3.3 Graphing $f(x) = ax^2 + bx + c$

Objective: Today we will graph and solve quadratics of the form $f(x) = ax^2 + bx + c$, and we will find their maximum/minimum values.

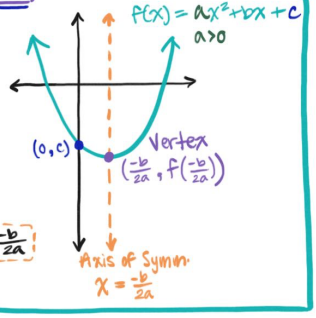
Warm-up: Graph the function. Compare the graph to the graph of $f(x) = x^2$.

2. $h(x) = 2x^2 - 6$

3.3 GRAPHING $f(x) = ax^2 + bx + c$

GRAPHING $f(x) = ax^2 + bx + c$

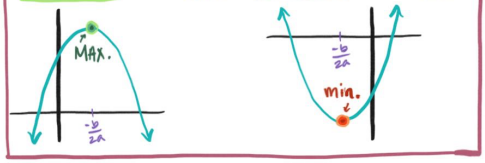
- OPENS UP if $a > 0$ & it OPENS DOWN if $a < 0$
- y-intercept is at $(0, c)$
- x-coordinate of the Vertex is $x = \frac{-b}{2a}$
- Axis of Symmetry at $x = \frac{-b}{2a}$



MAXIMUM & MINIMUM VALUES

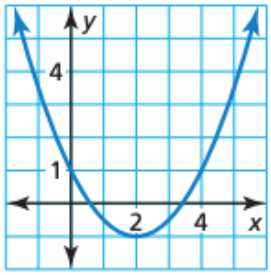
for $ax^2 + bx + c$

- if $a < 0$ (opens ↓), then there is a MAXimum at $x = \frac{-b}{2a}$.
- if $a < 0$ (opens ↑), then there is a minimum at $x = \frac{-b}{2a}$.

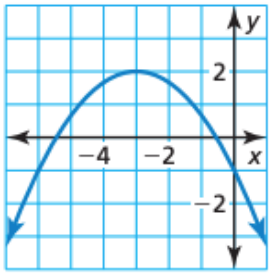


In Exercises 3–6, find the vertex, the axis of symmetry, and the *y*-intercept of the graph.

3.



4.

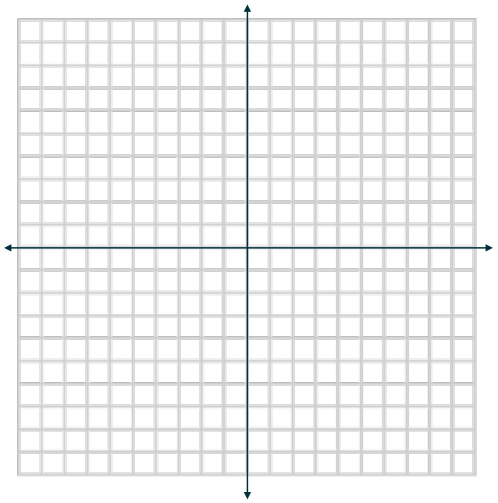


In Exercises 7–12, find (a) the axis of symmetry and (b) the vertex of the graph of the function.

7. $f(x) = 2x^2 - 4x$ **10.** $f(x) = -6x^2 + 24x - 20$ **11.** $f(x) = \frac{2}{5}x^2 - 4x + 14$

In Exercises 13–18, graph the function. Describe the domain and range. *(See Example 2.)*

17. $y = \frac{2}{3}x^2 - 6x + 5$



3.3 Graphing $f(x) = ax^2 + bx + c$

Objective: Today we will graph and solve quadratics of the form $f(x) = ax^2 + bx + c$, and we will find their maximum/minimum values.

Checkpoint: Graph $f(x) = 3x^2 + 6x + 2$. Find the axis of symmetry and the vertex of the graph. Describe the domain and range.

In Exercises 21–26, tell whether the function has a minimum value or a maximum value. Then find the value. *(See Example 3.)*

21. $y = 3x^2 - 18x + 15$ **23.** $f(x) = -4x^2 + 4x - 2$ **26.** $f(x) = \frac{1}{5}x^2 - 5x + 27$

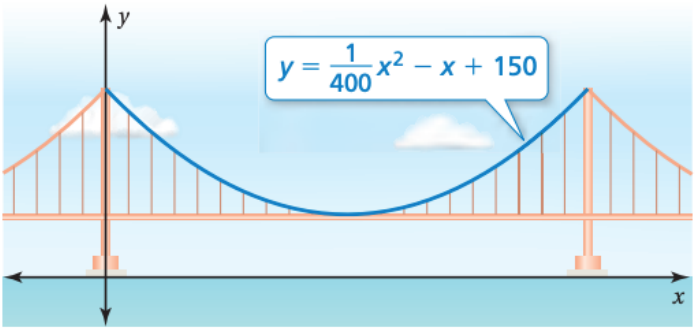
28. MODELING WITH MATHEMATICS The function $h(t) = -16t^2 + 16t$ represents the height (in feet) of a horse t seconds after it jumps during a steeplechase.

a. When does the horse reach its maximum height?

b. Can the horse clear a fence that is 3.5 feet tall? If so, by how much?

c. How long is the horse in the air?

29. MODELING WITH MATHEMATICS The cable between two towers of a suspension bridge can be modeled by the function shown, where x and y are measured in feet. The cable is at road level midway between the towers.



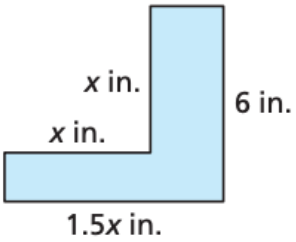
a. How far from each tower shown is the lowest point of the cable?

b. How high is the road above the water?

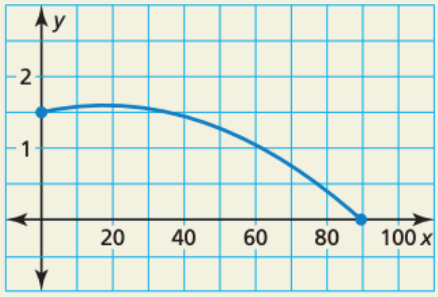
c. Describe the domain and range of the function shown.

MATHEMATICAL CONNECTIONS In Exercises 39 and 40, (a) find the value of x that maximizes the area of the figure and (b) find the maximum area.

39.



42. HOW DO YOU SEE IT? During an archery competition, an archer shoots an arrow. The arrow follows the parabolic path shown, where x and y are measured in meters.



a. What is the initial height of the arrow?

b. Estimate the maximum height of the arrow.

c. How far does the arrow travel?