

AS PURE MATHEMATICS PRACTICE 1

Question 1

0 0

$$f(x) = \frac{(3 - 4\sqrt{x})^2}{\sqrt{x}}, \quad x > 0$$

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- (a) Show that $f(x) = 9x^{-\frac{1}{2}} + Ax^{\frac{1}{2}} + B$, where A and B are constants to be found.

(3)

- (b) Find $f'(x)$.

(3)

- (c) Evaluate $f'(9)$.

(2)

Question 2

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The curve C with equation $y = f(x)$ is such that

$$\frac{dy}{dx} = 3\sqrt{x} + \frac{12}{\sqrt{x}}, \quad x > 0.$$

- (a) Show that, when $x = 8$, the exact value of $\frac{dy}{dx}$ is $9\sqrt{2}$.

(3)

The curve C passes through the point $(4, 30)$.

- (b) Using integration, find $f(x)$.

(6)

Question 3

Given that $32\sqrt{2} = 2^a$, find the value of a .

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(Total 3 marks)

Question 4

Solve the equation $2^{1-x} = 4^x$.

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(Total 3 marks)

Question 5

Simplify

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$$\frac{5 - \sqrt{3}}{2 + \sqrt{3}},$$

giving your answer in the form $a + b\sqrt{3}$, where a and b are integers.

(Total 4 marks)

Question 6

The points A and B have coordinates $(1, 2)$ and $(5, 8)$ respectively.

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(a) Find the coordinates of the mid-point of AB .

(2)

(b) Find, in the form $y = mx + c$, an equation for the straight line through A and B .

(4)

Question 7

- (a) Find an equation of the line p which passes through the point $(-3, 2)$ and which is parallel to the line q with equation $7x - 2y - 14 = 0$.

(3)

The lines p and q meet the y -axis at the points A and B respectively.

- (b) Find the distance between AB .

(2)

Question 8

The point $A(-6, 4)$ and the point $B(8, -3)$ lie on the line L .

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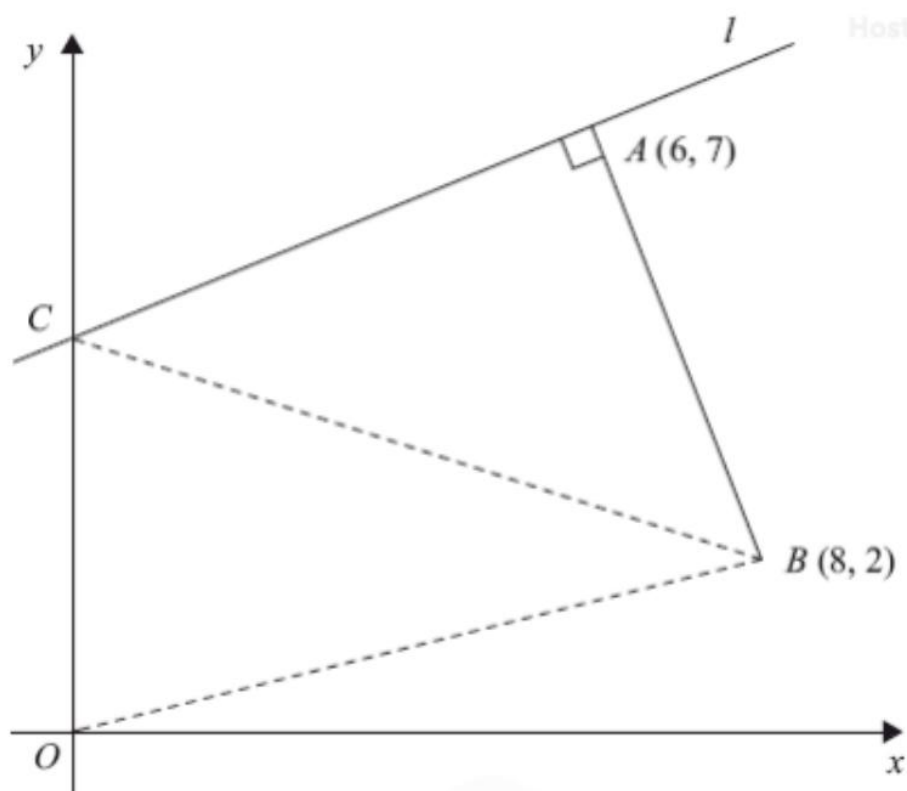
- (a) Find an equation for L in the form $ax + by + c = 0$, where a , b and c are integers.

(4)

- (b) Find the distance AB , giving your answer in the form $k\sqrt{5}$, where k is an integer.

(3)

Question 9



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The points A and B have coordinates $(6, 7)$ and $(8, 2)$ respectively.

The line l passes through the point A and is perpendicular to the line AB , as shown in the diagram above.

- (a) Find an equation for l in the form $ax + by + c = 0$, where a , b and c are integers.

(4)

Given that l intersects the y -axis at the point C , find

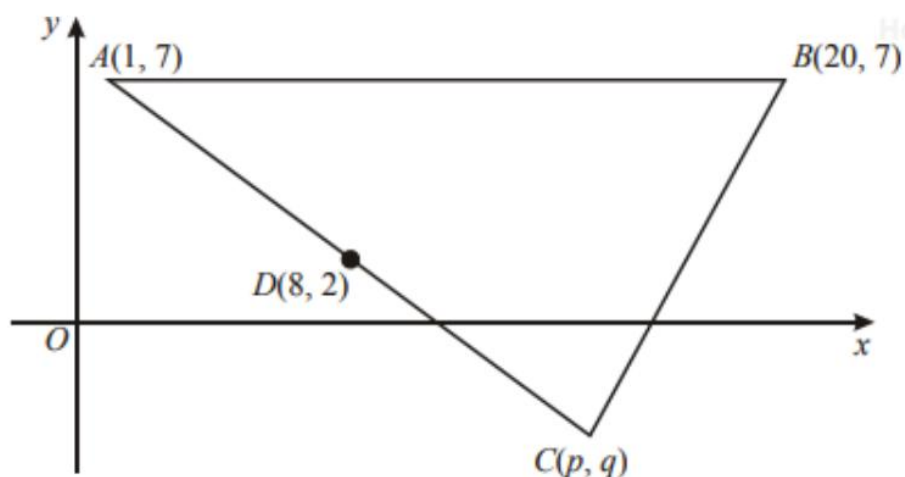
- (b) the coordinates of C ,

(2)

- (c) the area of $\triangle OCB$, where O is the origin.

(2)

Question 10



The points $A(1, 7)$, $B(20, 7)$ and $C(p, q)$ form the vertices of a triangle ABC , as shown in the diagram. The point $D(8, 2)$ is the mid-point of AC .

- (a) Find the value of p and the value of q .

(2)

The line l , which passes through D and is perpendicular to AC , intersects AB at E .

- (b) Find an equation for l , in the form $ax + by + c = 0$, where a , b and c are integers.

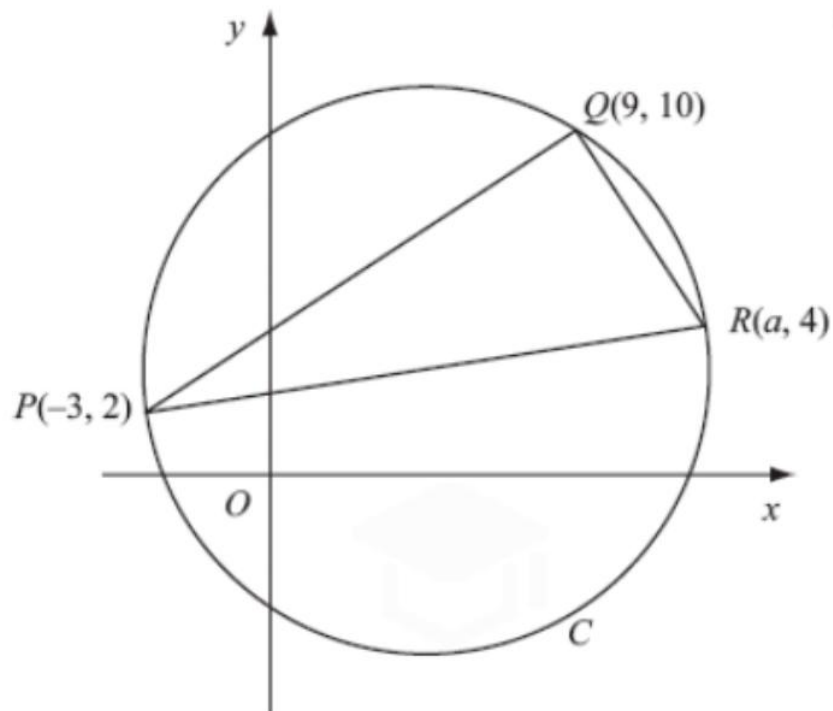
(5)

- (c) Find the exact x -coordinate of E .

(2)

Question 11

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The points $P(-3, 2)$, $Q(9, 10)$ and $R(a, 4)$ lie on the circle C , as shown in the diagram above.

Given that PR is a diameter of C ,

(a) show that $a = 13$,

(3)

(b) find an equation for C .

(5)

Question 12

The circle C has centre $A(2,1)$ and passes through the point $B(10, 7)$.

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- (a) Find an equation for C .

(4)

The line l_1 is the tangent to C at the point B .

- (b) Find an equation for l_1 .

(4)

The line l_2 is parallel to l_1 and passes through the mid-point of AB .

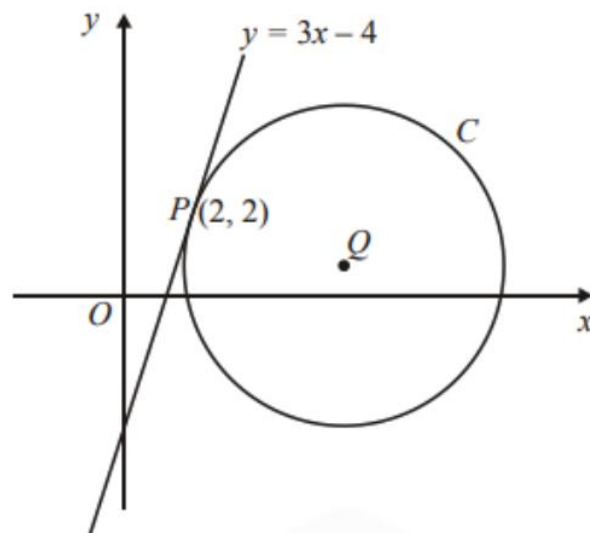
Given that l_2 intersects C at the points P and Q ,

- (c) find the length of PQ , giving your answer in its simplest surd form.

(3)

Question 13

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The line $y = 3x - 4$ is a tangent to the circle C , touching C at the point $P(2, 2)$, as shown in the figure above.

The point Q is the centre of C .

- (a) Find an equation of the straight line through P and Q .

(3)

Given that Q lies on the line $y = 1$,

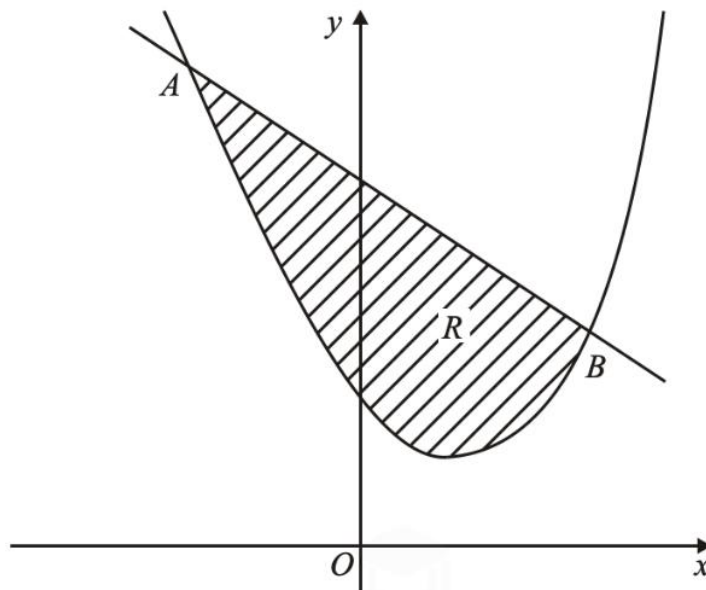
- (b) show that the x -coordinate of Q is 5,

(1)

- (c) find an equation for C .

(4)

Question 14



The diagram above shows the line with equation $y = 9 - x$ and the curve with equation $y = x^2 - 2x + 3$. The line and the curve intersect at the points A and B , and O is the origin.

- (a) Calculate the coordinates of A and the coordinates of B .

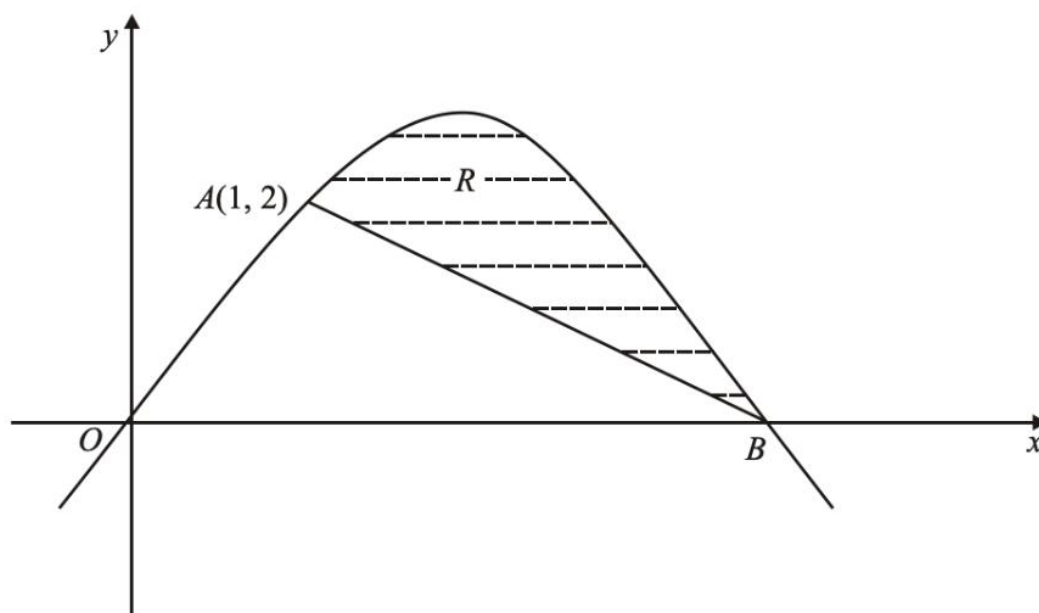
(5)

The shaded region R is bounded by the line and the curve.

- (b) Calculate the area of R .

(7)

Question 15



The curve C , shown above, has equation $y = 3x - x^2$. It passes through the origin O and the point B on the x -axis.

- (a) Find, in the form $ax + by + c = 0$, an equation of the normal to C at the point $A(1, 2)$.

(5)

- (b) Show that this normal passes through the point B .

(2)

The shaded region R is bounded by the curve and the line AB .

- (c) Find, by integration, the area of R .

(7)

Question 16

Solve

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(a) $5^x = 8$, giving your answers to 3 significant figures,

(3)

(b) $\log_2(x + 1) - \log_2 x = \log_2 7$.

(3)

Question 17

Solve the equation $5^{2x} - 12(5^x) + 35 = 0$.

(4)

Question 17

A heated metal ball is dropped into a liquid. As the ball cools, its temperature, T °C, t minutes after it enters the liquid, is given by

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$$T = 400 e^{-0.05t} + 25, t \geq 0.$$

- (a) Find the temperature of the ball as it enters the liquid. (1)
- (b) Find the value of t for which $T = 300$, giving your answer to 3 significant figures. (4)
- (c) Find the rate at which the temperature of the ball is decreasing at the instant when $t = 50$. Give your answer in °C per minute to 3 significant figures. (3)
- (d) From the equation for temperature T in terms of t , given above, explain why the temperature of the ball can never fall to 20 °C. (1)

Question 18

Rabbits were introduced onto an island. The number of rabbits, P , t years after they were introduced is modelled by the equation

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$$P = 80e^{\frac{1}{5}t} \quad t \in \mathbb{R}, t \geq 0$$

- (a) Write down the number of rabbits that were introduced to the island.

(1)

- (b) Find the number of years it would take for the number of rabbits to first exceed 1000.

(2)

- (c) Find $\frac{dP}{dt}$.

(2)

- (d) Find P when $\frac{dP}{dt} = 50$.

(3)