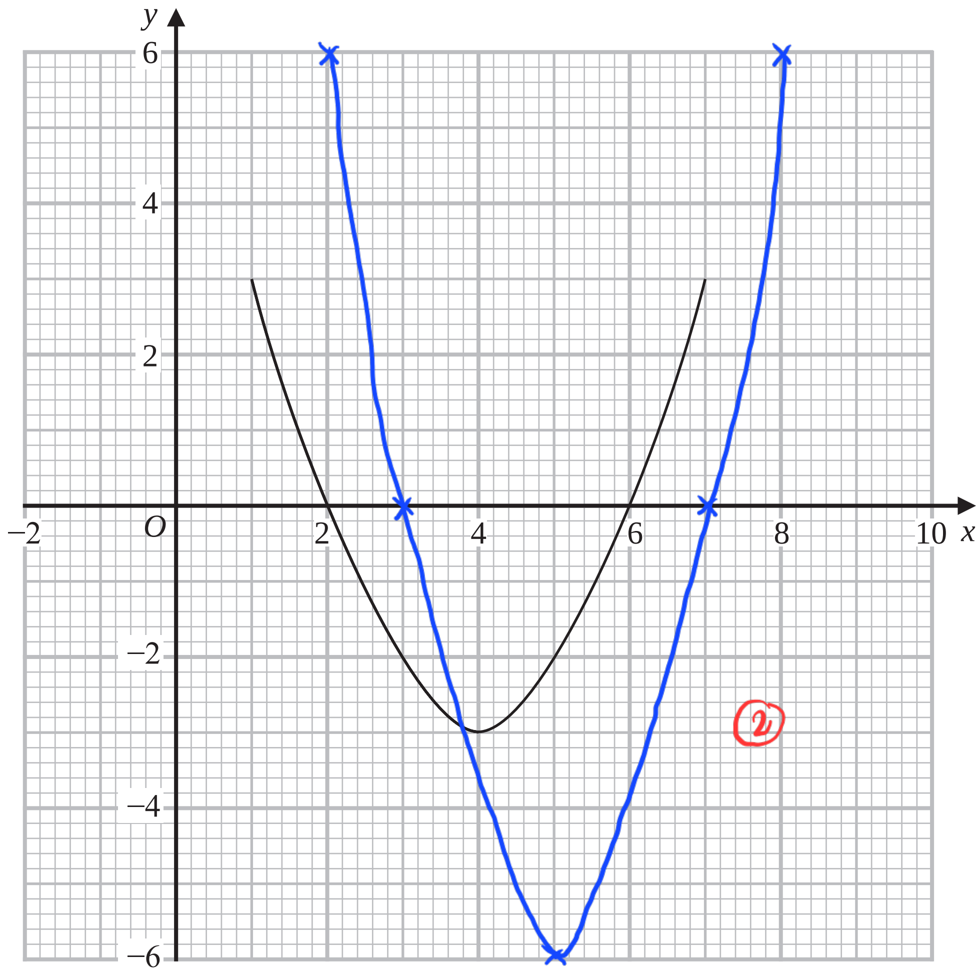
1 The curve with equation $y = g(x)$ is transformed to the curve with equation $y = -g(x)$ by the single transformation **T**.

(a) Describe fully the transformation **T**.

Reflection in the x-axis 1

(1)

The diagram shows the graph of $y = f(x)$



x-coordinate move one position to the right

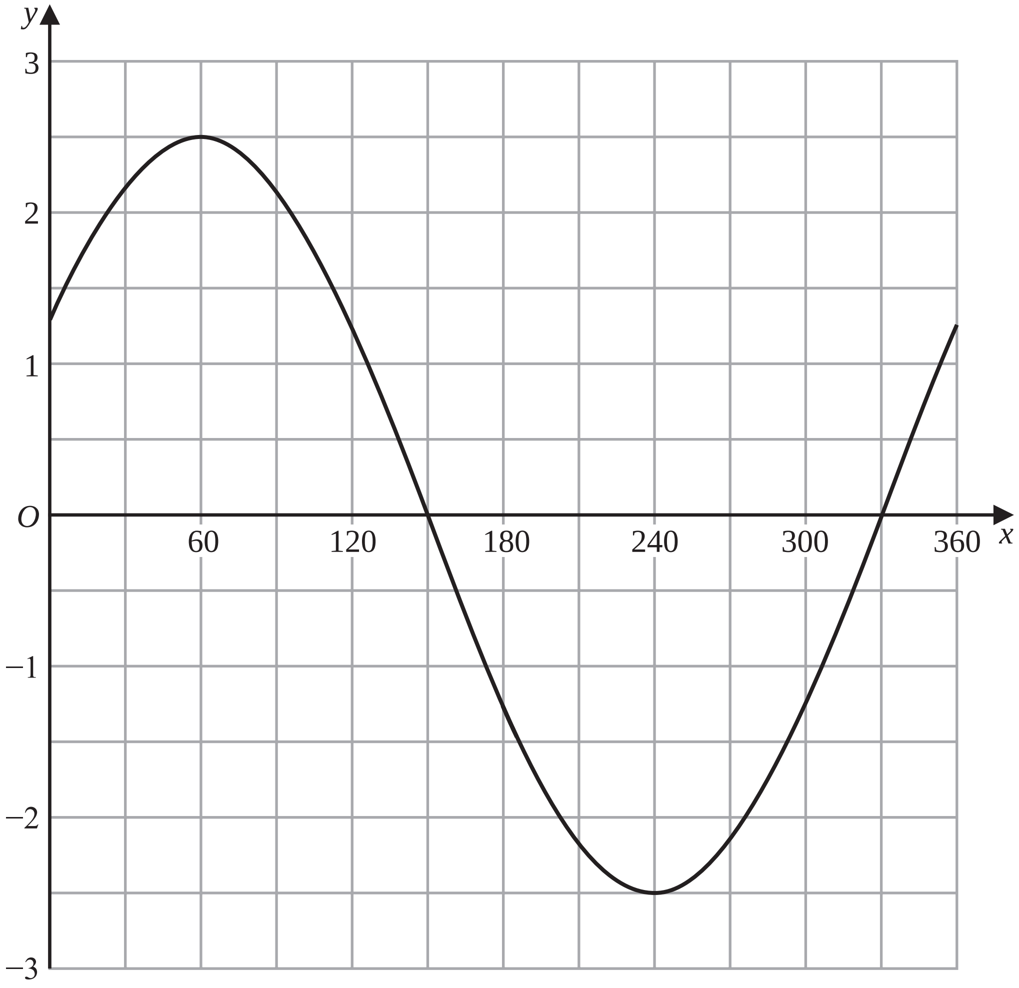
(b) On the grid, draw the graph of $y = 2f(x - 1)$

multiply y-coordinate by 2

(2)

(Total for Question 1 is 3 marks)

2 The graph of $y = a\cos(x + b)°$ for $0 \leqslant x \leqslant 360$ is drawn on the grid.



(a) Find the value of a and the value of b.

If $b > 0$, then curve shifts to the left

If $b < 0$, then curve shifts to the right

$a =$ 2.5 (1)

$b =$ −60 (1)

(2)

Another curve C has equation $y = f(x)$
The coordinates of the minimum point of C are (4, 5)

(b) Write down the coordinates of the minimum point of the curve with equation

(i) $y = f(2x)$

$\frac{4}{2} = 2$ y-coordinate unaffected

(2 , 5) (1)

(ii) $y = f(x) - 7$

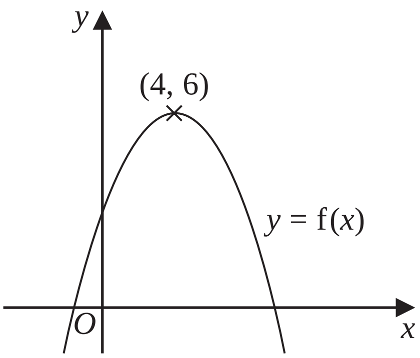
$5 - 7 = -2$ x-coordinate unaffected

(4 , −2) (1)

(2)

(Total for Question 2 is 4 marks)

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



There is one maximum point on this curve.
The coordinates of this maximum point are (4, 6)

(a) Write down the coordinates of the maximum point on the curve with equation

(i) $y = \mathrm{f}(x + 4)$ – shift x 4 position to the left

(.....0....., ...6.....) 1

(ii) $y = \mathrm{f}(2x)$ – divide x by 2

(.....2....., ...6.....) 1

(2)

The equation of a curve **C** is $y = x^2 + 3x + 4$

The curve **C** is transformed to curve **S** under the translation $\begin{pmatrix} 4 \\ 6 \end{pmatrix}$ $\begin{array}{l} -(x-4) \\ -\mathrm{f}(x)+6 \end{array}$

(b) Find an equation of curve **S**.

You do not need to simplify the equation.

$y = (x-4)^2 + 3(x-4) + 4\ (+6)$ 1

$= x^2 - 8x + 16 + 3x - 12 + 10$

$= x^2 - 5x + 14$ 1

$y = x^2 - 5x + 14$

(2)

(Total for Question 3 is 4 marks)

4 The curve **S** has equation $y = \mathrm{f}(x)$ where $\mathrm{f}(x) = x^2$
The curve **T** has equation $y = \mathrm{g}(x)$ where $\mathrm{g}(x) = 2x^2 - 12x + 13$

By writing $\mathrm{g}(x)$ in the form $a(x - b)^2 - c$, where a, b and c are constants, describe fully a series of transformations that map the curve **S** onto the curve **T**.

$$g(x) = 2x^2 - 12x + 13$$
$$= 2(x^2 - 6x) + 13$$
$$= 2\left[(x-3)^2 - 9\right] + 13$$
$$= 2(x-3)^2 - 18 + 13 \quad (1)$$
$$g(x) = 2(x-3)^2 - 5 \quad (1)$$

x : translate 3 positions to the right

y : translate 5 position downward

stretch y-direction with scale factor 2 and followed by translation $\begin{pmatrix} 3 \\ -5 \end{pmatrix}$.
(1) (1)

(Total for Question 4 is 4 marks)

5 A curve has equation $y = f(x)$

The coordinates of the minimum point on this curve are (–9, 15)

(a) Write down the coordinates of the minimum point on the curve with equation

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

move x 3 positions to the left

1

(......-12...... , ...15......)

(ii) $y = \frac{1}{3}f(x)$

$y = \frac{1}{3}(15)$

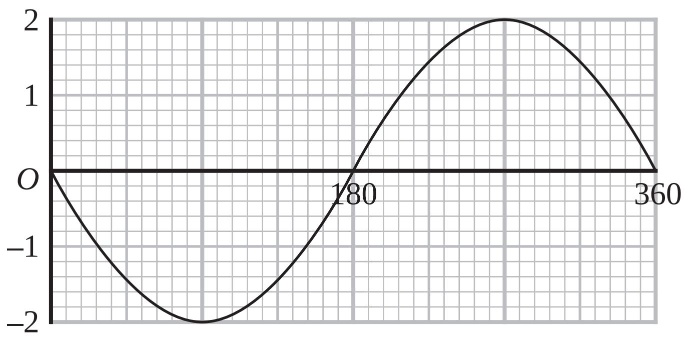
$= 5$

1

(......-9...... , ...5......)

(2)

The graph of $y = a\cos(x + b)°$ for $0 \leqslant x \leqslant 360$ is drawn on the grid below.



$= y = 2\cos(x + 90)°$

Given that $a > 0$ and that $0 < b < 360$

upper and lower limit $= 2$

so, $a = 2$.

(b) find the value of a and the value of b.

$a =$ ......2...... 1

$b =$ ......90...... 1

(2)

(Total for Question 5 is 4 marks)

6 The point A with coordinates $(-3, 2)$ lies on the straight line with equation $y = f(x)$

(a) Find the coordinates of the image of the point A on the straight line with equation

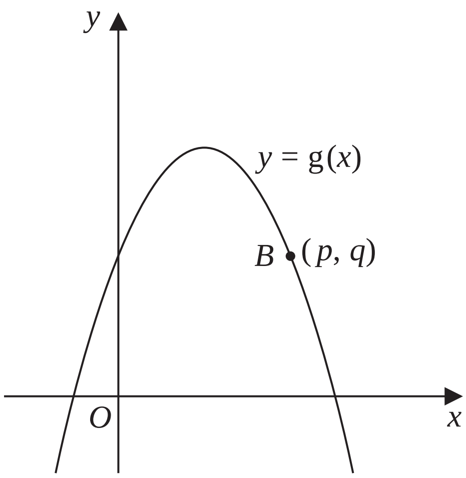
(i) $y = f(x) - 3$ - y is translated 3 positions to the left

(.....-3....., ...-1.....)
(1)

(ii) $y = f\left(\frac{x}{2}\right)$ - x is doubled

(.....-6....., ...2.....)
(1)

Here is a sketch of part of the curve with equation $y = g(x)$



The point B with coordinates (p, q) lies on the curve.

(b) Find the coordinates of the image of the point B on the curve with equation

$$y = -g(\underline{x - c})$$

where c is a constant.

y is negated

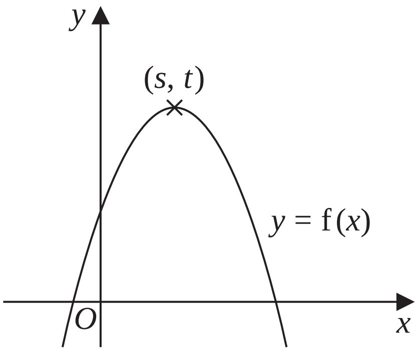
x is translated c coordinate to the right

2

(.....p+c....., ...-q.....)
(2)

(Total for Question 6 is 4 marks)

7 The diagram shows a sketch of part of the curve with equation $y = f(x)$



There is one maximum point on this curve.
The coordinates of this maximum point are (s, t)

Find, in terms of s and t, the coordinates of the maximum point on the curve with equation

(i) $y = f(x - 2)$

(s+2 , t) 1

(1)

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

(s 1, 3t)

(1)

(Total for Question 7 is 2 marks)

8 The curve with equation $y = f(x)$ has one turning point.

The coordinates of this turning point are $(-6, -4)$

(a) Write down the coordinates of the turning point on the curve with equation

(i) $y = f(x) + 5$

$(-6, -4+5)$

$= (-6, 1)$

(-6 , 1) 1

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

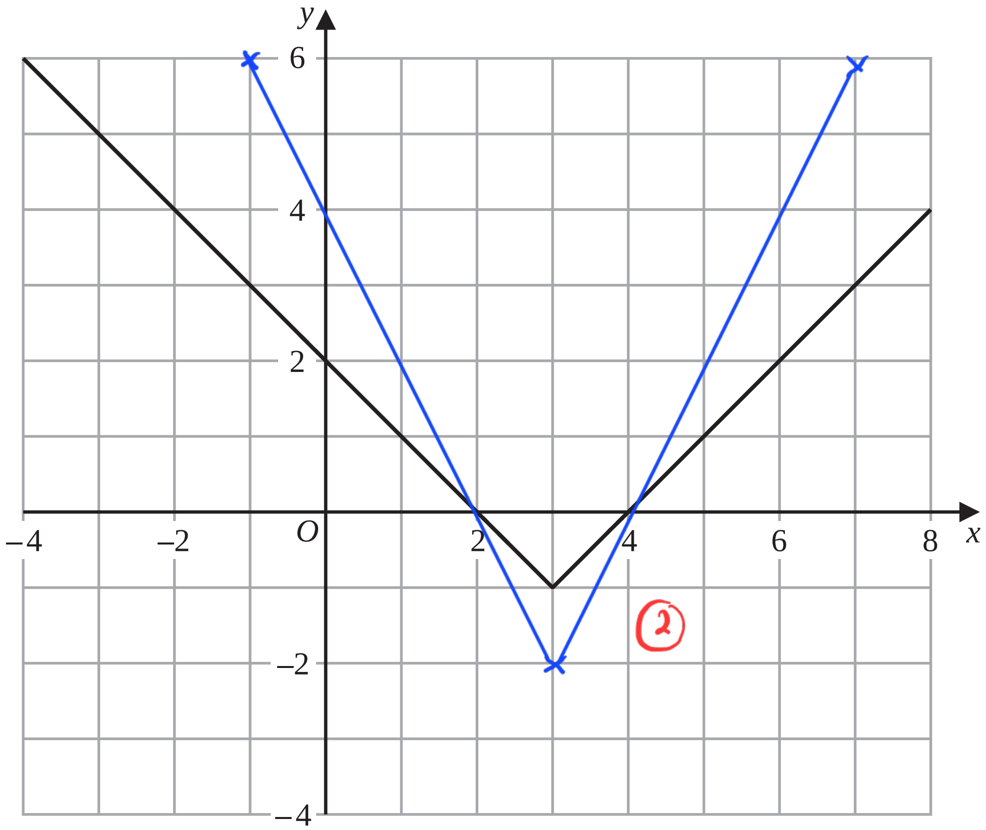
$\left(\frac{-6}{3}, -4\right)$

$= (-2, -4)$

(-2 , -4) 1

(2)

The graph of $y = g(x)$ is shown on the grid below.



(b) On the grid, sketch the graph of $y = 2g(x)$ for $-1 \leqslant x \leqslant 7$

(2)

The graph of $y = \mathrm{h}(x)$ intersects the x-axis at two points.
The coordinates of the two points are (–1, 0) and (6, 0)

The graph of $y = \mathrm{h}(x + a)$ passes through the point with coordinates (2, 0), where a is a constant.

(c) Find the two possible values of a

$-1-2=-3$

$6-2=4$

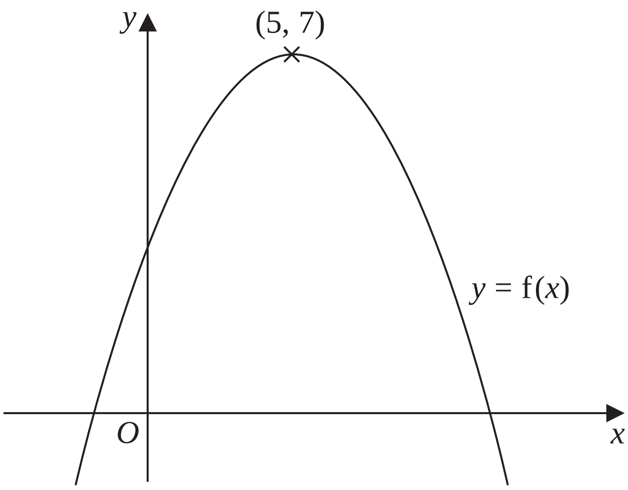
2

-3 , 4

(2)

(Total for Question 8 is 6 marks)

9 The diagram shows a sketch of the curve with equation $y = \mathrm{f}(x)$



There is only one maximum point on the curve.
The coordinates of this maximum point are (5, 7)

Write down the coordinates of the maximum point on the curve with equation

(i) $y = \mathrm{f}(x + 9)$

(-4 , 7) 1

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

(5 , 10) 1

(Total for Question 9 is 2 marks)

10 Curve **C** has equation $y = f(x)$
The graph of curve **C** has one maximum point.
The coordinates of this maximum point are (3, 5)

(a) Write down the coordinates of the maximum point on the curve with equation

(i) $y = 2f(x)$

(3 , 10)
(1) 1

(ii) $y = f(x) - 7$

(3 , −2)
(1) 1

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

(−3 , 5)
(1) 1

Curve **L** has equation $y = x^2 + 7x + 20$

Curve **L** is transformed to curve **S** under the translation $\begin{pmatrix} 2 \\ 0 \end{pmatrix}$

(b) Find an equation for **S**
Give your answer in the form $y = ax^2 + bx + c$

1
$y = (x-2)^2 + 7(x-2) + 20$

1 $= x^2 - 4x + 4 + 7x - 14 + 20$ 1

$= x^2 + 3x + 10$ 1

$y =$ $x^2 + 3x + 10$
(4)

(Total for Question 10 is 7 marks)

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

There is only one turning point on the curve.
The coordinates of this turning point are (6, 5)

Write down the coordinates of the turning point on the curve with equation

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

(10 , 5) 1

(1)

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

(2 , 5) 1

(1)

(Total for Question 11 is 2 marks)