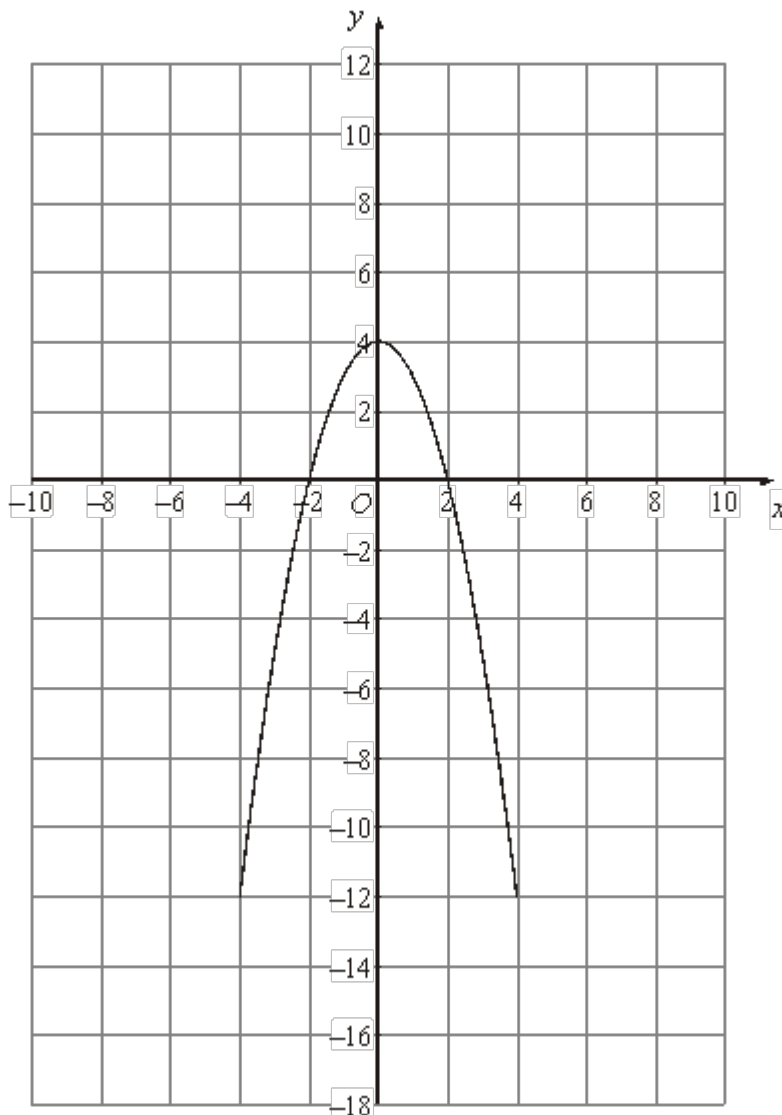


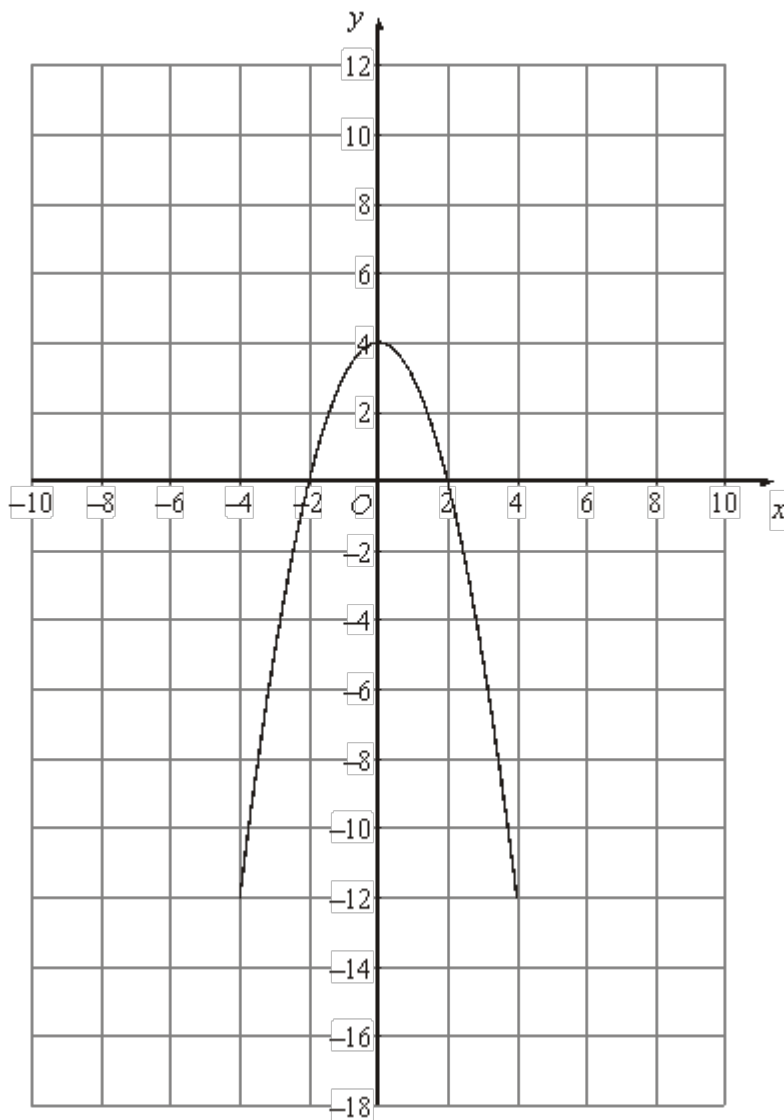
**Q1.** The graph of  $y = f(x)$  is shown on the grids.

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



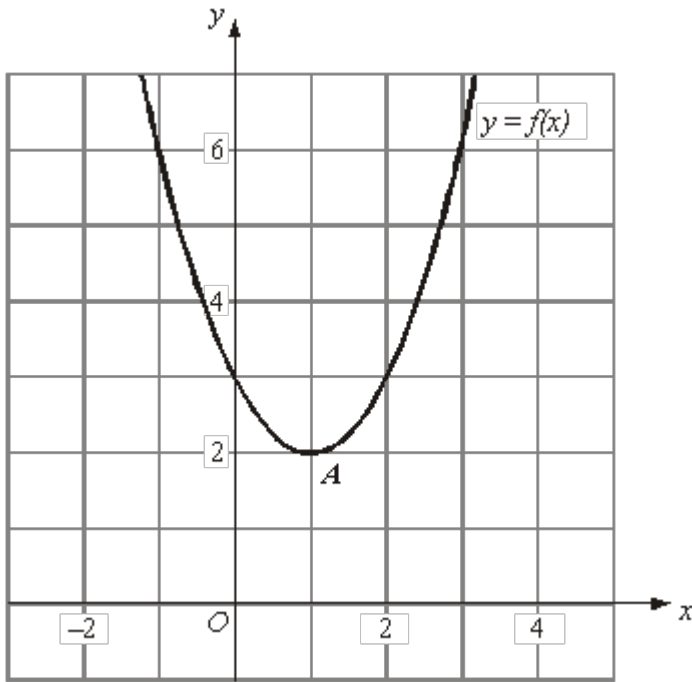
(2)

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



(2)  
(Total 4 marks)

Q2.



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

The only vertex of the graph is  $A$  at  $(1, 2)$ .

Write down the coordinates of the vertex of the curve with equation.

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

....., .....

(1)

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

....., .....

(1)

The curve with equation  $y = f(x)$  is transformed to give the curve with equation  $y = -f(x)$

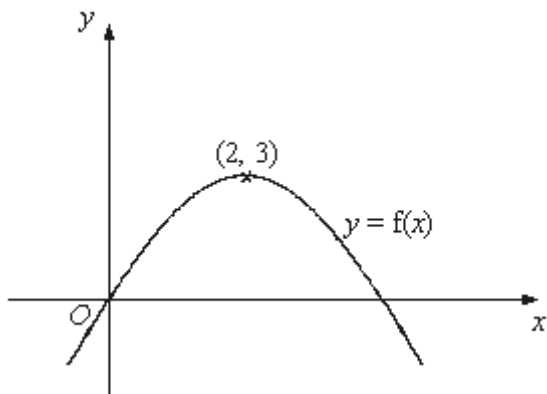
(b) Describe the transformation.

.....

(1)

(Total 3 marks)

Q3.



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)

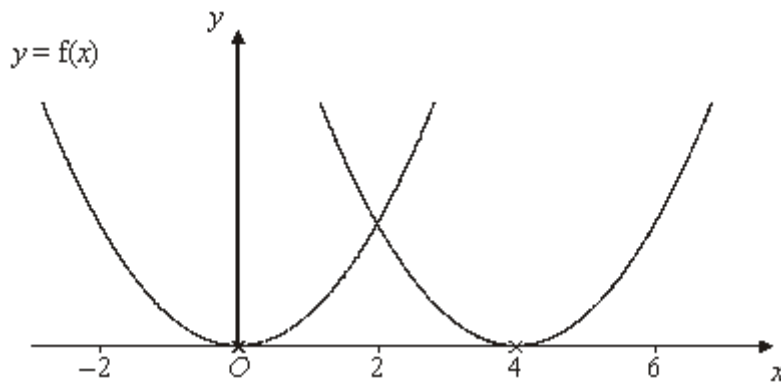
(b)  $y = 2f(x)$

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

(1)

(Total 2 marks)

Q4.

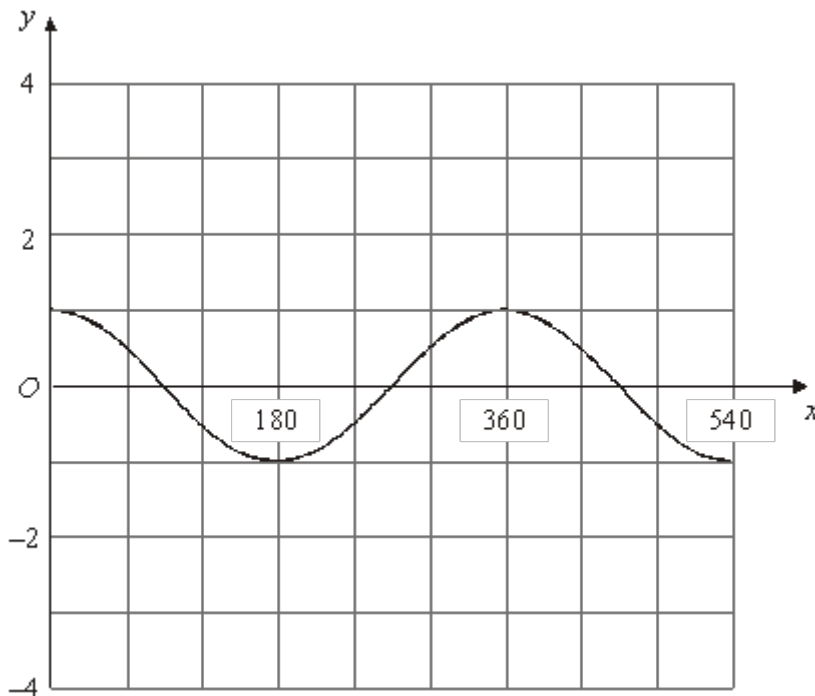


The curve with equation  $y = f(x)$  is translated so that the point at  $(0, 0)$  is mapped onto the point  $(4, 0)$ .

- (a) Find an equation of the translated curve.

.....

(2)



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

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

(2)

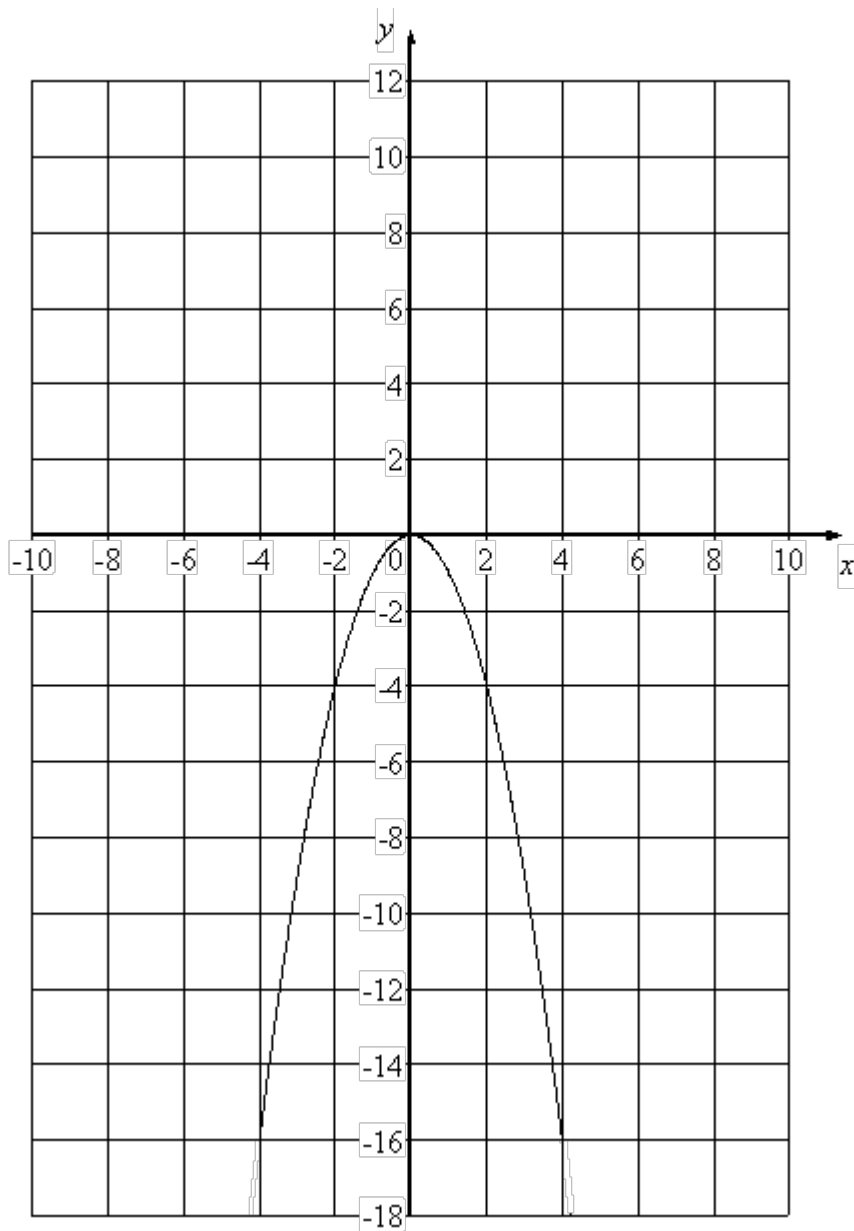
(Total 4 marks)

M1.

	Answer	Mark	Additional Guidance
(a)	Curve	2	<p><b>B2</b> parabola max (0, 0), through (-2, -4) and (2, -4) Tol <math>\frac{1}{2}</math>sq</p> <p><b>B1</b> parabola with single maximum point (0, 0) or through (-2, -4) and (2, -4), but not both or the given parabola translated along the <math>y</math>-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 <math>\frac{1}{2}</math>sq)</p>
(b)	Curve	2	<p><b>B2</b> parabola max (0, 4), through (-4, 0) and (4, 0) Tol <math>\frac{1}{2}</math>sq</p> <p><b>B1</b> parabola with single maximum point (0, 4) Tol <math>\frac{1}{2}</math>sq</p>
			<b>Total for Question: 4 marks</b>

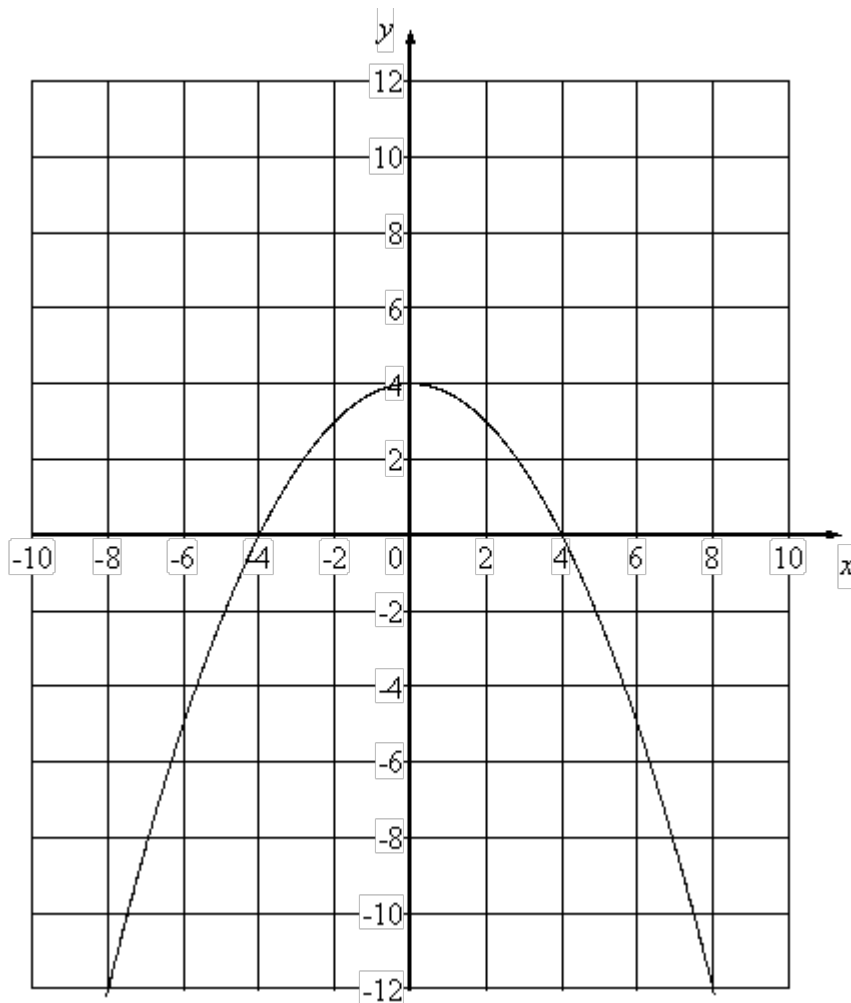
PTO for graphs

(a)



(b)





M2.

	Working	Answer	Mark	Additional Guidance
(a)(i)		(1, 5)	2	<b>B1</b> cao
(ii)		(3, 2)		<b>B1</b> cao
(b)		Reflection in $x$ axis	1	<b>B1</b> cao
				<b>Total for Question: 3 marks</b>

M3.

	Answer	Mark	Additional Guidance
(a)	(4, 3)	2	<b>B1</b> for (4, 3)
(b)	(2, 6)		<b>B1</b> for (2, 6)
<b>Total for Question: 2 marks</b>			

M4.

	Answer	Mark	Additional Guidance
(a)	$y = f(x - 4)$	2	<b>B2</b> cao ( <b>B1</b> for $f(x - 4)$ or $y = f(x + a)$ , $a \neq -4$ , $a \neq 0$ )
(b)		2	<b>B2</b> cao ( <b>B1</b> cosine curve with either correct amplitude or correct period, but not both)

**Total for Question: 4 marks**

**E1.** 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.

**E3.** 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  $(4, 3)$ .

**E4.** 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.