4.

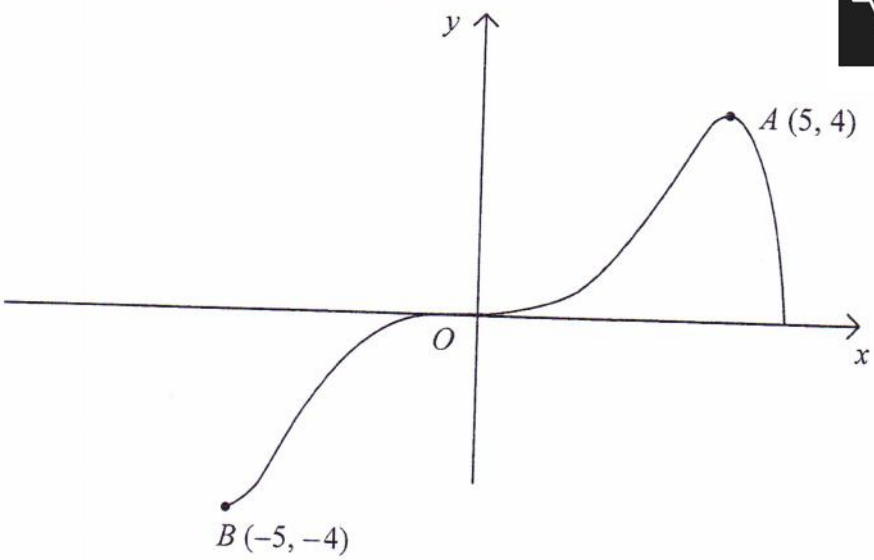


Figure 1

Figure 1 shows a sketch of the curve with equation $y = \mathrm{f}(x)$.
The curve passes through the origin O and the points $A(5, 4)$ and $B(-5, -4)$.

In separate diagrams, sketch the graph with equation

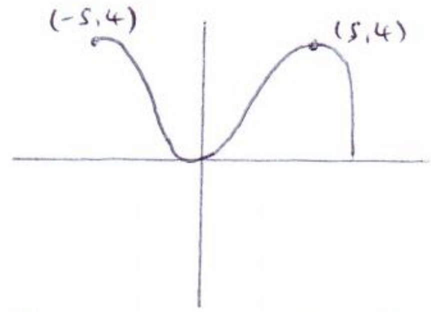
(a) $y = |\mathrm{f}(x)|$, **(3)**

(b) $y = \mathrm{f}(|x|)$, **(3)**

(c) $y = 2\mathrm{f}(x+1)$. **(4)**

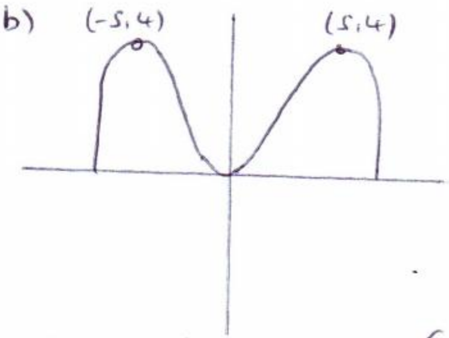
On each sketch, show the coordinates of the points corresponding to A and B.

a)



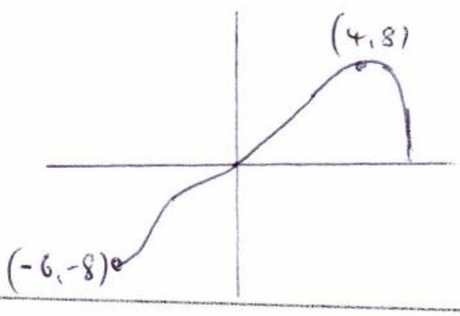
• reflect in x axis for $f(x)<0$

b)



• reflect in y-axis for $x \geq 0$.

c)



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3.

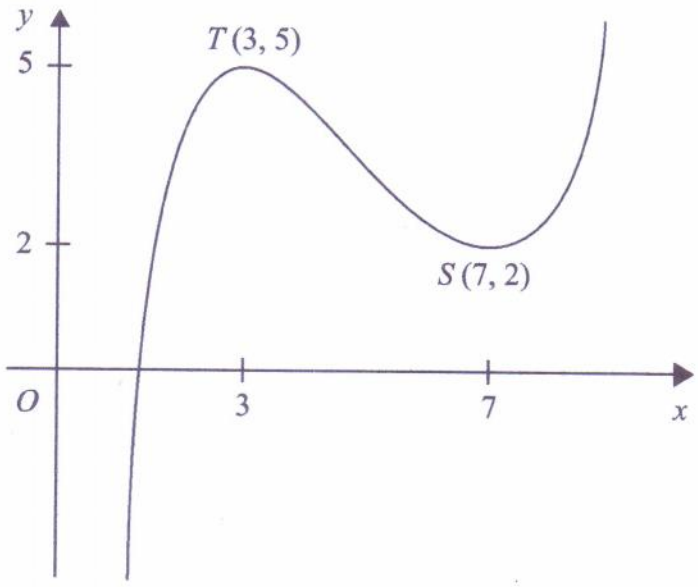


Figure 1

Figure 1 shows the graph of $y = \mathrm{f}(x)$, $\quad 1 < x < 9$.
The points $T(3, 5)$ and $S(7, 2)$ are turning points on the graph.

Sketch, on separate diagrams, the graphs of

(a) $y = 2\mathrm{f}(x) - 4$,

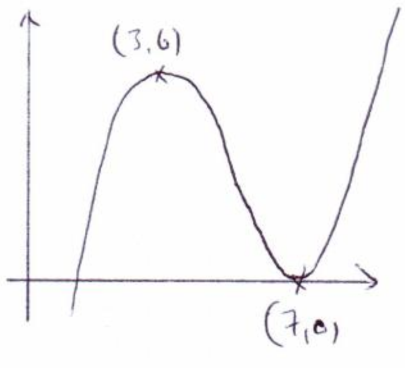
(3)

(b) $y = |\mathrm{f}(x)|$.

(3)

Indicate on each diagram the coordinates of any turning points on your sketch.

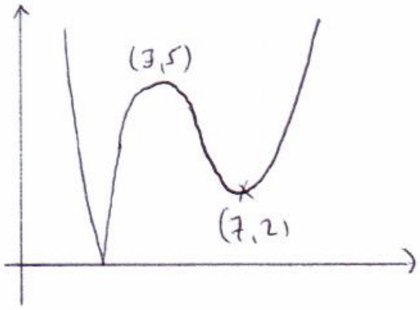
a)



2f(x) doubles y-coordinate
then -4 subtracts 4 from
y - coordinate.

x coordinate not affected

b)



|f(x)| reflects any points below
x - axis in x - axis

6.

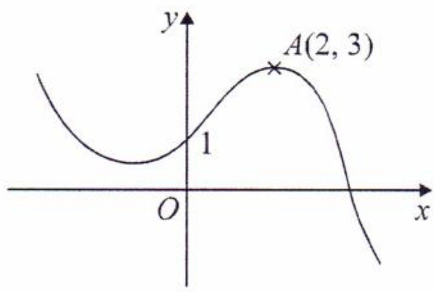


Figure 1

Figure 1 shows a sketch of the graph of $y = \mathrm{f}(x)$.

The graph intersects the y-axis at the point $(0, 1)$ and the point $A(2, 3)$ is the maximum turning point.

Sketch, on separate axes, the graphs of

(i) $y = \mathrm{f}(-x) + 1$,

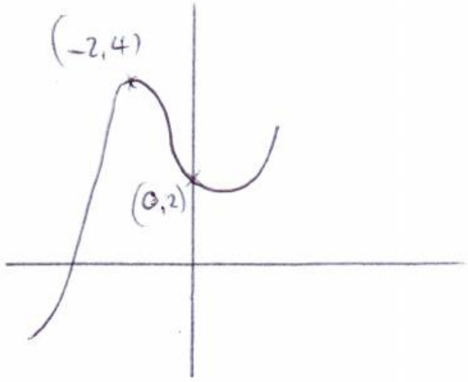
(ii) $y = \mathrm{f}(x + 2) + 3$,

(iii) $y = 2\mathrm{f}(2x)$.

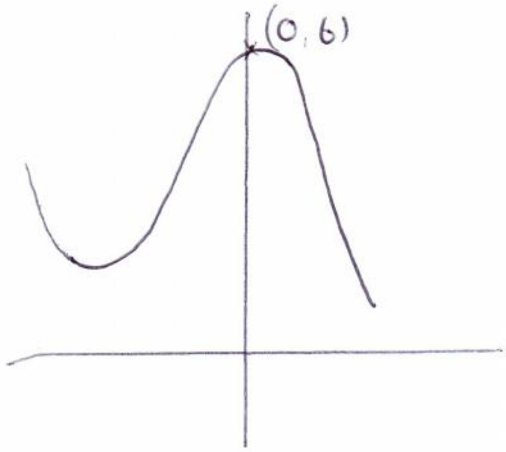
On each sketch, show the coordinates of the point at which your graph intersects the y-axis and the coordinates of the point to which A is transformed.

(9)

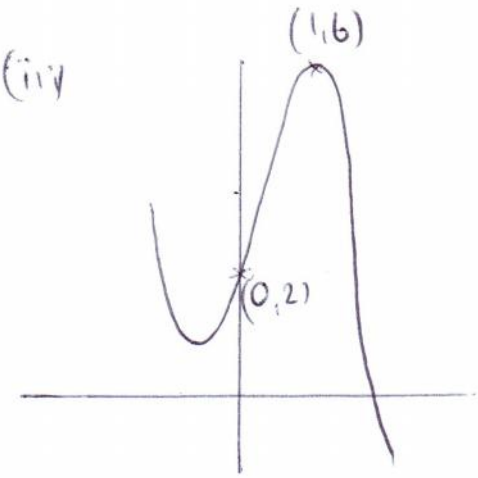
(i)



(ii)



(iii)



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2.

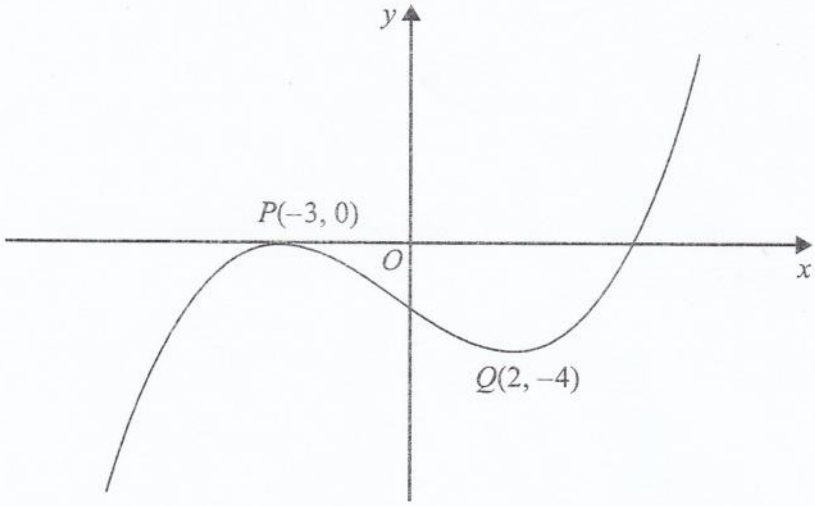


Figure 1

Figure 1 shows the graph of equation $y = \mathrm{f}(x)$.

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

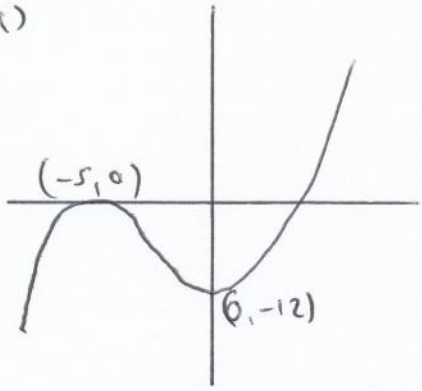
Sketch, on separate diagrams, the graphs of

(a) $y = 3\mathrm{f}(x+2)$ **(3)**

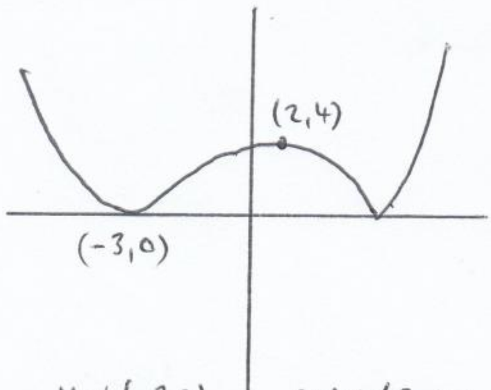
(b) $y = |\mathrm{f}(x)|$ **(3)**

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

(a)



(b)



MIN (−3, 0) MAX (2, 4)

3.

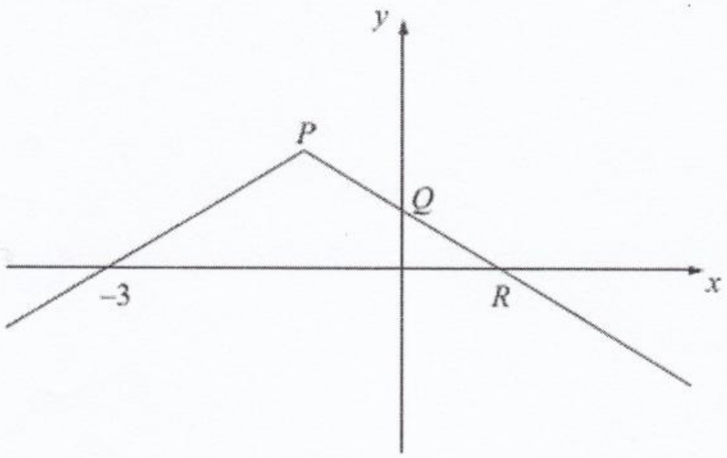


Figure 1

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

The graph consists of two line segments that meet at the point P.

The graph cuts the y-axis at the point Q and the x-axis at the points $(-3, 0)$ and R.

Sketch, on separate diagrams, the graphs of

(*a*) $y = |\mathrm{f}(x)|$,

(2)

(*b*) $y = \mathrm{f}(-x)$.

(2)

Given that $\mathrm{f}(x) = 2 - |x + 1|$,

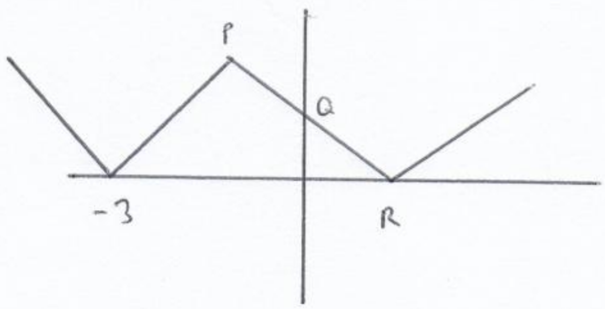
(*c*) find the coordinates of the points P, Q and R,

(3)

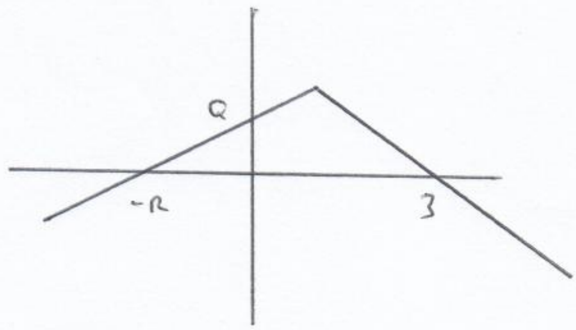
(*d*) solve $\mathrm{f}(x) = \frac{1}{2}x$.

(5)

(3) $|f(x)|$ reflect in x-axis



(b) $f(-x)$ reflect in y-axis



c) $f(x) = 2 - |x+1|$

when $x = 0$ $\quad f(0) = 2 - |0+1|$ $\Rightarrow$ Q is $(0, 1)$

$= 1$

when $y = 0$ $\quad 0 = 2 - |x+1|$ $\Rightarrow$ R is $(1, 0)$

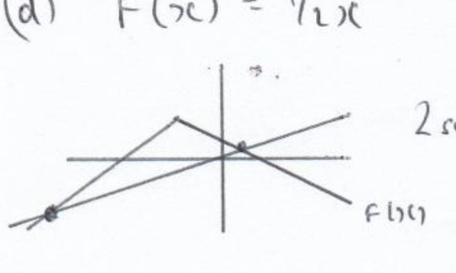
so $x = 1$

Maximum point graph is $f(x) = 2$

so $x + 1 = 0$ $\Rightarrow$ P is $(-1, 2)$

$x = -1$

(d) $f(x) = \frac{1}{2}x$



2 solutions

① $2 - x - 1 = \frac{1}{2}x$

$1 = \frac{3}{2}x$

$x = \frac{2}{3}$

② $2 + x + 1 = \frac{1}{2}x$

$\frac{1}{2}x = -3$

$x = -6$

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5.

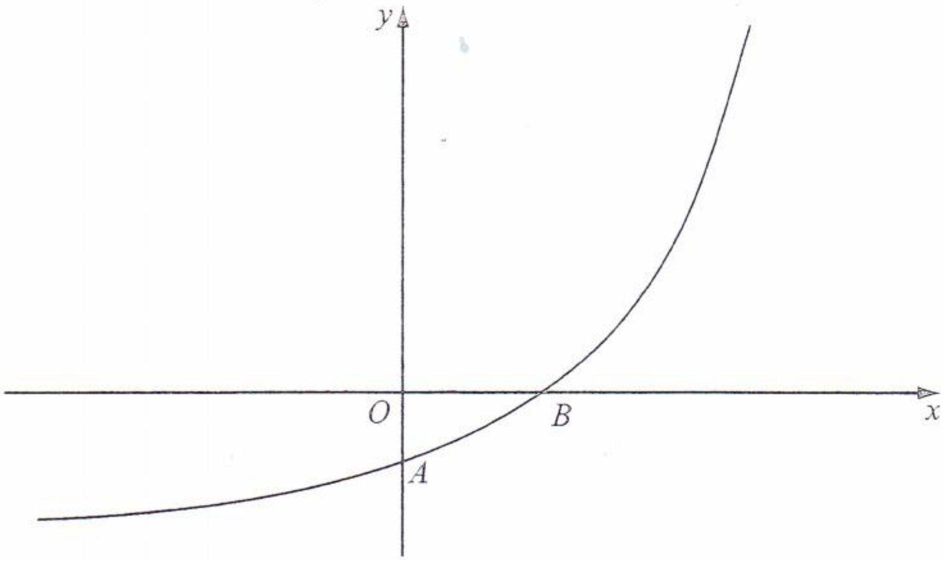


Figure 2

Figure 2 shows a sketch of part of the curve with equation $y = \mathrm{f}(x)$, $x \in \mathbb{R}$.

The curve meets the coordinate axes at the points $A(0, 1-k)$ and $B(\frac{1}{2}\ln k, 0)$, where k is a constant and $k > 1$, as shown in Figure 2.

On separate diagrams, sketch the curve with equation

(a) $y = |\mathrm{f}(x)|$, **(3)**

(b) $y = \mathrm{f}^{-1}(x)$. **(2)**

Show on each sketch the coordinates, in terms of k, of each point at which the curve meets or cuts the axes.

Given that $\mathrm{f}(x) = \mathrm{e}^{2x} - k$,

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

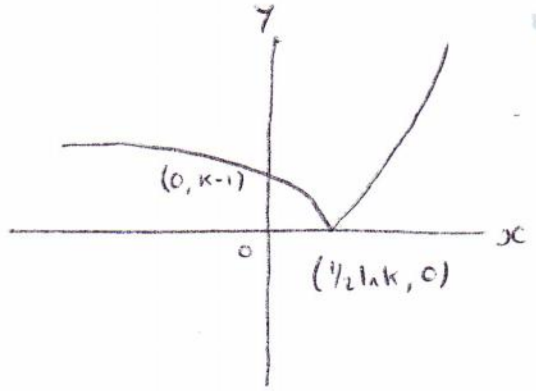
(d) find $\mathrm{f}^{-1}(x)$, **(3)**

(e) write down the domain of f^{-1}. **(1)**

H 3 4 2 6 4 A 0 1 4 2 8

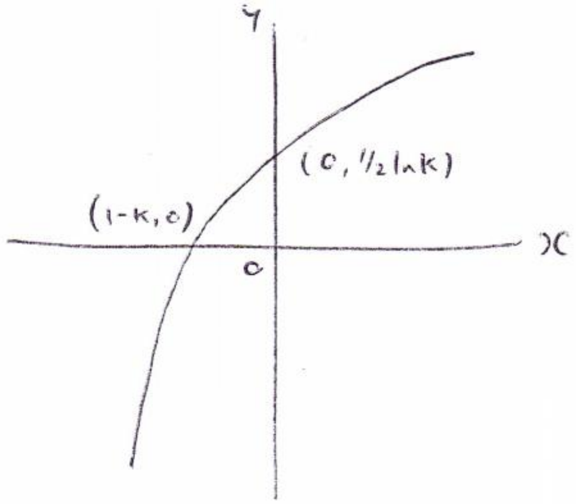
Question 5 continued

a)



reflect points below x-axis in x-axis

(b)



reflect in $y = x$

(c) $y > -k$

(d) $y = e^{2x} - k$

$y + k = e^{2x}$

$\ln(y+k) = 2x$

$x = \frac{\ln(y+k)}{2}$

$f^{-1}(x) = \frac{1}{2}\ln(x+k)$

e) $x > -k$

Turn over

6.

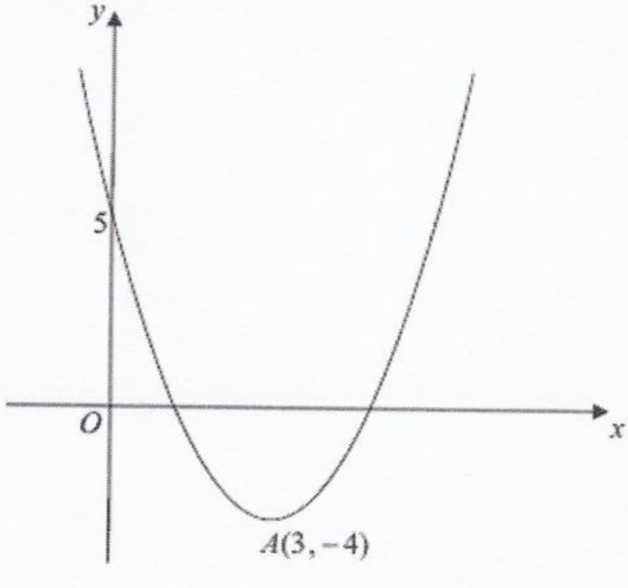


Figure 2

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

The curve has a turning point at $A(3, -4)$ and also passes through the point $(0, 5)$.

(*a*) Write down the coordinates of the point to which A is transformed on the curve with equation

(i) $y = |\mathrm{f}(x)|$,

(ii) $y = 2\mathrm{f}(\frac{1}{2}x)$.

(4)

(*b*) Sketch the curve with equation $y = \mathrm{f}(|x|)$.

On your sketch show the coordinates of all turning points and the coordinates of the point at which the curve cuts the y-axis.

(3)

The curve with equation $y = \mathrm{f}(x)$ is a translation of the curve with equation $y = x^2$.

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

(2)

(*d*) Explain why the function f does not have an inverse.

(1)

6a i) $y = |f(x)|$ reflect in x-axis graph below x-axis.

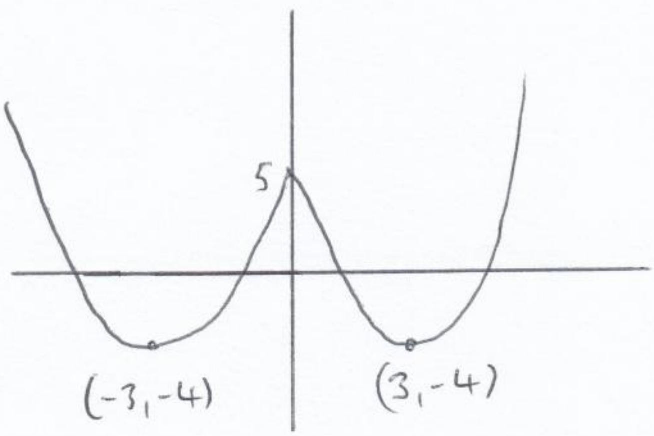
$\Rightarrow (3, 4)$

(ii) $y = 2f(\tfrac{1}{2}x)$ · stretch s.f. 2 parallel to x-axis

· stretch s.f. 2 parallel to y-axis

$\Rightarrow (6, -8)$

(b) $y = f(|x|)$ reflect in y-axis



(c) $(0, 0) \rightarrow (3, -4)$

· translate ~~the~~ +3 parallel to x-axis

-4 parallel to y-axis

$y = (x-3)^2 - 4$

(d) function f not a one to one mapping.

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3.

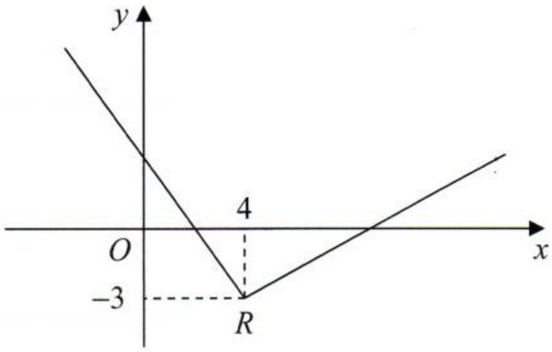


Figure 1

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

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

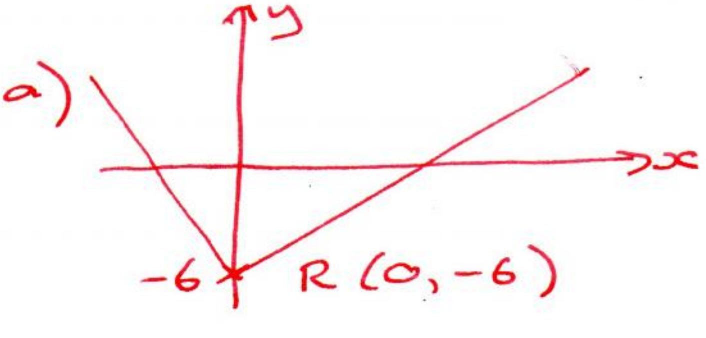
(a) $y = 2\mathrm{f}(x+4)$, shifted 4 units left then y-direction ×2 **(3)**

$\uparrow$ $\downarrow$ $\leftarrow 4$

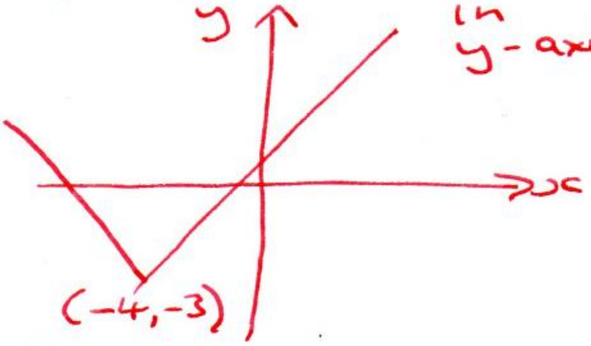
(b) $y = |\mathrm{f}(-x)|$. **(3)**

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

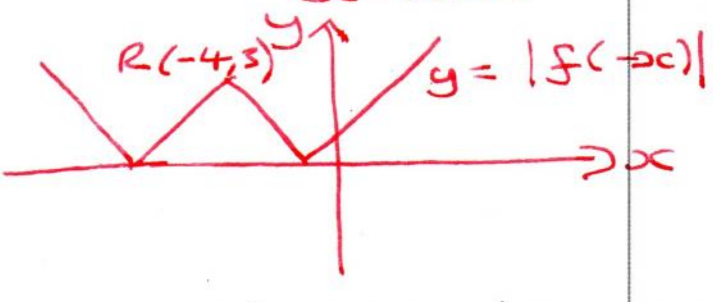
a)



b) f(−x) reflected in y-axis



Then modulus function reflects part of graph below x-axis



P 3 8 1 5 9 A 0 6 2 4

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4.

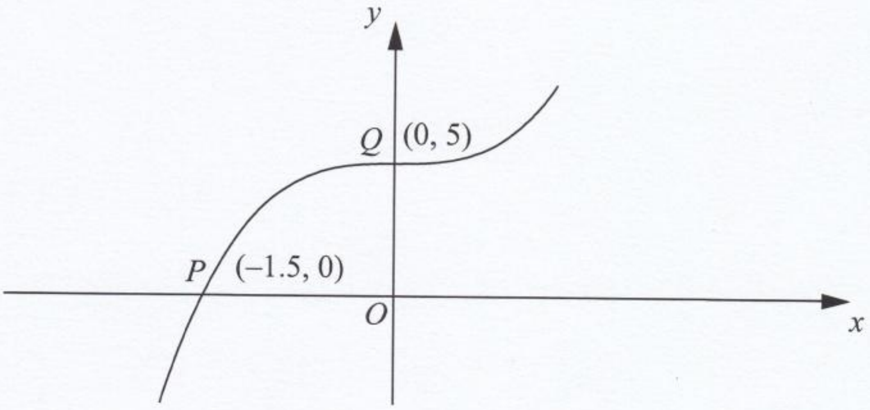


Figure 2

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

On separate diagrams, sketch the curve with equation

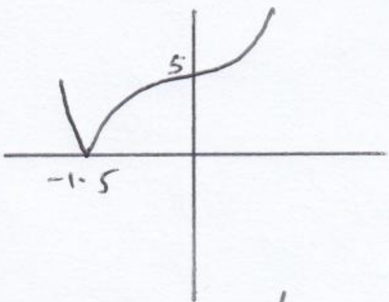
(a) $y = |\mathrm{f}(x)|$ **(2)**

(b) $y = \mathrm{f}(|x|)$ **(2)**

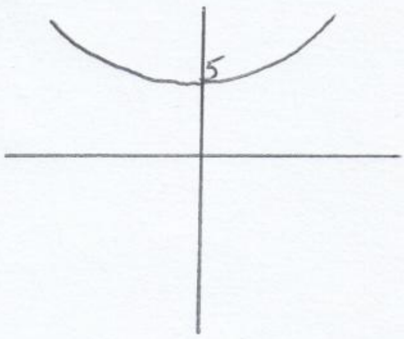
(c) $y = 2\mathrm{f}(3x)$ **(3)**

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

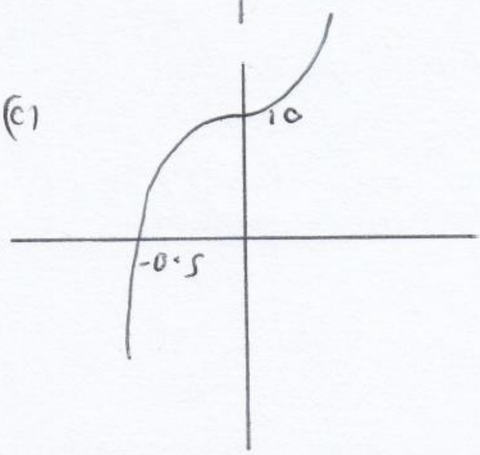
a)



(b)



(c)



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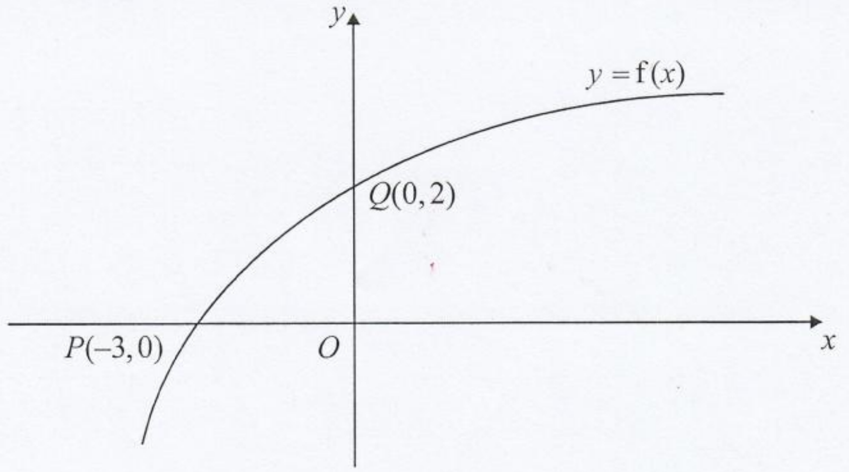


Figure 1

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

The curve passes through the points $Q(0,2)$ and $P(-3,0)$ as shown.

(a) Find the value of $\mathrm{ff}(-3)$.

(2)

On separate diagrams, sketch the curve with equation

(b) $y = \mathrm{f}^{-1}(x)$,

(2)

(c) $y = \mathrm{f}(|x|) - 2$,

(2)

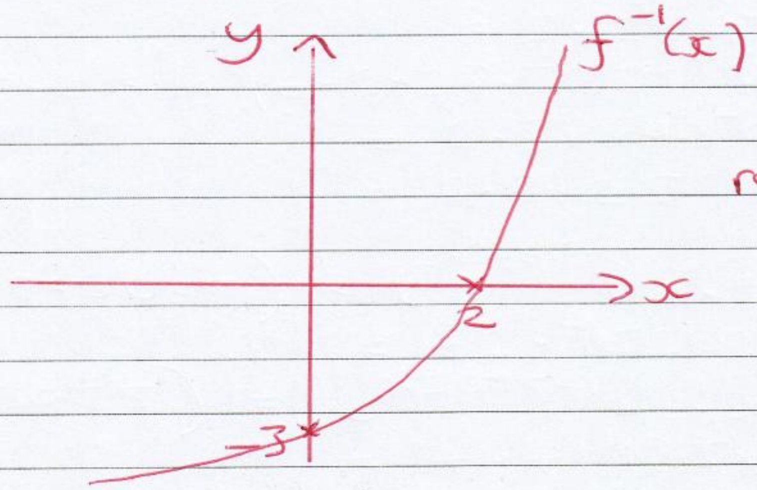
(d) $y = 2\mathrm{f}\left(\frac{1}{2}x\right)$.

(3)

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

a) $ff(-3) = f(0) = 2$ (using diagram)

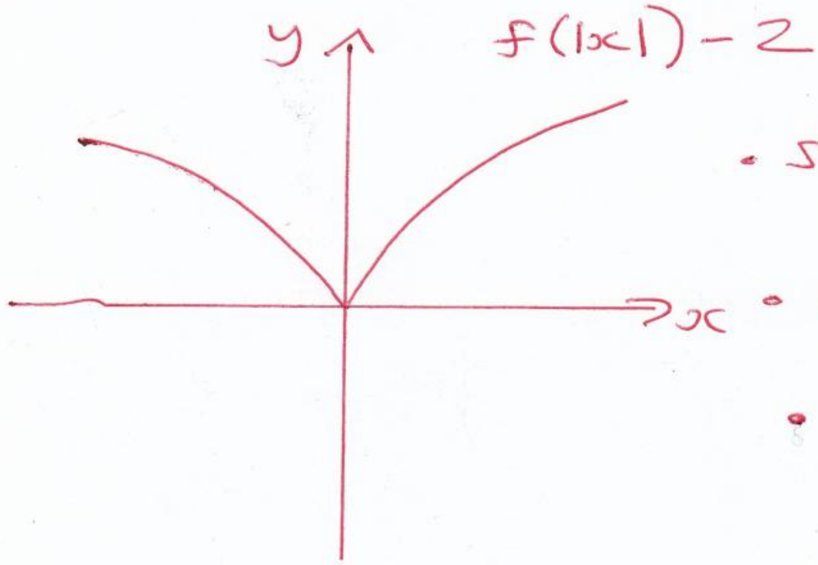
b)



reflection in $y=x$ for inverse function

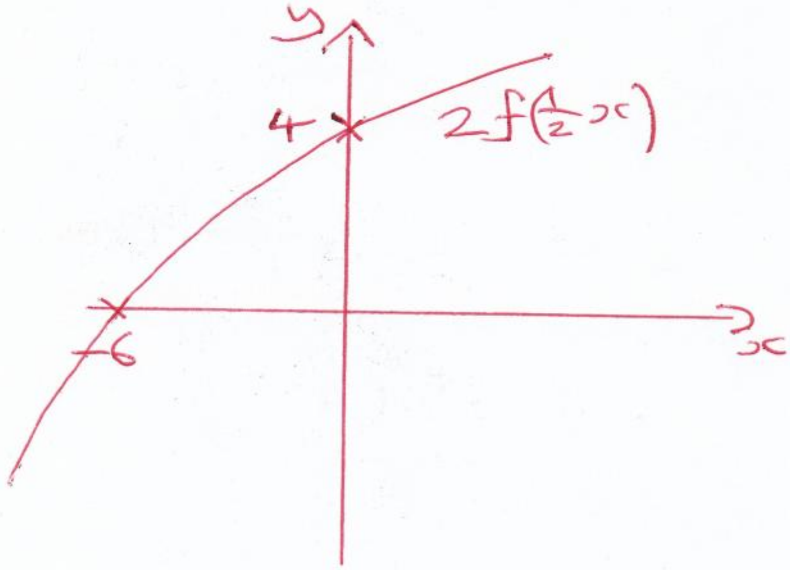
CJ JAN 2013

3c)



- sketch $y = f(x)$ for $x \geqslant 0$
- reflect in y-axis
- shift graph down 2 units

3d)



- $f(\frac{1}{2}x)$ doubles x-coord from -3 to -6
- then $2f(\frac{1}{2}x)$ doubles y-coord from 2 to 4.

Leave blank

2. Given that

$$f(x) = \ln x, \quad x > 0$$

sketch on separate axes the graphs of

(i) $y = f(x)$,

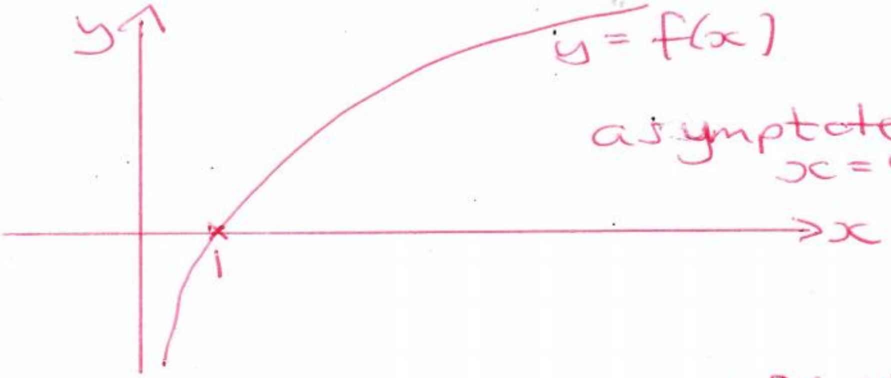
(ii) $y = |f(x)|$,

(iii) $y = -f(x - 4)$.

Show, on each diagram, the point where the graph meets or crosses the x-axis.
In each case, state the equation of the asymptote.

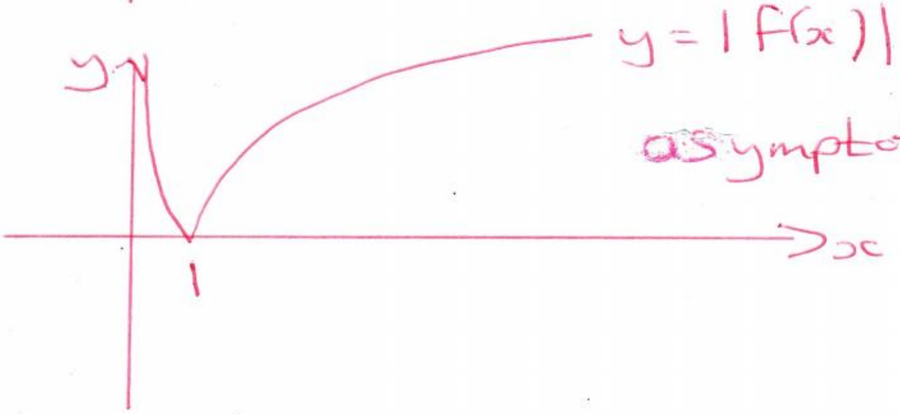
(7)

(i)



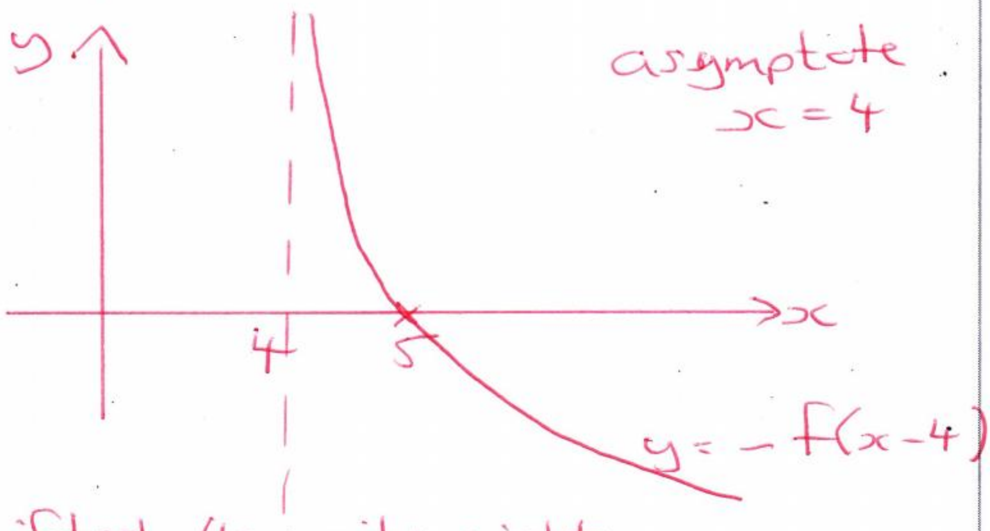
asymptote $x = 0$

(ii)



asymptote

(iii)



asymptote $x = 4$

shifted 4 units right and inverted