

1. (a) Find the binomial expansion of

$$(4 + 5x)^{\frac{1}{2}}, \quad |x| < \frac{4}{5}$$

in ascending powers of x , up to and including the term in x^2 .
Give each coefficient in its simplest form.

(5)

- (b) Find the exact value of $(4 + 5x)^{\frac{1}{2}}$ when $x = \frac{1}{10}$

Give your answer in the form $k\sqrt{2}$, where k is a constant to be determined.

(1)

- (c) Substitute $x = \frac{1}{10}$ into your binomial expansion from part (a) and hence find an approximate value for $\sqrt{2}$

Give your answer in the form $\frac{p}{q}$ where p and q are integers.

(2)



Question 2 continued

Blank lined area for writing answers.



P 4 4 8 2 7 A 0 5 3 2

3.

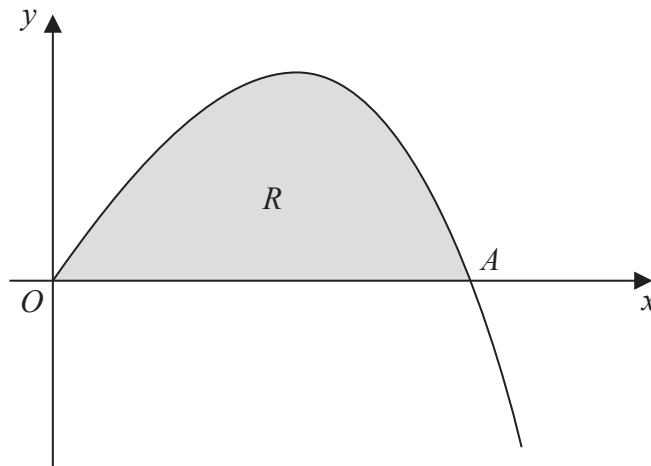


Figure 1

Figure 1 shows a sketch of part of the curve with equation $y = 4x - xe^{\frac{1}{2}x}$, $x \geq 0$

The curve meets the x -axis at the origin O and cuts the x -axis at the point A .

(a) Find, in terms of $\ln 2$, the x coordinate of the point A . (2)

(b) Find

$$\int xe^{\frac{1}{2}x} dx$$
(3)

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

$$y = 4x - xe^{\frac{1}{2}x}, \quad x \geq 0$$

(c) Find, by integration, the exact value for the area of R .
Give your answer in terms of $\ln 2$ (3)



Question 3 continued

Lined area for writing the answer to Question 3.



4. With respect to a fixed origin O , the lines l_1 and l_2 are given by the equations

$$l_1: \mathbf{r} = \begin{pmatrix} 5 \\ -3 \\ p \end{pmatrix} + \lambda \begin{pmatrix} 0 \\ 1 \\ -3 \end{pmatrix}, \quad l_2: \mathbf{r} = \begin{pmatrix} 8 \\ 5 \\ -2 \end{pmatrix} + \mu \begin{pmatrix} 3 \\ 4 \\ -5 \end{pmatrix}$$

where λ and μ are scalar parameters and p is a constant.

The lines l_1 and l_2 intersect at the point A .

(a) Find the coordinates of A . **(2)**

(b) Find the value of the constant p . **(3)**

(c) Find the acute angle between l_1 and l_2 , giving your answer in degrees to 2 decimal places. **(3)**

The point B lies on l_2 where $\mu = 1$

(d) Find the shortest distance from the point B to the line l_1 , giving your answer to 3 significant figures. **(3)**



Question 4 continued

Handwriting practice area consisting of 29 horizontal lines.

(Total 11 marks)

Q4

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7. (a) Express $\frac{2}{P(P - 2)}$ in partial fractions.

(3)

A team of biologists is studying a population of a particular species of animal.

The population is modelled by the differential equation

$$\frac{dP}{dt} = \frac{1}{2}P(P - 2)\cos 2t, \quad t \geq 0$$

where P is the population in thousands, and t is the time measured in years since the start of the study.

Given that $P = 3$ when $t = 0$,

(b) solve this differential equation to show that

$$P = \frac{6}{3 - e^{\frac{1}{2}\sin 2t}}$$

(7)

(c) find the time taken for the population to reach 4000 for the first time.
Give your answer in years to 3 significant figures.

(3)



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Question 7 continued

Lined writing area with 28 horizontal lines for student response.



8.

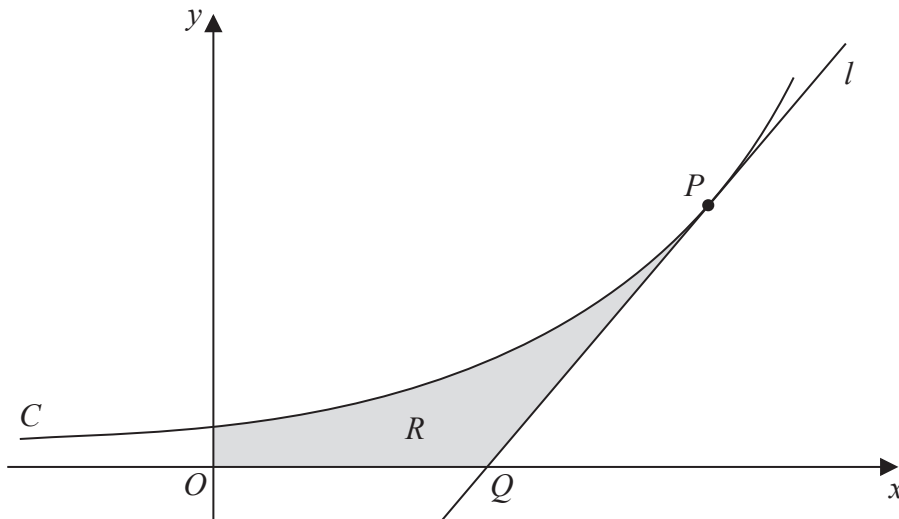


Figure 3

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

$$y = 3^x$$

The point P lies on C and has coordinates $(2, 9)$.

The line l is a tangent to C at P . The line l cuts the x -axis at the point Q .

(a) Find the exact value of the x coordinate of Q .

(4)

The finite region R , shown shaded in Figure 3, is bounded by the curve C , the x -axis, the y -axis and the line l . This region R is rotated through 360° about the x -axis.

(b) Use integration to find the exact value of the volume of the solid generated.

Give your answer in the form $\frac{p}{q}$ where p and q are exact constants.

[You may assume the formula $V = \frac{1}{3}\pi r^2 h$ for the volume of a cone.]

(6)



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Question 8 continued

Lined area for writing the answer to Question 8.

Q8

(Total 10 marks)

TOTAL FOR PAPER: 75 MARKS

END

