vertical stretch/compression

3.1 Quadratic Functions in Vertex Form – Part 2 $y = a(x - p)^2 + q$

horizontal shift left or right (−) (+)

vertical shift up or down (+) (−)

1. Graph the following quadratic functions:

- no stretch
- 2 units to right
- down 4 units

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

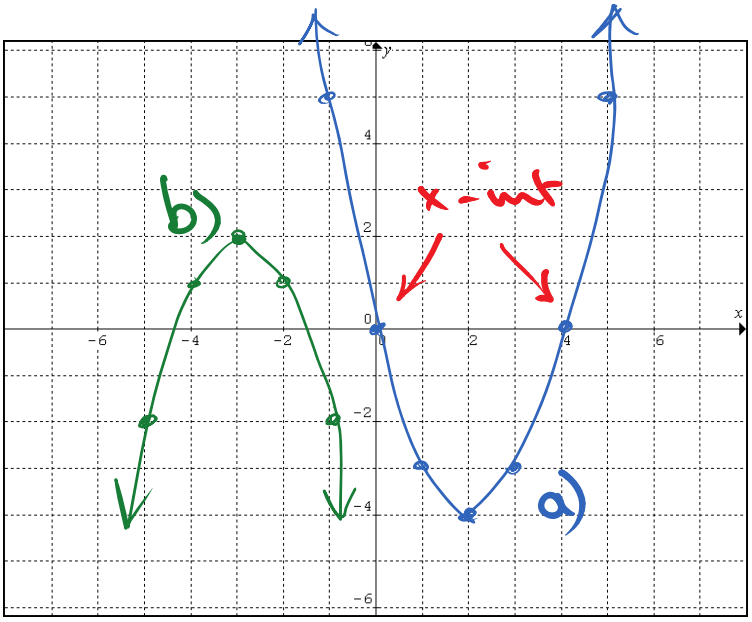
$p = 2$ $q = -4$ $a = 1$

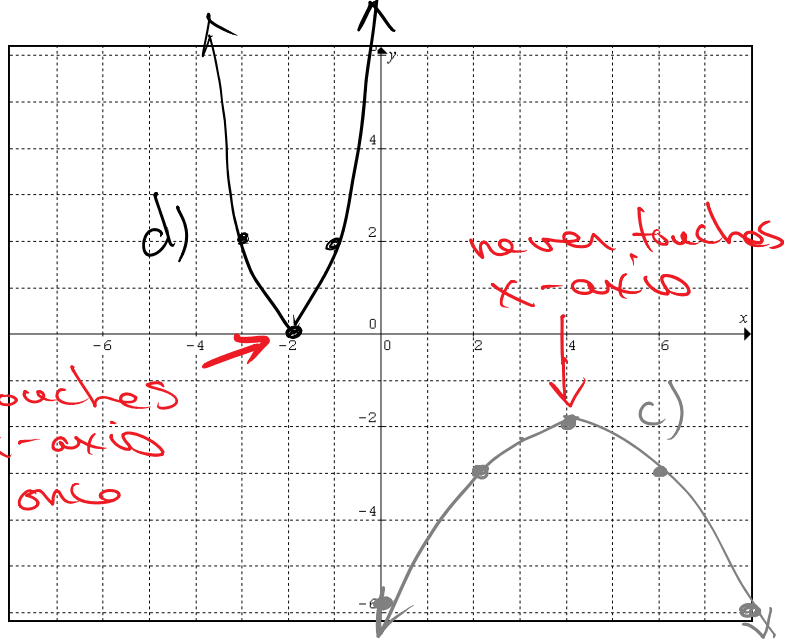
Coordinates of the vertex	(2, −4)
Axis of symmetry	$x = 2$
Opening (a is pos.)	up
Range	$y \geq -4$
Domain (all real numbers)	$x \in \mathbb{R}$
# of x-intercepts	2

b) $f(x) = -(x+3)^2 + 2$

$p = -3$ $q = 2$ $a = -1$

Coordinates of the vertex	(−3, 2)
Axis of symmetry	$x = -3$
Opening (a is neg.)	down
Range	$y \leq 2$
Domain	$x \in \mathbb{R}$
# of x-intercepts	2





c) $y = -\frac{1}{4}(x-4)^2 - 2$

$p = 4$ $q = -2$ $a = -\frac{1}{4}$

Coordinates of the vertex	(4, −2)
Axis of symmetry	$x = 4$
Opening	down
Range	$y \leq -2$
Domain	$x \in \mathbb{R}$
# of x-intercepts	0

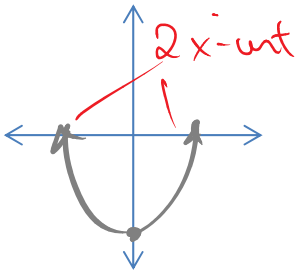
d) $f(x) = 2(x+2)^2$

$p = -2$ $q = 0$ $a = 2$

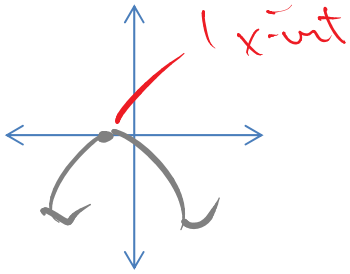
Coordinates of the vertex	(−2, 0)
Axis of symmetry	$x = -2$
Opening	up
Range	$y \geq 0$
Domain	$x \in \mathbb{R}$
# of x-intercepts	1

2. Without graphing precisely (just a sketch), determine the number of **x-intercepts**:

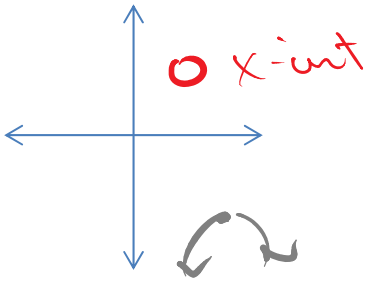
a) $f(x) = 0.5x^2 - 7$ — opens up, vertex $(0,-7)$



b) $g(x) = -2(x+1)^2$ — opens down, vertex $(-1,0)$



c) $f(x) = -\frac{1}{6}(x-5)^2 - 11$ — opens down, vertex $(5,-11)$



3. Determine the **equation** of a Quadratic Function in Vertex Form from its graph.

a) $y = a(x-p)^2 + q$

3 -5 -3 1

$3 = a(-5-(-3))^2 + 1$

$3 = a(4) + 1$

$-1 \quad -1$

$\frac{2}{4} = \frac{4a}{4}$

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

must know

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

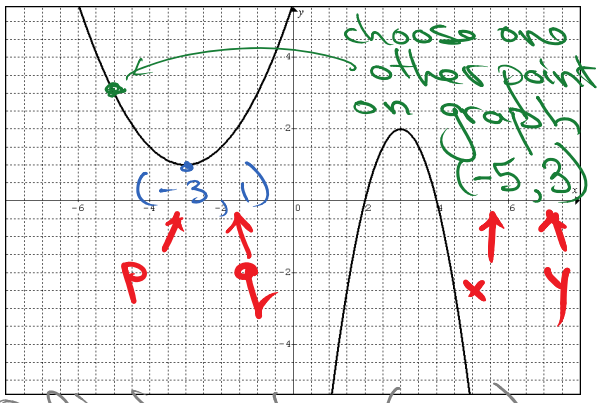
$p = -3$

$q = 1$

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

simplify

$y = \frac{1}{2}(x+3)^2 + 1$



① find vertex (p,q)
② find another point on graph (x,y)
③ sub into formula to find a
④ write formula with values for a, p & q

4. Determine the equation of (a) above if the parabola opens upward and is translated 3 units to the left.

5. Determine a quadratic function in vertex form that has the following characteristics: vertex at (0,-3) and passes through the point (5,-4).

p q

$y = a(x-p)^2 + q$

$(-4) = a(5-0)^2 + (-3)$

$-4 = a(25) - 3$

$+3 \quad +3$

$\frac{-1}{25} = \frac{25a}{25}$

$-\frac{1}{25} = a$

x y

$y = a(x-p)^2 + q$

$y = -\frac{1}{25}(x-0)^2 + (-3)$

simplify

$y = -\frac{1}{25}x^2 - 3$

Practice: p. 157 #4, 5ac, 6, 7, 8, 9 (**QUIZ** next class!)