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

quadratic function $f(x) = ax^2 + bx + c$
quadratic term ax^2
linear term bx
constant term
parabola   graph
axis of symmetry
y-intercept
vertex — turning pt
• maximum
• minimum
✗ domain (x) always all reals
✗ range (y) depends...use graph to answer

activity: giant graphs

axis of symmetry
whiteboards

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

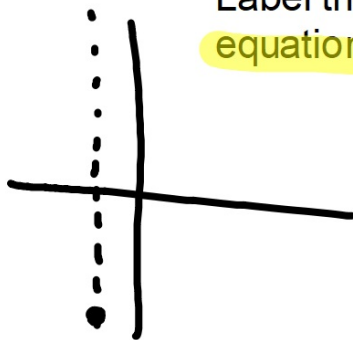$f(x) = ax^2 + bx + c,$ where $a \neq 0$

quadratic term   linear term   constant term

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.

$$y = 3x^2 + 6x - 3$$

$$\overset{a}{3}(-1)^2 + \overset{b}{6}(-1) - 3$$

$$3 \pm 6 \pm 3$$

x	y
-1	-6

$$x = \frac{-6}{2 \cdot 3} = \frac{-6}{6} = -1$$

4.1

13-390dd

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

quadratic term   linear term   constant term

Example 1 Graph a Quadratic Function by Using a Table

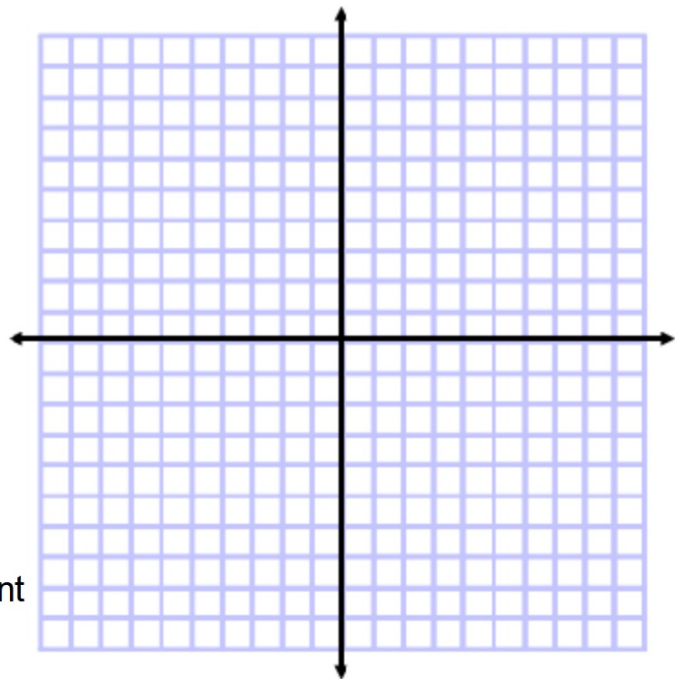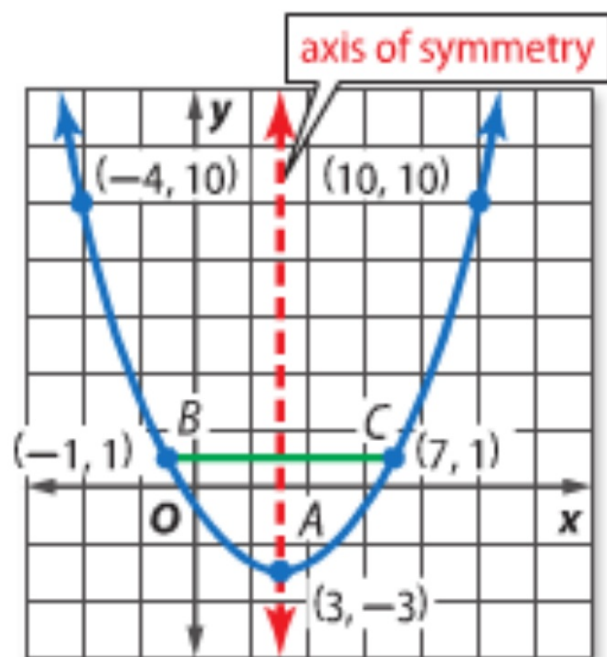Graph $f(x) = 3x^2 - 12x + 6$ by making a table of values.

Table of values: Not always convenient
What is the y-intercept?
What is the vertex -b/2a?
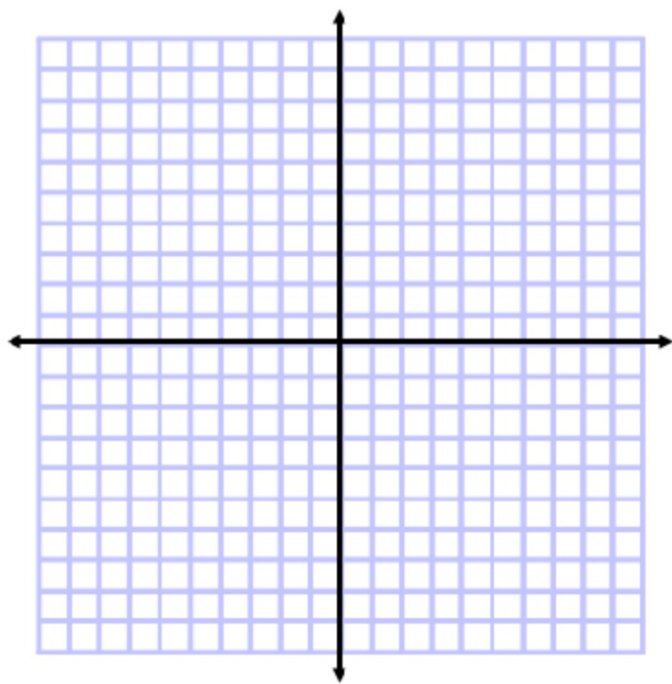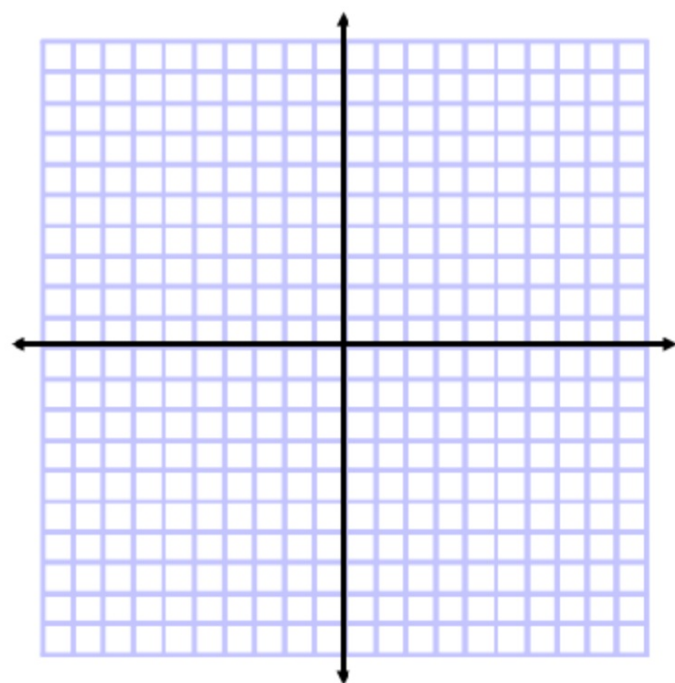Use information efficiently (line of symmetry, etc.)

axis of symmetry

$(-4, 10)$ $(10, 10)$

$(-1, 1)$ B C $(7, 1)$

O A

$(3, -3)$

$-b/2a$

Use your resources:

Graph each function by making a table of values.

1B. $h(x) = 4x^2 - 8x + 1$
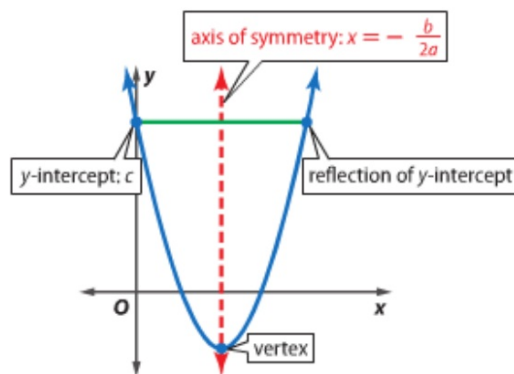
1A. $g(x) = -2x^2 + 8x - 3$

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 $x = -\dfrac{b}{2a}$.
- The x-coordinate of the vertex is $-\dfrac{b}{2a}$.

Model

axis of symmetry: $x = -\dfrac{b}{2a}$

y-intercept: c

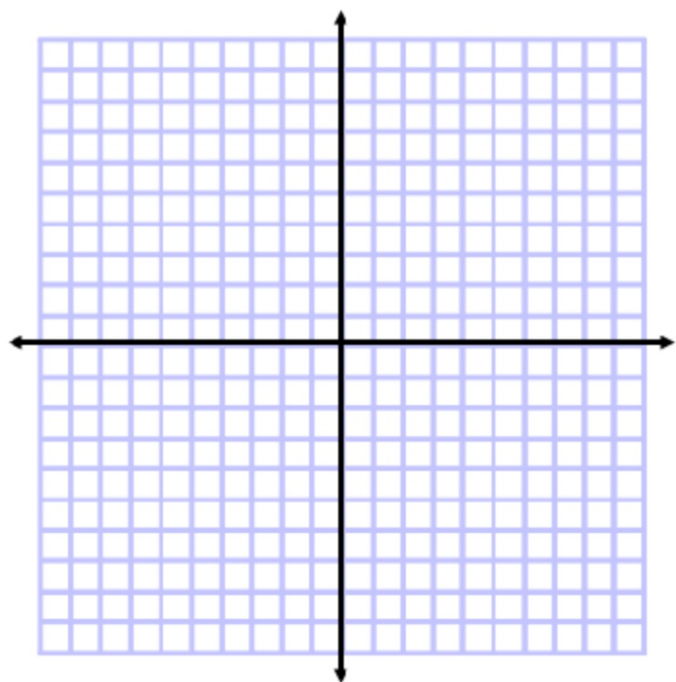reflection of y-intercept

vertex

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.

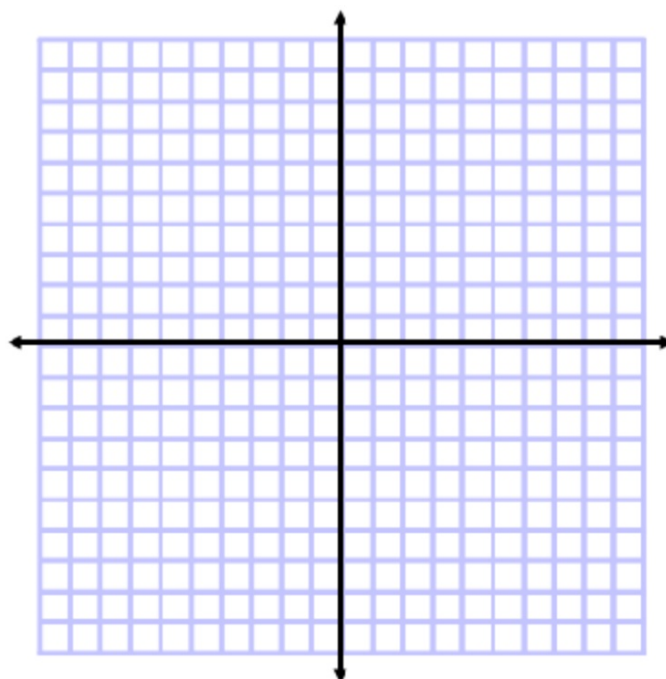**c. Use this information to graph the function.**

axis of symmetry
vertex
y-intercept
coordinates

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.

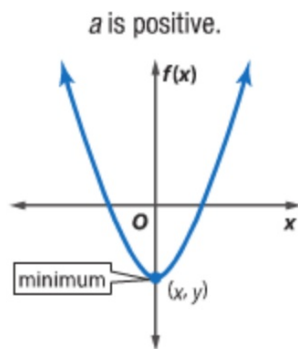**C.** Use this information to graph the function.

Maximum
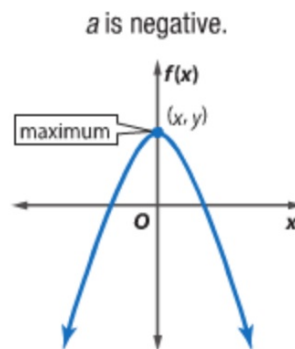Minimum

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

a is positive.

a is negative.

The *y*-coordinate is the minimum value.

The *y*-coordinate is the maximum value.

Example 3 Maximum or Minimum Values

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

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.

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

ordered pair or y-coordinate only?

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)