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

(a) Sketch the curve $C$ with equation

$$y = \frac{1}{x+6}$$

State on your sketch

- the equation of the vertical asymptote
- the coordinates of the point of intersection of $C$ with the $y$-axis

**(3)**

The straight line $l$ has equation $y = mx - 4$, where $m$ is a constant.

Given that $l$ cuts $C$ at least once,

(b) (i) show that

$$9m^2 + 13m + 4 \geqslant 0$$

(ii) find the range of values of $m$.

**(6)**



**3.**

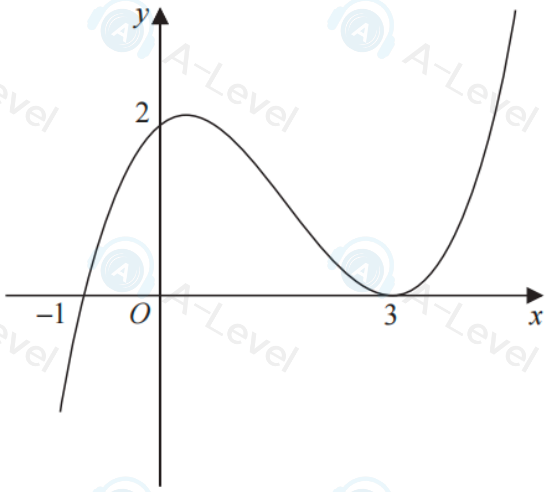


**Figure 1**

Figure 1 shows a sketch of the curve with equation $y = f(x)$.

The curve passes through the points $(-1, 0)$ and $(0, 2)$ and touches the $x$-axis at the point $(3, 0)$.

On separate diagrams, sketch the curve with equation

(a) $y = f(x + 3)$

**(3)**

(b) $y = f(-3x)$

**(3)**

On each diagram, show clearly the coordinates of all the points where the curve cuts or touches the coordinate axes.

blank

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

Given

$$f(x) = 2x^{\frac{5}{2}} - 40x + 8 \qquad x > 0$$

(a) solve the equation $f'(x) = 0$

**(4)**

(b) solve the equation $f''(x) = 5$

**(3)**

DO NOT WRITE IN THIS AR

**4.** The curve $C_1$ has equation

$$y = x^2 + kx - 9$$

and the curve $C_2$ has equation

$$y = -3x^2 - 5x + k$$

where $k$ is a constant.

Given that $C_1$ and $C_2$ meet at a single point $P$

(a) show that

$$k^2 + 26k + 169 = 0$$

**(3)**

(b) Hence find the coordinates of $P$

**(3)**

DO NOT WRITE IN THIS AREA

**10.**

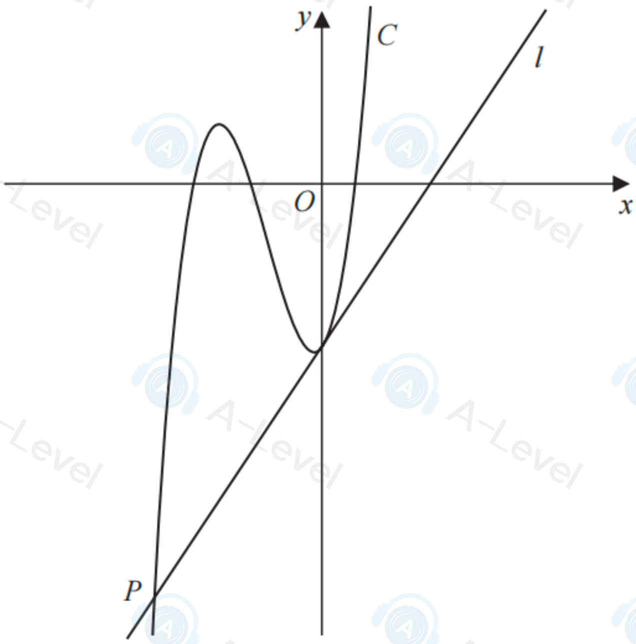


**Figure 4**

Figure 4 shows a sketch of part of the curve $C$ with equation $y = f(x)$, where

$$f(x) = (3x + 20)(x + 6)(2x - 3)$$

(a) Use the given information to state the values of $x$ for which

$$f(x) > 0$$

**(2)**

(b) Expand $(3x + 20)(x + 6)(2x - 3)$, writing your answer as a polynomial in simplest form.

**(3)**

The straight line $l$ is the tangent to $C$ at the point where $C$ cuts the $y$-axis.

Given that $l$ cuts $C$ at the point $P$, as shown in Figure 4,

(c) find, using algebra, the $x$ coordinate of $P$

*(Solutions based on calculator technology are not acceptable.)*

**(5)**

**9.** Given that

- the point $A$ has coordinates (4, 2)
- the point $B$ has coordinates (15, 7)
- the line $l_1$ passes through $A$ and $B$

(a) find an equation for $l_1$, giving your answer in the form $px + qy + r = 0$ where $p$, $q$ and $r$ are integers to be found.

**(3)**

The line $l_2$ passes through $A$ and is parallel to the $x$-axis.

The point $C$ lies on $l_2$ so that the length of $BC$ is $5\sqrt{5}$

(b) Find both possible pairs of coordinates of the point $C$.

**(4)**

(c) Hence find the minimum possible area of triangle $ABC$.

**(2)**

**7.**

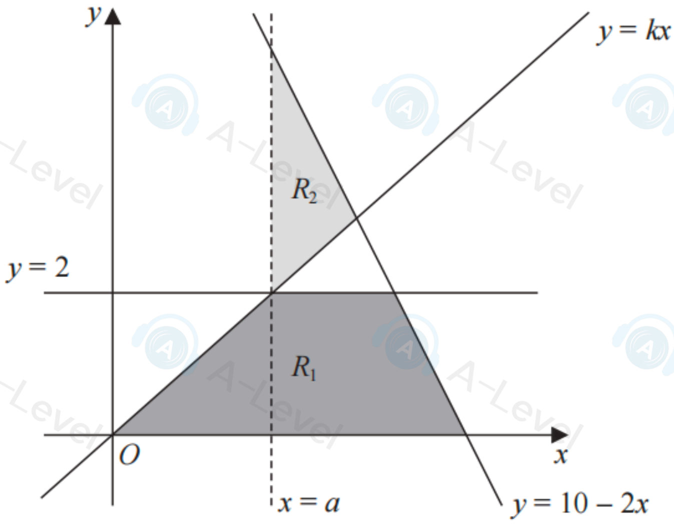


**Figure 2**

The region $R_1$, shown shaded in Figure 2, is defined by the inequalities

$$0 \leqslant y \leqslant 2 \qquad y \leqslant 10 - 2x \qquad y \leqslant kx$$

where $k$ is a constant.

The line $x = a$, where $a$ is a constant, passes through the intersection of the lines $y = 2$ and $y = kx$

Given that the area of $R_1$ is $\frac{27}{4}$ square units,

(a) find

(i) the value of $a$

(ii) the value of $k$

**(4)**

(b) Define the region $R_2$, also shown shaded in Figure 2, using inequalities.

**(2)**

**2.** Given that

$$a = \frac{1}{64}x^2 \qquad b = \frac{16}{\sqrt{x}}$$

express each of the following in the form $kx^n$ where $k$ and $n$ are simplified constants.

(a) $a^{\frac{1}{2}}$

**(1)**

(b) $\frac{16}{b^3}$

**(1)**

(c) $\left(\frac{ab}{2}\right)^{-\frac{4}{3}}$

**(2)**

**Answer all questions. Write your answers in the spaces provided.**

blank

DO NOT WRITE IN THIS AREA

1. The curve $C$ has equation $y = \frac{1}{8}x^3 - \frac{24}{\sqrt{x}} + 1$

(a) Find $\frac{dy}{dx}$, giving the answer in its simplest form.

**(3)**

The point $P(4, -3)$ lies on $C$.

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

**(3)**