Edexcel

Pure Mathematics

Year 1

Integration 2

Past paper questions from Core Maths 2 and IAL C12

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Past paper questions from

Edexcel Core Maths 2 and IAL C12.

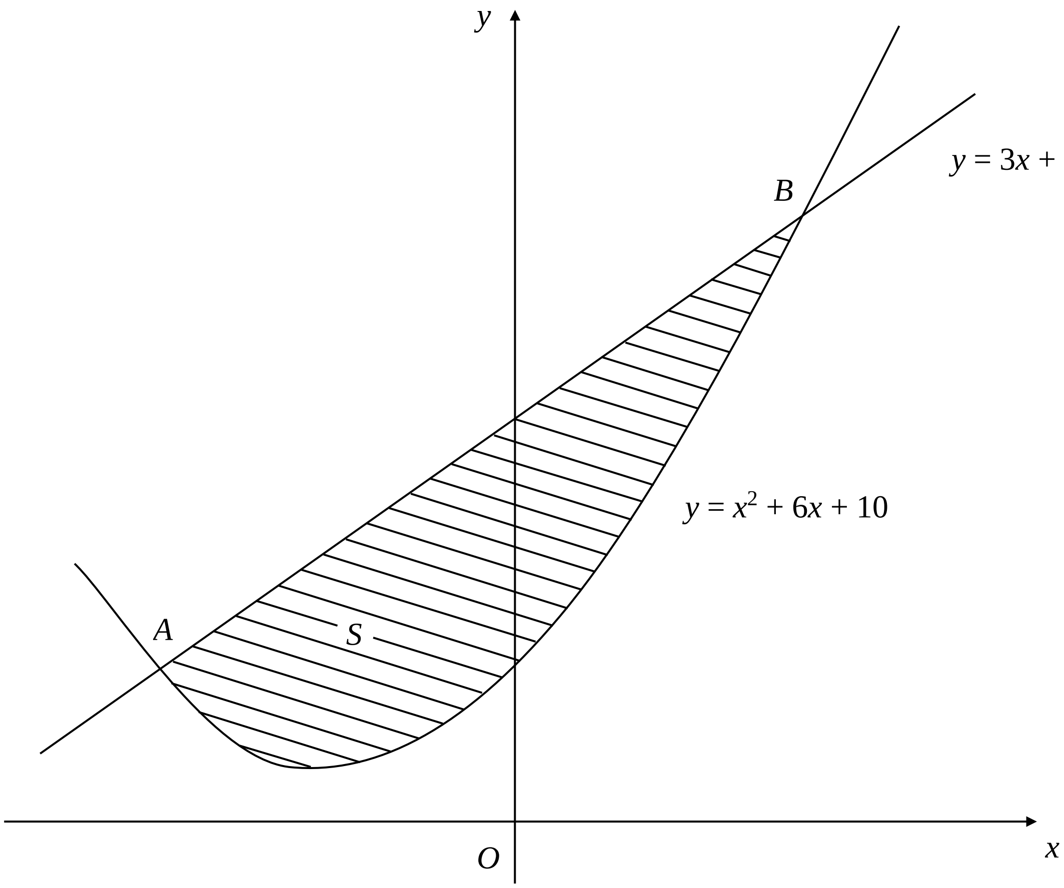
From Jan 2005 to May 2019.

Integration 02

This Section 1 has 54 Questions on application on integration, area under the curves.

Please check the Edexcel website for the solutions.

1. **Figure 2**



The line with equation $y = 3x + 20$ cuts the curve with equation $y = x^2 + 6x + 10$ at the points A and B, as shown in Figure 2.

(a) Use algebra to find the coordinates of A and the coordinates of B.

(5)

The shaded region S is bounded by the line and the curve, as shown in Figure 2.

(b) Use calculus to find the exact area of S.

(7)

(C2 Jan 2005, Q8)

2. Evaluate $\int_1^8 \frac{1}{\sqrt{x}}\,dx$, giving your answer in the form $a + b\sqrt{2}$, where a and b are integers.

(4)

(C2 May 2007, Q1)

3. **Figure 1**

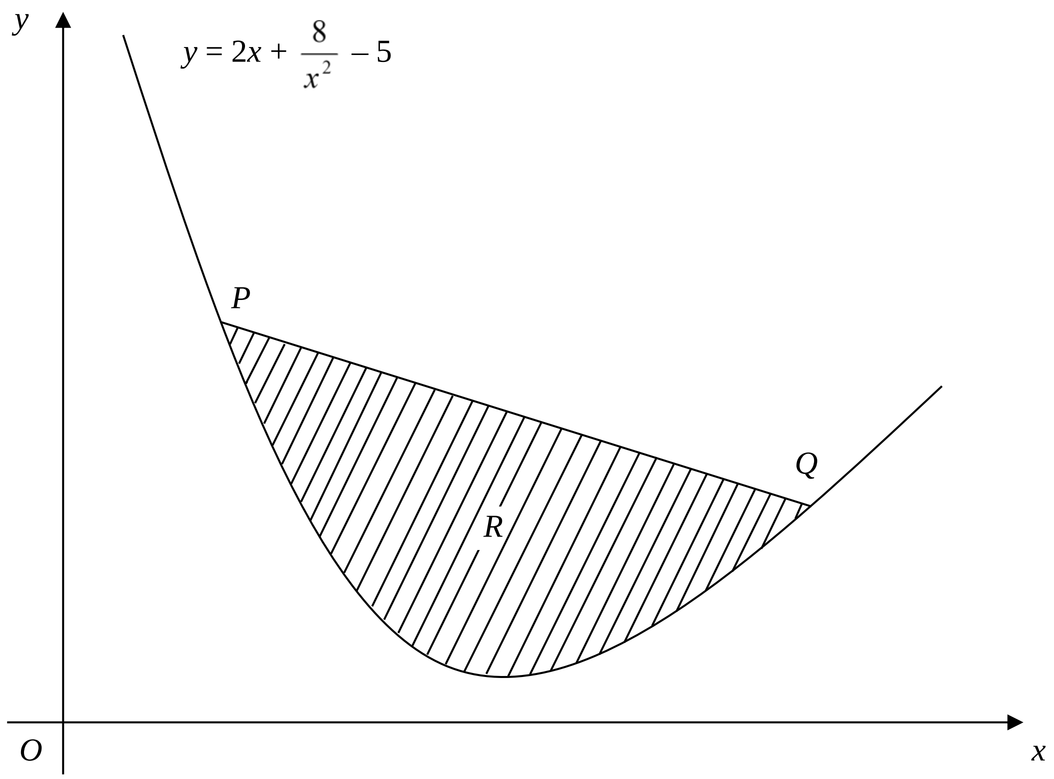


Figure 1 shows part of a curve C with equation $y = 2x + \frac{8}{x^2} - 5$, $x > 0$.

The points P and Q lie on C and have x-coordinates 1 and 4 respectively. The region R, shaded in Figure 1, is bounded by C and the straight line joining P and Q.

(*a*) Find the exact area of R.

(8)

(*b*) Use calculus to show that y is increasing for $x > 2$.

(4)

(C2 June 2005, Q10)

4. Use calculus to find the exact value of $\int_1^2 \left(3x^2 + 5 + \frac{4}{x^2}\right) \mathrm{d}x$.

(5)

(C2 May 2006, Q2)

5. **Figure 3**

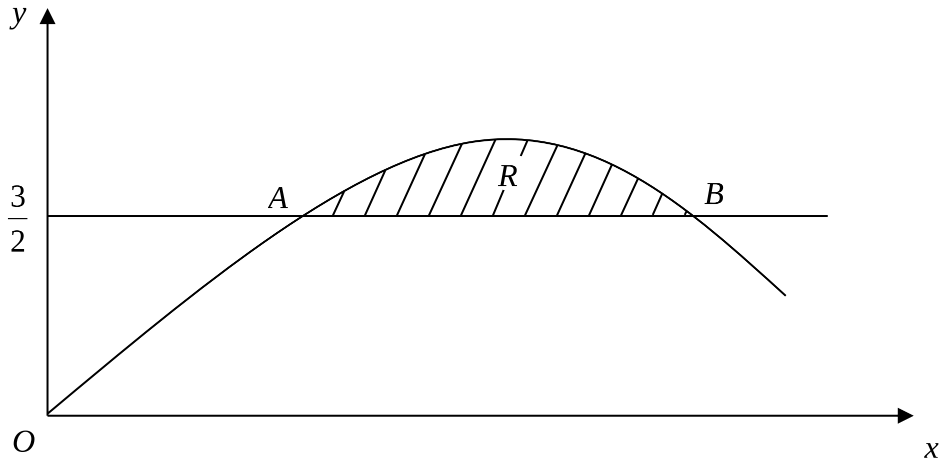


Figure 3 shows the shaded region R which is bounded by the curve $y = -2x^2 + 4x$ and the line $y = \frac{3}{2}$. The points A and B are the points of intersection of the line and the curve.

Find

(a) the x-coordinates of the points A and B,

(4)

(b) the exact area of R.

(6)

(C2 Jan 2006, Q9)

6. $$\mathrm{f}(x) = x^3 + 3x^2 + 5.$$

Find

(a) $\mathrm{f}''(x)$,

(3)

(b) $\int_1^2 \mathrm{f}(x)\ \mathrm{d}x$. **(4)**

(C2 Jan 2007, Q1)

7. **Figure 3**

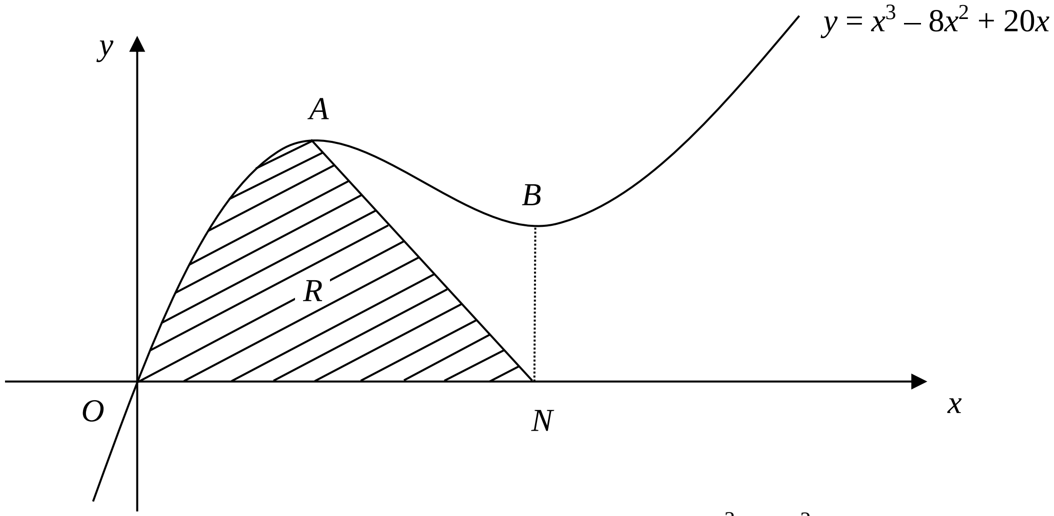


Figure 3 shows a sketch of part of the curve with equation $y = x^3 - 8x^2 + 20x$. The curve has stationary points A and B.

(*a*) Use calculus to find the x-coordinates of A and B.

(4)

(*b*) Find the value of $\frac{d^2y}{dx^2}$ at A, and hence verify that A is a maximum.

(2)

The line through B parallel to the y-axis meets the x-axis at the point N. The region R, shown shaded in Figure 3, is bounded by the curve, the x-axis and the line from A to N.

(*c*) Find $\int (x^3 - 8x^2 + 20x) \; dx$. **(3)**

(*d*) Hence calculate the exact area of R.

(5)

(C2 May 2006, Q10)

8. Use calculus to find the value of

$$\int_1^4 (2x + 3\sqrt{x}) \; dx.$$

(5)

(C2 June 2009, Q1)

9. **Figure 1**

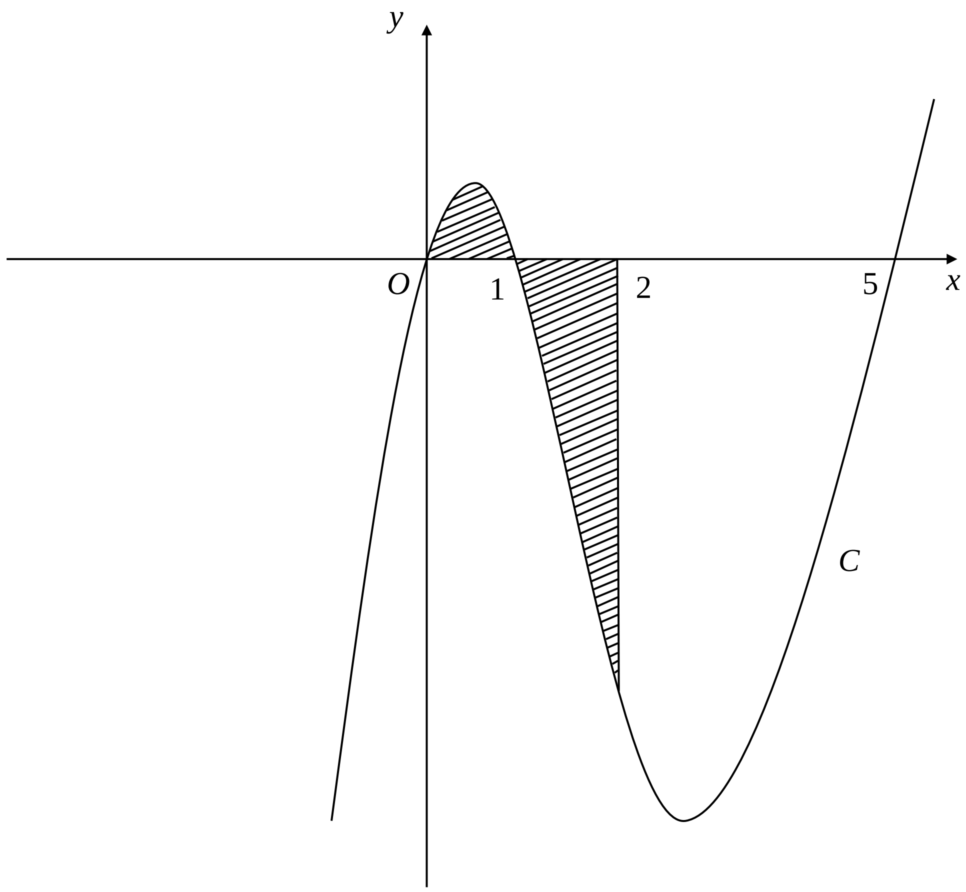


Figure 1 shows a sketch of part of the curve C with equation

$$y = x(x - 1)(x - 5).$$

Use calculus to find the total area of the finite region, shown shaded in Figure 1, that is between $x = 0$ and $x = 2$ and is bounded by C, the x-axis and the line $x = 2$.

(9)

(C2 Jan 2007, Q7)

10. Use integration to find

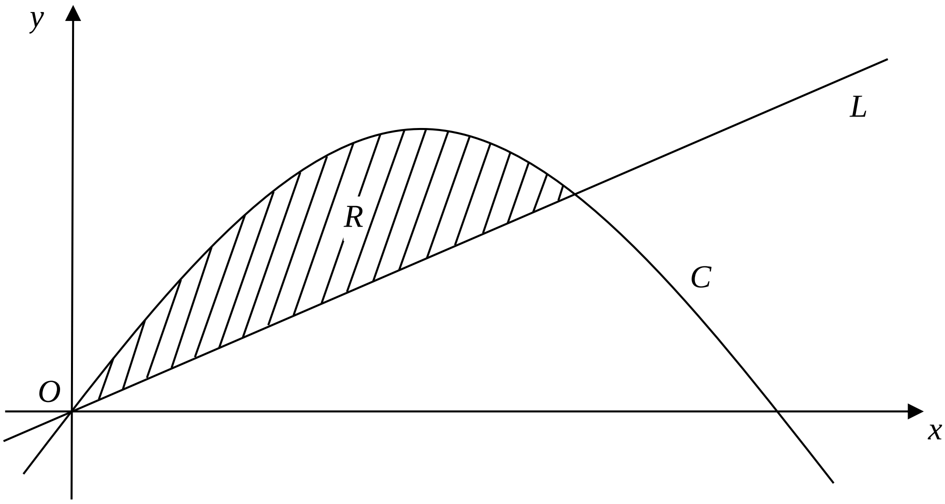
$$\int_1^{\sqrt{3}} \left(\frac{x^3}{6} + \frac{1}{3x^2} \right) dx,$$

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

(5)

(C2 May 2014, Q4)

11. **Figure 2**



In Figure 2 the curve C has equation $y = 6x - x^2$ and the line L has equation $y = 2x$.

(*a*) Show that the curve C intersects with the x-axis at $x = 0$ and $x = 6$.

(1)

(*b*) Show that the line L intersects the curve C at the points (0, 0) and (4, 8).

(3)

The region R, bounded by the curve C and the line L, is shown shaded in Figure 2.

(*c*) Use calculus to find the area of R.

(6)

(C2 Jan 2008, Q7)

12.

$$\mathrm{f}(x) = \frac{8}{x^2} - 4\sqrt{x} + 3x - 1, \qquad x > 0$$

Giving your answers in their simplest form, find

(*a*) $\mathrm{f}'(x)$

(3)

(*b*) $\int \mathrm{f}(x)\,\mathrm{d}x$

(4)

(IAL C12 Jan 2014, Q2)

13.

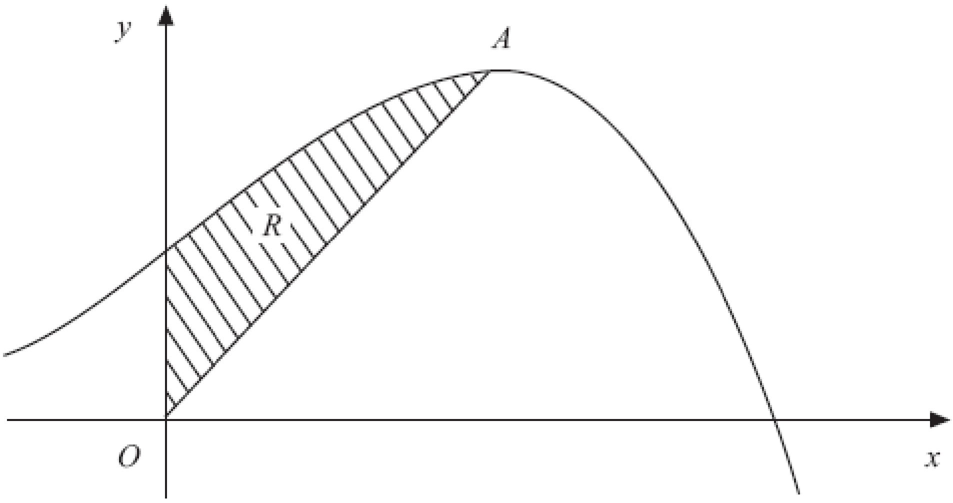


Figure 2

Figure 2 shows a sketch of part of the curve with equation $y = 10 + 8x + x^2 - x^3$.

The curve has a maximum turning point *A*.

(*a*) Using calculus, show that the *x*-coordinate of *A* is 2.

(3)

The region *R*, shown shaded in Figure 2, is bounded by the curve, the *y*-axis and the line from *O* to *A*, where *O* is the origin.

(*b*) Using calculus, find the exact area of *R*.

(8)

(C2 June 2008, Q8)

14. (i) A curve with equation $y = f(x)$ passes through the point (2, 3).

Given that

$$f'(x) = \frac{4}{x^3} + 2x - 1$$

find the value of f(1).

(5)

(ii) Given that

$$\int_1^4 \left(3\sqrt{x} + A\right) dx = 21$$

find the exact value of the constant *A*.

(5)

(IAL C12 May 2014, Q7)

15.

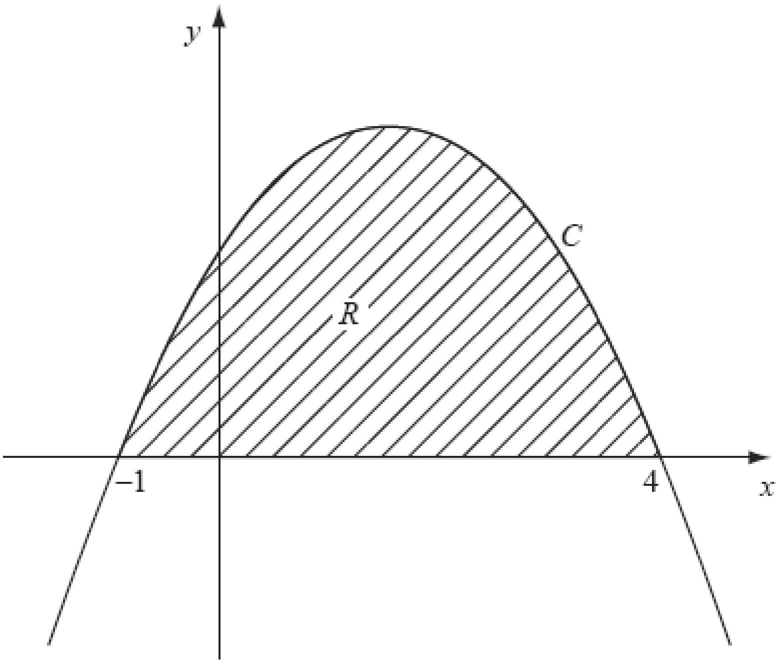


Figure 1

Figure 1 shows part of the curve C with equation $y = (1 + x)(4 - x)$.

The curve intersects the x-axis at $x = -1$ and $x = 4$. The region R, shown shaded in Figure 1, is bounded by C and the x-axis.

Use calculus to find the exact area of R.

(5)

(C2 Jan 2009, Q2)

16. The curve C has equation $y = f(x)$, $x > 0$, where

$$f'(x) = 3\sqrt{x} - \frac{9}{\sqrt{x}} + 2$$

Given that the point P (9, 14) lies on C,

(*a*) find f(x), simplifying your answer,

(6)

(*b*) find an equation of the normal to C at the point P, giving your answer in the form $ax + by + c = 0$ where a, b and c are integers.

(5)

(IAL C12 May 2015, Q11)

17.

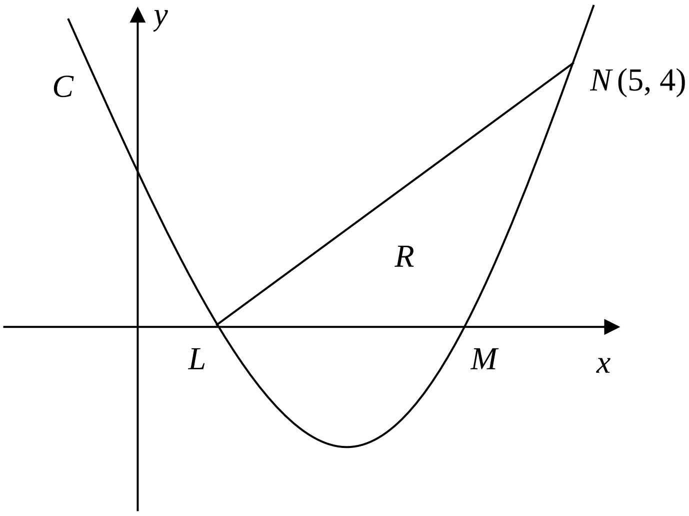


Figure 2

The curve C has equation $y = x^2 - 5x + 4$. It cuts the x-axis at the points L and M as shown in Figure 2.

(a) Find the coordinates of the point L and the point M.

(2)

(b) Show that the point $N(5, 4)$ lies on C.

(1)

(c) Find $\int (x^2 - 5x + 4) \; \mathrm{d}x$.

(2)

The finite region R is bounded by LN, LM and the curve C as shown in Figure 2.

(d) Use your answer to part (c) to find the exact value of the area of R.

(5)

(C2 Jan 2010, Q7)

18. Find, using calculus and showing each step of your working,

$$\int_1^4 \left(6x - 3 - \frac{2}{\sqrt{x}}\right) \mathrm{d}x$$

(5)

(IAL C12 Jan 2016, Q3)

19.

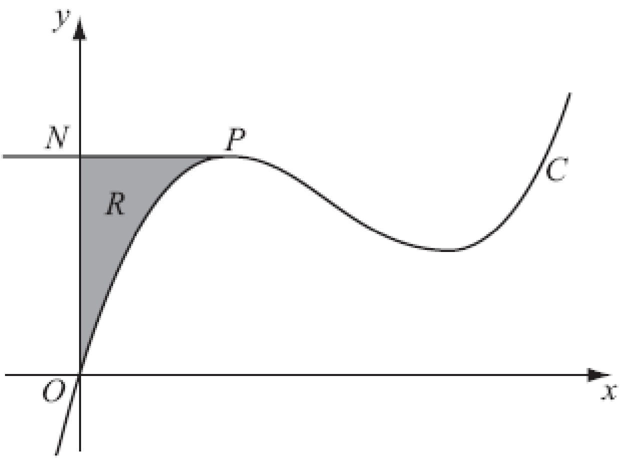


Figure 2

Figure 2 shows a sketch of part of the curve C with equation

$$y = x^3 - 10x^2 + kx,$$

where k is a constant.

The point P on C is the maximum turning point.

Given that the x-coordinate of P is 2,

(a) show that $k = 28$.

(3)

The line through P parallel to the x-axis cuts the y-axis at the point N.
The region R is bounded by C, the y-axis and PN, as shown shaded in Figure 2.

(b) Use calculus to find the exact area of R.

(6)

(C2 June 2010, Q8)

20. (a) Show that $\dfrac{x^2 - 4}{2\sqrt{x}}$ can be written in the form $Ax^p + Bx^q$, where A, B, p and q are constants to be determined.

(3)

(b) Hence find

$$\int \frac{x^2 - 4}{2\sqrt{x}}\,dx, \quad x > 0$$

giving your answer in its simplest form.

(4)

(IAL C12 May 2016, Q6)

21.

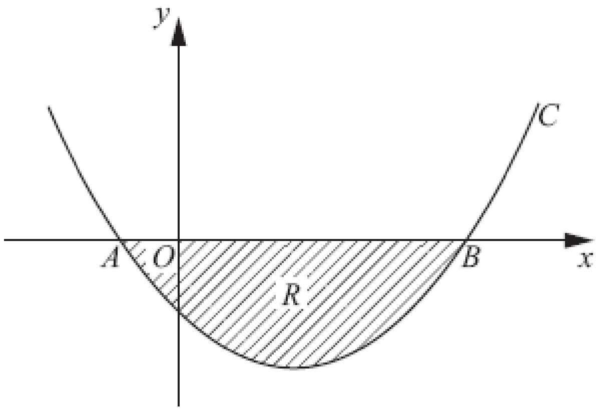


Figure 1

Figure 1 shows a sketch of part of the curve C with equation

$$y = (x + 1)(x - 5).$$

The curve crosses the x-axis at the points A and B.

(a) Write down the x-coordinates of A and B.

(1)

The finite region R, shown shaded in Figure 1, is bounded by C and the x-axis.

(b) Use integration to find the area of R.

(6)

(C2 Jan 2011, Q4)

22. $$\mathrm{f}(x) = 3x^2 + x - \frac{4}{\sqrt{x}} + 6x^{-3}, \quad x > 0$$

Find $\int \mathrm{f}(x)\mathrm{d}x$, simplifying each term.

(5)

(IAL C12 Oct 2016, Q1)

23.

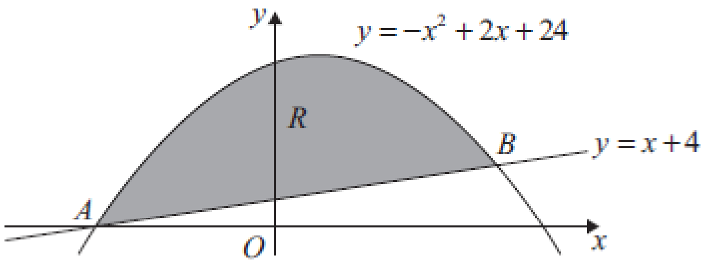


Figure 3

The straight line with equation $y = x + 4$ cuts the curve with equation $y = -x^2 + 2x + 24$ at the points A and B, as shown in Figure 3.

(*a*) Use algebra to find the coordinates of the points A and B.

(4)

The finite region R is bounded by the straight line and the curve and is shown shaded in Figure 3.

(*b*) Use calculus to find the exact area of R.

(7)

(C2 May 2011, Q9)

24. (i) Find

$$\int \frac{2 + 4x^3}{x^2}\,dx$$

giving each term in its simplest form.

(4)

(ii) Given that k is a constant and

$$\int_2^4 \left(\frac{4}{\sqrt{x}} + k\right) dx = 30$$

find the exact value of k.

(5)

(IAL C12 Jan2016, Q7)

25.

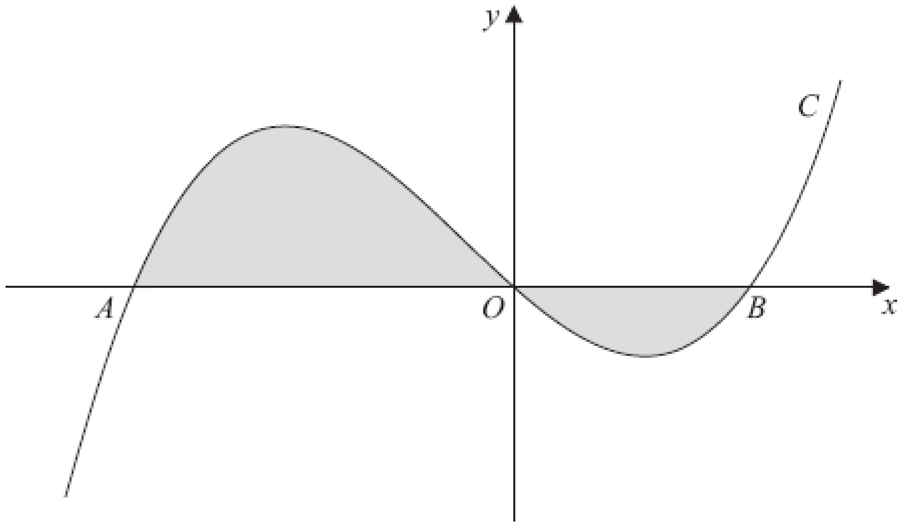


Figure 3

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

$$y = x(x + 4)(x - 2).$$

The curve C crosses the x-axis at the origin O and at the points A and B.

(*a*) Write down the x-coordinates of the points A and B.

(1)

The finite region, shown shaded in Figure 3, is bounded by the curve C and the x-axis.

(*b*) Use integration to find the total area of the finite region shown shaded in Figure 3.

(7)

(C2 May 2013, Q6)

26. (*a*) Find $\int (3x^2 + 4x - 15)\,\mathrm{d}x$, simplifying each term.

(3)

Given that b is a constant and

$$\int_b^4 (3x^2 + 4x - 15)\,\mathrm{d}x = 36$$

(*b*) show that $b^3 + 2b^2 - 15b = 0$

(2)

(*c*) Hence find the possible values of b.

(3)

(IAL C12 May 2017, Q8)

27.

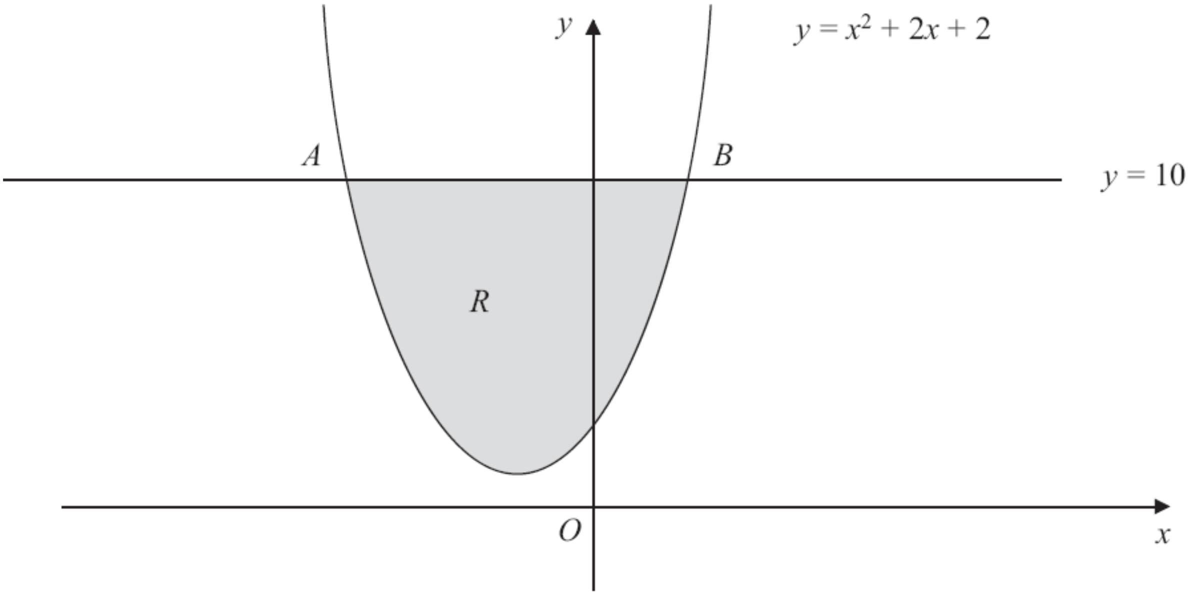


Figure 1

The line with equation $y = 10$ cuts the curve with equation $y = x^2 + 2x + 2$ at the points A and B as shown in Figure 1. The figure is not drawn to scale.

(a) Find by calculation the x-coordinate of A and the x-coordinate of B.

(2)

The shaded region R is bounded by the line with equation $y = 10$ and the curve as shown in Figure 1.

(b) Use calculus to find the exact area of R.

(7)

(C2 May 2013_R, Q7)

28. (a) Express $\frac{x^3 + 4}{2x^2}$ in the form $Ax^p + Bx^q$, where A, B, p and q are constants.

(3)

(b) Hence find

$$\int \frac{x^3 + 4}{2x^2} \mathrm{d}x$$

simplifying your answer.

(3)

(IAL C12 Oct 2017, Q3)

29.

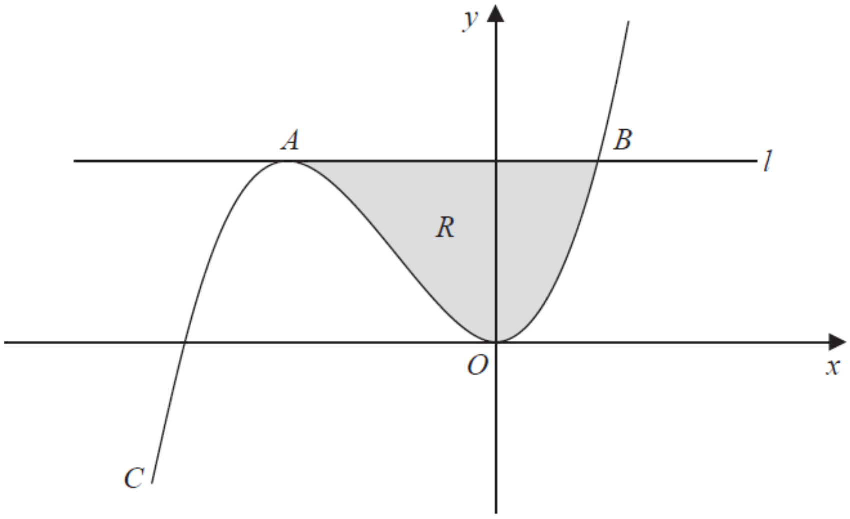


Figure 3

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

$$y = \frac{1}{8}x^3 + \frac{3}{4}x^2, \qquad x \in \mathbb{R}$$

The curve C has a maximum turning point at the point A and a minimum turning point at the origin O.

The line l touches the curve C at the point A and cuts the curve C at the point B.

The x coordinate of A is –4 and the x coordinate of B is 2.

The finite region R, shown shaded in Figure 3, is bounded by the curve C and the line l.

Use integration to find the area of the finite region R.

(7)

(C2 May 2014_R, Q6)

30. Given that

$$y = \frac{2x^{\frac{2}{3}} + 3}{6}, \qquad x > 0$$

find, in the simplest form,

(*a*) $\frac{dy}{dx}$

(2)

(*b*) $\int y \, dx$

(3)

(IAL C12 Jan 2018, Q1)

31. (*a*) Find

$$\int 10x(x^{\frac{1}{2}} - 2)\ \ dx,$$

giving each term in its simplest form.

(4)

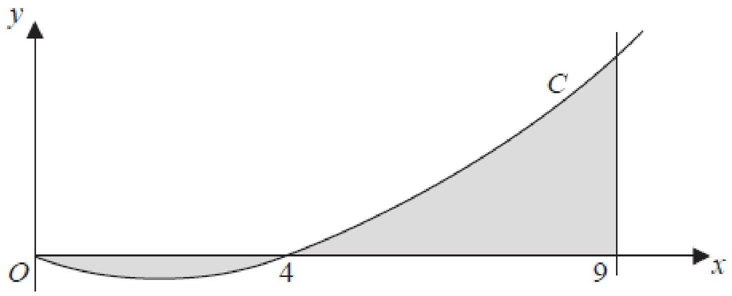


Figure 2

Figure 2 shows a sketch of part of the curve *C* with equation

$$y = 10x(x^{\frac{1}{2}} - 2), \qquad x \geq 0.$$

The curve *C* starts at the origin and crosses the *x*-axis at the point (4, 0).

The area, shown shaded in Figure 2, consists of two finite regions and is bounded by the curve *C*, the *x*-axis and the line $x = 9$.

(*b*) Use your answer from part (*a*) to find the total area of the shaded regions.

(5)

(C2 May 2015, Q6)

32. The curve *C* has equation $y = f(x)$, $x > 0$, where

$$f'(x) = \frac{5x^2 + 4}{2\sqrt{x}} - 5$$

It is given that the point $P(4, 14)$ lies on *C*.

(*a*) Find f(*x*), writing each term in a simplified form.

(6)

(*b*) Find the equation of the tangent to *C* at the point *P*, giving your answer in the form $y = mx + c$, where *m* and *c* are constants.

(4)

(IAL C12 May 2018, Q11)

33.

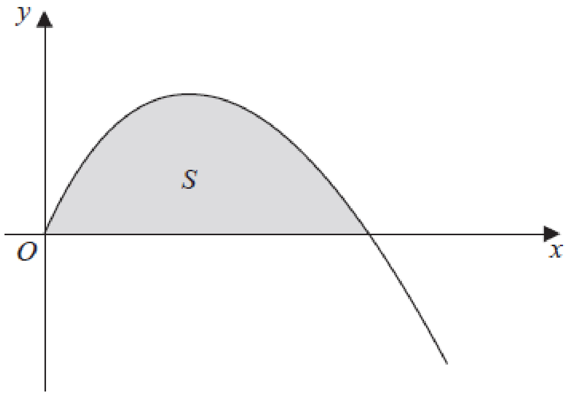


Figure 3

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

$$y = 3x - x^{\frac{3}{2}} \qquad x \geq 0 .$$

The finite region S, bounded by the x-axis and the curve, is shown shaded in Figure 3.

(a) Find

$$\int \left(3x - x^{\frac{3}{2}}\right) \mathrm{d}x .$$

(3)

(b) Hence find the area of S.

(3)

(C2 May 2016, Q7)

34. Given that $y = 2x^3 - \dfrac{5}{3x^2} + 7, \quad x \neq 0,$ find in its simplest form

(a) $\dfrac{\mathrm{d}y}{\mathrm{d}x}$,

(3)

(b) $\int y \, \mathrm{d}x$.

(4)

(IAL C12 Oct 2018, Q3)

35.

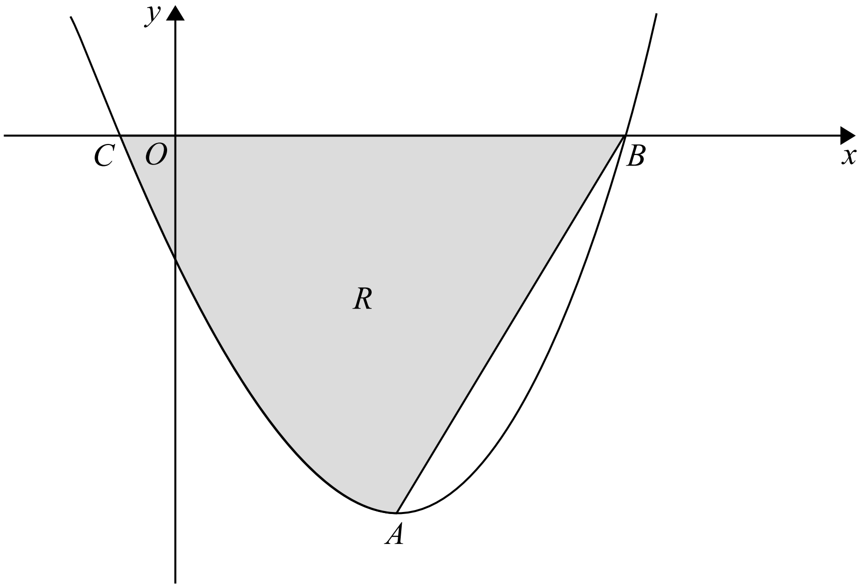


Figure 2

Figure 2 shows a sketch of part of the curve with equation

$$y = 4x^3 + 9x^2 - 30x - 8, \qquad -0.5 \leqslant x \leqslant 2.2$$

The curve has a turning point at the point A.

(a) Using calculus, show that the x coordinate of A is 1

(3)

The curve crosses the x-axis at the points B (2, 0) and $C\left(-\frac{1}{4}, 0\right)$

The finite region R, shown shaded in Figure 2, is bounded by the curve, the line AB, and the x-axis.

(b) Use integration to find the area of the finite region R, giving your answer to 2 decimal places.

(7)

(C2 May 2017, Q10)

36. Given $k > 3$ and

$$\int_3^k \left(2x + \frac{6}{x^2}\right) \mathrm{d}x = 10k$$

show that $k^3 - 10k^2 - 7k - 6 = 0$

(5)

(IAL C12 Jan 2019, Q8)

37.

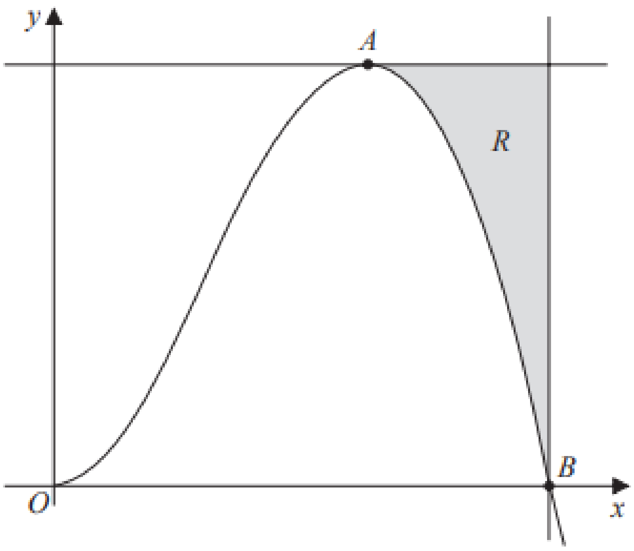


Figure 3

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

$$y = 7x^2(5 - 2\sqrt{x}), \qquad x \geqslant 0$$

The curve has a turning point at the point A, where $x > 0$, as shown in Figure 3.

(a) Using calculus, find the coordinates of the point A.

(5)

The curve crosses the x-axis at the point B, as shown in Figure 3.

(b) Use algebra to find the x coordinate of the point B.

(2)

The finite region R, shown shaded in Figure 3, is bounded by the curve, the line through A parallel to the x-axis and the line through B parallel to the y-axis.

(c) Use integration to find the area of the region R, giving your answer to 2 decimal places.

(5)

(C2 May 2018, Q9)

38. Find

$$\int \left(\frac{1}{2x^3} + 3x^{\frac{1}{2}} - 6 \right) \mathrm{d}x \qquad\qquad x > 0$$

writing each term as simply as possible.

(4)

(IAL C12 Oct 2019, Q1)

39.

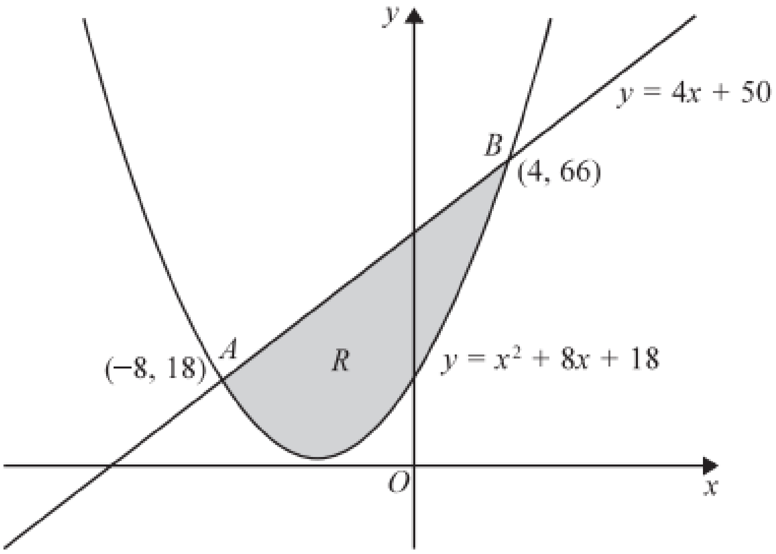


Figure 2

Figure 2 shows the line with equation $y = 4x + 50$ and the curve with equation $y = x^2 + 8x + 18$. The line cuts the curve at the points A $(-8, 18)$ and B $(4, 66)$.

The shaded region R is bounded by the line and the curve, as shown in Figure 2.

Using calculus, find the area of R.

(6)

(C2 May 2019, Q6)

40.

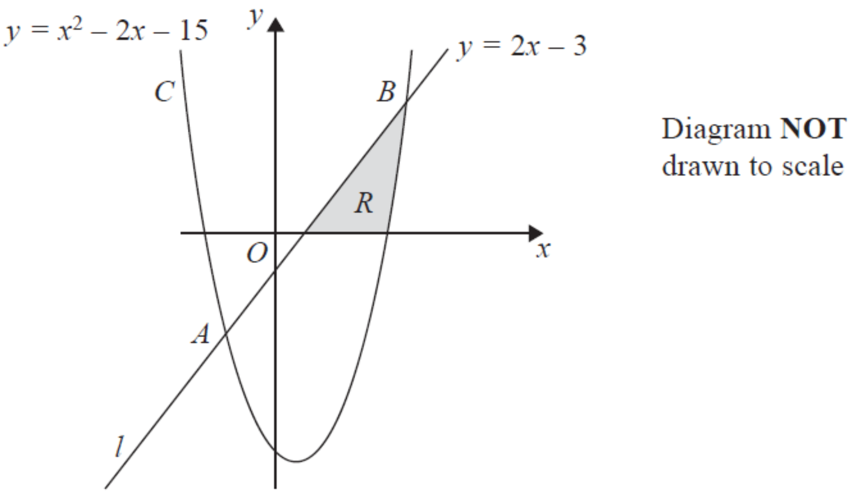


Figure 2

Figure 2 shows part of the line l with equation $y = 2x - 3$ and part of the curve C with equation $y = x^2 - 2x - 15$.

The line l and the curve C intersect at the points A and B as shown.

(*a*) Use algebra to find the coordinates of A and the coordinates of B.

(5)

In Figure 2, the shaded region R is bounded by the line l, the curve C and the positive x-axis.

(*b*) Use integration to calculate an exact value for the area of R.

(7)

(IAL C12 Jan 2014, Q14)

41.

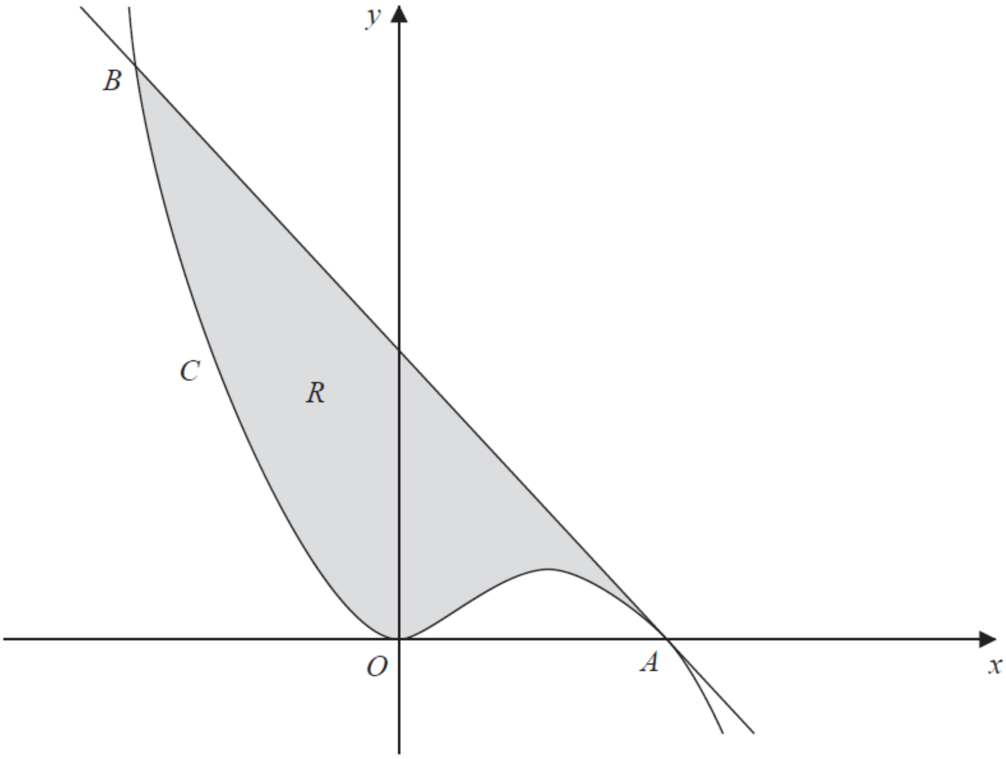


Figure 5

Figure 5 shows a sketch of part of the curve C with equation $y = x^2 - \frac{1}{3}x^3$.

C touches the x-axis at the origin and cuts the x-axis at the point A.

(a) Show that the coordinates of A are (3, 0).

(1)

(b) Show that the equation of the tangent to C at the point A is $y = -3x + 9$.

(5)

The tangent to C at A meets C again at the point B, as shown in Figure 5.

(c) Use algebra to find the x coordinate of B.

(4)

The region R, shown shaded in Figure 5, is bounded by the curve C and the tangent to C at A.

(d) Find, by using calculus, the area of region R.

(*Solutions based entirely on graphical or numerical methods are not acceptable.*)

(5)

(IAL C12 May 2014, Q12)

42.

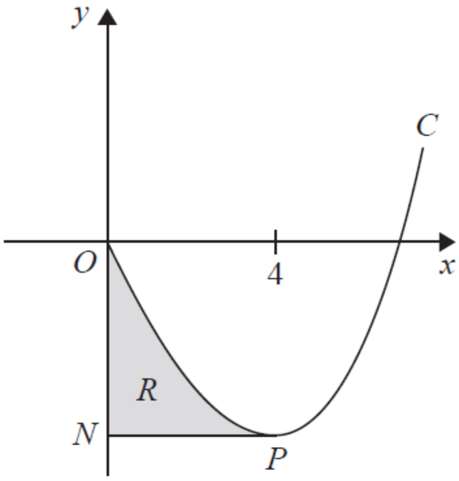


Figure 5

Figure 5 shows a sketch of part of the curve C with equation

$$y = x^3 + 10x^{\frac{3}{2}} + kx, \quad x \geq 0$$

where k is a constant.

(a) Find $\frac{\mathrm{d}y}{\mathrm{d}x}$

(2)

The point P on the curve C is a minimum turning point.
Given that the x coordinate of P is 4,

(b) show that $k = -78$.

(2)

The line through P parallel to the x-axis cuts the y-axis at the point N.

The finite region R, shown shaded in Figure 5, is bounded by C, the y-axis and PN.

(c) Use integration to find the area of R.

(7)

(IAL C12 Jan 2015, Q15)

43.

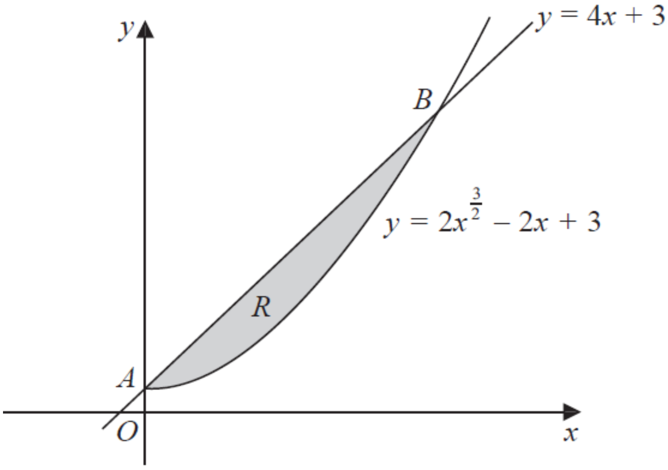


Figure 3

The finite region R, which is shown shaded in Figure 3, is bounded by the straight line l with equation $y = 4x + 3$ and the curve C with equation

$y = 2x^{\frac{3}{2}} - 2x + 3,\ x \geq 0$

The line l meets the curve C at the point A on the y-axis and l meets C again at the point B, as shown in Figure 3.

(a) Use algebra to find the coordinates of A and B.

(4)

(b) Use integration to find the area of the shaded region R.

(6)

(IAL C12 May 2015, Q14)

44.

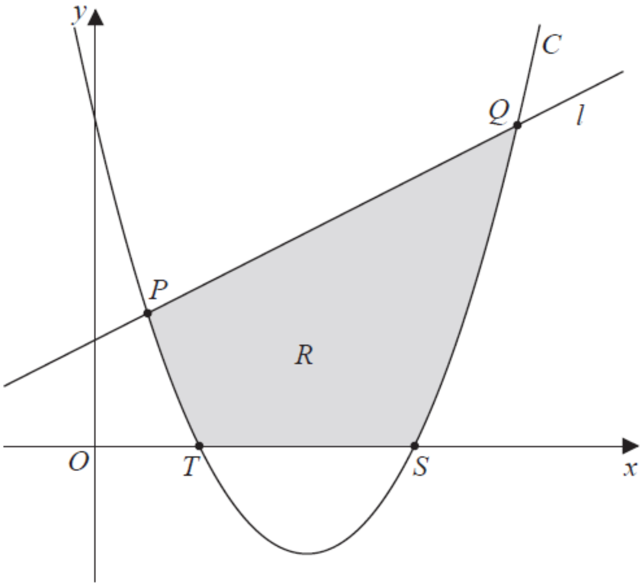


Figure 2

The straight line l with equation $y = \frac{1}{2}x + 1$ cuts the curve C, with equation $y = x^2 - 4x + 3$, at the points P and Q, as shown in Figure 2.

(*a*) Use algebra to find the coordinates of the points P and Q.

(5)

The curve C crosses the x-axis at the points T and S.

(*b*) Write down the coordinates of the points T and S.

(2)

The finite region R is shown shaded in Figure 2. This region R is bounded by the line segment PQ, the line segment TS, and the arcs PT and SQ of the curve.

(*c*) Use integration to find the exact area of the shaded region R.

(8)

(IAL C12 Jan 2016, Q6)

45.

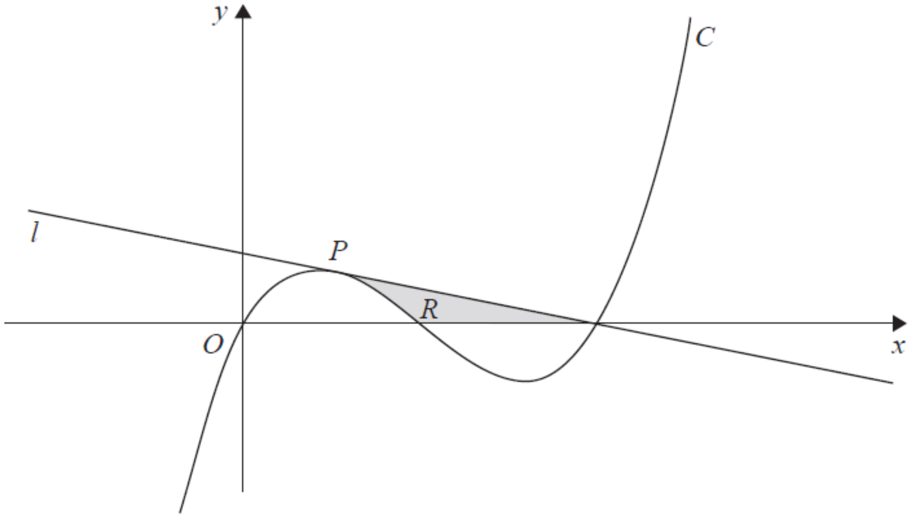


Figure 6

Figure 6 shows a sketch of part of the curve C with equation

$$y = x(x-1)(x-2)$$

The point P lies on C and has x coordinate $\frac{1}{2}$

The line l, as shown on Figure 6, is the tangent to C at P.

(*a*) Find $\frac{\mathrm{d}y}{\mathrm{d}x}$

(2)

(*b*) Use part (*a*) to find an equation for l in the form $ax + by = c$, where a, b and c are integers.

(4)

The finite region R, shown shaded in Figure 6, is bounded by the line l, the curve C and the x-axis.

The line l meets the curve again at the point (2, 0)

(*c*) Use integration to find the exact area of the shaded region R.

(6)

(IAL C12 May 2016, Q16)

46.

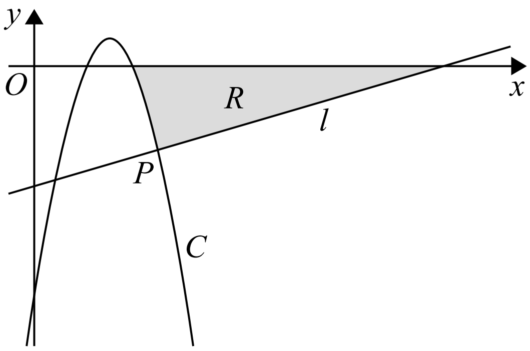


Figure 3

Figure 3 shows a sketch of the curve C with equation $y = -x^2 + 6x - 8$. The normal to C at the point $P(5, -3)$ is the line l, which is also shown in Figure 3.

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

(5)

The finite region R, shown shaded in Figure 3, is bounded below by the line l and the curve C, and is bounded above by the x-axis.

(*b*) Find the exact value of the area of R.

(6)

(IAL C12 Oct 2016, Q14)

47.

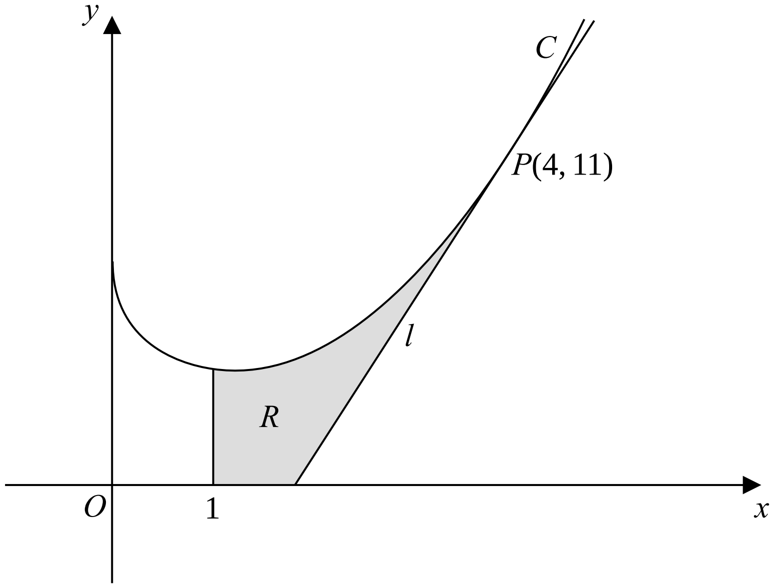


Figure 4

Figure 4 shows a sketch of part of the curve C with equation

$$y = \frac{3}{4}x^2 - 4\sqrt{x} + 7, \quad x > 0$$

The point P lies on C and has coordinates (4, 11).

Line l is the tangent to C at the point P.

(a) Use calculus to show that l has equation $y = 5x - 9$

(5)

The finite region R, shown shaded in Figure 4, is bounded by the curve C, the line $x = 1$, the x-axis and the line l.

(b) Find, by using calculus, the area of R, giving your answer to 2 decimal places.

(6)

(IAL C12 Jan 2017, Q12)

48.

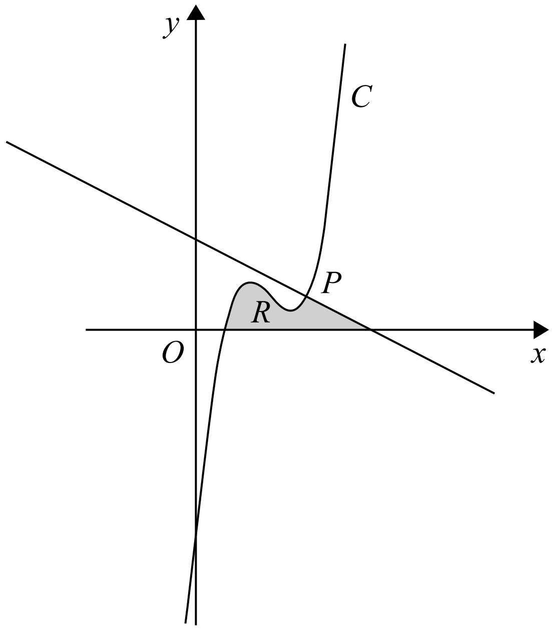


Figure 4

Figure 4 shows a sketch of part of the curve C with equation

$$y = x^3 - 9x^2 + 26x - 18$$

The point P (4, 6) lies on C.

(a) Use calculus to show that the normal to C at the point P has equation

$$2y + x = 16$$

(5)

The region R, shown shaded in Figure 4, is bounded by the curve C, the x-axis and the normal to C at P.

(b) Show that C cuts the x-axis at (1, 0)

(1)

(c) Showing all your working, use calculus to find the exact area of R.

(6)

(IAL C12 May 2017, Q12)

49.

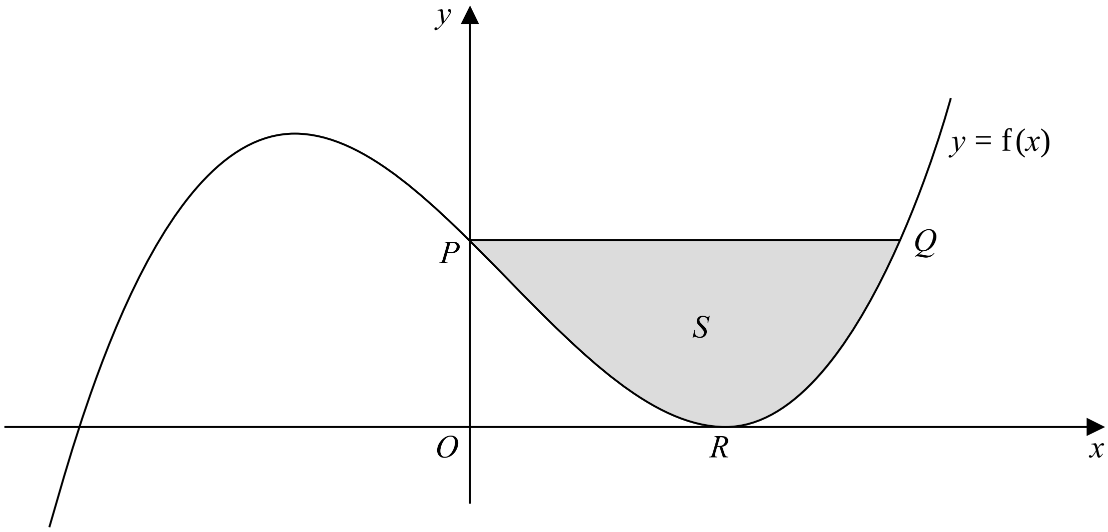


Figure 5

Figure 5 shows a sketch of part of the graph $y = \mathrm{f}(x)$, where

$$\mathrm{f}(x) = \frac{(x-3)^2(x+4)}{2}, \qquad x \in \mathbb{R}$$

The graph cuts the y-axis at the point P and meets the positive x-axis at the point R, as shown in Figure 5.

(*a*) (i) State the y coordinate of P.

(ii) State the x coordinate of R.

(2)

The line segment PQ is parallel to the x-axis. Point Q lies on $y = \mathrm{f}(x)$, $x > 0$

(*b*) Use algebra to show that the x coordinate of Q satisfies the equation

$$x^2 - 2x - 15 = 0$$

(3)

(*c*) Use part (*b*) to find the coordinates of Q.

(3)

The region S, shown shaded in Figure 5, is bounded by the curve $y = \mathrm{f}(x)$ and the line segment PQ.

(*d*) Use calculus to find the exact area of S.

(6)

(IAL C12 Oct 2017, Q15)

50.

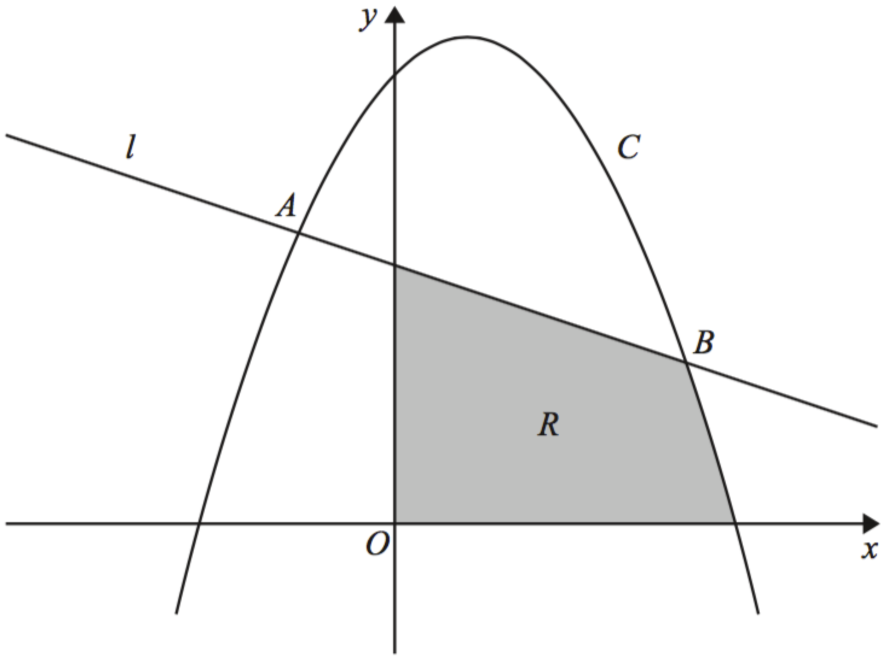


Figure 5

Figure 5 shows a sketch of part of the line l with equation $y = 8 - x$ and part of the curve C with equation $y = 14 + 3x - 2x^2$

The line l and the curve C intersect at the point A and the point B as shown.

(a) Use algebra to find the coordinates of A and the coordinates of B.

(5)

The region R, shown shaded in Figure 5, is bounded by the coordinate axes, the line l, and the curve C.

(b) Use algebraic integration to calculate the exact area of R.

(8)

(IAL C12 Jan 2018, Q14)

51.

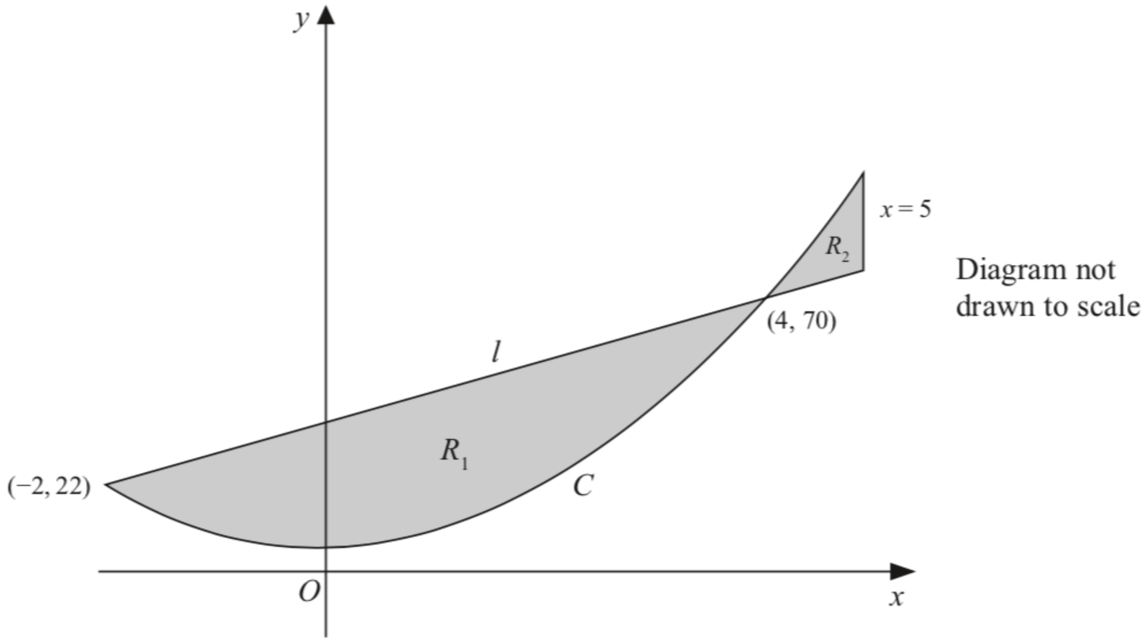


Figure 3

A design for a logo consists of two finite regions R_1 and R_2, shown shaded in Figure 3.

The region R_1 is bounded by the straight line l and the curve C.

The region R_2 is bounded by the straight line l, the curve C and the line with equation $x = 5$

The line l has equation $y = 8x + 38$

The curve C has equation $y = 4x^2 + 6$

Given that the line l meets the curve C at the points (–2, 22) and (4, 70),
use integration to find

(*a*) the area of the larger lower region, labelled R_1

(6)

(*b*) the exact value of the total area of the two shaded regions.

(3)

Given that

$$\frac{\text{Area of } R_1}{\text{Area of } R_2} = k$$

(*c*) find the value of k.

(1)

(IAL C12 May 2018, Q15)

52.

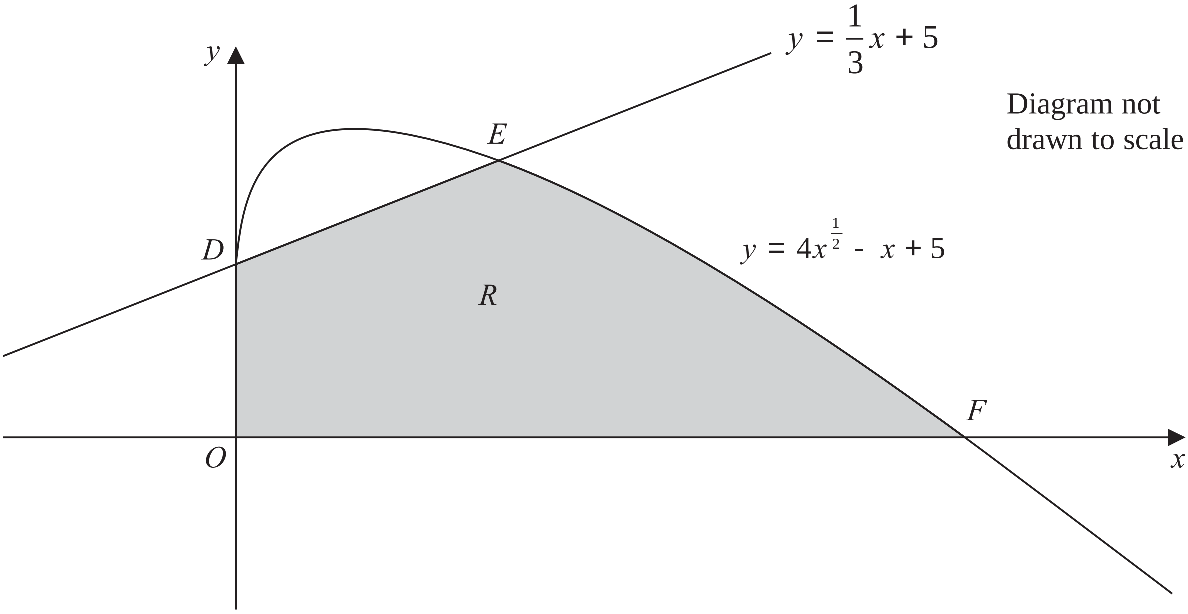


Figure 1

The finite region R, which is shown shaded in Figure 1, is bounded by the coordinate axes, the straight line l with equation $y = \frac{1}{3}x + 5$ and the curve C with equation $y = 4x^{\frac{1}{2}} - x + 5, \ x \geqslant 0$

The line l meets the curve C at the point D on the y-axis and at the point E, as shown in Figure 1.

(a) Use algebra to find the coordinates of the points D and E.

(4)

The curve C crosses the x-axis at the point F.

(b) Verify that the x coordinate of F is 25

(1)

(c) Use algebraic integration to find the exact area of the shaded region R.

(6)

(IAL C12 Oct 2018, Q10)

53.

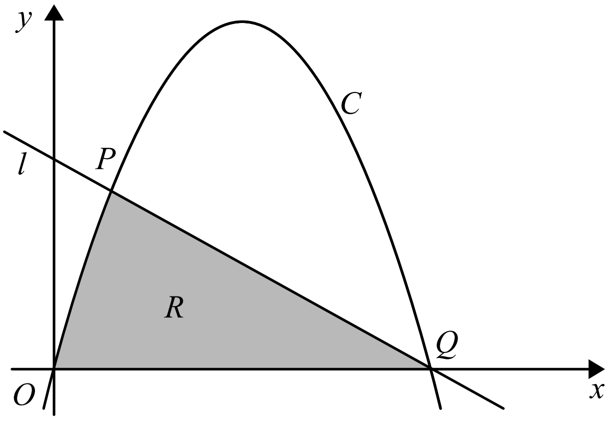


Figure 3

The straight line l with equation $y = 5 - 3x$ cuts the curve C, with equation $y = 20x - 12x^2$, at the points P and Q, as shown in Figure 3.

(a) Use algebra to find the exact coordinates of the points P and Q.

(5)

The finite region R, shown shaded in Figure 3, is bounded by the line l, the x-axis and the curve C.

(b) Use calculus to find the exact area of R.

(6)

(IAL C12 Jan 2019, Q15)

54.

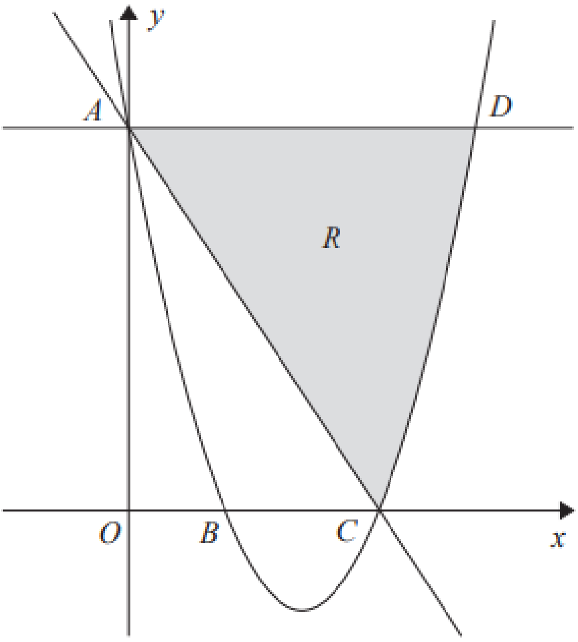


Figure 4

Figure 4 shows a sketch of the curve with equation $y = 2x^2 - 11x + 12$. The curve crosses the y-axis at the point A and crosses the x-axis at the points B and C.

(a) Find the coordinates of the points A, B and C.

(3)

The point D lies on the curve such that the line AD is parallel to the x-axis.

The finite region R, shown shaded in Figure 4, is bounded by the curve, the line AC and the line AD.

(b) Use algebraic integration to find the exact area of R.

(7)

(IAL C12 May 2019, Q16)