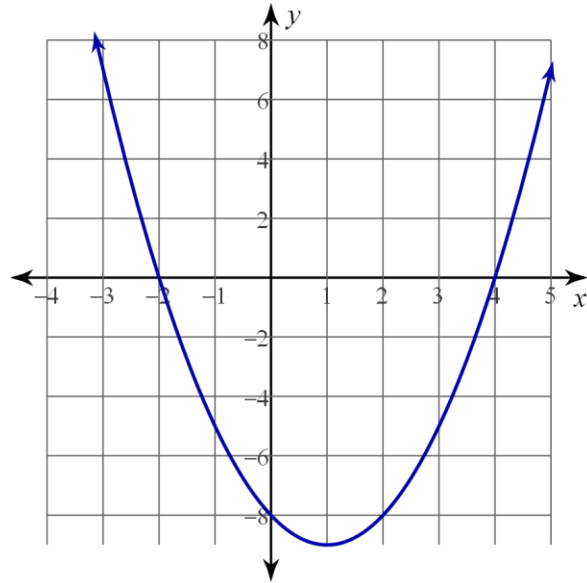


# SM3 Lesson 2-3 (Intercept Form Quadratic Equation)



Factor the following quadratic expressions:

$$x^2 + 11x + 30 \rightarrow (x + 5)(x + 6)$$

$$x^2 - 10x - 24 \rightarrow (x - 12)(x + 2)$$

$$x^2 - 8x + 15 \rightarrow (x - 5)(x - 3)$$

Standard Form Quadratic Equation  $y = ax^2 + bx + c$

$$y = x^2 + 11x + 30 \quad y = (x + 5)(x + 6)$$

$$y = x^2 - 10x - 24 \quad y = (x - 12)(x + 2)$$

$$y = x^2 - 8x + 15 \quad y = (x - 5)(x - 3)$$

Intercept Form Quadratic Equation

$$y = a(x - p)(x - q)$$

The Zero Product Property: Zero multiplied by any number equals zero (elementary school definition).

The Zero Product Property: If two numbers are multiplied together and the product equals zero, then one or both of the factors must equal zero.

$$A * B = 0$$

→ either  $A = 0$  or  $B = 0$  or both A and B equal zero.

$$0 = (x + 6)(x - 1)$$

$$0 = A * B$$

Zero Product Property: either  
 $x + 6 = 0$  or  $x - 1 = 0$

$$y = (x + 4)(x - 2)$$

The y-value of an x-intercept always equals Zero

$$0 = (x + 4)(x - 2)$$

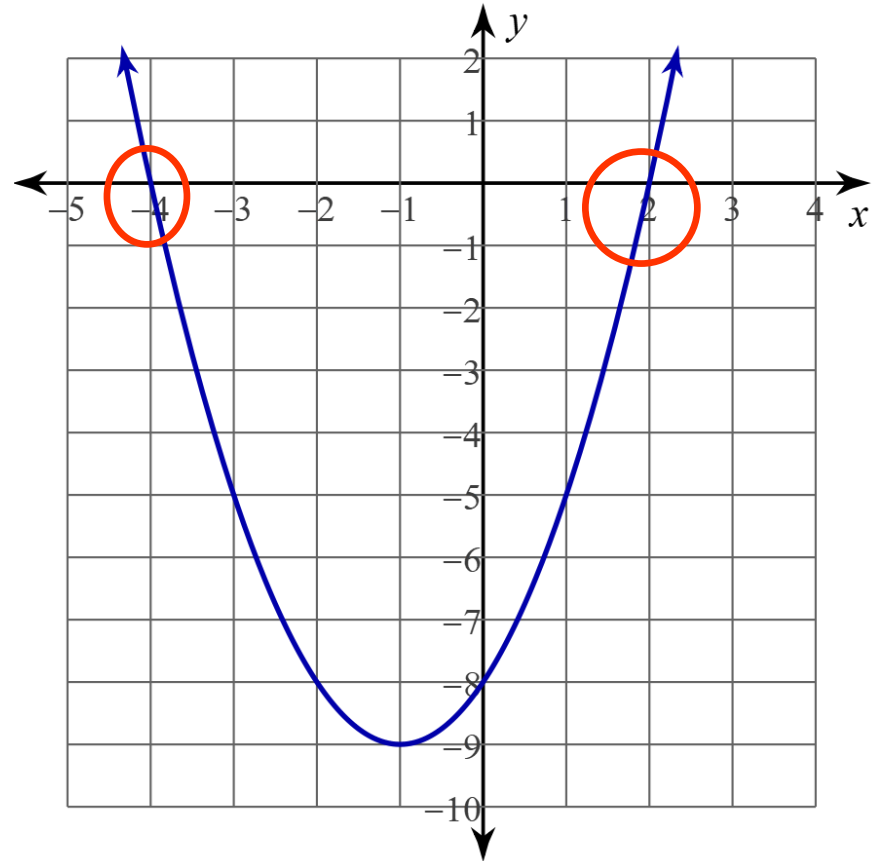
$$0 = A * B$$

Zero Product Property: either  
 $(x + 4) = 0$  or  $(x - 2) = 0$

$$x + 4 = 0 \quad x - 2 = 0$$

$$x = -4 \quad x = +2$$

Notice the shape  
of the parabola.



X-intercept: the x-y pair where the graph crosses the x-axis.

The y-value of an x-intercept always equals Zero

Y-intercept: the x-y pair where the graph crosses the y-axis.

The x-value of an y-intercept always equals Zero

Zero of an equation: the input value that has a corresponding output value of zero. Examples:

$$f(x) = (x - 2)(x + 4) \quad \boxed{f(2) = 0} \quad \boxed{f(-4) = 0}$$

$$f(x) = x^2 + 4 \quad f(x) = (x + 2i)(x - 2i)$$
$$\boxed{f(2i) = 0} \quad \boxed{f(-2i) = 0}$$

Zeroes of equations are not always real numbers.

Real number zeroes are x-intercepts.

$$y = (x - 1)(x - 3)$$

The y-value of an x-intercept always equals Zero

$$0 = (x - 1)(x - 3)$$

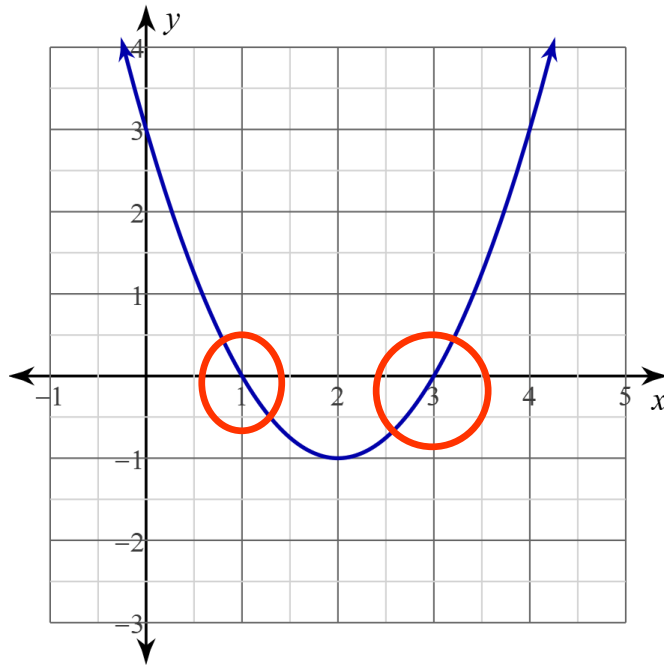
$$0 = A * B$$

Zero Product Property: either

$$(x - 1) = 0 \text{ or } (x - 3) = 0$$

$$x - 1 = 0 \qquad x - 3 = 0$$

$$x = 1 \qquad x = 3$$



Standard Form Quadratic Equation is converted to an Intercept Form Quadratic Equation by factoring.

$$y = x^2 + 10x + 21 \quad \rightarrow \quad y = (x + 7)(x + 3)$$

(-7, 0)    (-3, 0)

What are x-intercepts?

$$y = x^2 - 6x - 16 \quad \rightarrow \quad y = (x - 8)(x + 2)$$

(8, 0)    (-2, 0)

$$y = x^2 - 9x + 18 \quad \rightarrow \quad y = (x - 6)(x - 3)$$

(6, 0)    (3, 0)

# Intercept Form Quadratic Equation:

Vertical  
Stretch  
Factor!

'x-intercepts are 'p' and 'q'

$$y = (-1)a(x - p)(x - q)$$

If negative: reflected  
across x-axis.

'x-intercepts are:  
'1' and '3'

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

Opens  
down

'x-intercepts are:  
'-2' and '-4'

$$y = (x - 1)(x - 3)$$

Each set of parentheses is  
called a "factor". Why?



## Convert to Intercept Form

$$y = 2x^2 + 6x + 4$$

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

$$y = 2(x + 2)(x + 1)$$

Always factor out the common factor first.

Now factor the trinomial.

What are the x-intercepts?

'x-intercepts are:  
'-2' and '-1'

Which way (up/down) does the parabola open?

Up (not reflected across x-axis)

What is the vertical stretch factor?

VSF = 2

## Convert to Intercept Form

$$y = 3x^2 - 15x - 18$$

$$y = 3(x^2 - 5x - 6)$$

$$y = 3(x - 6)(x + 1)$$

Always factor out the common factor first.

Now factor the trinomial.

What are the x-intercepts?

'x-intercepts are:  
'6' and '-1'

Which way (up/down) does the parabola open?

Up (not reflected across x-axis)

What is the vertical stretch factor?

VSF = 3

$$y = 2(3x - 2)(-2x - 1)$$

What are the zeroes?

$$3x - 2 = 0$$

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

$$-2x - 1 = 0$$

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

Convert to Standard Form

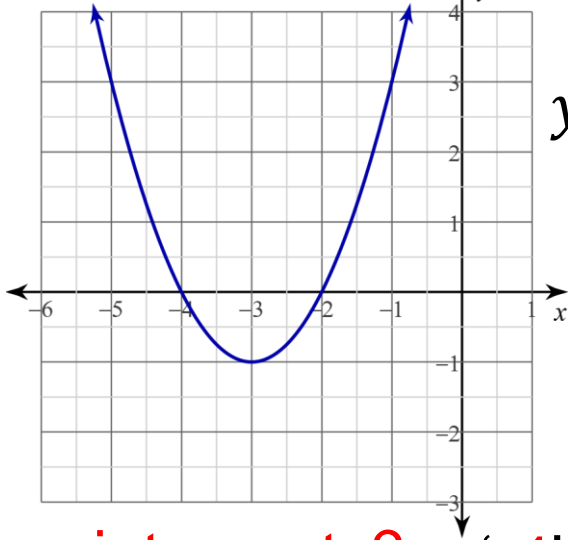
$$y = -12x^2 - 14x + 4$$

Which way (up/down) does the parabola open?

Down--reflected across x-axis

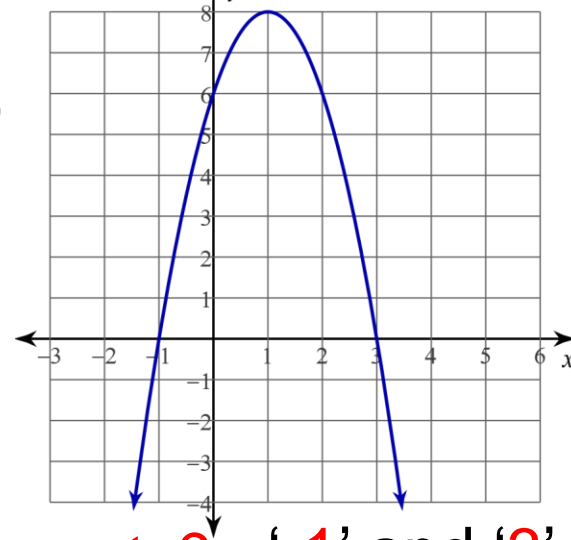
What is the vertical stretch factor?

$$\text{VSF} = 6$$



$$y = (-1)a(x - p)(x - q)$$

x-intercepts? '-4' and '-2'



x-intercepts? '-1' and '3'

What is the x-coordinate of the vertex?

The x-coordinate of the vertex is halfway between the x-intercepts.

x-coordinate of the vertex?

(-3, \_\_\_)

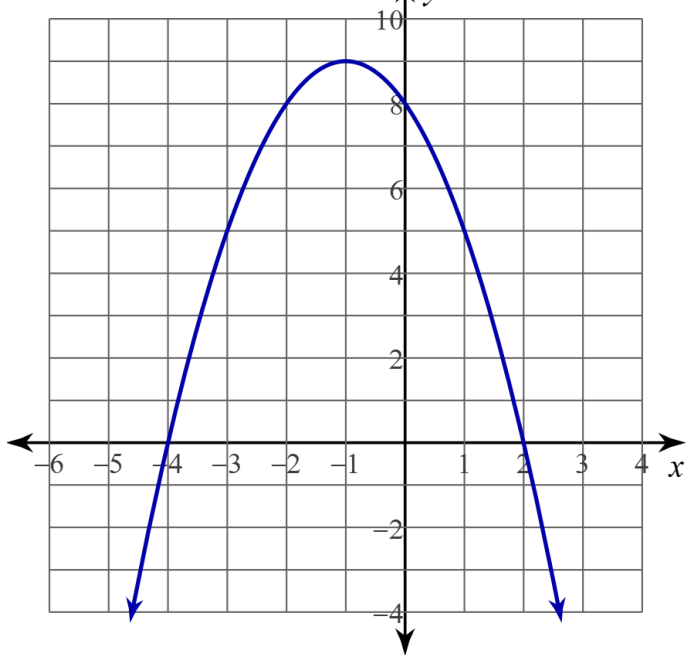
x-coordinate of the vertex?

(4, \_\_\_)

What is the equation that has been graphed (in intercept form)?

$$y = (x + 4)(x + 2)$$

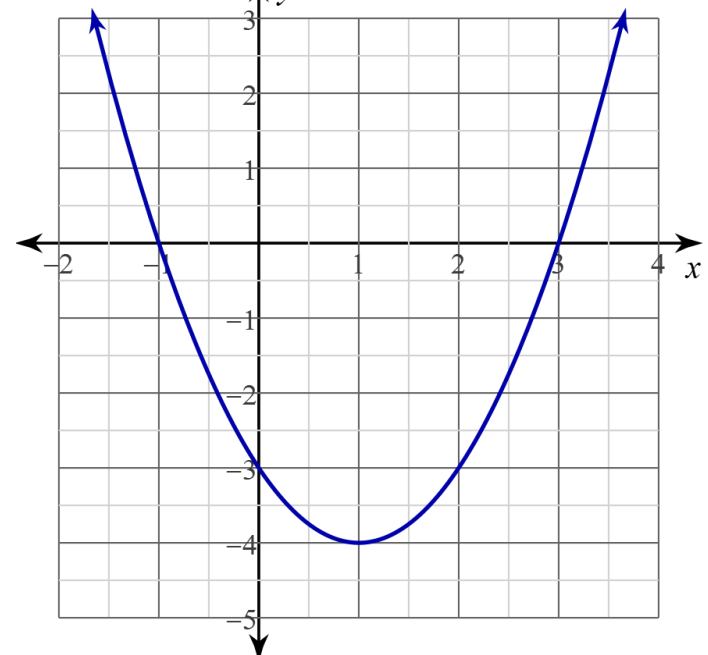
$$y = -2(x + 1)(x - 3)$$



x-intercepts? '-4' and '2'

x-coordinate of the vertex?

(-1, \_\_\_\_)



x-intercepts? '-1' and '3'

x-coordinate of the vertex?

(1, \_\_\_\_)

What is the Intercept form equation of the parabola?

$$y = -(x + 4)(x - 2)$$

$$y = (x + 1)(x - 3)$$

# Forms of the Quadratic Equation

$$y = ax^2 + bx + c$$

Standard form

Factoring

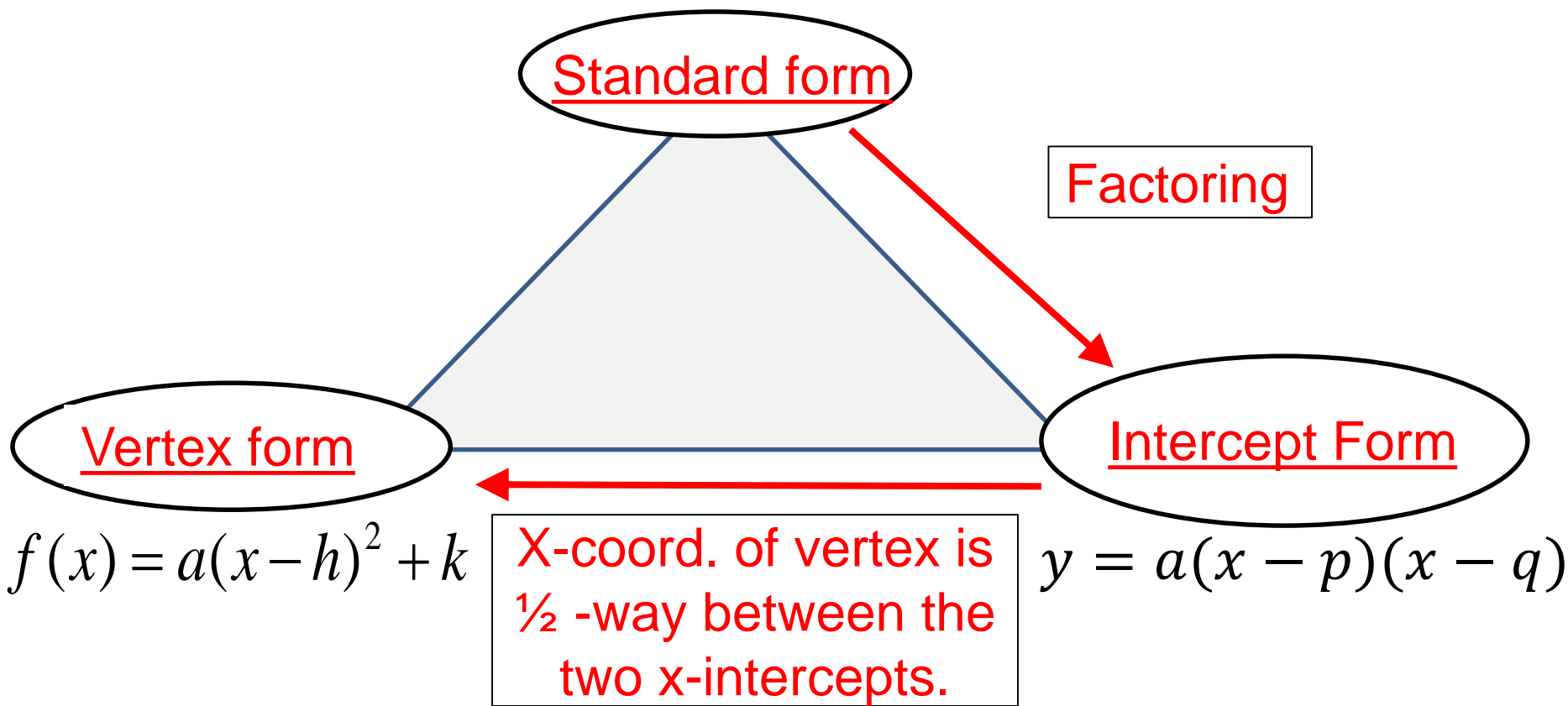
Intercept Form

Vertex form

$$f(x) = a(x - h)^2 + k$$

X-coord. of vertex is  
 $\frac{1}{2}$  -way between the  
two x-intercepts.

$$y = a(x - p)(x - q)$$



Half-way between two numbers is the average of the two numbers. The x-coordinate of the vertex is exactly half-way between the two x-intercepts.

$$f(x) = (x + 5)(x - 1) \quad x = \frac{-5 + 1}{2} = \frac{-4}{2} = -2$$

$x = -5$     $x = 1$

What are the x-intercepts?

What is the x-coordinate of the vertex?

$$(-2, \underline{\quad})$$

What is the y-coordinate of the vertex?

$$f(-2) = ?$$

$$f(-2) = -9$$

$$f(-2) = (-2 + 5)(-2 - 1) = (3)(-3)$$

What is the VSF?

$$a = 1$$

$$y = a(x - p)(x - q)$$

What is the vertex form equation?

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

$$y = a(x - h)^2 + k$$

$$y = ax^2 + bx + c$$

$$f(x) = 2(x - 6)(x - 4)$$

What are the x-intercepts?  $x = 6$   $x = 4$

What is the x-coordinate of the vertex?  $x = \frac{6 + 4}{2} = \frac{10}{2} = 5$   
(5, \_\_\_)

What is the y-coordinate of the vertex?  $f(5) = ?$

$$f(5) = 2(5 - 6)(5 - 4) \quad f(5) = 2(-1)(1) \quad f(5) = -2$$

Vertex: (5, -2)

What is the coefficient?  $a = 2$

What is the vertex form equation?  $y = a(x - h)^2 + k$

$$y = 2(x - 5)^2 - 2$$



## What is the vertex?

$$f(x) = 2(x + 2)(x - 4)$$

$$x = -2 \quad x = 4$$

(1, \_\_\_\_\_)

$$f(x) = 2(1 + 2)(1 - 4) \quad y = 2(3)(-3)$$

$$f(1) = -18$$

Vertex: (1, -18)

$$x = \frac{-2 + 4}{2} = \frac{2}{2} = 1$$

## What is the vertex form equation?

$$y = 2(x - 1)^2 - 18$$

$$y = a(x - h)^2 + k$$

## What is the standard form equation?

$$y = 2(x + 2)(x - 4)$$

	x	-4
2x	2x <sup>2</sup>	-8x
4	4x	-16

(Distributive Property)

$$y = (2x + 4)(x - 4)$$

$$y = ax^2 + bx + c$$

$$y = 2x^2 - 4x - 16$$

What is the vertex form equation?

$$y = 3(x + 1)(x - 5)$$

$x = -1$     $x = 5$

$$x = \frac{-1 + 5}{2} = \frac{4}{2} = 2$$

$(2, \underline{\quad})$     $(2, -27)$

$y = 3(2 + 1)(2 - 5)$     $y = 3(3)(-3)$     $y = -27$

$$y = 3(x - 2)^2 - 27$$

What is the standard form equation?

$$y = 3(x + 1)(x - 5)$$

(Distributive Property)

$$y = (3x + 3)(x - 5)$$

$$y = ax^2 + bx + c$$

	x	-5
3x	$3x^2$	$-15x$
3	$3x$	$-15$

$$y = 3x^2 - 12x - 15$$

What is the vertex form equation?

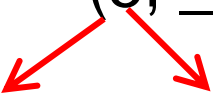
$$y = (x - 8)(x - 2)$$

$x = 8$       $x = 2$

$$x = \frac{8 + 2}{2} = \frac{12}{2} = 5$$

(5, \_\_\_\_\_)

(5, -9)



$$y = (5 - 8)(5 - 2)$$

$$y = (-3)(3)$$

$$y = -9$$

$$y = (x - 5)^2 - 9$$

What is the standard form equation?

$$y = (x - 8)(x - 2)$$

	x	-2
x	$x^2$	$-2x$
-8	$-8x$	16

$$y = ax^2 + bx + c$$

$$y = x^2 - 10x + 16$$

What is the intercept form equation?

$$y = -3x^2 + 6x + 72$$

Common factor?

$$y = -3(x^2 - 2x - 24)$$

Factor trinomial?

$$y = -3(x - 6)(x + 4)$$

What are the x-intercepts?

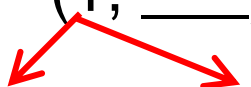
$$x = 6 \quad x = -4$$

What is the vertex form equation?

$$x = \frac{6 - 4}{2} = \frac{2}{2} = 1$$

(1, \_\_\_\_\_)

(1, 75)


$$y = -3(1 - 6)(1 + 4)$$

$$y = -3(-5)(5)$$

$$y = 75$$

$$y = -3(x - 1)^2 + 75$$