6.

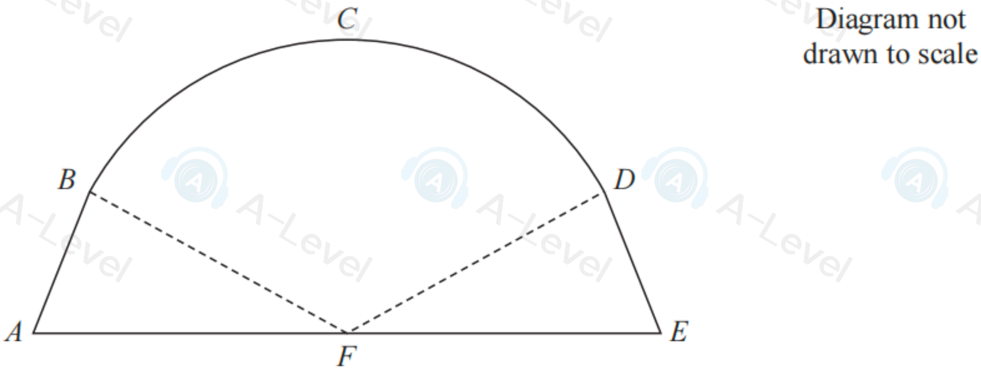

Figure 1

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 is a straight line

$AF = FE = 6.4\,\text{m}$

$FB = FD = 6.2\,\text{m}$

angle $BFD = 2.275$ 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)

DO NOT WRITE IN THIS AREA

7. **In this question you must show all stages of your working.**
Solutions relying entirely on calculator technology are not acceptable.

The curve C has equation

$$y = \frac{2}{x} - k$$

where k is a **positive** constant.

(a) Sketch the graph of C.

Show on your sketch

- the coordinates of any points of intersection of C with the coordinate axes
- the equation of the horizontal asymptote to C

stating each in terms of k.

(3)

The line l has equation $y = -kx - 6$

Given that l intersects C at 2 distinct points,

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

(5)

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

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

Given that

- the point $P\left(2, 8\sqrt{2}\right)$ lies on C
- $f'(x) = 4\sqrt{x^3} + \dfrac{k}{x^2}$ where k is a constant
- $f''(x) = 0$ at P

(a) find the exact value of k,

(4)

(b) find $f(x)$, giving your answer in simplest form.

(4)

10. The curve C has equation $y = \mathrm{f}(x)$.

Given that

- $\mathrm{f}'(x) = \dfrac{k\sqrt{x}(x-3)}{5}$ where k is a constant
- the point P with x coordinate 4 lies on C
- the equation of the normal to C at P is $y = -\dfrac{5}{4}x + 2$

(a) find an equation of the tangent to C at P, giving your answer in the form $y = mx + c$, where m and c are constants,

(3)

(b) find the value of k,

(2)

(c) find $\mathrm{f}(x)$, writing the answer in simplest form.

(5)

blank

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

Solutions relying on calculator technology are not acceptable.

A curve C has equation $y = \mathrm{f}(x)$ where

$$\mathrm{f}(x) = 2(x+1)(x-3)^2$$

(a) Sketch a graph of C.

Show on your graph the coordinates of the points where C cuts or meets the coordinate axes.

(3)

(b) Write $\mathrm{f}(x)$ in the form $ax^3 + bx^2 + cx + d$, where a, b, c and d are constants to be found.

(3)

(c) Hence, find the equation of the tangent to C at the point where $x = \dfrac{1}{3}$

(4)

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

Solutions relying on calculator technology are not acceptable.

Solve the inequality

$$4x^2 - 3x + 7 \geqslant 4x + 9$$

(4)

10. The curve C has equation $y = \mathrm{f}(x)$ where $x > 0$

Given that

- $\mathrm{f}'(x) = 6x - \dfrac{(2x-1)(3x+2)}{2\sqrt{x}}$
- the point $P(4, 12)$ lies on C

(a) find the equation of the normal to C at P, giving your answer in the form $y = mx + c$ where m and c are integers to be found,

(4)

(b) find $\mathrm{f}(x)$, giving each term in simplest form.

(6)

9.

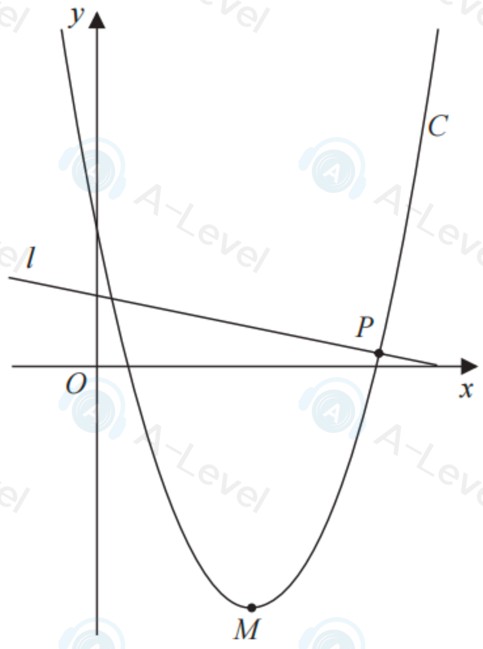

Figure 3

Figure 3 shows a sketch of the curve C with equation

$$y = \frac{1}{2}x^2 - 10x + 22$$

(a) Write $\frac{1}{2}x^2 - 10x + 22$ in the form

$$a(x + b)^2 + c$$

where a, b and c are constants to be found.

(3)

The point M is the minimum turning point of C, as shown in Figure 3.

(b) Deduce the coordinates of M

(2)

The line l is the normal to C at the point P, as shown in Figure 3.

Given that l has equation $y = k - \frac{1}{8}x$, where k is a constant,

(c) (i) find the coordinates of P

(ii) find the value of k

(6)

Question 9 continued

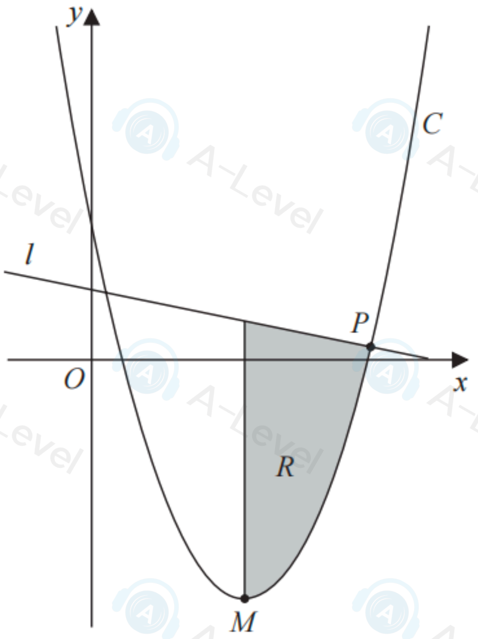

Figure 4

Figure 4 is a copy of Figure 3. The finite region R, shown shaded in Figure 4, is bounded by l, C and the line through M parallel to the y-axis.

(d) Identify the inequalities that define R.

(3)

4.

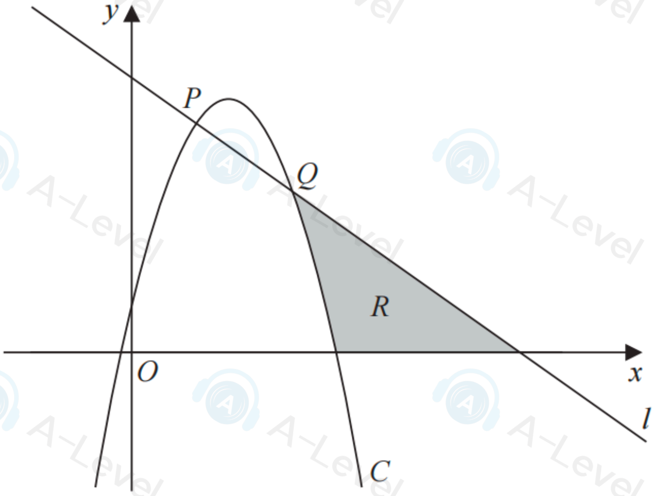

Figure 1

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)