



**Essential Question:** How can I graph a parabola by hand, without a graphing calculator?

**Questions / Big Ideas**

**Discover the Pattern**

Determine the outputs for the following quadratic functions? Calculate the 1<sup>st</sup> differences (subtract each output value from the one above it). What do you notice?

a)

b)

$x$	$f(x) = x^2$		$x$	$f(x) = 2x^2$	
-3			-3		
-2		_____	-2		_____
-1		_____	-1		_____
0		_____	0		_____
1		_____	1		_____
2		_____	2		_____
3		_____	3		_____

c)

d)

$x$	$f(x) = 3x^2$		$x$	$f(x) = \frac{1}{2}x^2$	
-3			-3		
-2		_____	-2		_____
-1		_____	-1		_____
0		_____	0		_____
1		_____	1		_____
2		_____	2		_____
3		_____	3		_____

Questions / Big Ideas

**Compare the First Differences. What do you notice?**

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**What is the Quadratic Staircase Pattern?**

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**Quadratic Staircase**

1. Using the pattern you discovered, we can graph quadratics by hand!
2. Graph the coordinate for the vertex, then count ONE unit to the right (horizontal).
3. Move up or down (vertically) depending on the sign of the leading coefficient (a-value), which affects the graph's concavity.
4. For each stair, do NOT return to the vertex. Instead, continue where you plotted the last point.
5. Use the Axis of Symmetry to help create symmetric points for the negative input values.
6. Connect the points with a smooth curve.

Questions / Big Ideas

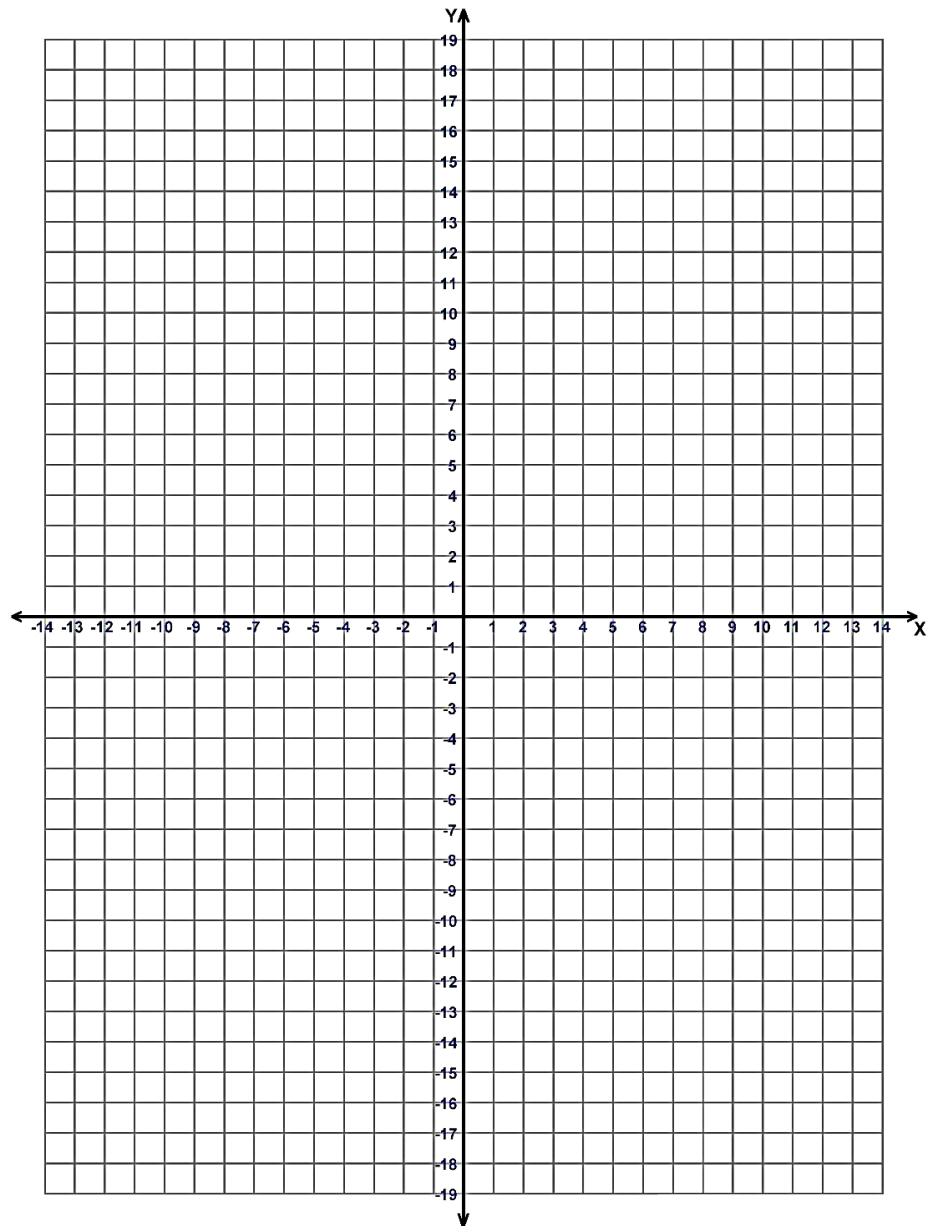
**Guided Practice** – Using the *Quadratic Staircase* pattern, graph the following quadratics based on the key characteristics below.

- 1. Key Characteristics Given
  - a. *Vertex:  $(-4, -8)$*
  - b. *Concave: Up*
  - c. *Dilation: None*

- 2. Key Characteristics Given
  - a. *Vertex:  $(0, 3)$*
  - b. *Concave: Up*
  - c. *Dilation: None*

- 3. Key Characteristics Given
  - a. *Vertex:  $(5, 12)$*
  - b. *Concave: Down*
  - c. *Dilation: None*

- 4. Key Characteristics Given
  - a. *Vertex:  $(8, 0)$*
  - b. *Concave: Down*
  - c. *Dilation: None*



**Guided Practice** – Using the *Quadratic Staircase* pattern, graph the following quadratics based on the key characteristics below.

5. Key Characteristics Given

- a. *Vertex:*  $(-9, 0)$
- b. *Concave:* *Up*
- c. *Dilation:*  $2$

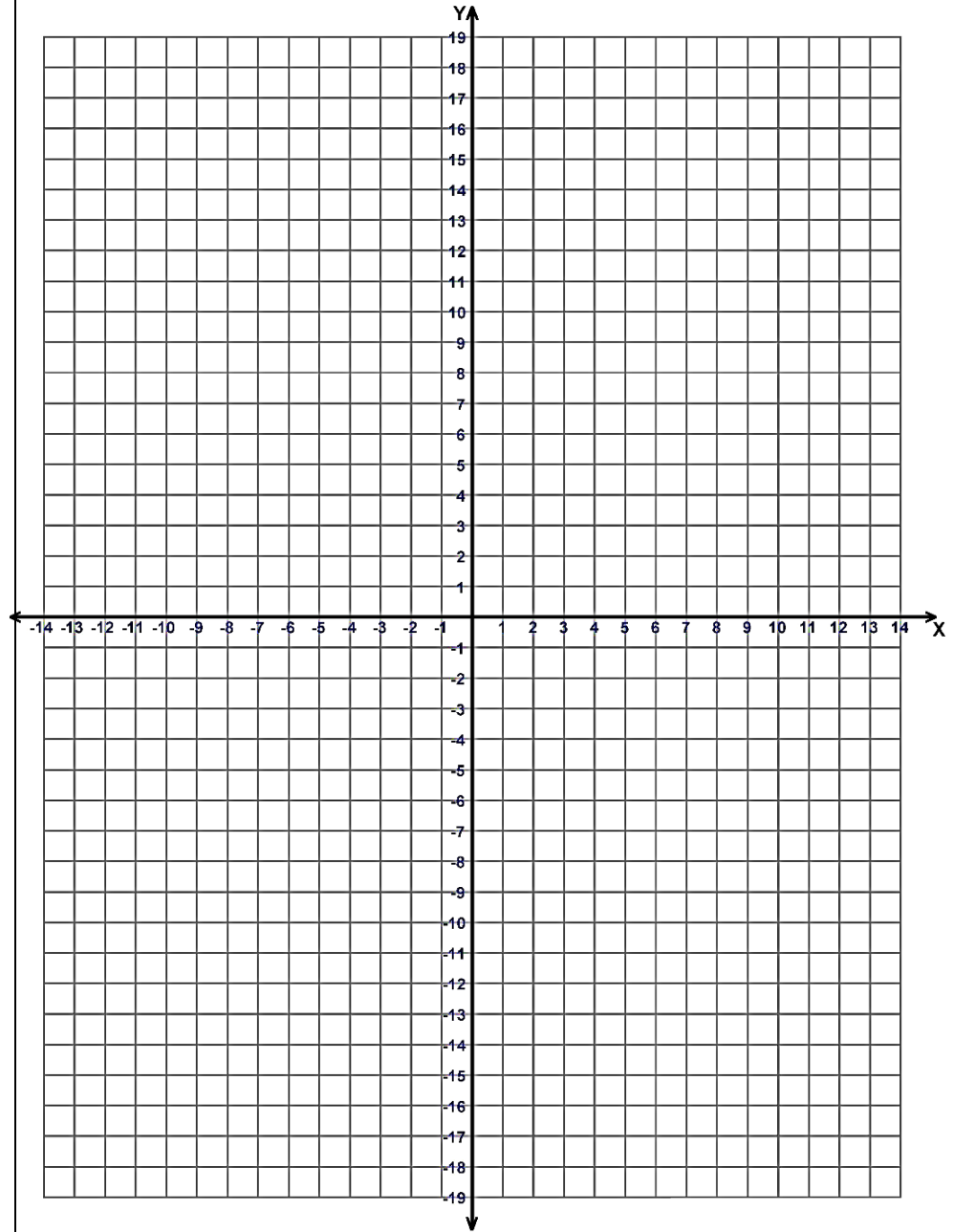
6. Key Characteristics Given

- a. *Vertex:*  $(3, 14)$
- b. *Concave:* *Down*
- c. *Dilation:*  $\frac{1}{2}$

7. Key Characteristics Given

- a. *Vertex:*  $(8, 0)$
- b. *Concave:* *Up*
- c. *Dilation:*  $\frac{1}{2}$

**Questions / Big Ideas**



**Summary:** \_\_\_\_\_

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