

Algebra 2 4.1

Graph quadratic functions * Algebra 1 Ch.9

Find and interpret maximum and minimum values of a quadratic function

quadratic function

quadratic term x^2

linear term x

constant term c

parabola

axis of symmetry

y-intercept

vertex turning point (x, y)

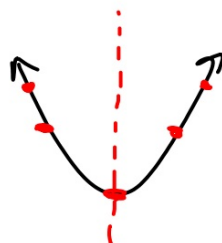
maximum a is neg

minimum a is pos

domain (x) always all reals

range (y) depends...use graph to answer

activity: giant graphs



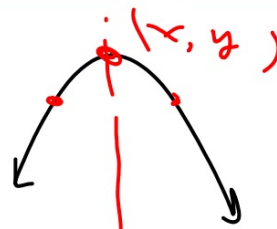
axis of symmetry
whiteboards

$$\frac{-b}{2a}$$

$\uparrow$
x-coor. of vertex

$$f(x) = ax^2 + bx + c, \text{ where } a \neq 0$$

quadratic term linear term constant term



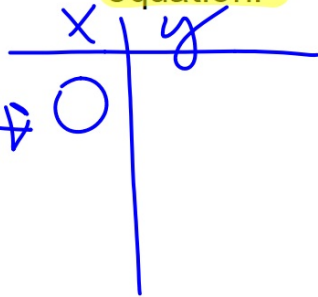
$$x = \frac{-b}{2a}$$

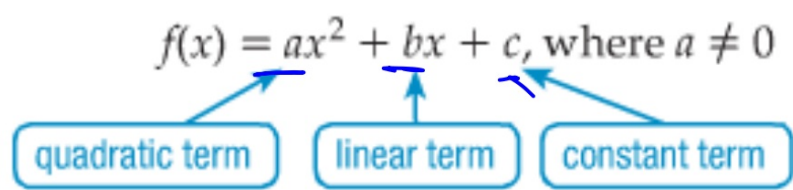
Giant graphs (10 min.)

Use a table of values to graph the quadratic function.

(Make sure you follow correct order of operations).

Label the graph with **vertex**, **axis of symmetry** and **equation**.





$$y = x^2 + 3$$

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



Example 1 Graph a Quadratic Function by Using a Table

Graph $f(x) = 3x^2 - 12x + 6$ by making a table of values.

$$X = \frac{-b}{2a} = \frac{12}{2 \cdot 3} = \frac{12}{6}$$

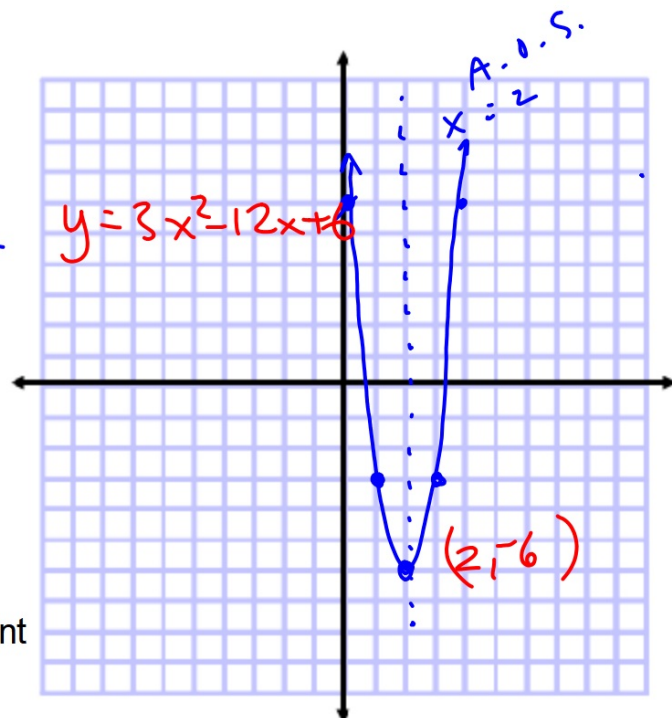
	$3x^2 - 12x + 6$	
2	$3 \cdot 4 - 12 \cdot 2 + 6$ $12 - 24 + 6$	-6
3	$3 \cdot 9 - 12 \cdot 3 + 6$ $27 - 36 + 6$	-3
4	$3 \cdot 16 - 12 \cdot 4 + 6$ $48 - 48 + 6$	6

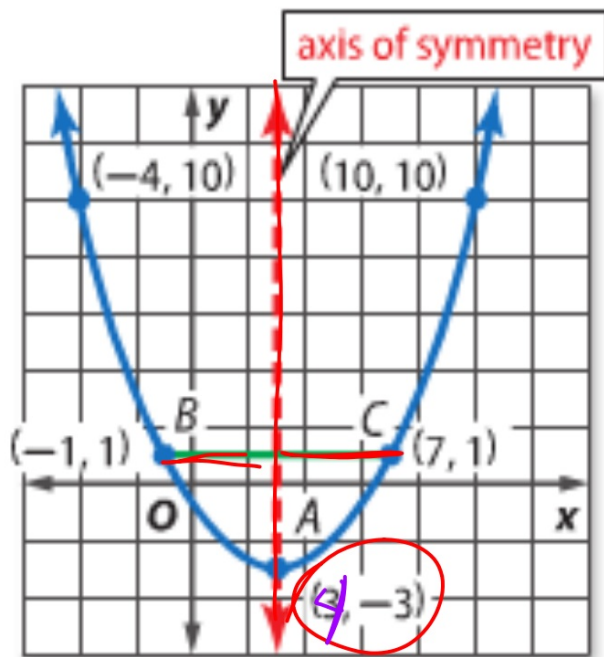
Table of values: Not always convenient

What is the y-intercept?

What is the vertex?

Use information efficiently (line of symmetry, etc.)





axis of symmetry

$$\underline{x = 3}$$

$$-b/2a$$

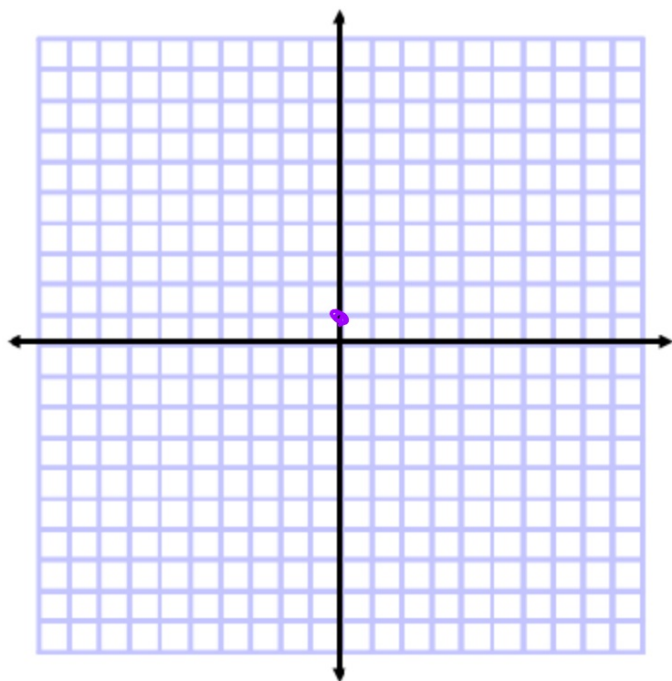
$$y = (x - 3)^2 - 3$$

Use your resources:

• **Guided Practice**

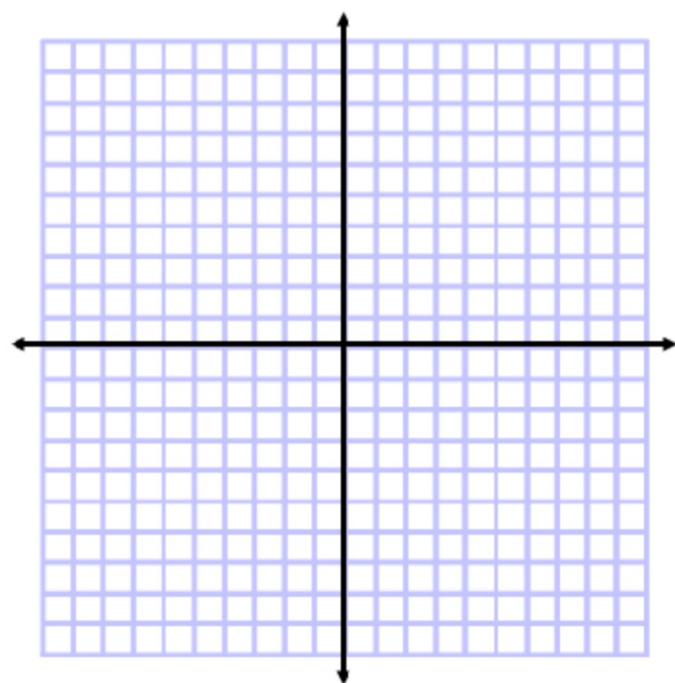
Graph each function by making a table of values.

1B. $h(x) = 4x^2 - 8x + 1$



$$\frac{8}{2 \cdot 4} = 1$$
$$\begin{array}{r|l} & 4x^2 - 8x + 1 \\ 1 & \end{array}$$

1A. $g(x) = -2x^2 + 8x - 3$

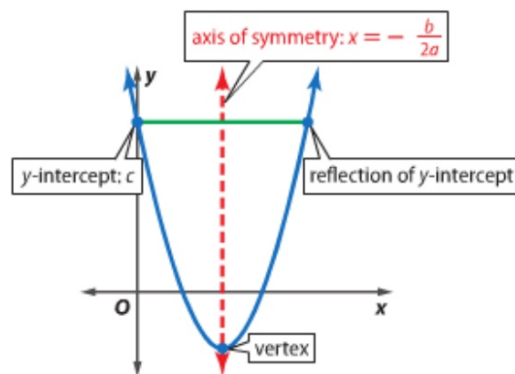


Key Concept Graph of a Quadratic Function—Parabola

Words Consider the graph of $y = ax^2 + bx + c$, where $a \neq 0$.

- The y -intercept is $a(0)^2 + b(0) + c$ or c .
- The equation of the axis of symmetry is $x = -\frac{b}{2a}$.
- The x -coordinate of the vertex is $-\frac{b}{2a}$.

Model



4.1
13-390



Example 2 Axis of Symmetry, y -intercept, and Vertex

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

- a. Find the y -intercept, the equation of the axis of symmetry, and the x -coordinate of the vertex.

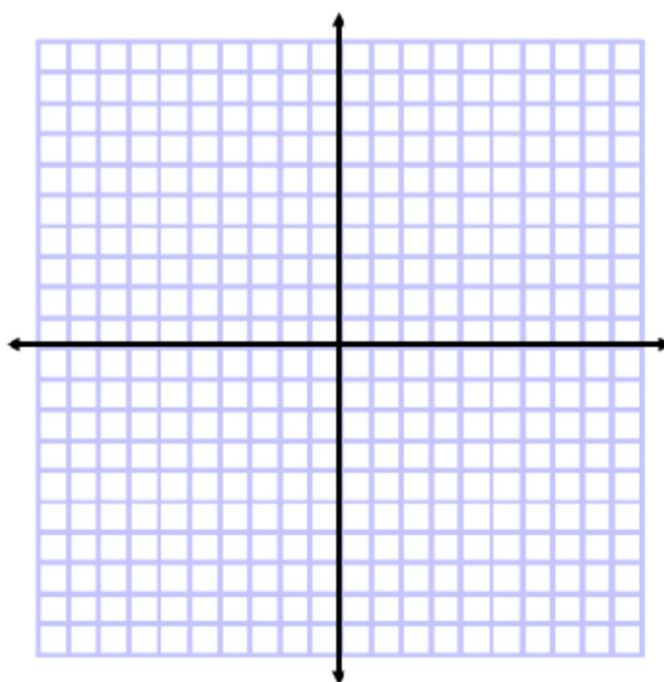
c. Use this information to graph the function.

axis of symmetry

vertex

y-intercept

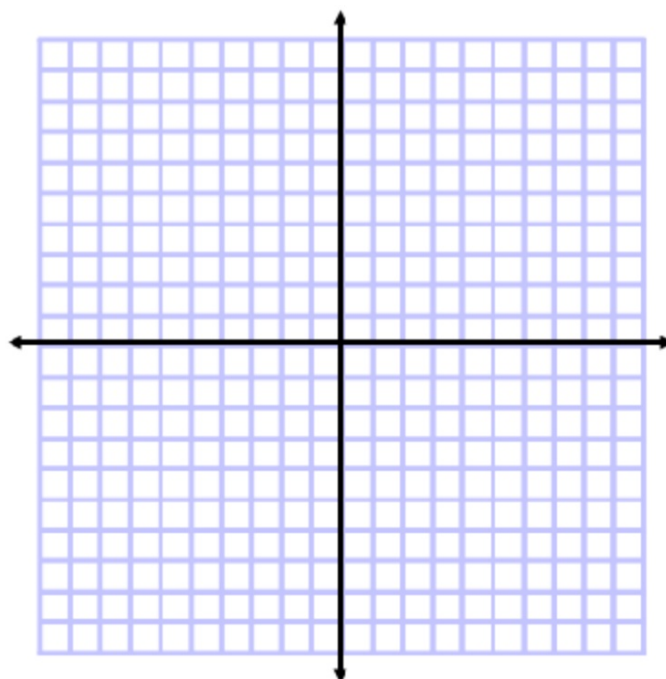
coordinates



Guided Practice

2. Consider $f(x) = -5x^2 - 10x + 6$.

- A. Find the y -intercept, the equation of the axis of symmetry, and the x -coordinate of the vertex.
- B. Make a table of values that includes the vertex.
- C. Use this information to graph the function.



Maximum
Minimum

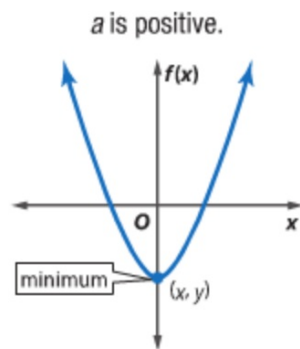
KeyConcept Maximum and Minimum Value

Words

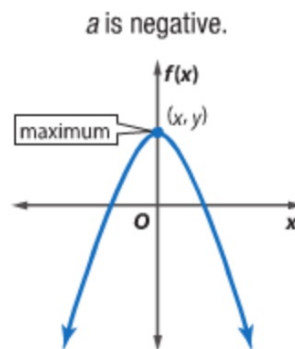
The graph of $f(x) = ax^2 + bx + c$, where $a \neq 0$,

- opens up and has a minimum value when $a > 0$, and
- opens down and has a maximum value when $a < 0$.

Model



The y -coordinate is the minimum value.



The y -coordinate is the maximum value.

Example 3 Maximum or Minimum Values

Consider $f(x) = -4x^2 + 12x + 18$.

- Determine whether the function has a *maximum* or *minimum* value.
- State the maximum or minimum value of the function.
- State the domain and range of the function.

Technically:

minimum point (x,y) is vertex

minimum value y-coord is "how low does it go?"

ordered pair or y-coordinate only?

WatchOut!

Maxima and Minima The terms *minimum point* and *minimum value* are not interchangeable. The minimum point on the graph of a quadratic function is the ordered pair that describes the location of the vertex. The minimum value of a function is the y-coordinate of the minimum point. It is the smallest value obtained when $f(x)$ is evaluated for all values of x .

Guided Practice

3. Consider $f(x) = 4x^2 - 24x + 11$.

- A. Determine whether the function has a maximum or minimum value.
- B. State the maximum or minimum value of the function.
- C. State the domain and range of the function.

Study Tip

Domain and Range The domain of a quadratic function will always be all real numbers. The range will either be all real numbers less than or equal to the maximum or all real numbers greater than or equal to the minimum.

Domain ARN

Range: from vertex (up or down)