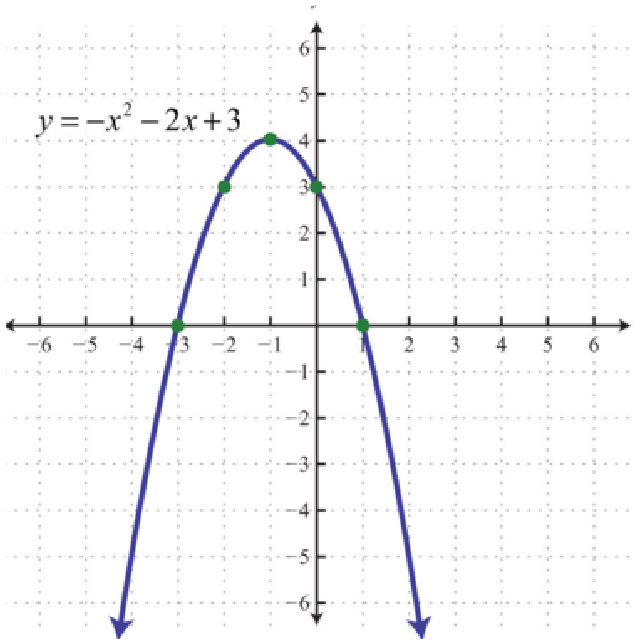
Recall the key features of a parabola



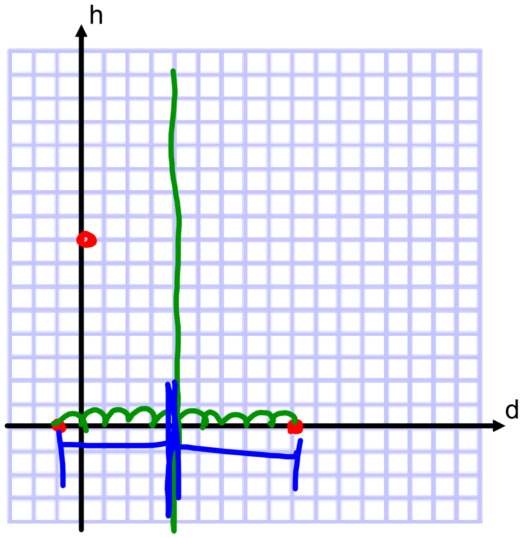
optimal Value

* Maximum / Minimum
* y - intercept
* Vertex
* x - intercept(s)
* Axis of Symmetry

A football is kicked and follows the path $h = -d^2 + 8d + 9$, where h is the height and d is the horizontal distance away from the kicker. Determine the maximum height of the ball.

$h = -(d-4)^2 + 25$

* Not realistic numbers *



$h = -d^2 + 8d + 9$

$h = -(d^2 - 8d - 9)$ ⊗ -9 ⊕ -8

$h = -(d+1)(d-9)$ $1, -9$

$d = -1$ $d = +9$

$\frac{-1+9}{2} = 4$

$h = -(4+1)(4-9)$

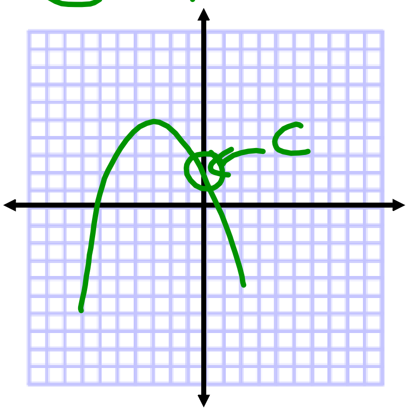
$h = -(5)(-5)$

$\boxed{= 25}$

What does each form of a quadratic tell us about the graph?

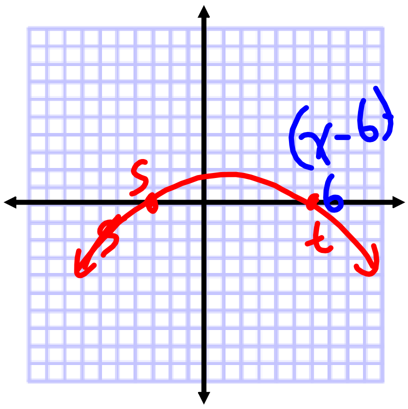
Standard
$ax^2 + bx + c$

c = y-int



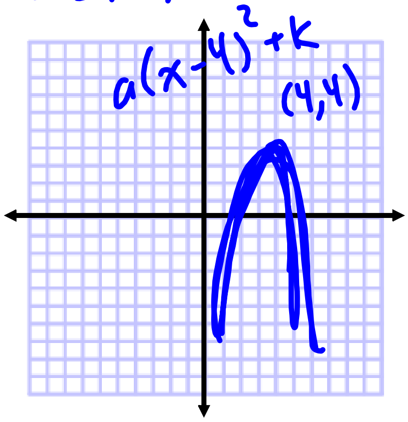
Factored
$(x - s)(x - t)$

x-int = s, t



Vertex
$a(x - h)^2 + k$

Vertex = (h, k)



Determine a value for "k" that will make each a perfect square trinomial

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

$\frac{6}{2}$

$(x+3)^2$

$k = 9$

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

$k = 4$

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

$\left(\frac{-14}{2}\right)^2$

$k = 49$

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

$k = 25$

Perfect square

$25 = 5^2$

$4 = 2^2$

$16 = 4^2$

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

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

$= x^2 + \underbrace{2x + 2x} + 4$

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

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

$$(x+3)^2 = x^2+6x+9$$

$$(x+4)^2 = x^2+8x+16$$

$$(x-7)^2 = x^2-14x+49$$

$$(x-7)(x-7) = x^2 \underbrace{-7x-7x}+49$$

Determine the vertex of the following parabola.

$$y = x^2 + 6x + 7$$

Complete the Square

To convert from standard form to vertex form

$y = x^2 + 6x + 7$

$= x^2 + 6x + \underline{9} - \underline{9} + 7$

$= (x + \underline{3})^2 - \underline{9} + 7$

$\boxed{= (x + \underline{3})^2 - \underline{2}}$

Vertex - (-3,-2)

Steps

0. Give yourself some room.

1. Determine a value that would make a perfect square trinomial
2. Add and subtract that value from your expression ∴ Doesn't change the equation.
3. Factor the perfect square trinomial
4. Add / Subtract the remaining numbers.

Determine the vertex of the following

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

$y = \underbrace{x^2 + 12x + 36} - 36 - 4$

$= (x + 6)^2 - 40$

Vertex = $(-6, -40)$

$y = x^2 - 20x + 35$

$y = \underbrace{x^2 - 20x + 100} - 100 + 35$

$y = (x - 10)^2 - 65$

Vertex = $(10, -65)$

the + ___ − ___

will always be

$$\left(\frac{b}{2}\right)^2 \qquad x^2 + bx + \_ - \_ + c$$

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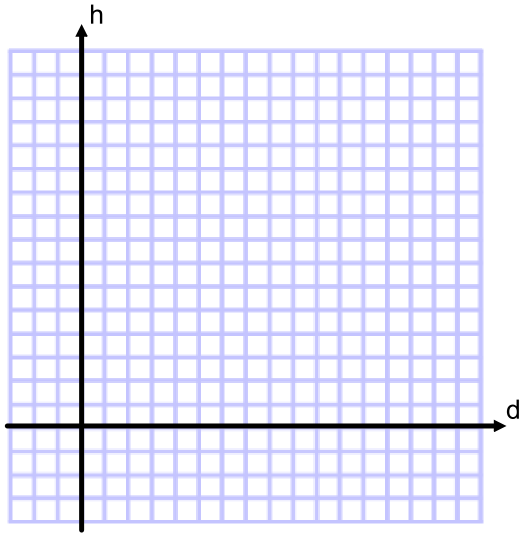
* Not realistic numbers *



y = x² + 5x - 4

$$-6.25$$

$$y = \underbrace{x^2 + 5x + \frac{25}{4}}\; - \frac{25}{4} - 4$$

$$y = \left(x + \frac{5}{2}\right)^2 - \frac{25}{4} - \frac{16}{4}$$

$$y = \left(x + \frac{5}{2}\right)^2 - \frac{41}{4}$$

y = 2x² + 12x - 9

$$y = 2(\underbrace{x^2 + 6x + 9}\; - 9) - 9$$

$$y = 2\left[(x+3)^2 - 9\right] - 9$$

$$y = 2(x+3)^2 - 18 - 9$$

$$\boxed{y = 2(x+3)^2 - 27}$$

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