration $x_{n+1} = \sqrt[3]{x_n + 7}$ with $x_1 = 2$ to find the values of x_2 , x_3 and x_4 , giving your answers to three significant figures.

(3 marks)

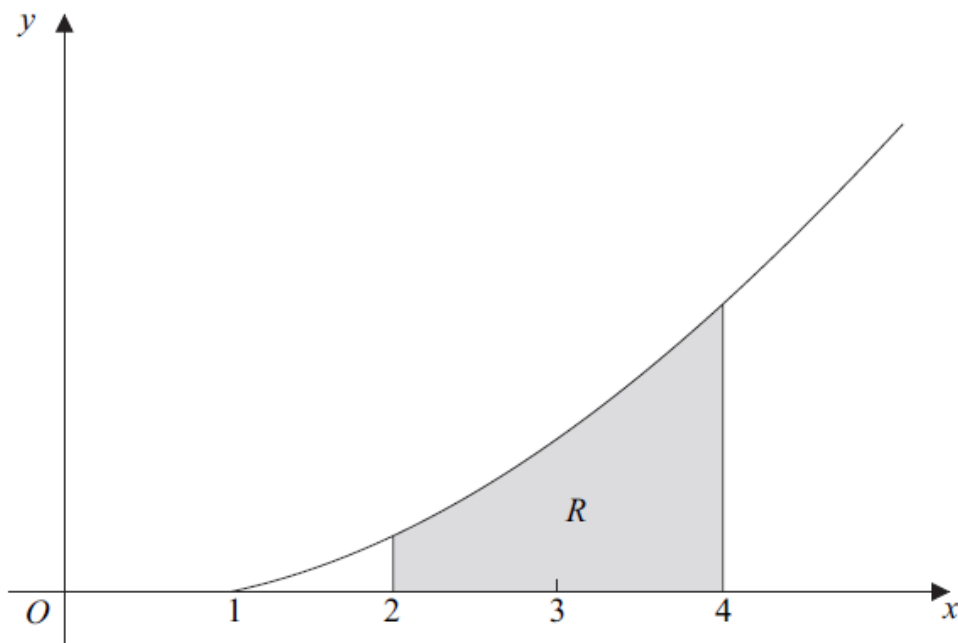
-
- 6 (a) Use the mid-ordinate rule with four strips to find an estimate for $\int_1^5 \ln x \, dx$, giving your answer to three significant figures. (3 marks)
-

- (c) The region R is bounded by the curve $y = \sec x$, the x -axis and the lines $x = 0$ and $x = 1$.

Find the volume of the solid formed when R is rotated through 2π radians about the x -axis, giving your answer to three significant figures. (3 marks)

- 1 Use the mid-ordinate rule with four strips of equal width to find an estimate for $\int_1^5 \frac{1}{1 + \ln x} \, dx$, giving your answer to three significant figures. (4 marks)
-

- (b) The diagram shows the curve with equation $y = 2\sqrt{(x-1)^3}$ for $x \geq 1$.



The shaded region R is bounded by the curve $y = 2\sqrt{(x-1)^3}$, the lines $x = 2$ and $x = 4$, and the x -axis.

Find the exact value of the volume of the solid formed when the region R is rotated through 360° about the x -axis. (4 marks)

- (c) Describe a sequence of **two** geometrical transformations that maps the graph of $y = \sqrt{x^3}$ onto the graph of $y = 2\sqrt{(x-1)^3}$. (4 marks)
-

4 [Figure 1, printed on the insert, is provided for use in this question.]

- (a) Use Simpson's rule with 5 ordinates (4 strips) to find an approximation to $\int_1^2 3^x dx$, giving your answer to three significant figures. (4 marks)

- (b) The curve $y = 3^x$ intersects the line $y = x + 3$ at the point where $x = \alpha$.

(i) Show that α lies between 0.5 and 1.5. (2 marks)

- (ii) Show that the equation $3^x = x + 3$ can be rearranged into the form

$$x = \frac{\ln(x+3)}{\ln 3} \quad (2 \text{ marks})$$

- (iii) Use the iteration $x_{n+1} = \frac{\ln(x_n + 3)}{\ln 3}$ with $x_1 = 0.5$ to find x_3 to two significant figures. (2 marks)

- (iv) The sketch on **Figure 1** shows part of the graphs of $y = \frac{\ln(x+3)}{\ln 3}$ and $y = x$, and the position of x_1 .

On **Figure 1**, draw a cobweb or staircase diagram to show how convergence takes place, indicating the positions of x_2 and x_3 on the x -axis. (2 marks)



Figure 1 (for Question 6)

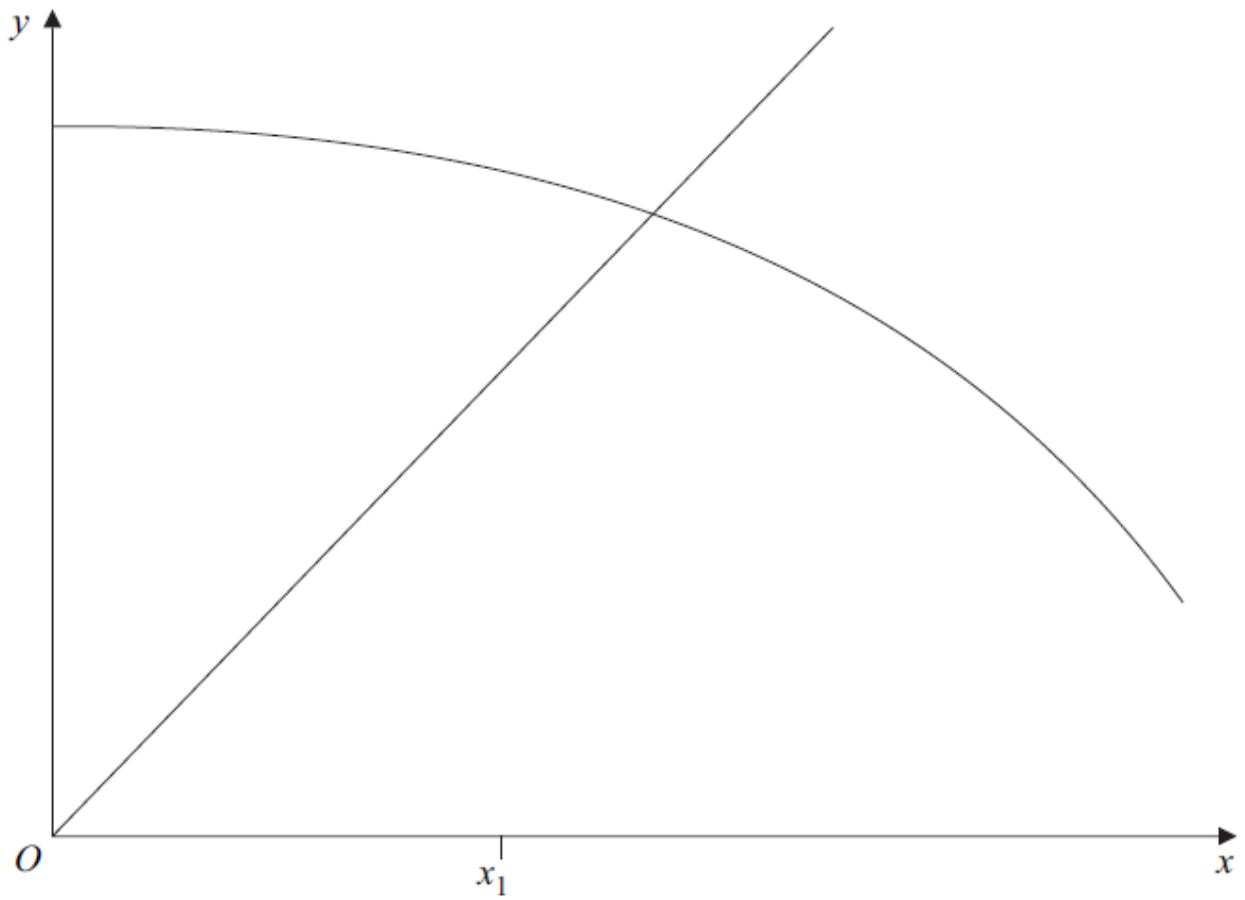


Figure 1 (for use in Question 4)

