

Vertex Form of a Quadratic Equation

- **Vertex Form of a Quadratic Equation:** $f(x) = a(x - h)^2 + k$
- (h, k) is the vertex (change h , keep k)
- a determines the width and direction of the parabola
 - $|a| > 1$ stretches the graph (makes it skinnier)
 - $|a| < 1$ shrinks the graph (makes it wider)
 - $-a$ reflects the graph over the x -axis.
- h determines the horizontal shift ($+h$ moves to the left, $-h$ moves to the right)
- k determines the vertical shift ($+k$ moves the graph up, $-k$ moves the graph down)
- To find the y-intercept of the graph, plug in 0 for x and simplify the expression.

Why we use this form?

Vertex form shows the transformations on a quadratic in relation to its parent function $f(x) = x^2$.

Directions: Describe how each function compares to the parent function. Then, state the vertex.

Comparing to the Parent Function

1.) $f(x) = x^2 + 9$
up 9 (0, 9)

2.) $f(x) = x^2 - 2$
down 2 (0, -2)

3.) $f(x) = -(x + 5)^2$
reflect
left 5 (-5, 0)

4.) $f(x) = (x - 4)^2 - 1$
right 4
down 1 (4, -1)

5.) $f(x) = \frac{1}{3}x^2 + 2$
shrink by $\frac{1}{3}$
up 2 (0, 2)

6.) $f(x) = -2(x + 4)^2$
reflect
stretch by 2 (-4, 0)
left 4

7.) $f(x) = 3(x - 2)^2 + 3$
stretch by 3
right 2 (2, 3)
up 3

8.) $f(x) = -\frac{3}{4}(x + 3)^2 - 7$
reflect
shrink by $\frac{3}{4}$ (-3, -7)
left 3
down 7

Directions: Given the transformations described, write the quadratic function in vertex form.

9.) Mason graphed the parent function of a quadratic equation. Then, he reflected the parabola over the x-axis, and translated it seven units up and three units to the right. What is the equation of the new parabola?

$$f(x) = -(x-3)^2 + 7$$

10.) Kyria graphed the parent function of a quadratic equation. Then, she stretched the parabola by a factor of 3, and translated it one unit to the left and five units down. What is the equation of the new parabola?

$$f(x) = 3(x+1)^2 - 5$$

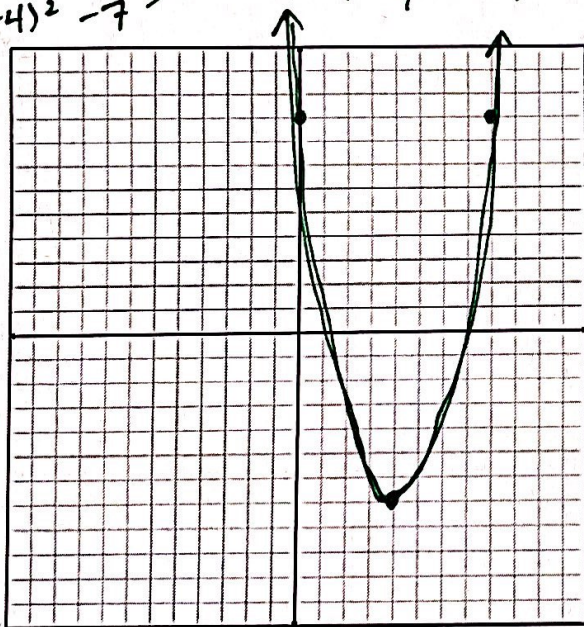
11.) A quadratic equation has a vertex of $(-2, -4)$ and was reflected over the x-axis. What is the equation of the parabola?

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

Directions: Find the vertex and y-intercept of the graph. Then plot the points to graph the equation.

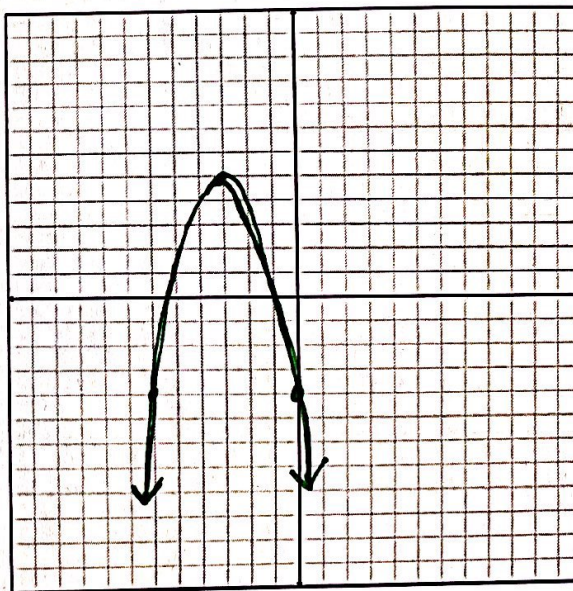
12.) $f(x) = (x-4)^2 - 7$ vertex: $(4, -7)$

$(0-4)^2 - 7 \rightarrow 16 - 7 = 9 = y\text{-intercept}$
 $(-4)^2 - 7$



13.) $f(x) = -(x+3)^2 + 5$ vertex: $(-3, 5)$

$-(0+3)^2 + 5 \rightarrow -9 + 5 = -4 = y\text{-intercept}$
 $-(3)^2 + 5$



14.) $f(x) = 2(x-1)^2$ vertex $(1, 0)$

$$2(0-1)^2$$

$$2(-1)^2$$

$$2(1) = 2 = y\text{-intercept}$$

