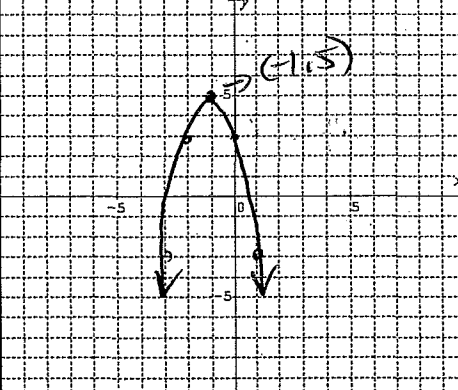
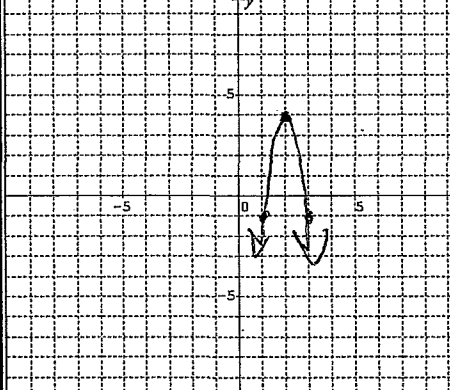
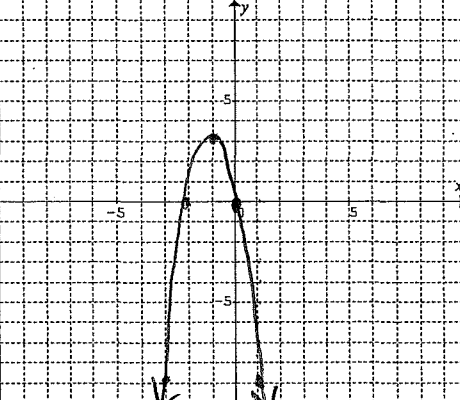
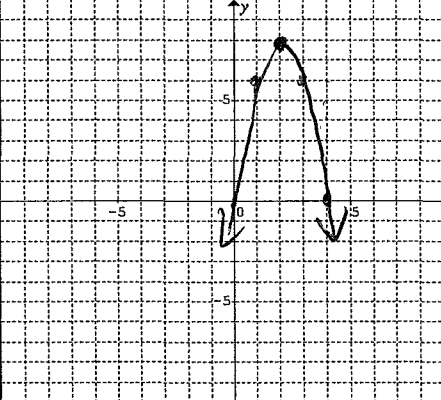


# Completing the Square - Vertex & Graphs

Steps	Example #1 $y = -2x^2 - 4x + 3$	Example #2 $y = -5x^2 + 20x - 16$
Common factor the coefficient of the $x^2$ term from the first two terms. Do not factor out the $x$ .	$y = -2(x^2 + 2x) + 3$	$y = -5(x^2 - 4x) - 16$
Divide the coefficient of $x$ by 2, then square it.	$\left(\frac{2}{2}\right)^2 = 1$	$\left(\frac{-4}{2}\right)^2 = 4$
Add and subtract that value inside the bracket of the equation two steps above.	$y = -2(x^2 + 2x + 1 - 1) + 3$ $(-2x - 1) = 2 \rightarrow$	$y = -5(x^2 - 4x + 4 - 4) - 16$
Move the last term in the bracket to the outside of the bracket and multiply it with the number in front of the bracket. Add the two constants together.	$y = -2(x^2 + 2x + 1) + 2 + 3$	$y = -5(x^2 - 4x + 4) + 20 - 16$ $(-5)(-4) = 20$
Factor the perfect square trinomial inside the bracket.	$y = -2(x + 1)^2 + 5$	$y = -5(x - 2)^2 + 4$
		

Steps	Example #5 $y = -3x^2 - 6x$	Example #6 $y = -2x^2 + 8x$
Common factor the coefficient of the $x^2$ term from the first two terms. Do not factor out the $x$ .	$y = -3(x^2 + 2x)$	$y = -2(x^2 - 4x)$
Divide the coefficient of $x$ by 2, then square it.	$\left(\frac{2}{2}\right)^2 = 1$	$\left(\frac{-4}{2}\right)^2 = 4$
Add and subtract that value inside the bracket of the equation two steps above.	$y = -3(x^2 + 2x + 1 - 1)$	$y = -2(x^2 - 4x + 4 - 4)$
Move the last term in the bracket to the outside of the bracket and multiply it with the number in front of the bracket. Add the two constants together.	$= -3(x^2 + 2x + 1) + 3$	$y = -2(x^2 - 4x + 4) + 8$
Factor the perfect square trinomial inside the bracket.	$y = -3(x+1)^2 + 3$	$y = -2(x-2)^2 + 8$
		

When the "a" value in  $y = ax^2 + bx + c$  is not 1, it must be factored first.

1. Convert  $y = 2x^2 + 12x - 1$  to the form  $y = a(x - h)^2 + k$  and state its vertex.

$$y = 2(x^2 + 6x) - 1 \quad \left(\frac{6}{2}\right)^2 = 9$$

$$= 2(x^2 + 6x + 9 - 9) - 1$$

$$= 2(x^2 + 6x + 9) - 18 - 1$$

$$= 2(x + 3)^2 - 19$$

Vertex  $(-3, -19)$

2. Convert  $y = -x^2 + 4x + 5$  to the form  $y = a(x - h)^2 + k$  and state its vertex.

$$y = -(x^2 - 4x) + 5 \quad \left(\frac{-4}{2}\right)^2 = 4$$

$$= -(x^2 - 4x + 4 - 4) + 5$$

$$= -(x - 2)^2 + 4 + 5$$

$$= -(x - 2)^2 + 9$$

Vertex  $(2, 9)$

3. Convert  $y = -3x^2 + 6x + 7$  to the form  $y = a(x - h)^2 + k$  and state its vertex.

$$y = -3(x^2 - 2x) + 7 \quad \left(\frac{-2}{2}\right)^2 = 1$$

$$= -3(x^2 - 2x + 1 - 1) + 7$$

$$= -3(x^2 - 2x + 1) + 3 + 7$$

$$= -3(x - 1)^2 + 10$$