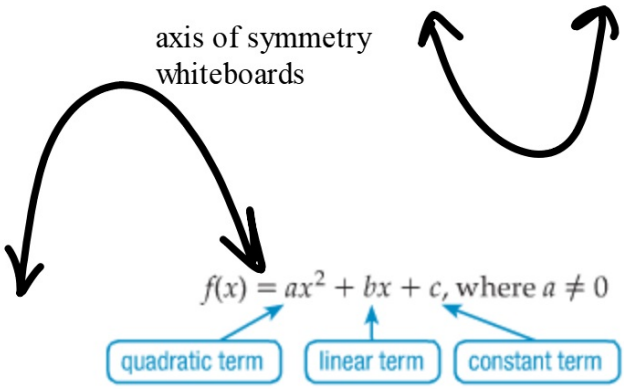
Algebra 2 4.1
Graph quadratic functions * Algebra 1 Ch.9
Find and interpret maximum and minimum values of a quadratic function

quadratic function
quadratic term $y = x^2$
linear term x
constant term number
parabola
axis of symmetry $x = -\frac{b}{2a}$
y-intercept
vertex (x, y)
maximum highest
minimum least
domain (x) always all reals
range (y) depends...use graph to answer



activity: giant graphs

Giant graphs (10 min.)

$y = (x+2)^2$

$x^2 + 4x + 4$

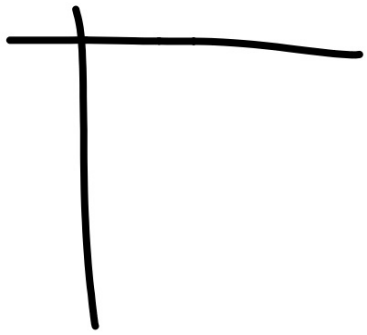
Use a table of values to graph the quadratic function. (Make sure you follow correct order of operations). Label the graph with vertex, axis of symmetry and equation.

$x+2$

$x+2$

x^2 $2x$ 4

$2x$



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



x-coord. of vertex $= -\frac{b}{2a}$

Example 1 Graph a Quadratic Function by Using a Table

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

a b c

$x = \frac{12}{6} = 2$

	$3x^2-12x+6$	
2	$12-24+6$	-6
3	$3\cdot9-12\cdot3$ $27-36+6$	-3
4	$3\cdot16-12\cdot4+6$ $48-48$	6

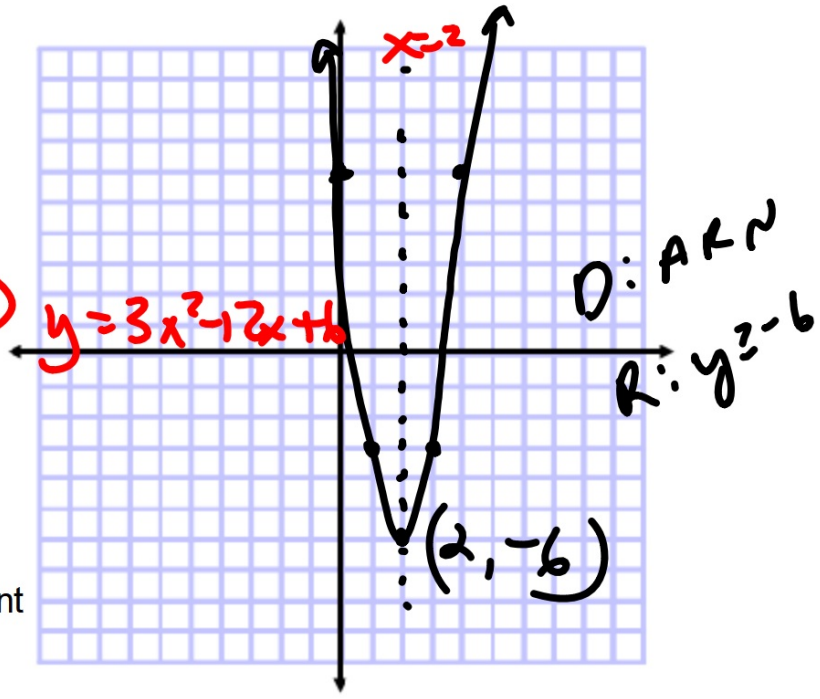
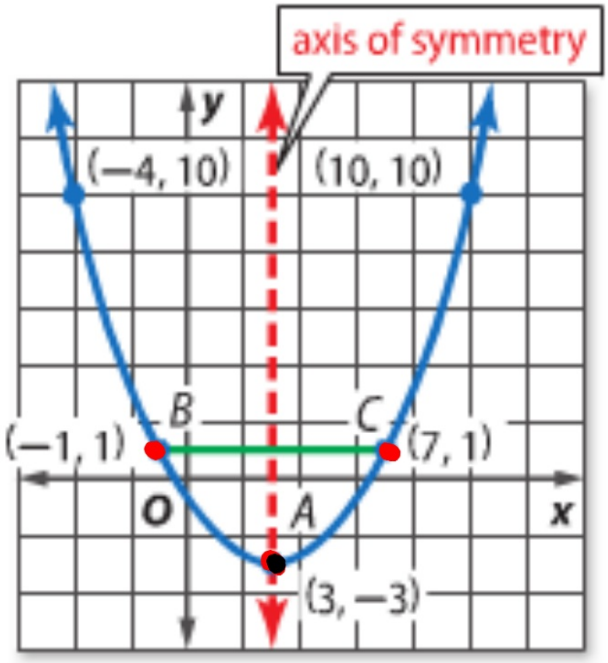


Table of values: Not always convenient
What is the y-intercept?
What is the vertex?
Use information efficiently (line of symmetry, etc.)



-b/2a

D: ARJ

R: $y \geq -3$

Use your resources:

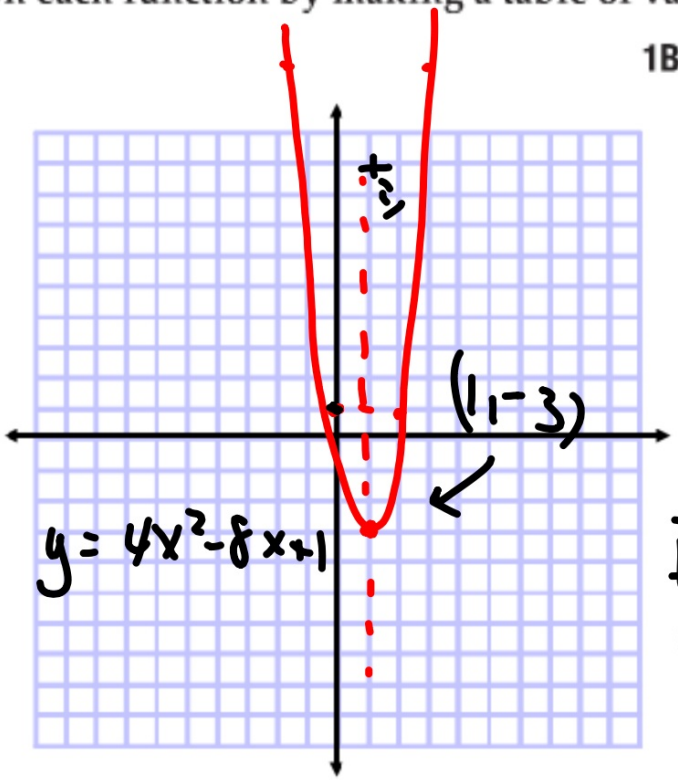
- **GuidedPractice**

$x = \frac{-b}{2a} = \frac{8}{8} = 1$

Graph each function by making a table of values.

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

a b c



	$4x^2-8x+1$	
1	4 - 8 + 1	-3
2	4·4 - 8·2 16 - 16 + 1	1
3	4·9 - 8·3 36 - 24 + 1	13

D: ARN

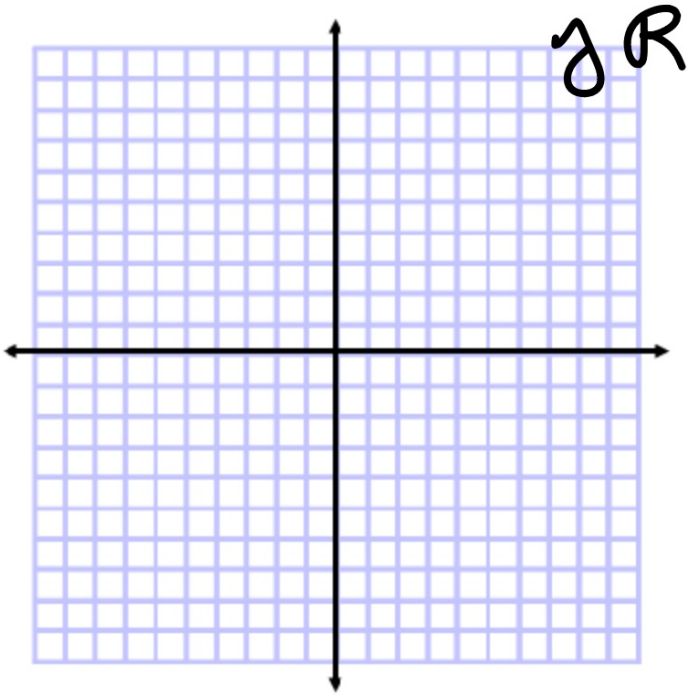
R: $y \geq -3$

G@MA

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

x Domain

y Range



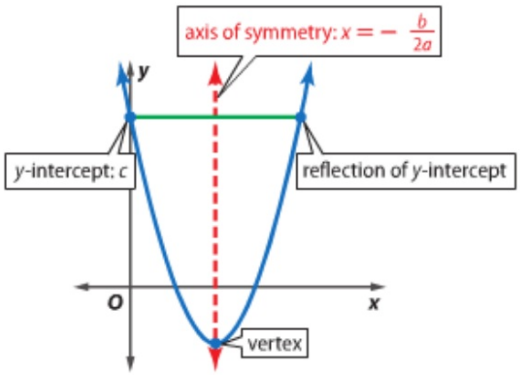
KeyConcept Graph of a Quadratic Function—Parabola

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





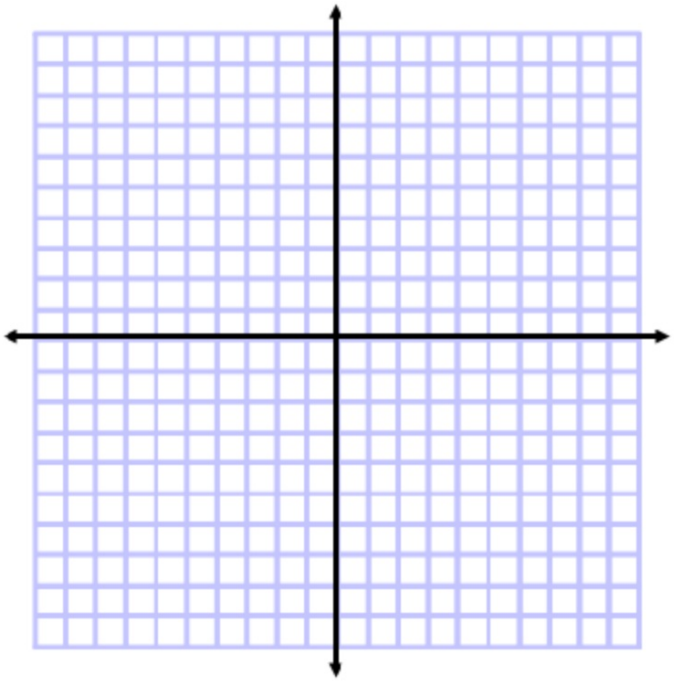
Example 2 Axis of Symmetry, *y*-intercept, and Vertex

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



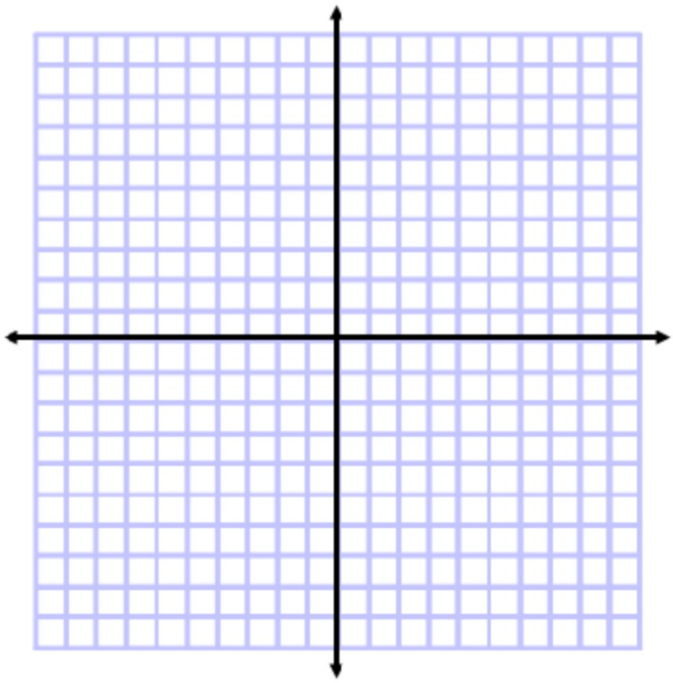
GuidedPractice

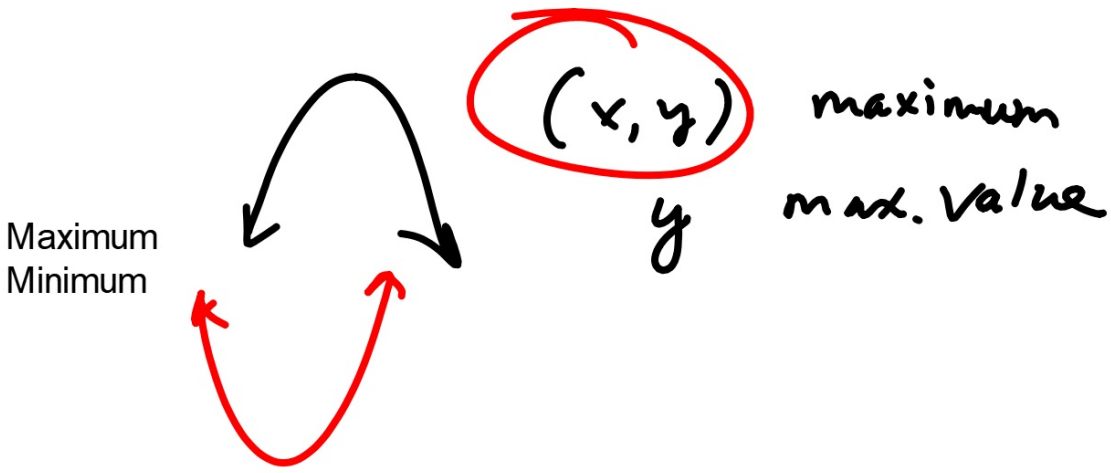
2. Consider $f(x) = -5x^2 - 10x + 6$.

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
(x, y)
maximum
y
max. value

KeyConcept Maximum and Minimum Value

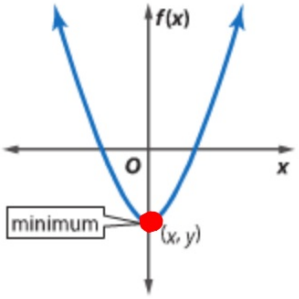
Words

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 $a < 0$.

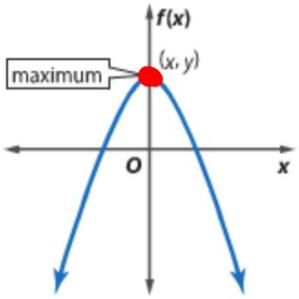
Model

a is positive.



The y-coordinate is the minimum value.

a is negative.



The y-coordinate is the maximum value.

Example 3 Maximum or Minimum Values

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

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.

13-31 of HW

graph

$\frac{-12}{2 \cdot -4}$ $\frac{-12}{-8}$ (1.5, 27)

D: ARN

R $y \leq 27$

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*.

Technically:
minimum point (x,y) is vertex
minimum value y-coord is "how low does it go?"

ordered pair or y-coordinate only?

GuidedPractice

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.

StudyTip

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)