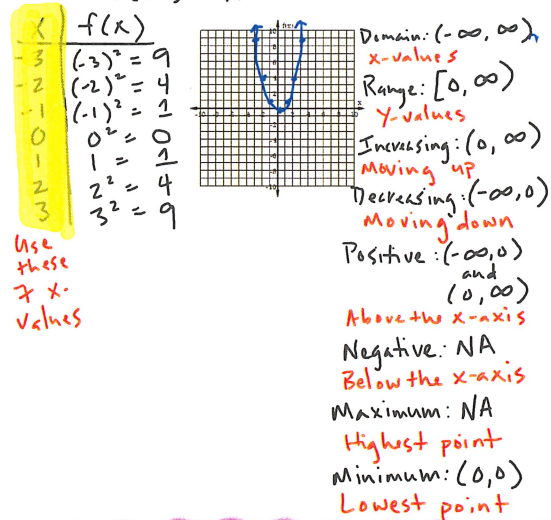


Understanding Quadratic Functions

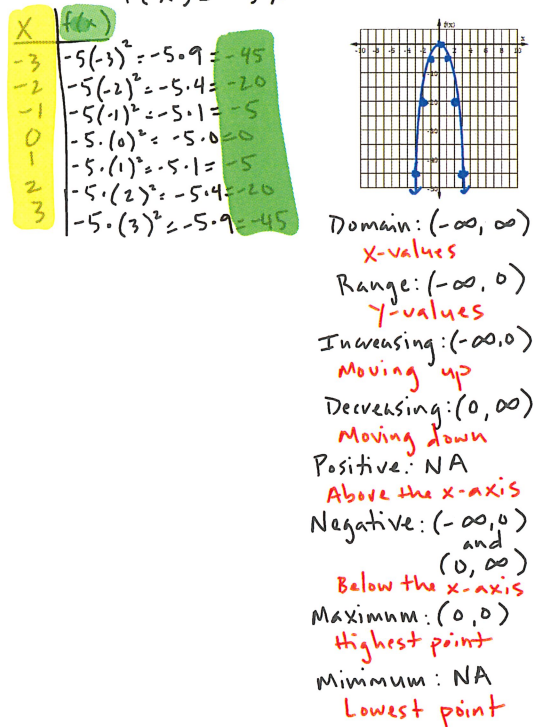
The graph of a quadratic function is not a straight line. It is a curve called a parabola. 

The most basic quadratic function is $f(x) = x^2$. This is also called the "parent function".

Ex: ① Graph the quadratic function $f(x) = x^2$.



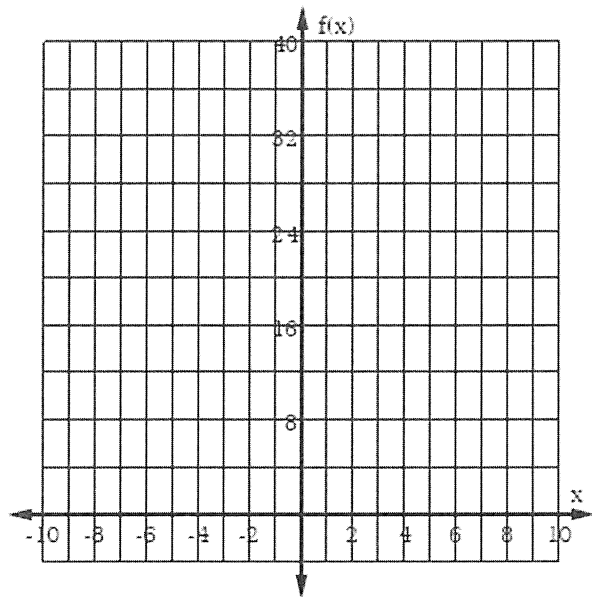
Ex: ② Graph the quadratic function $f(x) = -5x^2$



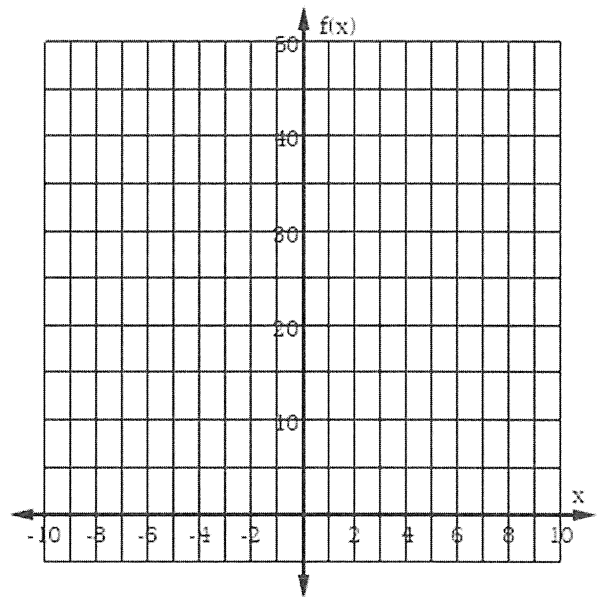
Understanding Quadratic Functions Homework

- Graph each quadratic function.
- State the domain and range.
- State the increasing interval and decreasing interval.
- State the positive interval and negative interval.
- State the maximum and minimum.

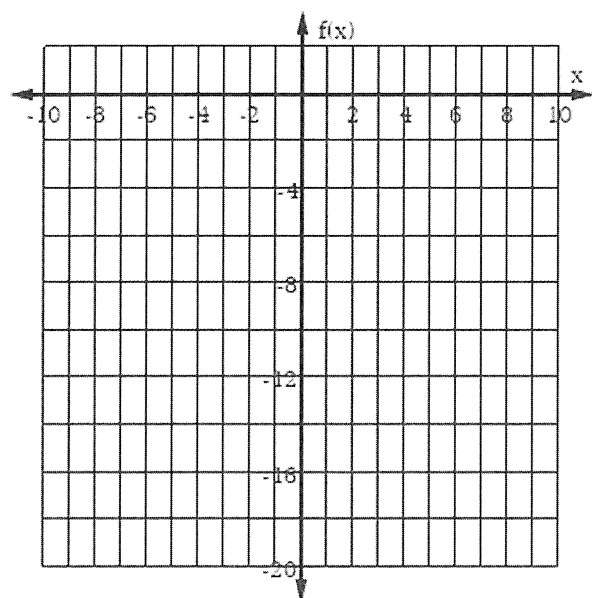
1. $f(x) = 4x^2$



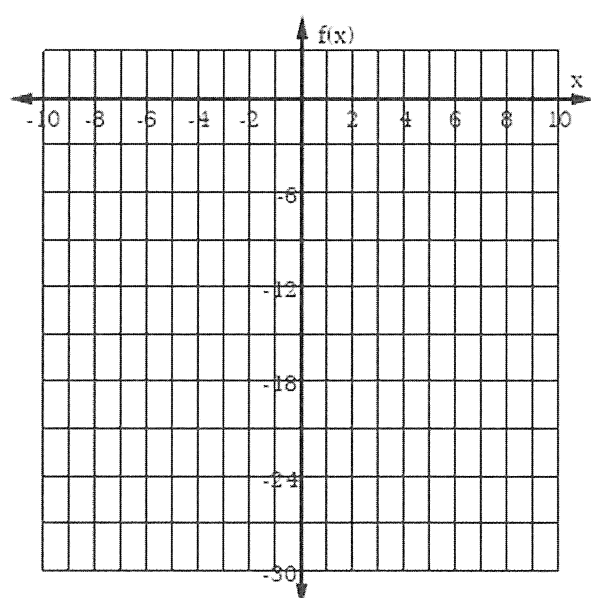
2. $f(x) = 5x^2$



3. $f(x) = -2x^2$



4. $f(x) = -3x^2$



Graphing Quadratic Equations in Standard Form

The standard form of a quadratic equation is $f(x) = ax^2 + bx + c$

- Concavity tells you if the parabola points up or down. The a -value tells you the concavity. Positive a is concave up & negative a is concave down.

- The axis of symmetry is the vertical line that passes through the middle of the parabola. The b -value & the a -value tell you the axis of symmetry. $x = \frac{-b}{2a}$

- The vertex is the point through which the parabola changes direction. It is also the maximum/minimum. To calculate the vertex you plug the x for the axis of symmetry back into the original equation. $(x, f(x))$
- The y -intercept is the point where the parabola crosses the y -axis. The c -value tells us the y -intercept. $(0, c)$

EX: ① Graph the quadratic function $f(x) = x^2 + 3x + 2$

- Concavity: $a = +1$, concave up ✓

- Axis of Symmetry: $a = +1$, $b = +3$
 $\frac{-b}{2a} = \frac{-(3)}{2(1)} = \frac{-3}{2} = -1.5$
 $x = -1.5$ ✓

- y -intercept: $c = +2$, $(0, 2)$ ✓

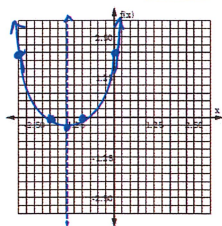
- Vertex: $f(x) = x^2 + 3x + 2$
 $f(-1.5) = (-1.5)^2 + 3(-1.5) + 2$
 $f(-1.5) = 2.25 + (-4.5) + 2$
 $f(-1.5) = -0.25$

$(-1.5, -0.25)$ ✓

- x -intercepts: $x^2 + 3x + 2 = 0$
 $(x+2)(x+1) = 0$
 $x+2=0$ $x+1=0$
 $x=-2$ $x=-1$

$(-2, 0)$ ✓

$(-1, 0)$ ✓



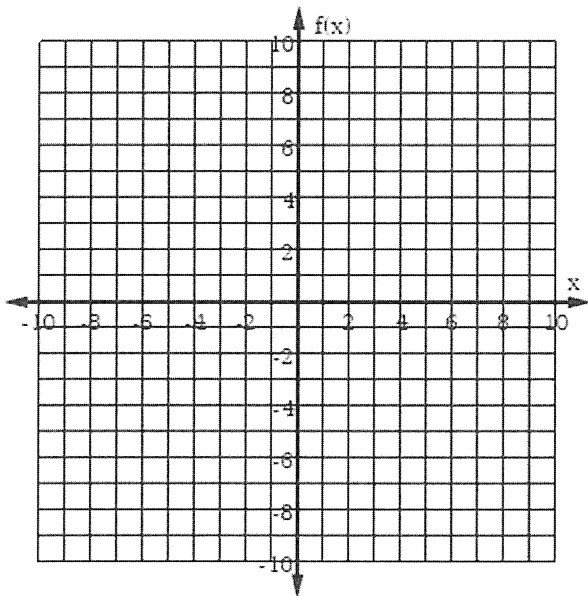
$\frac{1.25}{5} = 0.25$
 The graph is counting by 0.25

Graphing Quadratic Equations in Standard Form

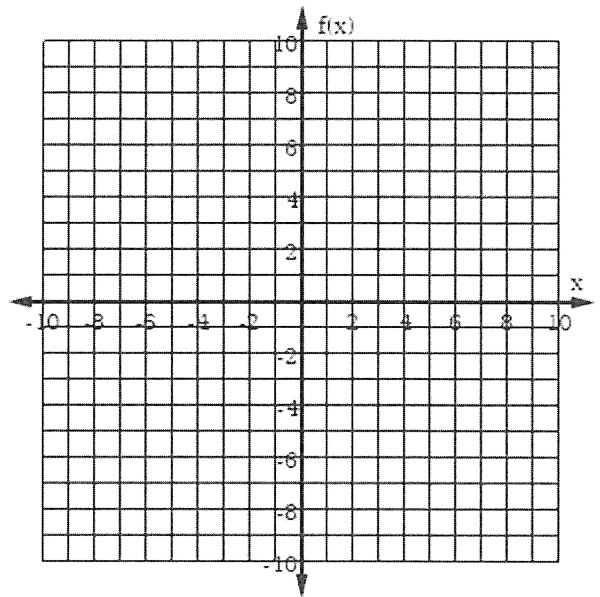
Homework

- Graph each quadratic function.
- State the concavity.
- State the axis of symmetry.
- State the y-intercept.
- State the vertex.
- State the x-intercepts.

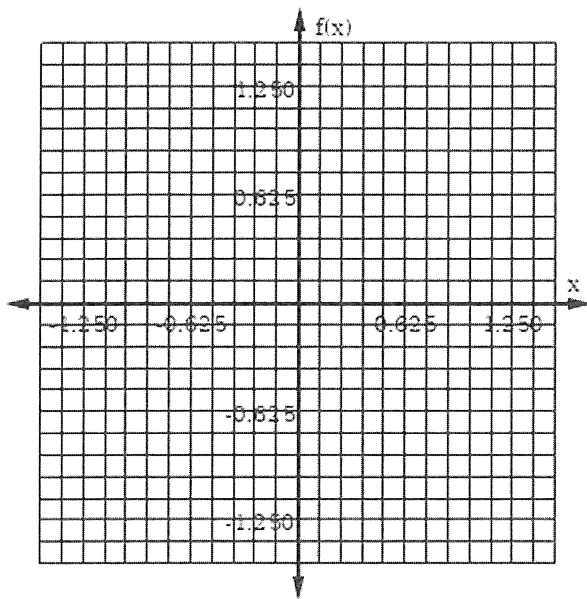
1. $f(x) = x^2 - 2x - 8$



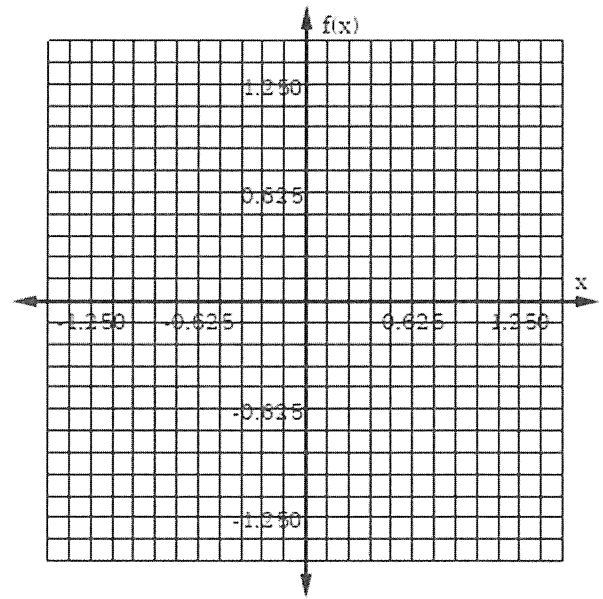
2. $f(x) = -x^2 - 4x - 3$



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



4. $f(x) = -2x^2 + x + 1$



Graphing Quadratic Equations in Vertex Form

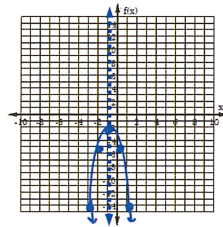
The vertex form of a quadratic equation is:

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

- The a -value tells you the concavity of the parabola. If a is positive, then the parabola is concave up. $\cup$ If a is negative, then the parabola is concave down. $\cap$
- The vertex is the highest or lowest point of the parabola. It is the point (h, k) .
- The axis of symmetry is the vertical line that splits the parabola in half. It is the line $x = h$.

EX: ① Graph $f(x) = -3(x+1)^2 - 2$
 $f(x) = -3(x - (-1))^2 + (-2)$

- Concave down
 $a = -3$
- Vertex is $(-1, -2)$
- Axis of symmetry is $x = -1$



x	$f(x)$
-3	-14
-2	-5
-1	-2
0	-5
1	-14

The vertex form of a quadratic equation describes how the parent function has been transformed.

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

- The a -value tells us the vertical dilation. If a is between 0 and 1, then the parabola is compressed. $\cup$ If a is bigger than 1, then the parabola is stretched. $\cup$
- If the a -value is negative, then the parabola has been reflected over the x -axis/flipped upside down. $\cap$ If the a -value is positive, then the parabola has NOT been reflected over the x -axis/right-side-up. $\cup$
- The h -value tells us the horizontal translation. If h is positive, then the parabola is shifted to the right. If h is negative, then the parabola is shifted to the left.
- The k -value tells us the vertical translation. If k is positive, then the parabola is shifted up. If k is negative, then the parabola is shifted down.

Ex: ② Describe how the parent function has been transformed.

$$f(x) = -5(x+1)^2 - 6$$

$$f(x) = \underset{a}{-5} (x - \underset{h}{(-1)})^2 + \underset{k}{(-6)}$$

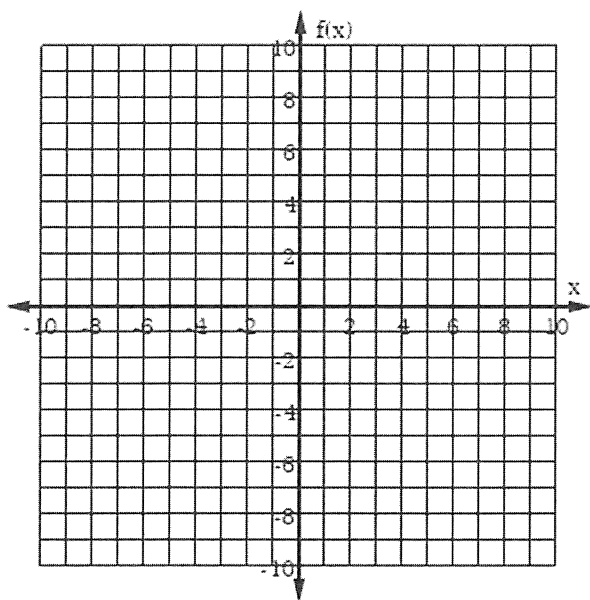
- The parabola is reflected over the x-axis
- The vertical dilation is a stretch of factor 5
- The horizontal translation is a shift 1 unit left
- The vertical translation is a shift 6 units down

Graphing Quadratic Equations in Vertex Form

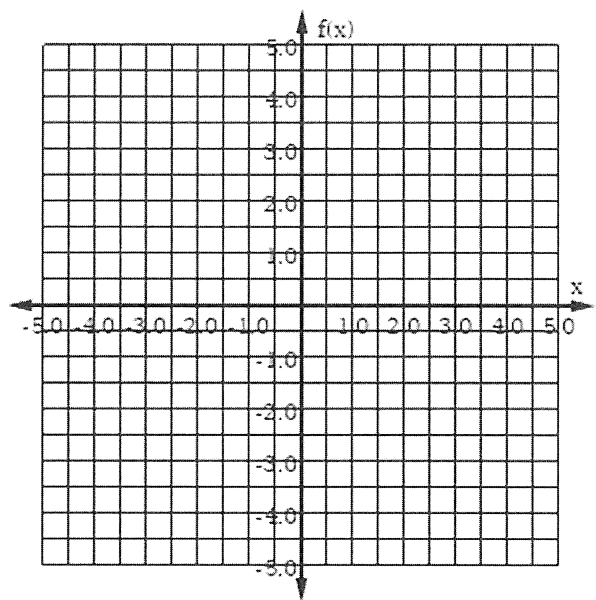
Homework

- Graph each quadratic function.
- State the concavity.
- State the vertex.
- State the axis of symmetry.

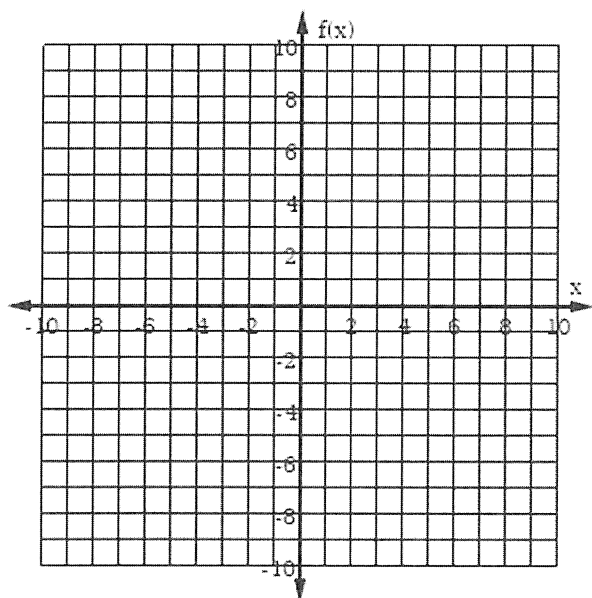
1. $f(x) = 2(x + 3)^2 - 6$



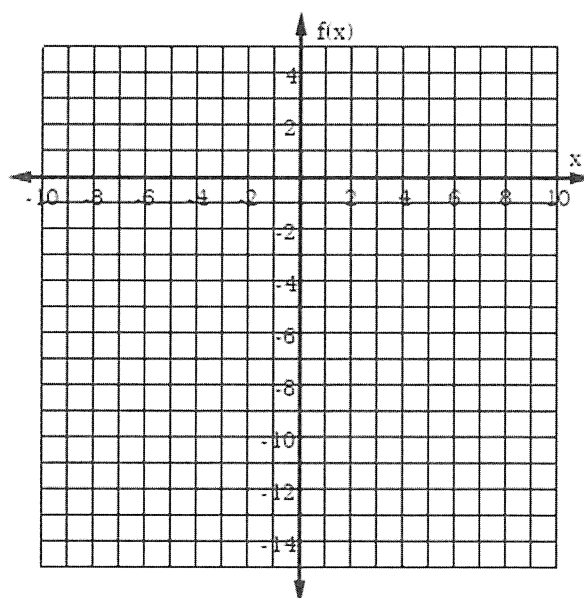
2. $f(x) = \frac{1}{2}(x - 3)^2 - 4$



3. $f(x) = -2(x - 2)^2 + 5$



4. $f(x) = -3(x - 4)^2 - 2$



- Describe the vertical transformation.
- Describe the horizontal transformation.
- Describe the vertical dilation.
- Has the parabola been reflected over the x-axis?

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

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

7. $f(x) = -\frac{1}{5}(x - 4)^2 + 6$

8. $f(x) = \frac{2}{3}(x + 2)^2 - 2$