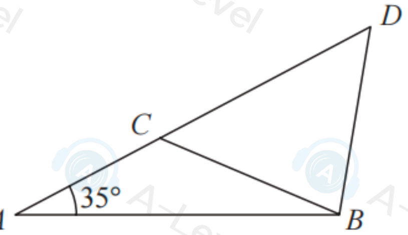
Leave blank

7.



Not to scale

Figure 3

Figure 3 shows the design for a structure used to support a roof.

The structure consists of four wooden beams, AB, BD, BC and AD.

Given $AB = 6.5$ m, $BC = BD = 4.7$ m and angle $BAC = 35°$

(a) find, to one decimal place, the size of angle ACB,

(3)

(b) find, to the nearest metre, the total length of wood required to make this structure.

(3)

DO NOT WRITE IN THIS AREA

DO NO

4. The curve C has equation

$$y = \frac{2}{x} + 3x - 4 \qquad x \neq 0$$

The straight line l has equation

$$y = kx + 2$$

where k is a constant.

(a) Show that l meets C when

$$(k-3)x^2 + 6x - 2 = 0$$

(2)

(b) Hence find the value of k for which l is a tangent to C

(3)

DO NOT WRITE IN THIS AREA

5.

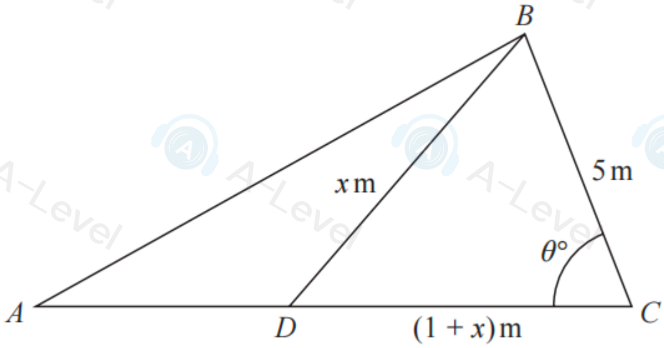


Diagram **NOT** accurately drawn

Figure 2

Figure 2 shows the plan view of a frame for a flat roof.

The shape of the frame consists of triangle ABD joined to triangle BCD.

Given that

- $BD = x$ m
- $CD = (1 + x)$ m
- $BC = 5$ m
- angle $BCD = \theta°$

(a) show that $\cos\theta° = \frac{13 + x}{5 + 5x}$

(2)

Given also that

- $x = 2\sqrt{3}$
- angle $BAC = 30°$
- ADC is a straight line

(b) find the area of triangle ABC, giving your answer, in m^2, to one decimal place.

(5)

8.

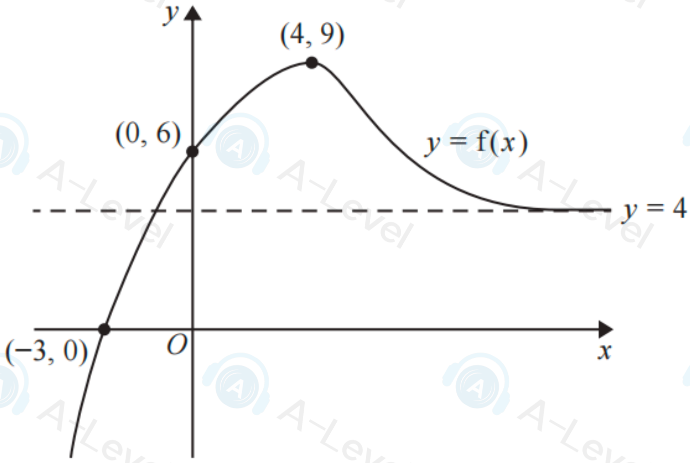


Figure 4

The curve C with equation $y = \mathrm{f}(x)$ is shown in Figure 4.

The curve C

- has a single turning point, a maximum at (4, 9)
- crosses the coordinate axes at only two places, (−3, 0) and (0, 6)
- has a single asymptote with equation $y = 4$

as shown in Figure 4.

(a) State the equation of the asymptote to the curve with equation $y = \mathrm{f}(-x)$. **(1)**

(b) State the coordinates of the turning point on the curve with equation $y = \mathrm{f}\left(\frac{1}{4}x\right)$. **(1)**

Given that the line with equation $y = k$, where k is a constant, intersects C at exactly one point,

(c) state the possible values for k. **(2)**

The curve C is transformed to a new curve that passes through the origin.

(d) (i) Given that the new curve has equation $y = \mathrm{f}(x) - a$, state the value of the constant a.

(ii) Write down an equation for another single transformation of C that also passes through the origin. **(2)**

1.

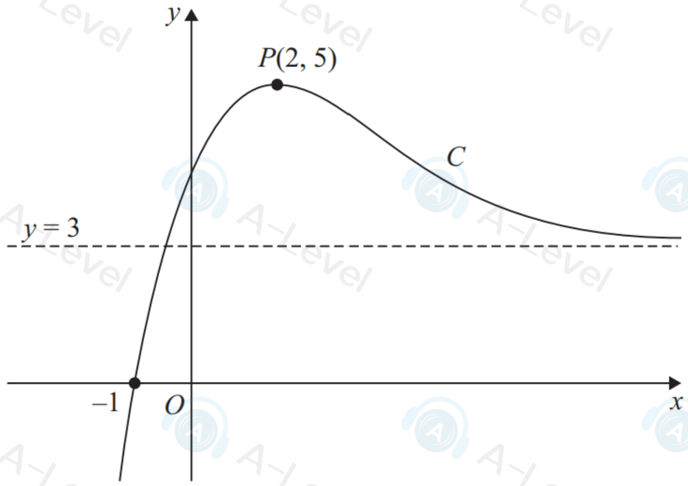


Figure 1

The curve C, shown in Figure 1,

- has equation $y = f(x), x \in \mathbb{R}$
- cuts the x-axis at -1
- has a maximum turning point at $P(2, 5)$
- has a horizontal asymptote with equation $y = 3$

The curve C has no other turning points or asymptotes.

(a) Find the coordinates of the point to which P is transformed when the curve with equation $y = f(x)$ is transformed to the curve with equation

(i) $y = f(x) + 7$

(ii) $y = 3f(x)$

(2)

Given that the line with equation $y = k$, where k is a constant, cuts or meets C exactly once,

(b) state the range of possible values of k.

(2)

(c) Write down the solution of the equation

$$f(x + 4) = 0$$

(1)

6.

Diagram not drawn to scale

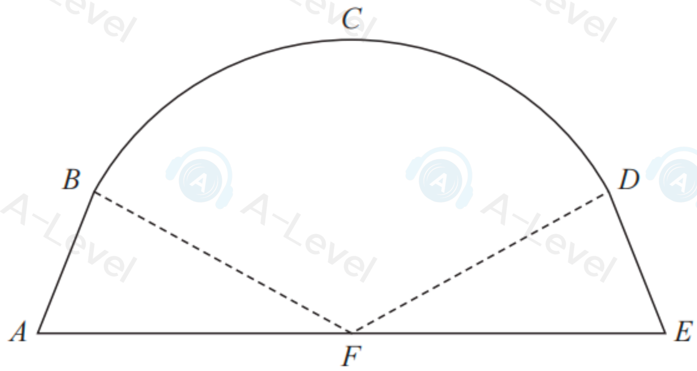


Figure 1

Figure 1 shows a sketch of the entrance to a tunnel.

The shape of the entrance consists of a sector *BCDF*, of a circle centre *F*, joined to two congruent (identical) triangles *ABF* and *EDF*.

Given that

$$AFE \text{ is a straight line}$$
$$AF = FE = 6.4\,\text{m}$$
$$FB = FD = 6.2\,\text{m}$$
$$\text{angle } BFD = 2.275 \text{ radians}$$

(a) Show that angle $AFB = 0.433$ radians to 3 decimal places.

(1)

(b) Find the perimeter of the entrance to the tunnel, *ABCDEFA*, in metres, to one decimal place.

(4)

(c) Find the cross-sectional area of the entrance to the tunnel, *ABCDEFA*, in m^2, to one decimal place.

(4)

7.

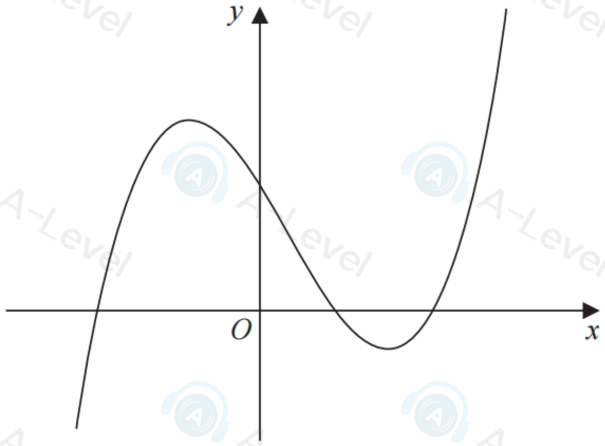


Figure 3

Figure 3 shows a sketch of part of the curve with equation $y = \mathrm{f}(x)$, where

$$\mathrm{f}(x) = (x + 4)(x - 2)(2x - 9)$$

Given that the curve with equation $y = \mathrm{f}(x) - p$ passes through the point with coordinates (0, 50)

(a) find the value of the constant p.

(2)

Given that the curve with equation $y = \mathrm{f}(x + q)$ passes through the origin,

(b) write down the possible values of the constant q.

(2)

(c) Find $\mathrm{f}'(x)$.

(4)

(d) Hence find the range of values of x for which the gradient of the curve with equation $y = \mathrm{f}(x)$ is less than -18

(3)

blank

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO

4.

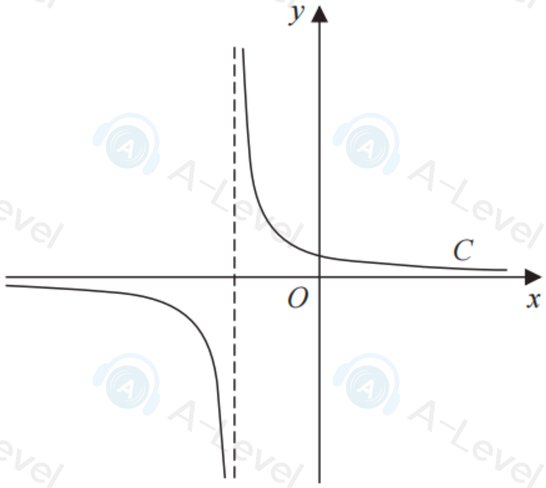


Figure 1

Figure 1 shows a sketch of part of the curve C with equation $y = \dfrac{1}{x+2}$

(a) State the equation of the asymptote of C that is parallel to the y-axis.

(1)

(b) Factorise fully $x^3 + 4x^2 + 4x$

(2)

A copy of Figure 1, labelled Diagram 1, is shown on the next page.

(c) On Diagram 1, add a sketch of the curve with equation

$$y = x^3 + 4x^2 + 4x$$

On your sketch, state clearly the coordinates of each point where this curve cuts or meets the coordinate axes.

(3)

(d) Hence state the number of real solutions of the equation

$$(x + 2)(x^3 + 4x^2 + 4x) = 1$$

giving a reason for your answer.

(1)

8. **In this question you must show all stages of your working.**

Solutions relying on calculator technology are not acceptable.

The curve C_1 has equation

$$xy = \frac{15}{2} - 5x \qquad x \neq 0$$

The curve C_2 has equation

$$y = x^3 - \frac{7}{2}x - 5$$

(a) Show that C_1 and C_2 meet when

$$2x^4 - 7x^2 - 15 = 0$$

(2)

Given that C_1 and C_2 meet at points P and Q

(b) find, using algebra, the exact distance PQ

(5)

6. **In this question you must show all stages of your working.**

Solutions relying on calculator technology are not acceptable.

The equation

$$4(p - 2x) = \frac{12 + 15p}{x + p} \qquad x \neq -p$$

where p is a constant, has two distinct real roots.

(a) Show that

$$3p^2 - 10p - 8 > 0$$

(3)

(b) Hence, using algebra, find the range of possible values of p

(3)

4.

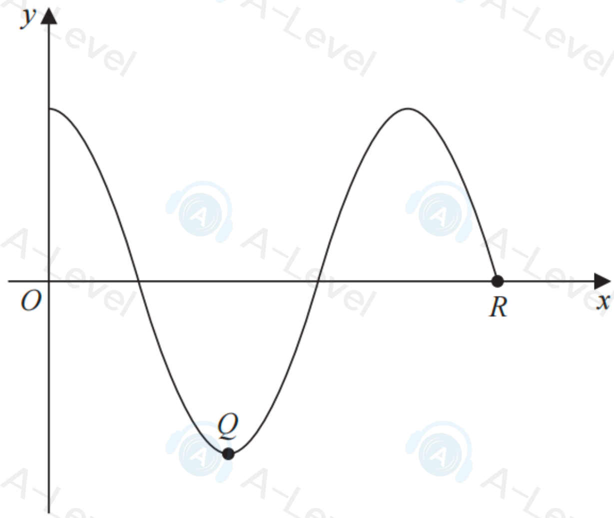


Figure 2

Figure 2 shows a sketch of the curve with equation $y = \mathrm{f}(x)$, where

$$\mathrm{f}(x) = \cos 2x^{\circ} \qquad 0 \leqslant x \leqslant k$$

The point Q and the point $R(k, 0)$ lie on the curve and are shown in Figure 2.

(a) State

(i) the coordinates of Q,

(ii) the value of k.

(3)

(b) Given that there are exactly two solutions to the equation

$$\cos 2x^{\circ} = p \qquad \text{in the region } 0 \leqslant x \leqslant k$$

find the range of possible values for p.

(2)

blank

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

5.

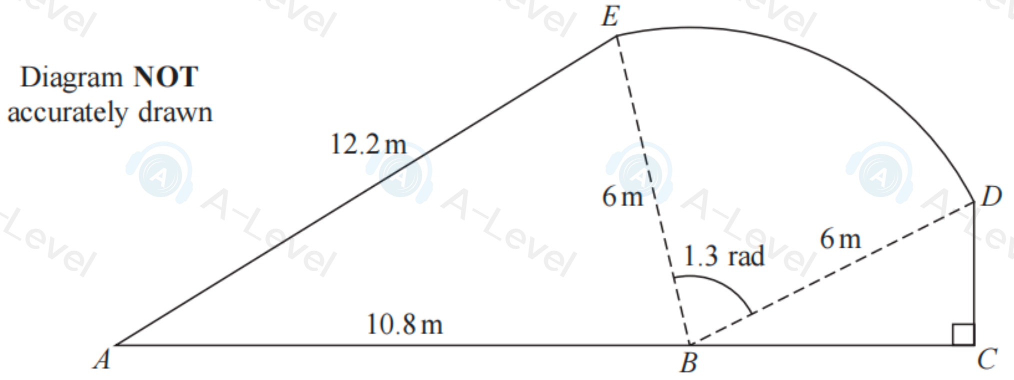


Figure 2

Figure 2 shows the plan view of a garden.

The shape of the garden *ABCDEA* consists of a triangle *ABE* and a right-angled triangle *BCD* joined to a sector *BDE* of a circle with radius 6 m and centre *B*.

The points *A*, *B* and *C* lie on a straight line with $AB = 10.8$ m

Angle $BCD = \frac{\pi}{2}$ radians, angle $EBD = 1.3$ radians and $AE = 12.2$ m

(a) Find the area of the sector *BDE*, giving your answer in m^2

(2)

(b) Find the size of angle *ABE*, giving your answer in radians to 2 decimal places.

(2)

(c) Find the area of the garden, giving your answer in m^2 to 3 significant figures.

(3)

Leave blank

4.

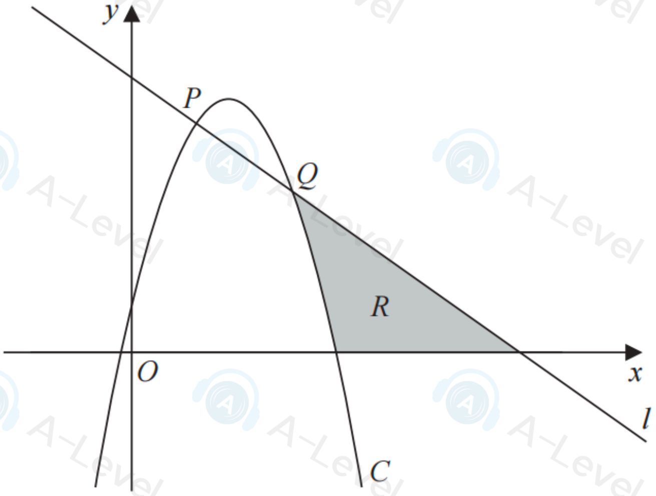


Figure 1

In this question you must show all stages of your working.

Solutions relying on calculator technology are not acceptable.

Figure 1 shows a line l with equation $x + y = 6$ and a curve C with equation $y = 6x - 2x^2 + 1$

The line l intersects the curve C at the points P and Q as shown in Figure 1.

(a) Find, using algebra, the coordinates of P and the coordinates of Q.

(4)

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

(b) Use inequalities to define the region R.

(3)