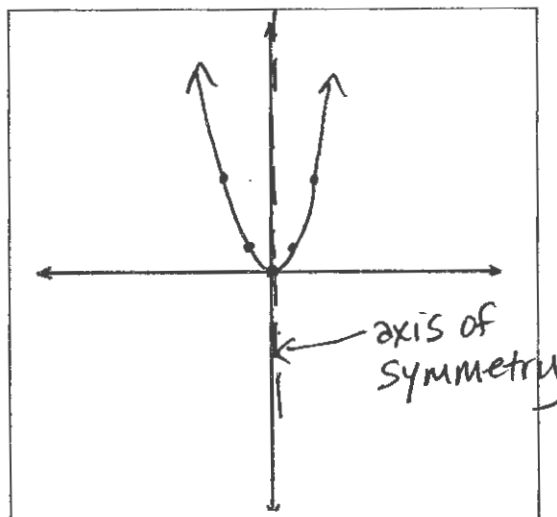# Quadratics: Graphs and Vertex Form

Parent Function: $y = x^2$

Features of Parent Graph:

1. Vertex: $(0, 0)$

2. Axis of Symmetry: $X = 0$

3. Domain: $(-\infty, \infty)$

4. Range: $y \geq 0$

5. Shape: Parabola

axis of symmetry

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

1. How does a affect the parent graph?

    a) If $a < 0$: *the parabola is reflected in the x-axis (up and down direction)*

    b) If $|a| > 1$: *the parabola is stretched vertically (it looks narrower)*

    c) If $|a| < 1$: *the parabola is compressed vertically (it looks wider)*

2. How do h and k affect the parent graph?

    a) h: *moves the parabola left/right (in the opposite direction)*

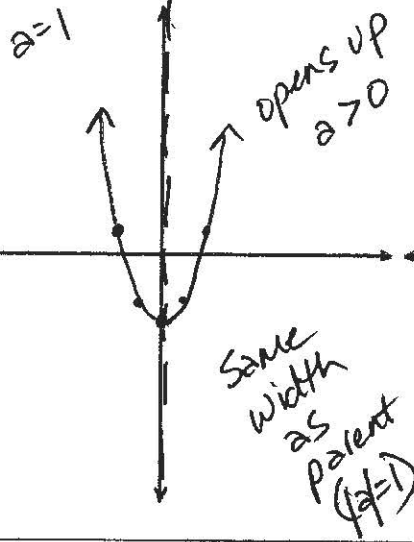   b) k: *moves the parabola up/down (in the indicated direction)*

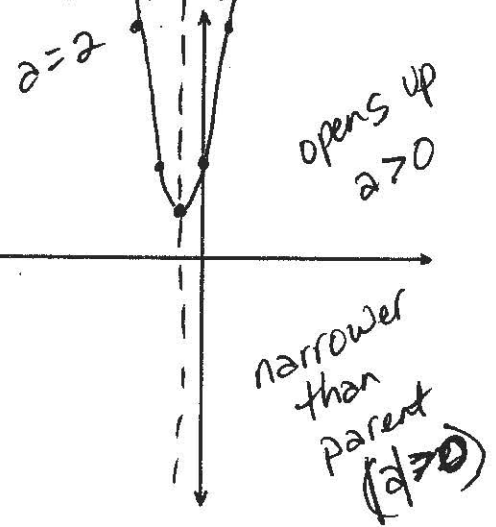**Examples: Graph the parabolas accurately**

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

$a=1$

opens up $(a>0)$

same width as parent $(|a|=1)$
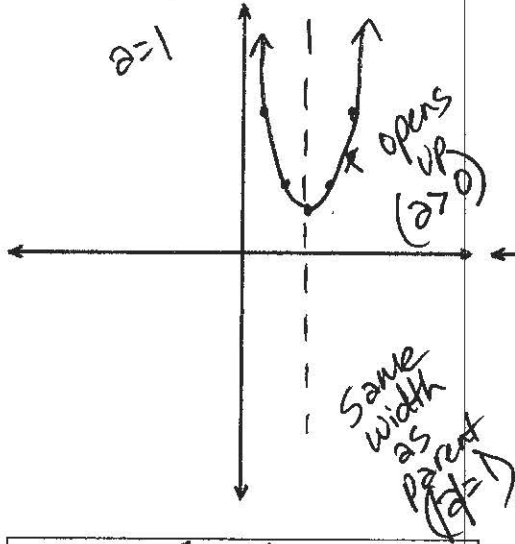
Vertex: $(3,2)$

Axis of Symmetry: $X=3$

(show as a dotted line in graph)

2. $y = x^2 - 3$

$a=1$

opens up $a>0$

same width as parent $(|a|=1)$

Vertex: $(0,-3)$

Axis of Symmetry: $X=0$

(show as a dotted line in graph)

3. $y = 2(x+1)^2 + 2$

$a=2$

opens up $a>0$

narrower than parent $(a>0)$

Vertex: $(-1,2)$

Axis of Symmetry: $X=-1$

(show as a dotted line in graph)

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

$a=-2$

opens down $a<0$

narrower $|a|=2$
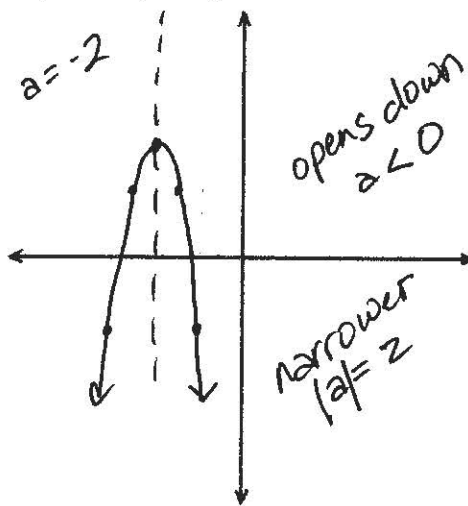
Vertex: $(-4,5)$

Axis of Symmetry: $X=-4$

(show as a dotted line in graph)

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

$a=-1$

opens down $a<0$

same width $|a|=1$
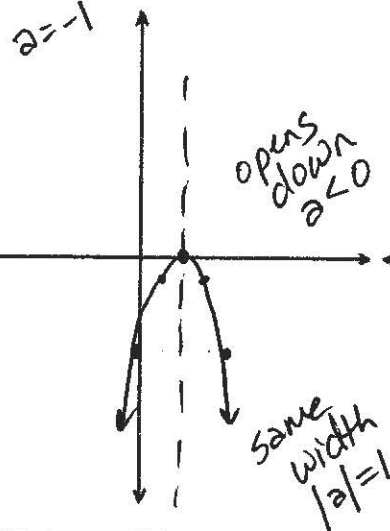
Vertex: $(2,0)$

Axis of Symmetry: $X=2$

(show as a dotted line in graph)

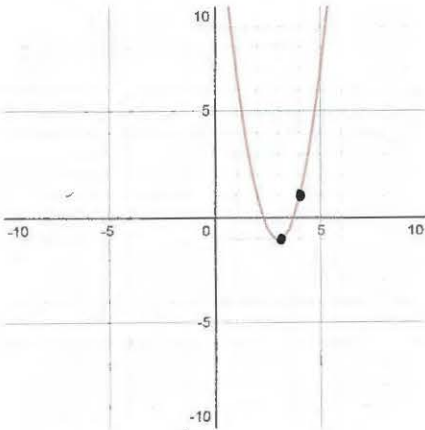6. $y = 3(x-1)^2 - 6$

$a=3$

opens up $a>0$

narrower $|a|>1$
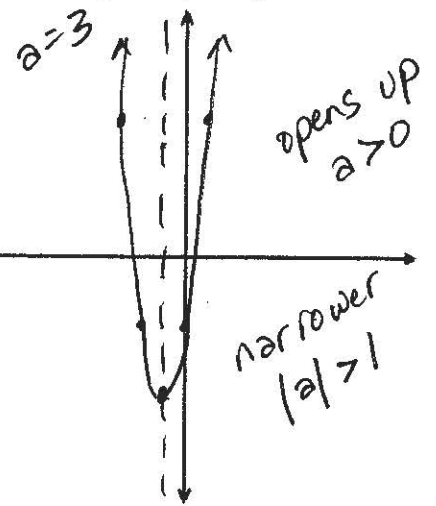
Vertex: $(1,-6)$

Axis of Symmetry: $X=1$

(show as a dotted line in graph)

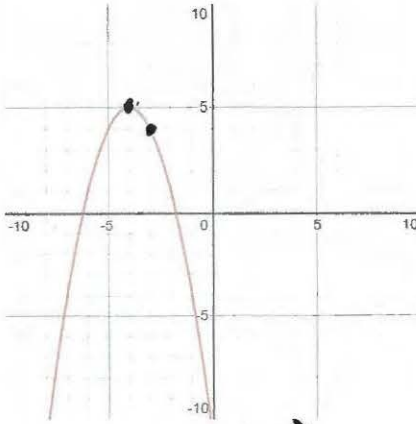Examples: Write the Equations of the Quadratic Function using the given graph. $y = a(x-h)^2 + K$
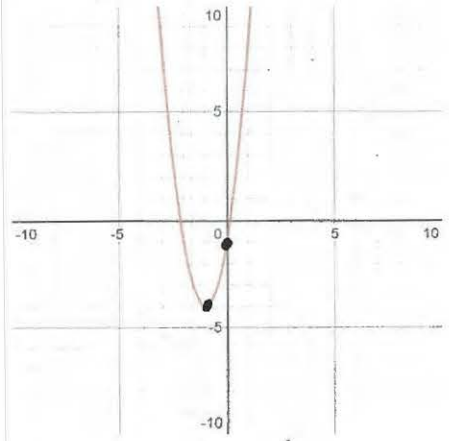
7. $y = 2(x-3)^2 - 1$

$V(3, -1)$
h, k

$a = 2$
from vertex
as x moves 1 rt
y moves 2.1² up

8. $y = -(x+4)^2 + 5$

$V(-4, 5)$
h, k

$a = -1$

9. $y = 3(x+1)^2 - 4$

$V(-1, -4)$
hk

$a = 3$

10. Write the equation for the parabola with a vertex of (2, -3) that goes through the point (1, 2).
$h, k x, y$

$y = a(x-h)^2 + K$
$2 = a(1-2)^2 - 3$
$2 = a(-1)^2 - 3$
$2 = a - 3$
$5 = a$

$\boxed{y = 5(x-2)^2 - 3}$

11. Write the equation for the parabola with a vertex of (-7, 6) that goes through the point (-5, -2)
$hk x y$

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

$-2 = a(-5 - 7)^2 + 6$
$-2 = a(2)^2 + 6$
$-2 = 4a + 6$
$-8 = 4a$
$-2 = a$

$\boxed{y = -2(x+7)^2 + 6}$