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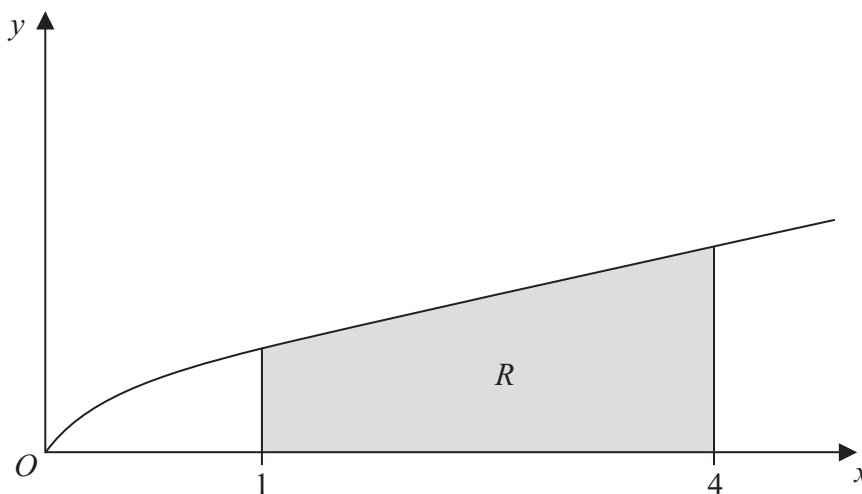


Figure 1

Figure 1 shows a sketch of part of the curve with equation  $y = \frac{x}{1 + \sqrt{x}}$ . The finite region  $R$ , shown shaded in Figure 1, is bounded by the curve, the  $x$ -axis, the line with equation  $x = 1$  and the line with equation  $x = 4$ .

- (a) Complete the table with the value of  $y$  corresponding to  $x = 3$ , giving your answer to 4 decimal places. (1)

$x$	1	2	3	4
$y$	0.5	0.8284		1.3333

- (b) Use the trapezium rule, with all the values of  $y$  in the completed table, to obtain an estimate of the area of the region  $R$ , giving your answer to 3 decimal places. (3)
- (c) Use the substitution  $u = 1 + \sqrt{x}$ , to find, by integrating, the exact area of  $R$ . (8)

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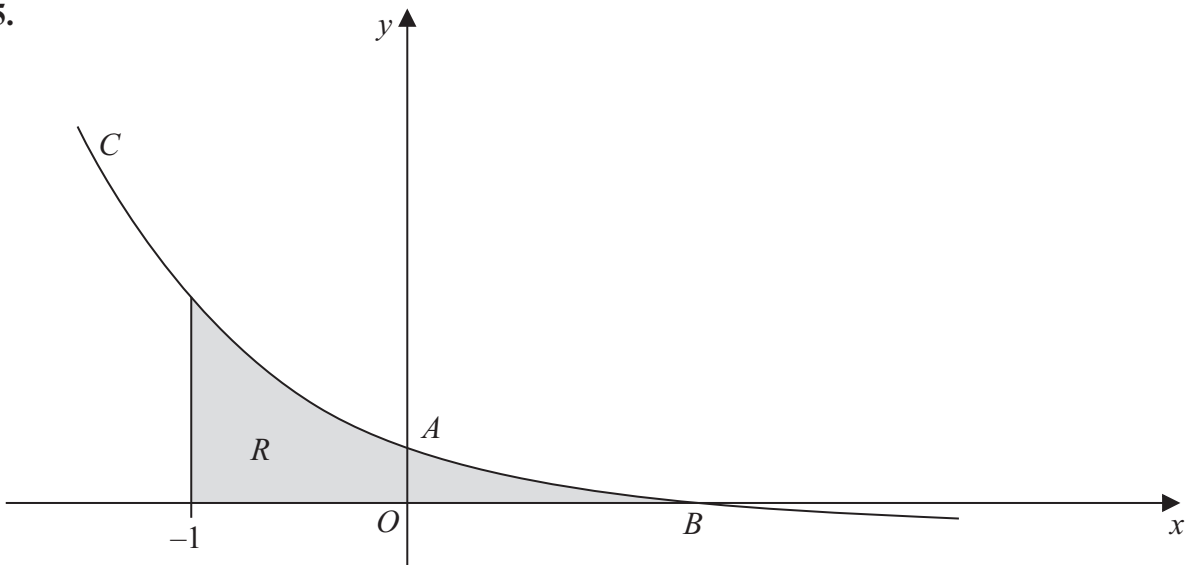








5.



**Figure 2**

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

$$x = 1 - \frac{1}{2}t, \quad y = 2^t - 1$$

The curve crosses the  $y$ -axis at the point  $A$  and crosses the  $x$ -axis at the point  $B$ .

- (a) Show that  $A$  has coordinates  $(0, 3)$ . **(2)**
- (b) Find the  $x$  coordinate of the point  $B$ . **(2)**
- (c) Find an equation of the normal to  $C$  at the point  $A$ . **(5)**

The region  $R$ , as shown shaded in Figure 2, is bounded by the curve  $C$ , the line  $x = -1$  and the  $x$ -axis.

- (d) Use integration to find the exact area of  $R$ . **(6)**

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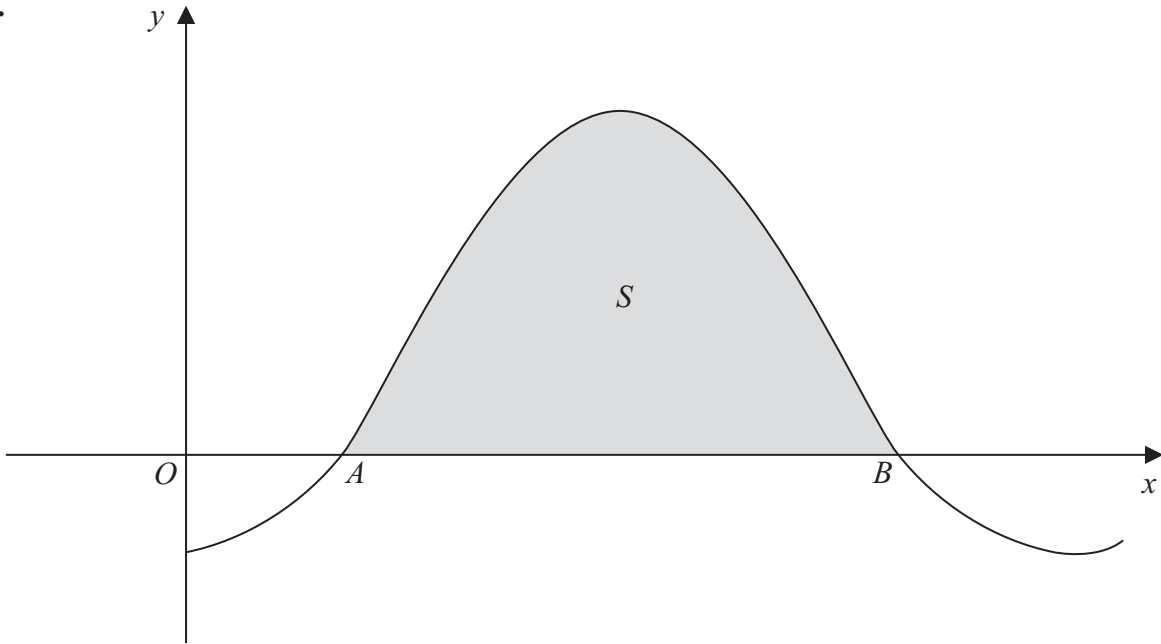
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6.



**Figure 3**

Figure 3 shows a sketch of part of the curve with equation  $y = 1 - 2 \cos x$ , where  $x$  is measured in radians. The curve crosses the  $x$ -axis at the point  $A$  and at the point  $B$ .

- (a) Find, in terms of  $\pi$ , the  $x$  coordinate of the point  $A$  and the  $x$  coordinate of the point  $B$ . **(3)**

The finite region  $S$  enclosed by the curve and the  $x$ -axis is shown shaded in Figure 3. The region  $S$  is rotated through  $2\pi$  radians about the  $x$ -axis.

- (b) Find, by integration, the exact value of the volume of the solid generated. **(6)**

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8. A bottle of water is put into a refrigerator. The temperature inside the refrigerator remains constant at  $3^\circ\text{C}$  and  $t$  minutes after the bottle is placed in the refrigerator the temperature of the water in the bottle is  $\theta^\circ\text{C}$ .

The rate of change of the temperature of the water in the bottle is modelled by the differential equation,

$$\frac{d\theta}{dt} = \frac{(3 - \theta)}{125}$$

- (a) By solving the differential equation, show that,

$$\theta = Ae^{-0.008t} + 3$$

where  $A$  is a constant.

**(4)**

Given that the temperature of the water in the bottle when it was put in the refrigerator was  $16^\circ\text{C}$ ,

- (b) find the time taken for the temperature of the water in the bottle to fall to  $10^\circ\text{C}$ , giving your answer to the nearest minute.

**(5)**

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**Question 8 continued**

Lined area for writing the answer to Question 8.







**Question 8 continued**

Lined area for writing the answer to Question 8.

**Q8**

**(Total 9 marks)**

**TOTAL FOR PAPER: 75 MARKS**

**END**

