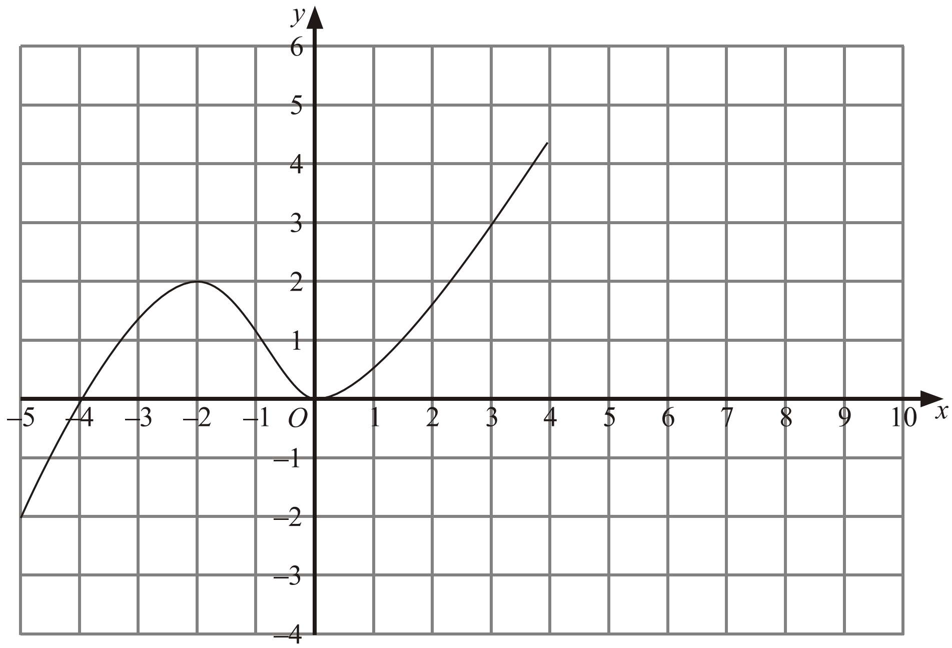
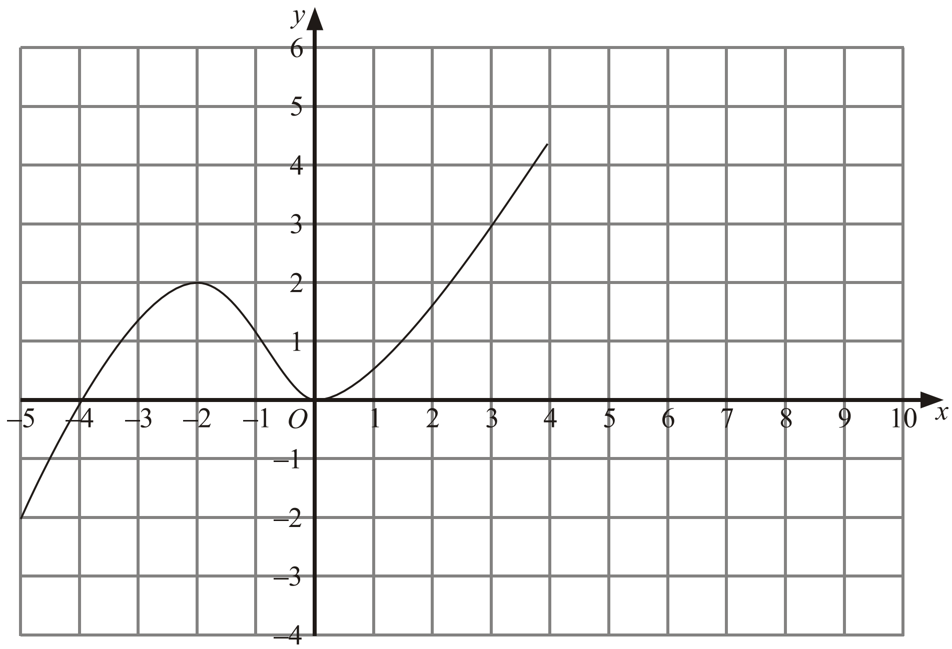
1. The graph of $y = f(x)$ is shown on the grids.

(a) On this grid, sketch the graph of $y = f(x) + 2$



(2)

(b) On this grid, sketch the graph of $y = -f(x)$



(2)
(Total 4 marks)

2. $x^2 - 8x + 23 = (x - p)^2 + q$ for all values of x.

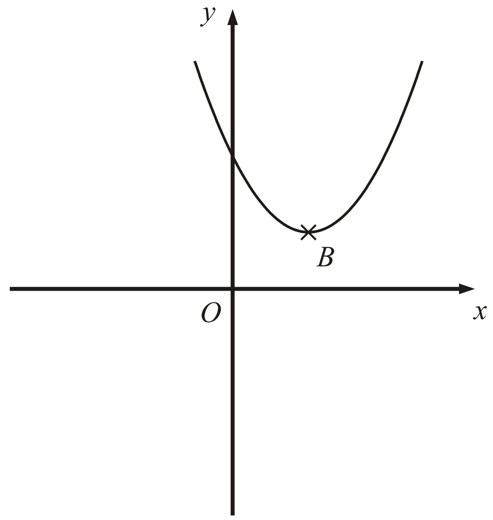
(a) Find the value of p and the value of q.

p = ...

q = ...

(3)

Here is a sketch of the curve with equation $y = x^2 - 8x + 23$



B is the minimum point on the curve.

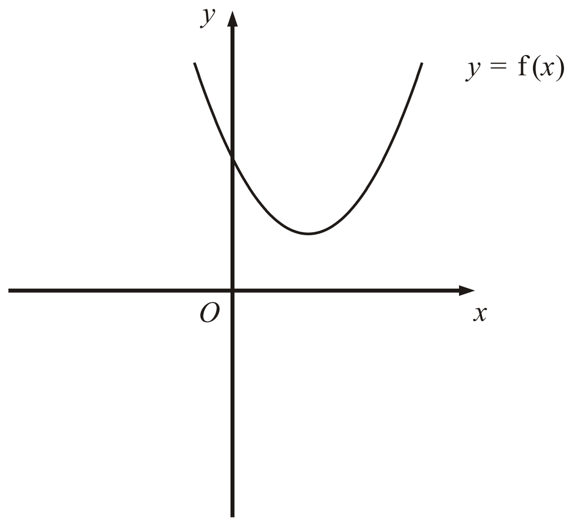
(b) Find the coordinates of B.

(............. , ...)

(1)

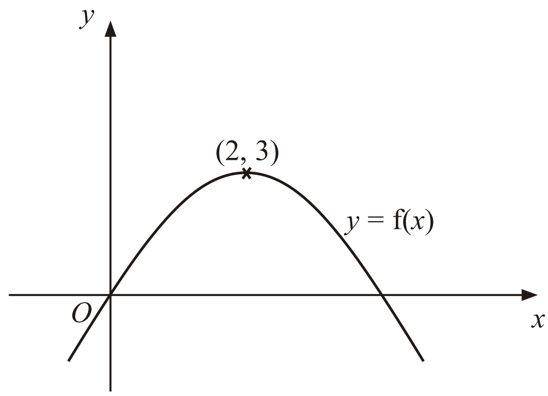
The equation of the curve can be written in the form $y = f(x)$,
where $f(x) = x^2 - 8x + 23$

(c) On the diagram below, draw a sketch of the curve $y = f(-x)$.



(1)
(Total 5 marks)

3.



The diagram shows part of the curve with equation $y = f(x)$.
The coordinates of the maximum point of this curve are (2, 3).

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

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

(......... , ...)

(1)

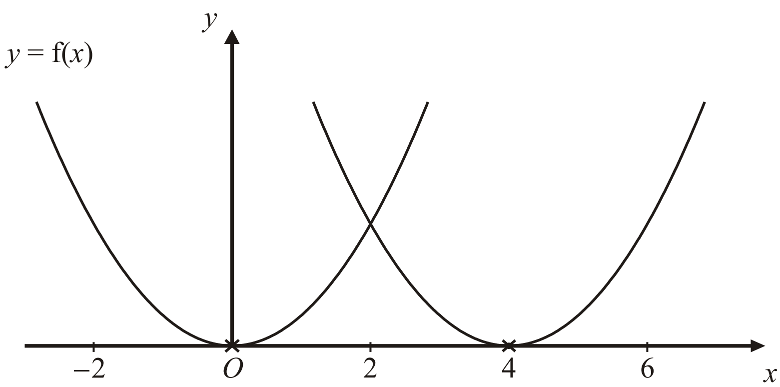
(b) $y = 2f(x)$

(......... , ...)

(1)

(Total 2 marks)

4.

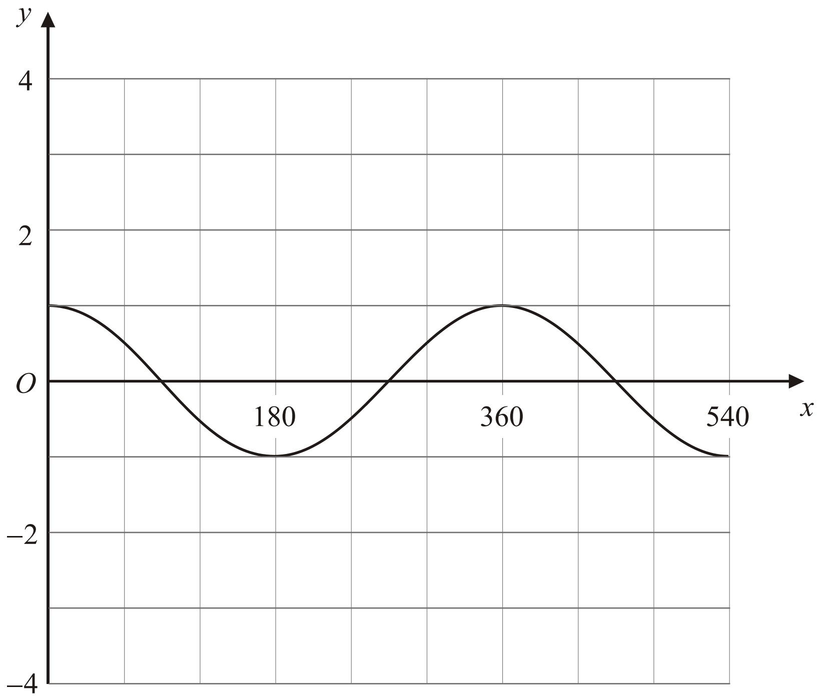


The curve with equation $y = f(x)$ is translated so that the point at (0, 0) is mapped onto the point (4, 0).

(a) Find an equation of the translated curve.

....

(2)



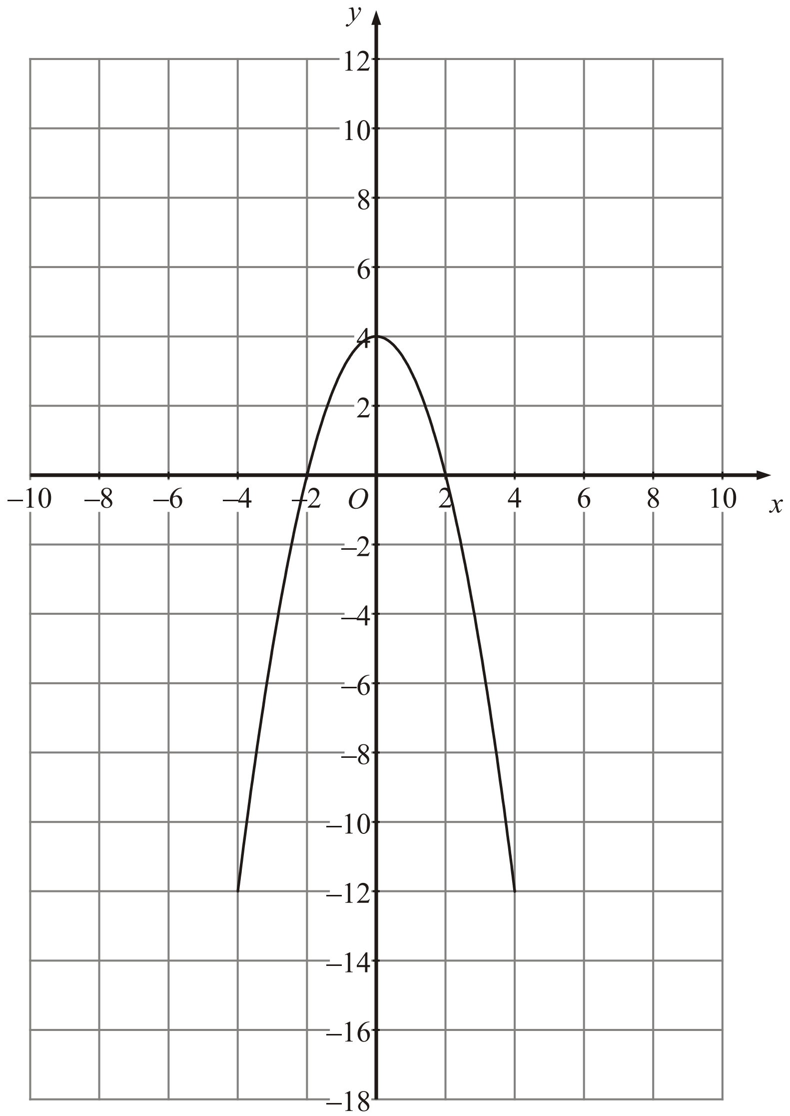
The grid shows the graph of $y = \cos x°$ for values of x from 0 to 540

(b) On the grid, sketch the graph of $y = 3\cos(2x°)$ for values of x from 0 to 540

(2)
(Total 4 marks)

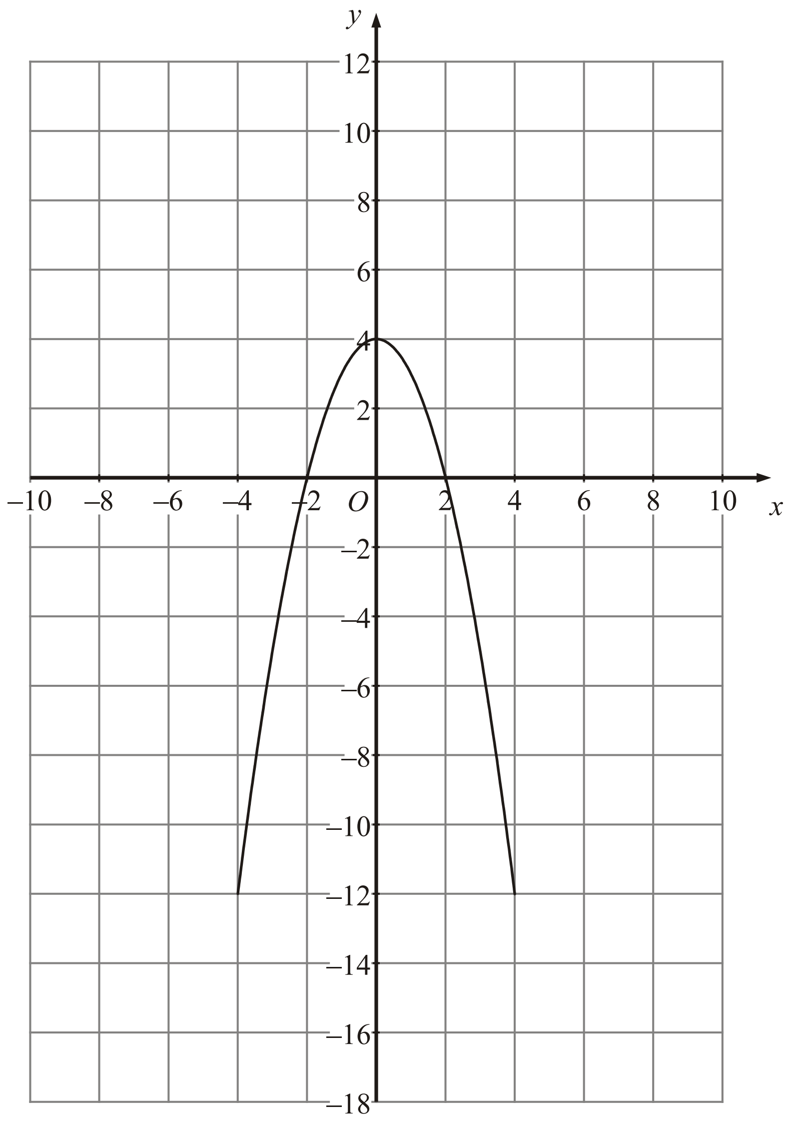
5. The graph of $y = f(x)$ is shown on the grids.

(a) On this grid, sketch the graph of $y = f(x) - 4$



(2)

(b) On this grid, sketch the graph of $y = f(\frac{1}{2}x)$.



(2)
(Total 4 marks)

1. (a) Graph translated 2 units upwards through points (–4, 2), (–2, 4), (0, 2) and (3, 5)
Sketch 2

M1 for a vertical translation

A1 curve through points (–4, 2), (–2, 4), (0, 2) and (3, 5) ± ½ square

(b) Graph reflected in x-axis through points
(–4, 0), (–2, –2), (0, 0) and (3, –3)
Sketch 2

M1 for reflection in x-axis or y-axis
A1 curve through points (–4, 0), (–2, –2), (0, 0) and (3, –3) ± ½ square

[4]

2. (a) $(x-4)^2 - 16 + 23$

$p = 4$, $q = 7$ 3

M1 for sight of $(x-4)^2$
A1 $p = 4$, *A1* $q = 7$
or
M1 $x^2 - 2px + p^2$ $(+q)$ *seen*
A1 $p = 4$, *A1* $q = 7$
or
M1 Substitute 2 different values of x and attempt to solve for p, q
A1 $p = 4$, *A1* $q = 7$

(b) (4, 7) 1

B1 ft on (a)

(c) Reflection in the y axis 1

B1

[5]

3. (a) (4, 3) 1

B1 for (4, 3)

(b) (2, 6) 1

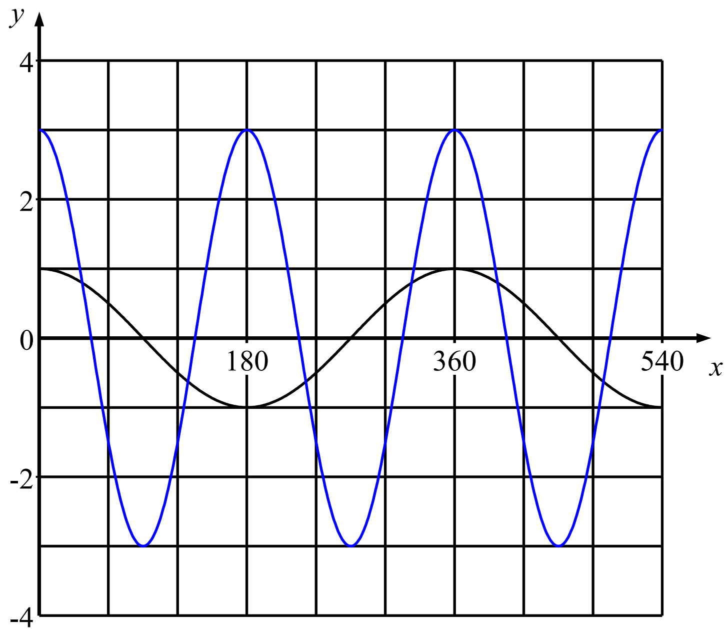
B1 for (2, 6)

[2]

4. (a) $y = f(x-4)$ 2

B2 cao
(B1 for $f(x-4)$ *or* $y = f(x+a)$, $a \neq -4$, $a \neq 0$*)*

(b)

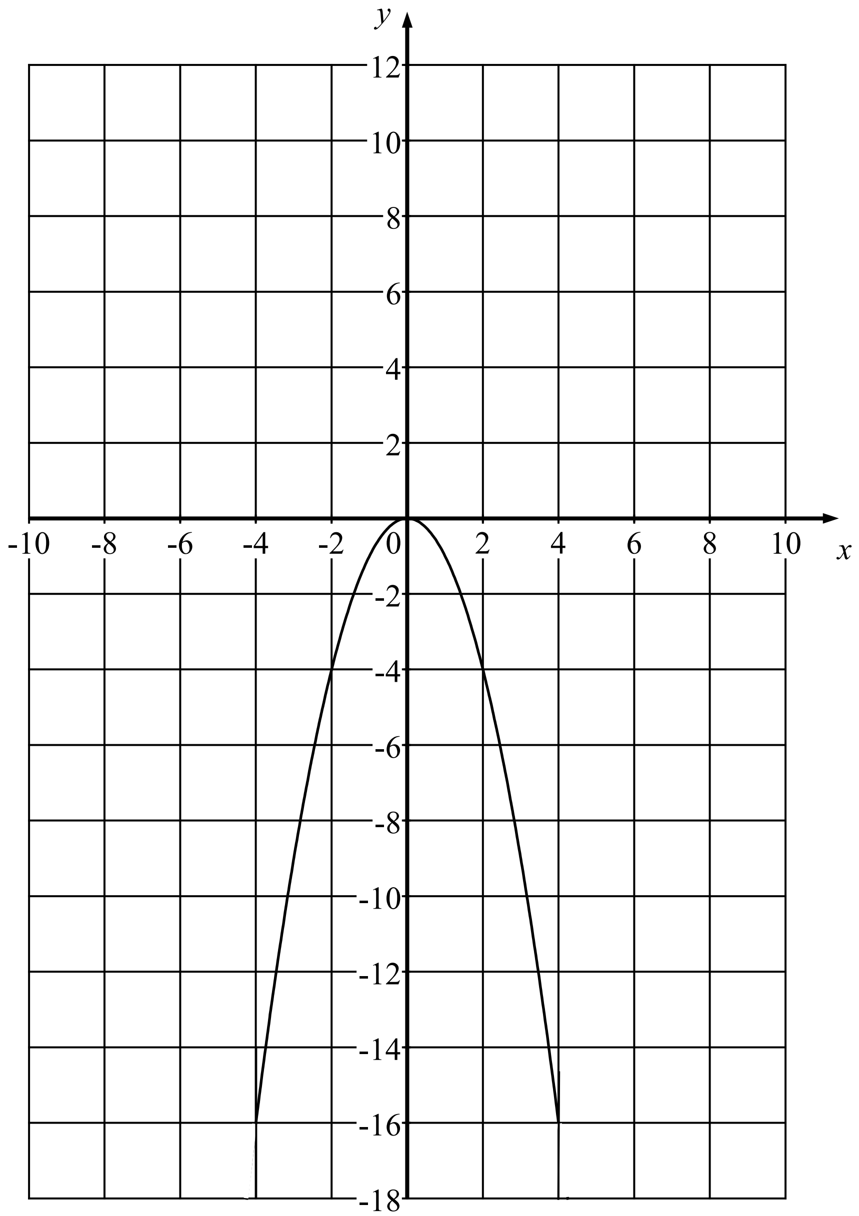


2

B2 cao
(B1 cosine curve with either correct amplitude or correct period, but not both)

[4]

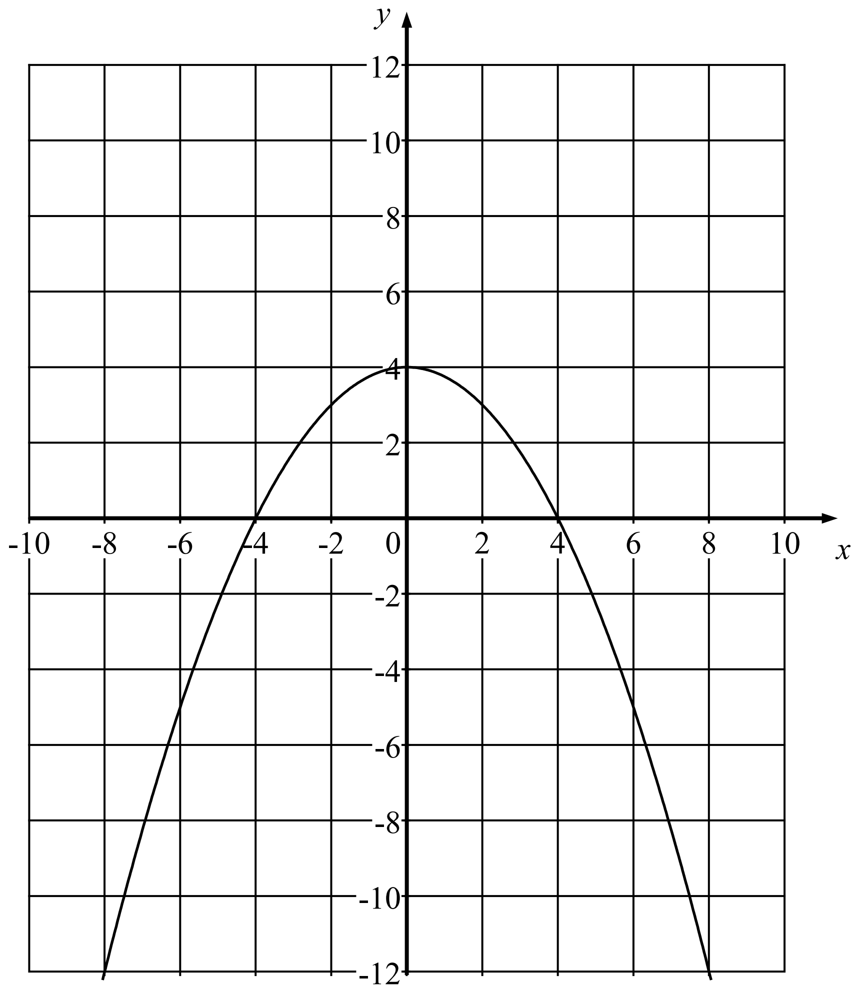
5. (a)



2

B2 parabola max (0,0), through (–2, –4) and (2, –4)
Tol ½sq
(B1 parabola with single maximum point (0, 0) or through (–2, –4) and (2, –4),but not both or the given parabola translated along the y-axis by any other value than -4 – the translation must be such that the points (0, 4), (–2, 0), (2, 0) are translated by the same amount.
Tol ½sq)

(b)



B2 parabola max (0, 4), through (–4, 0) and (4, 0)
Tol ½sq
(B1 parabola with single maximum point (0, 4))
Tol ½sq

2

[4]

1. Candidates of all abilities were able to score marks in this question- usually in part (a). In part (a), many candidates realised that they had to shift the curve vertically upwards, but some were careless in ensuring that all points were shifted by the same amount. A common error in part (b) was to reflect the curve in the *y*-axis.

2. Again another standard if rather sophisticated algebraic technique. Candidates who were familiar with the relationship that *p* is half the coefficient of *x* generally scored at least 2 of the marks. Many then went on to find *q*. Less certain approaches involved expanding $(x - p)^2$ and trying to spot values of *p* and *q* from the resulting expressions. Unfortunately, poor algebra often made this approach unfruitful. Similarly some candidates tried to substitute values of *x* in both sides of what is an identity, but could not solve the resulting simultaneous equations in *p* and *q*.

Part (b) generally followed on if the correct answer was obtained to part (a). Some candidates substituted systematically into $x^2 +- 8x + 23$and were able to pick out the minimum value.

Part (c) was poorly answered with only a few realising the required transformation was a reflection in the y axis

3. More than a fifth of the candidates were able to get each part of this question correct. In part (a), common incorrect answers were (0, 3) and (2, 3), and in part (b), common incorrect answers were (4, 6) and (4, 3).

4. Part (a) was answered quite well with a good proportion of candidates recognising the transformation and remembering how to write the equation down. Many candidates used a combination of f, x and 4 but opted for the wrong one so that $y = f(x + 4)$ and $y = 4f(x)$ were common incorrect answers. Relatively few fully correct answers were seen in part (b). Where one of the two marks was awarded, this was usually for drawing a graph with the correct amplitude. Graphs with the correct period but incorrect amplitude were much rarer.

Some candidates doubled the period rather than halving it. Marks were sometimes lost because the curve was not drawn accurately enough or only drawn for part of the given range. Not all candidates attempted this question but most of those who did tried to draw some sort of wave.

5. In part (a), many candidates understood that the required answer involved a translation along the y-axis. However, many of them fixed on the –4 as a position indicator rather than a translation indicator and drew the vertex of their parabola at (0, –4). In part (b), most candidates did not know the significance of the $\frac{1}{2}x$ and in many cases tried a translation parallel to the y-axis, usually by half a unit.