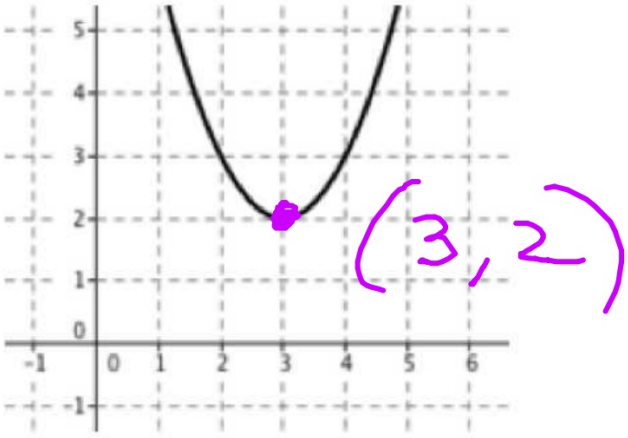
1.7 Completing The Square (Part 1)
1.2 Graph Quadratic Functions in Vertex and Intercept Forms

ex: Sketch: $y = -x^2 + 2x + 2$

*Graphing in standard form is doable, but graphing in vertex form and intercept forms is easier and a lot less work!

ex: Use the graph to determine the coordinates of the vertex.

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



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

ex: Determine the coordinates of the vertex without the use the graph.

a) $y=(x+9)^2+5$

$(-9, 5)$

b) $y=-2(x-1)^2+10$

$(1, 10)$

ex: Factor.

a) $x^2 - 10x + 25$ $(x-5)^2$

b) $x^2 + 12x + 36$ $(x+6)^2$

c) $9x^2 - 12x + 4$ $(3x-2)^2$

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

$$V:(h,k)$$

$$y = (x+7)^2$$

$$y = (x-(-7))^2$$

Rewriting From Standard To Vertex Form

*To rewrite a quadratic from standard form to vertex form you must complete the square.

ex: Write the quadratic function in vertex form.

a) $y = x^2 + 16x - 33$

$y = x^2 + 16x + 64 - 64 - 33$

$y = (x+8)^2 - 97$

$V: (-8, -97)$

1) Placeholders
2) $(b/2)^2$; add/subtract it
3) factor
4) add the constants

b) $y = x^2 - 6x + 19$

$y = x^2 - 6x + 9 - 9 + 19$ $\quad \left(\frac{-6}{2}\right)^2$

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

$V(3, 10)$

c) $y = x^2 + 7x + 2$

$y = x^2 + 7x + \frac{49}{4} - \frac{49}{4} + 2$ $\quad \left(\frac{7}{2}\right)^2 = \frac{49}{4}$

$y = \left(x + \frac{7}{2}\right)^2 - \frac{41}{4}$

$-\frac{49}{4} + \frac{2 \cdot 4}{1 \cdot 4}$

$-\frac{49+8}{4}$

d) $y = x^2 + 5x - 10$

e) $y = x^2 - 12x + 36$

$y = (x-6)^2$

$V(6,0)$

f) $y = 4x^2 + 24x + 17$

$y = 4(x^2 + 6x + 9) - 36 + 17$ $\left(\frac{6}{2}\right)^2$

$y = 4(x+3)^2 - 19$

g) $y = 6x^2 - 24x + 2$

$y = 6(x^2 - 4x + 4) - 24 + 2$

$y = 6(x-2)^2 - 22$ $V(2, -22)$

h) $y = -x^2 + 8x - 4$

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

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

$\left(\frac{-8}{2}\right)^2 = 16$

i) $y = 3x^2 - 4x + 1$

Sketching Quadratics In Vertex Form

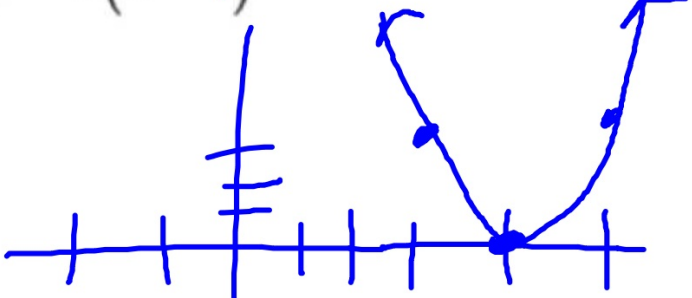
*To sketch in vertex form plot the vertex and two other points, one on each side of the vertex.

ex: Sketch the quadratic function.

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

x	y
0	-5
-1	-3
-2	-5

b) $y = 3(x-4)^2$



X	y
3	3
4	0
5	3

D: $(-\infty, \infty)$

R: $[0, \infty)$

In general...

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

a) When will the graph open up? $a > 0$

b) When will the graph open down? $a < 0$

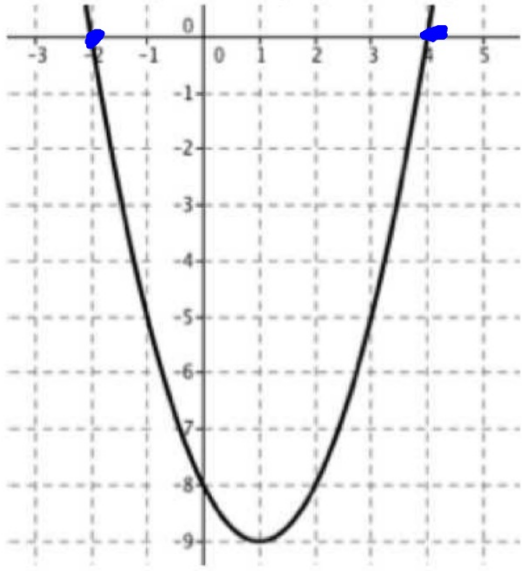
c) What is the axis of symmetry? $x = h$

d) What is the vertex? (h, k)

Exploring Intercept Form

ex: Use the graph to determine the coordinates of the vertex and state the x-intercepts.

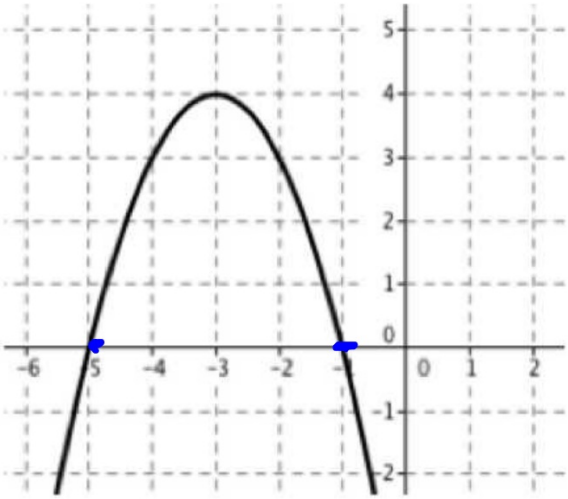
a) $y = (x+2)(x-4)$



$(-2, 0)$

$(4, 0)$

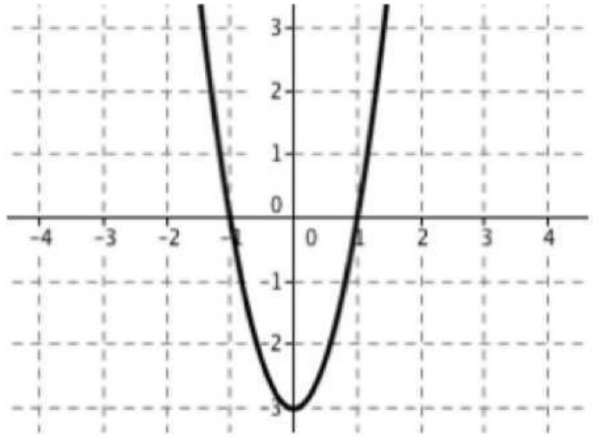
b) $y = -(x+1)(x+5)$



$(-5, 0)$

$(-1, 0)$

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



$(1, 0)$

$(-1, 0)$

ex: State the x-intercepts and the x-value of the vertex.

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

$x=-5, 1$

b) $y=-2(x-1)(x+6)$

$x=1, -6$

Sketching Quadratics In Intercept Form

*To sketch in vertex form find the vertex and the x-intercepts.

ex: Sketch the quadratic function.

a) $y = 2(x-1)(x+5)$

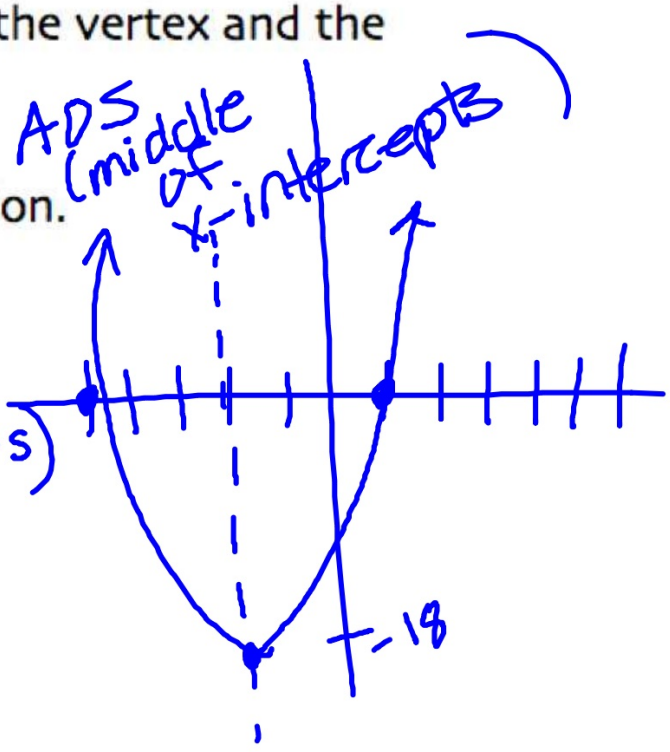
$\frac{1+-5}{2}$

$(-2, \quad)$

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

$= 2(-3)(3)$

$= -18$

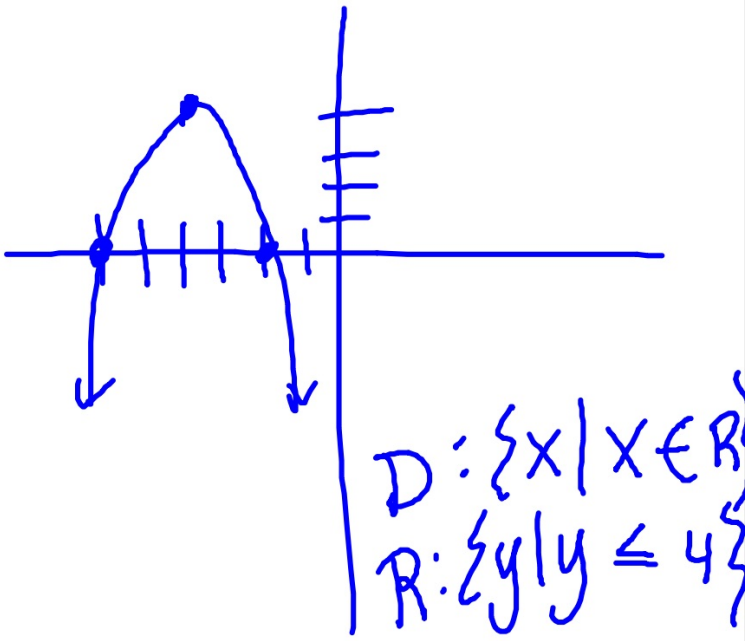


b) $y = -(x+2)(x+6)$

xint: $-2, -6$

$$\frac{-2 + -6}{2}$$

$(-4, 4)$



D: $\{x \mid x \in R$

R: $\{y \mid y \leq 4\}$

In general...

Intercept Form: $y = a(x-p)(x-q)$

a) When will the graph open up? $a > 0$

b) When will the graph open down? $a < 0$

c) What is the axis of symmetry? $x = \frac{p+q}{2}$

d) How do you find the y-value of the vertex? plug in

ex: Rewrite in standard form.

a) $y = 2(x+3)(x-5)$

$y = 2(x^2 - 2x - 15)$

$y = 2x^2 - 4x - 30$

$(x+5)^2 \neq x^2 + 25$

$(x+5)(x+5)$

$= x^2 + 10x + 25$

b) $y = -2(x+5)^2 + 10$

$y = -2(x^2 + 10x + 25) + 10$

$y = -2x^2 - 20x - 40$

Review:

ex: What number sets does $1.\overline{718}$ belong to?

ex: Express in set & interval notation: Any number, except 3.

59.) $2x^3 - 5x^2 + 3x$

$x(2x^2 - 5x + 3)$

FOIL

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

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

$-6x$

$-1x$

$-7x$

17.) $49x^2 + 70x + 25$

$(7x + 5)(7x + 5)$

or

$(7x + 5)^2$