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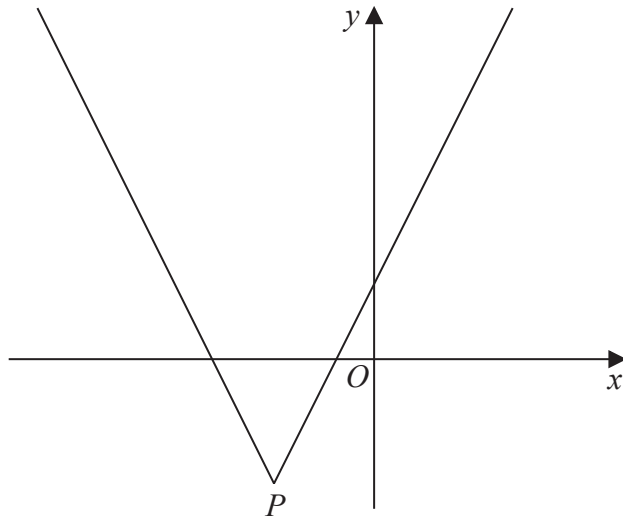


Figure 2

Figure 2 shows a sketch of the graph with equation

$$y = 2|x + 4| - 5$$

The vertex of the graph is at the point  $P$ , shown in Figure 2.

(a) Find the coordinates of  $P$ . (2)

(b) Solve the equation 
$$3x + 40 = 2|x + 4| - 5$$
 (2)

A line  $l$  has equation  $y = ax$ , where  $a$  is a constant.

Given that  $l$  intersects  $y = 2|x + 4| - 5$  at least once,

(c) find the range of possible values of  $a$ , writing your answer in set notation. (3)

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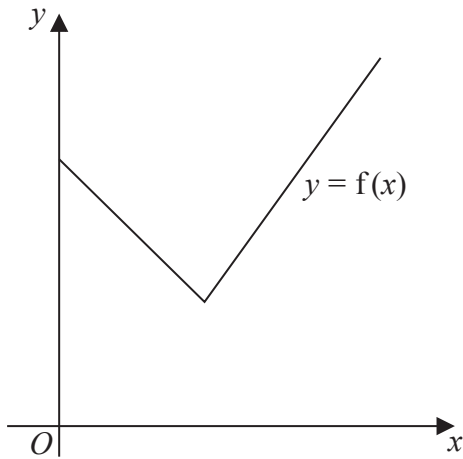


Figure 1

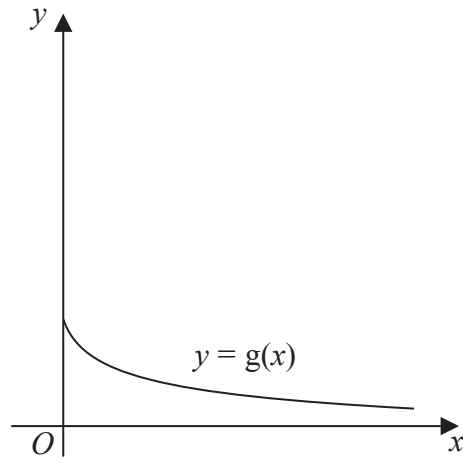


Figure 2

Figure 1 shows a sketch of part of the graph  $y = f(x)$ , where

$$f(x) = 2|3 - x| + 5, \quad x \geq 0$$

Figure 2 shows a sketch of part of the graph  $y = g(x)$ , where

$$g(x) = \frac{x + 9}{2x + 3}, \quad x \geq 0$$

(a) Find the value of  $fg(1)$  (2)

(b) State the range of  $g$  (2)

(c) Find  $g^{-1}(x)$  and state its domain. (4)

Given that the equation  $f(x) = k$ , where  $k$  is a constant, has exactly two roots,

(d) state the range of possible values of  $k$ . (3)

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3. The function  $g$  is defined by

$$g : x \mapsto |8 - 2x|, \quad x \in \mathbb{R}, \quad x \geq 0$$

(a) Sketch the graph with equation  $y = g(x)$ , showing the coordinates of the points where the graph cuts or meets the axes. **(3)**

(b) Solve the equation

$$|8 - 2x| = x + 5$$

**(3)**

The function  $f$  is defined by

$$f : x \mapsto x^2 - 3x + 1, \quad x \in \mathbb{R}, \quad 0 \leq x \leq 4$$

(c) Find  $fg(5)$ . **(2)**

(d) Find the range of  $f$ . You must make your method clear. **(4)**

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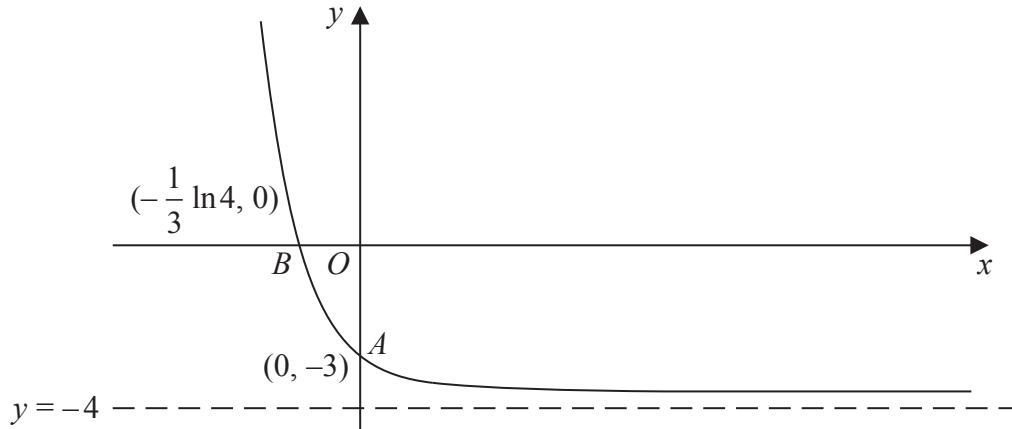


Figure 4

Figure 4 shows a sketch of part of the curve with equation  $y = f(x)$ ,  $x \in \mathbb{R}$

The curve meets the coordinate axes at the points  $A(0, -3)$  and  $B(-\frac{1}{3} \ln 4, 0)$  and the curve has an asymptote with equation  $y = -4$

In separate diagrams, sketch the graph with equation

(a)  $y = |f(x)|$  (4)

(b)  $y = 2f(x) + 6$  (3)

On each sketch, give the exact coordinates of the points where the curve crosses or meets the coordinate axes and the equation of any asymptote.

Given that

$$f(x) = e^{-3x} - 4, \quad x \in \mathbb{R}$$

$$g(x) = \ln\left(\frac{1}{x+2}\right), \quad x > -2$$

(c) state the range of  $f$ , (1)

(d) find  $f^{-1}(x)$ , (3)

(e) express  $fg(x)$  as a polynomial in  $x$ . (3)

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6. Given that  $a$  and  $b$  are constants and that  $a > b > 0$

(a) on separate diagrams, sketch the graph with equation

(i)  $y = |x - a|$

(ii)  $y = |x - a| - b$

Show on each sketch the coordinates of each point at which the graph crosses or meets the  $x$ -axis and the  $y$ -axis.

(5)

(b) Hence or otherwise find the complete set of values of  $x$  for which

$$|x - a| - b < \frac{1}{2}x$$

giving your answer in terms of  $a$  and  $b$ .

(4)

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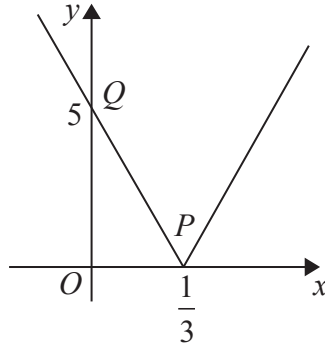


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7.



**Figure 2**

Figure 2 shows a sketch of the graph of  $y = f(x)$ ,  $x \in \mathbb{R}$ .

The point  $P\left(\frac{1}{3}, 0\right)$  is the vertex of the graph.

The point  $Q(0, 5)$  is the intercept with the  $y$ -axis.

Given that  $f(x) = |ax + b|$ , where  $a$  and  $b$  are constants,

(a) (i) find all possible values for  $a$  and  $b$ ,

(ii) hence find an equation for the graph.

**(4)**

(b) Sketch the graph with equation

$$y = f\left(\frac{1}{2}x\right) + 3$$

showing the coordinates of its vertex and its intercept with the  $y$ -axis.

**(3)**

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9.

$$f(x) = 2\ln(x) - 4, \quad x > 0, \quad x \in \mathbb{R}$$

(a) Sketch, on separate diagrams, the curve with equation

(i)  $y = f(x)$

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

On each diagram, show the coordinates of each point at which the curve meets or cuts the axes.

On each diagram state the equation of the asymptote.

**(5)**(b) Find the exact solutions of the equation  $|f(x)| = 4$ **(4)**

$$g(x) = e^{x+5} - 2, \quad x \in \mathbb{R}$$

(c) Find  $gf(x)$ , giving your answer in its simplest form.**(3)**(d) Hence, or otherwise, state the range of  $gf$ .**(1)**

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6. Given that  $a$  and  $b$  are positive constants,
- (a) on separate diagrams, sketch the graph with equation

(i)  $y = |2x - a|$

(ii)  $y = |2x - a| + b$

Show, on each sketch, the coordinates of each point at which the graph crosses or meets the axes.

(4)

Given that the equation

$$|2x - a| + b = \frac{3}{2}x + 8$$

has a solution at  $x = 0$  and a solution at  $x = c$ ,

- (b) find  $c$  in terms of  $a$ .

(4)

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2. Given that

$$f(x) = 2e^x - 5, \quad x \in \mathbb{R}$$

(a) sketch, on separate diagrams, the curve with equation

(i)  $y = f(x)$

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

On each diagram, show the coordinates of each point at which the curve meets or cuts the axes.

On each diagram state the equation of the asymptote.

**(6)**

(b) Deduce the set of values of  $x$  for which  $f(x) = |f(x)|$

**(1)**

(c) Find the exact solutions of the equation  $|f(x)| = 2$

**(3)**



5. (a) Sketch the graph with equation

$$y = |4x - 3|$$

stating the coordinates of any points where the graph cuts or meets the axes.

**(2)**

Find the complete set of values of  $x$  for which

- (b)

$$|4x - 3| > 2 - 2x$$

**(4)**

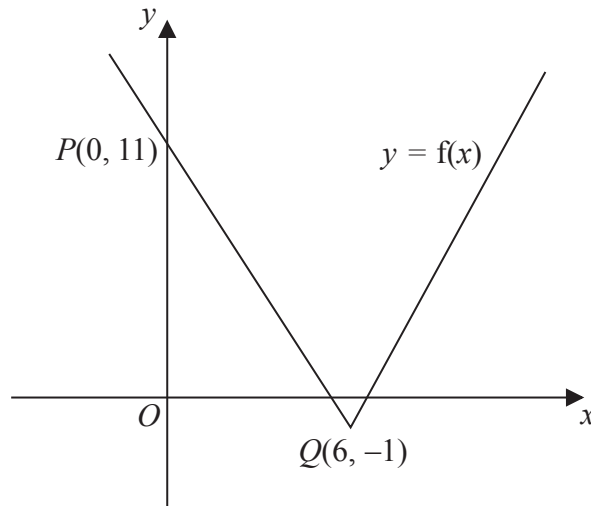
- (c)

$$|4x - 3| > \frac{3}{2} - 2x$$

**(2)**



4.



**Figure 1**

Figure 1 shows part of the graph with equation  $y = f(x)$ ,  $x \in \mathbb{R}$ .

The graph consists of two line segments that meet at the point  $Q(6, -1)$ .

The graph crosses the  $y$ -axis at the point  $P(0, 11)$ .

Sketch, on separate diagrams, the graphs of

(a)  $y = |f(x)|$  **(2)**

(b)  $y = 2f(-x) + 3$  **(3)**

On each diagram, show the coordinates of the points corresponding to  $P$  and  $Q$ .

Given that  $f(x) = a|x - b| - 1$ , where  $a$  and  $b$  are constants,

(c) state the value of  $a$  and the value of  $b$ . **(2)**

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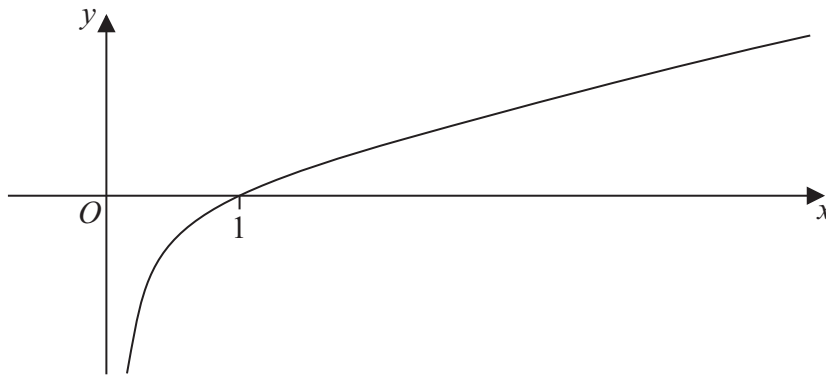
**Figure 1**

Figure 1 shows a sketch of the curve with equation  $y = f(x)$ ,  $x > 0$ , where  $f$  is an increasing function of  $x$ . The curve crosses the  $x$ -axis at the point  $(1, 0)$  and the line  $x = 0$  is an asymptote to the curve.

On separate diagrams, sketch the curve with equation

(a)  $y = f(2x)$ ,  $x > 0$  **(2)**

(b)  $y = |f(x)|$ ,  $x > 0$  **(3)**

Indicate clearly on each sketch the coordinates of the point at which the curve crosses or meets the  $x$ -axis.



4. The functions  $f$  and  $g$  are defined by

$$f : x \mapsto 2|x| + 3, \quad x \in \mathbb{R},$$

$$g : x \mapsto 3 - 4x, \quad x \in \mathbb{R}$$

(a) State the range of  $f$ . (2)

(b) Find  $fg(1)$ . (2)

(c) Find  $g^{-1}$ , the inverse function of  $g$ . (2)

(d) Solve the equation

$$gg(x) + [g(x)]^2 = 0$$
(5)

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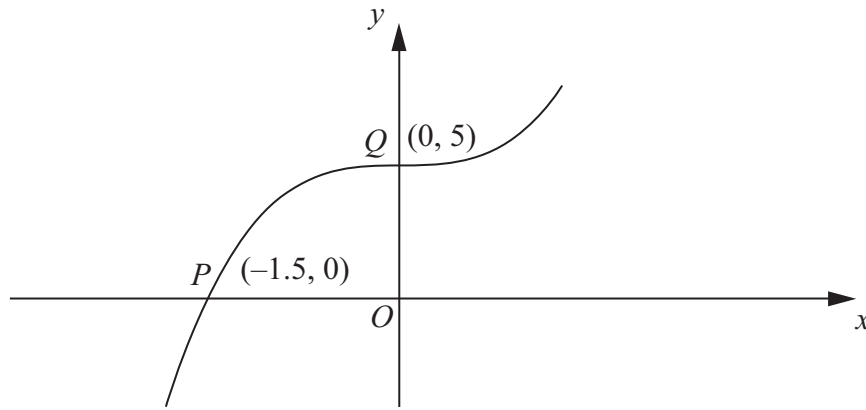
**Figure 2**

Figure 2 shows part of the curve with equation  $y = f(x)$   
The curve passes through the points  $P(-1.5, 0)$  and  $Q(0, 5)$  as shown.

On separate diagrams, sketch the curve with equation

(a)  $y = |f(x)|$  **(2)**

(b)  $y = f(|x|)$  **(2)**

(c)  $y = 2f(3x)$  **(3)**

Indicate clearly on each sketch the coordinates of the points at which the curve crosses or meets the axes.



3.

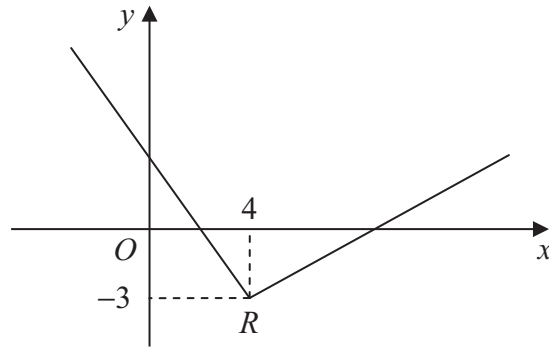
**Figure 1**

Figure 1 shows part of the graph of  $y = f(x)$ ,  $x \in \mathbb{R}$ .

The graph consists of two line segments that meet at the point  $R(4, -3)$ , as shown in Figure 1.

Sketch, on separate diagrams, the graphs of

(a)  $y = 2f(x+4)$ , **(3)**

(b)  $y = |f(-x)|$ . **(3)**

On each diagram, show the coordinates of the point corresponding to  $R$ .





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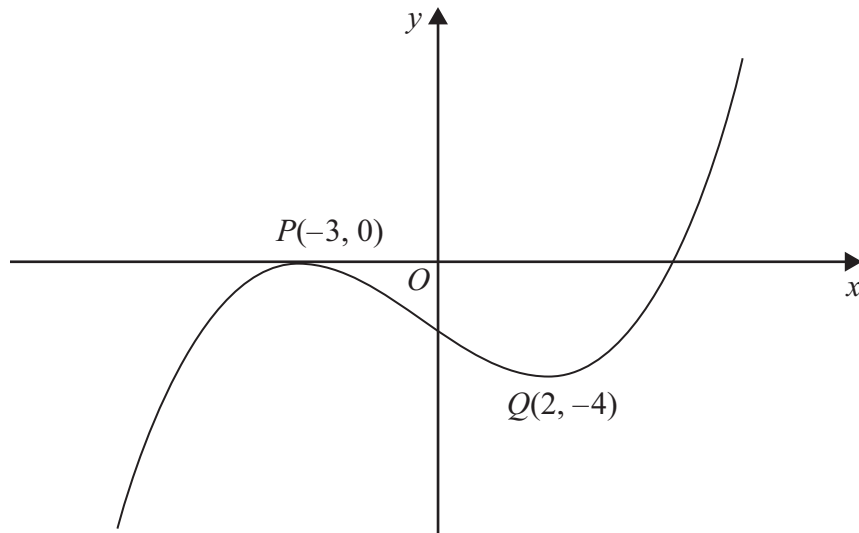
**Figure 1**

Figure 1 shows the graph of equation  $y = f(x)$ .

The points  $P(-3, 0)$  and  $Q(2, -4)$  are stationary points on the graph.

Sketch, on separate diagrams, the graphs of

(a)  $y = 3f(x + 2)$

**(3)**

(b)  $y = |f(x)|$

**(3)**

On each diagram, show the coordinates of any stationary points.

