

**Concepts and Vocabulary:**

1. The graph of any quadratic function  $f(x) = ax^2 + bx + c$ ,  $a \neq 0$ , is called a/an \_\_\_\_\_.
2. The graph of  $f(x) = ax^2 + bx + c$  opens upward if \_\_\_\_\_ and opens downward if \_\_\_\_\_.
3. The  $x$ -intercepts for the graph of  $f(x) = ax^2 + bx + c$  can be found by determining the real solutions of the equation \_\_\_\_\_.
4. The  $y$ -intercept for the graph of  $f(x) = ax^2 + bx + c$  can be determined by evaluating  $f$  of \_\_\_\_\_.
5. The  $x$ -coordinate of the vertex of the graph of  $f(x) = ax^2 + bx + c$  is \_\_\_\_\_. The  $y$ -coordinate of the vertex is found by evaluating  $f$  of \_\_\_\_\_.

**The ANSWERS to the next set of problems are at the end of this document since I've changed the directions from the text.**

**Practice Exercises:**

In exercises 1 - 35, follow the steps and use the information to graph the parabola.

1.  $y(x) = x^2 - 4x + 3$

a. Does the graph open up or down?

f. What is the  $y$ -intercepts mirror point or, if there is none, what are 2 other points on the graph?

b. What is the  $y$ -intercept?

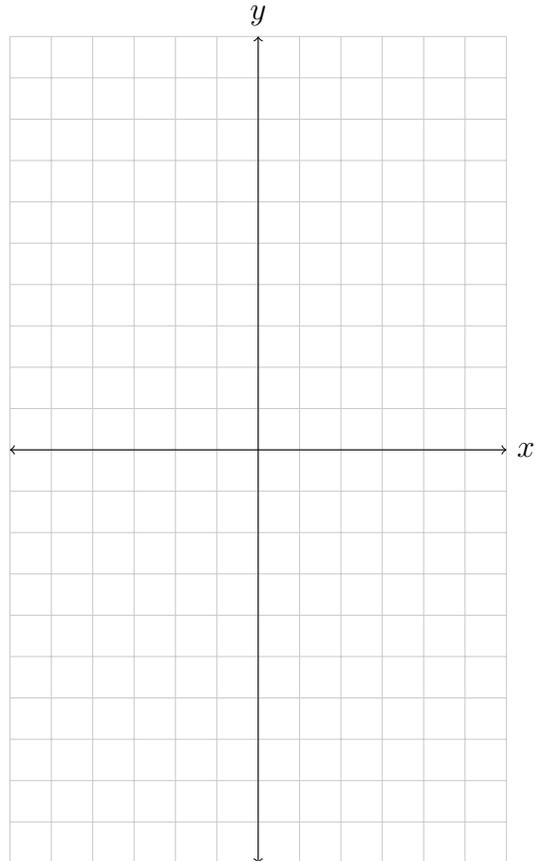
c. What, if any, are the  $x$ -intercepts?

g. State the domain and range of  $y(x)$ .

h. Graph the equation, labeling each of the items found in part a - f.

d. What is the vertex?

e. What is the equation for the axis of symmetry?



3.  $y(x) = -2x^2 + x + 6$

a. Does the graph open up or down?

f. What is the  $y$ -intercept's mirror point or, if there is none, what are 2 other points on the graph?

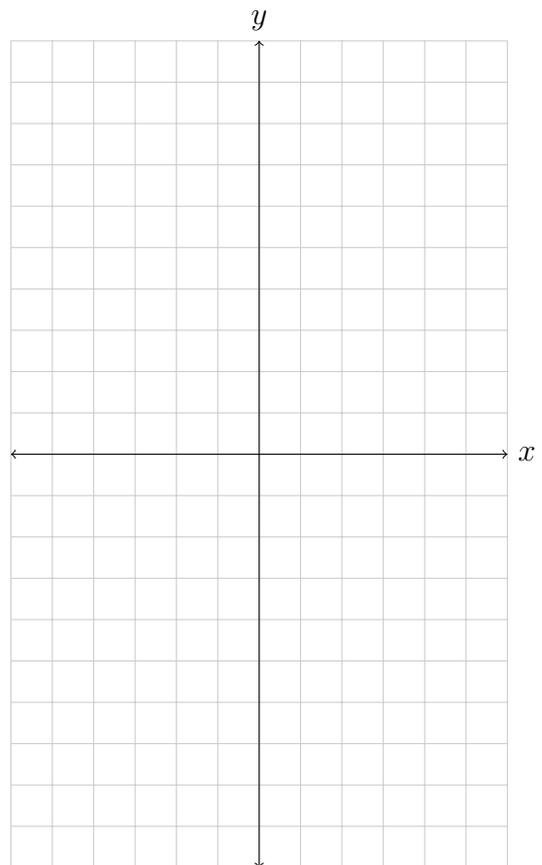
b. What is the  $y$ -intercept?

c. What, if any, are the  $x$ -intercepts?

g. State the domain and range of  $y(x)$ .

h. Graph the equation, labeling each of the items found in part a - f.

d. What is the vertex?



e. What is the equation for the axis of symmetry?

7.  $y(x) = -x^2 + 8x - 12$

a. Does the graph open up or down?

f. What is the  $y$ -intercept's mirror point or, if there is none, what are 2 other points on the graph?

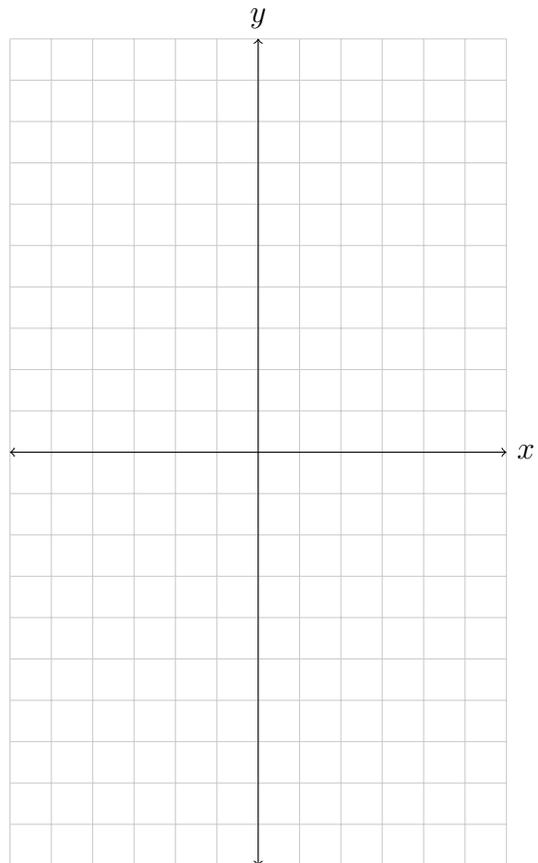
b. What is the  $y$ -intercept?

c. What, if any, are the  $x$ -intercepts?

g. State the domain and range of  $y(x)$ .

h. Graph the equation, labeling each of the items found in part a - f.

d. What is the vertex?



e. What is the equation for the axis of symmetry?

9.  $y(x) = x^2 + 2x - 4$

a. Does the graph open up or down?

f. What is the  $y$ -intercept's mirror point or, if there is none, what are 2 other points on the graph?

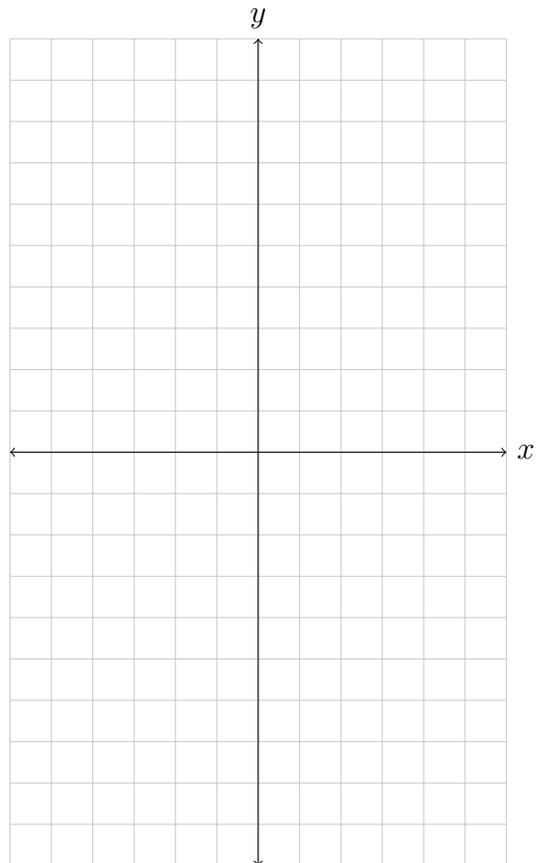
b. What is the  $y$ -intercept?

c. What, if any, are the  $x$ -intercepts?

g. State the domain and range of  $y(x)$ .

h. Graph the equation, labeling each of the items found in part a - f.

d. What is the vertex?



e. What is the equation for the axis of symmetry?

17.  $y(x) = x^2 + 6x$

a. Does the graph open up or down?

f. What is the  $y$ -intercept's mirror point or, if there is none, what are 2 other points on the graph?

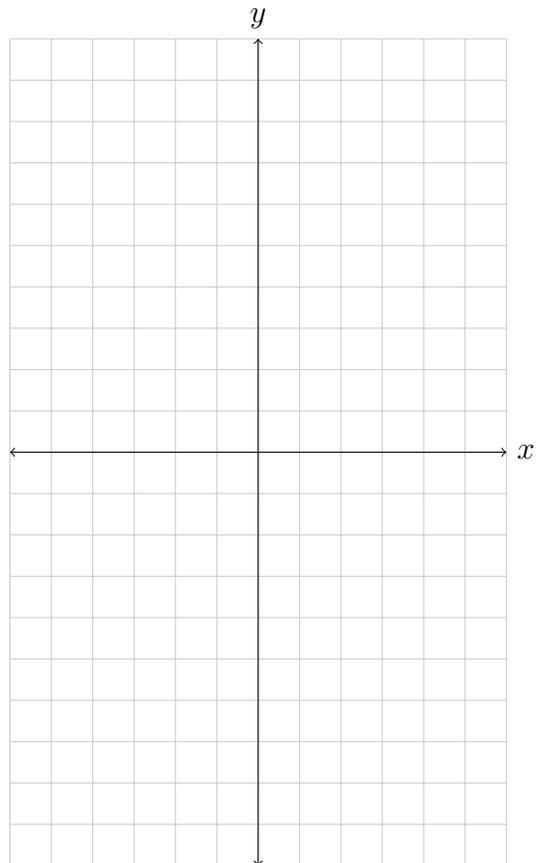
b. What is the  $y$ -intercept?

c. What, if any, are the  $x$ -intercepts?

g. State the domain and range of  $y(x)$ .

h. Graph the equation, labeling each of the items found in part a - f.

d. What is the vertex?



e. What is the equation for the axis of symmetry?

21.  $y(x) = 2x^2 + 4x - 6$

a. Does the graph open up or down?

b. What is the  $y$ -intercept?

c. What, if any, are the  $x$ -intercepts?

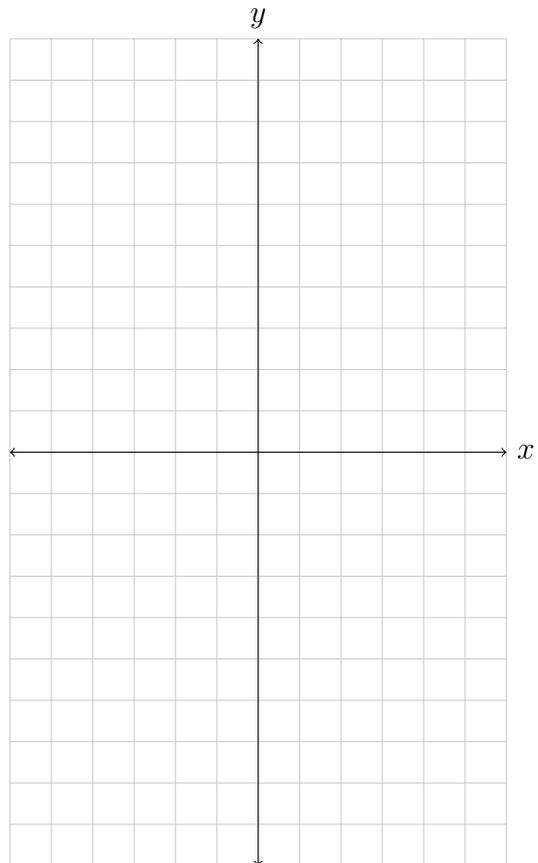
d. What is the vertex?

e. What is the equation for the axis of symmetry?

f. What is the  $y$ -intercept's mirror point or, if there is none, what are 2 other points on the graph?

g. State the domain and range of  $y(x)$ .

h. Graph the equation, labeling each of the items found in part a - f.



25.  $y(x) = x^2 + 8x + 7$

a. Does the graph open up or down?

f. What is the  $y$ -intercept's mirror point or, if there is none, what are 2 other points on the graph?

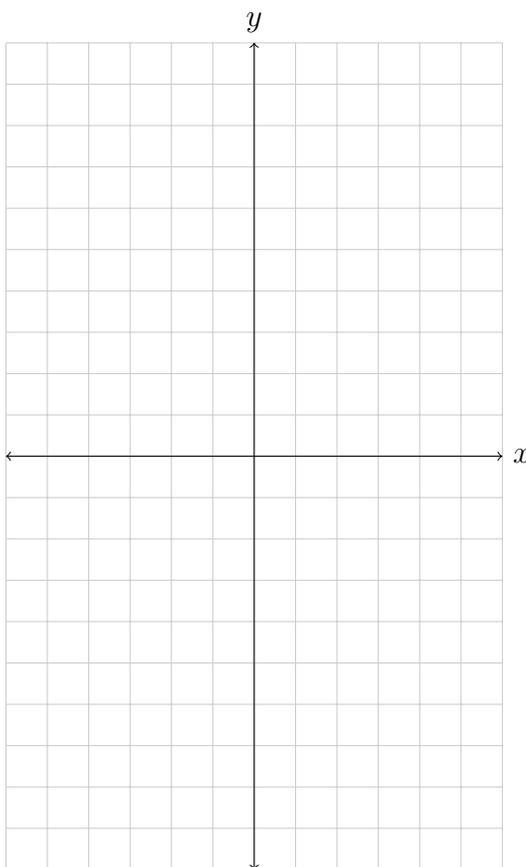
b. What is the  $y$ -intercept?

c. What, if any, are the  $x$ -intercepts?

g. State the domain and range of  $y(x)$ .

h. Graph the equation, labeling each of the items found in part a - f.

d. What is the vertex?



e. What is the equation for the axis of symmetry?

27.  $y(x) = x^2 - 2x - 8$

a. Does the graph open up or down?

f. What is the  $y$ -intercept's mirror point or, if there is none, what are 2 other points on the graph?

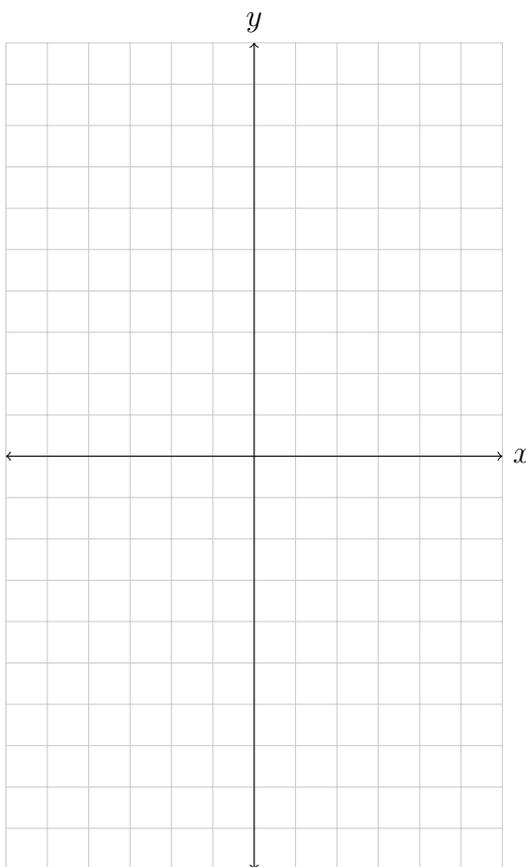
b. What is the  $y$ -intercept?

c. What, if any, are the  $x$ -intercepts?

g. State the domain and range of  $y(x)$ .

h. Graph the equation, labeling each of the items found in part a - f.

d. What is the vertex?



e. What is the equation for the axis of symmetry?

29.  $y(x) = -x^2 + 4x - 3$

a. Does the graph open up or down?

f. What is the  $y$ -intercept's mirror point or, if there is none, what are 2 other points on the graph?

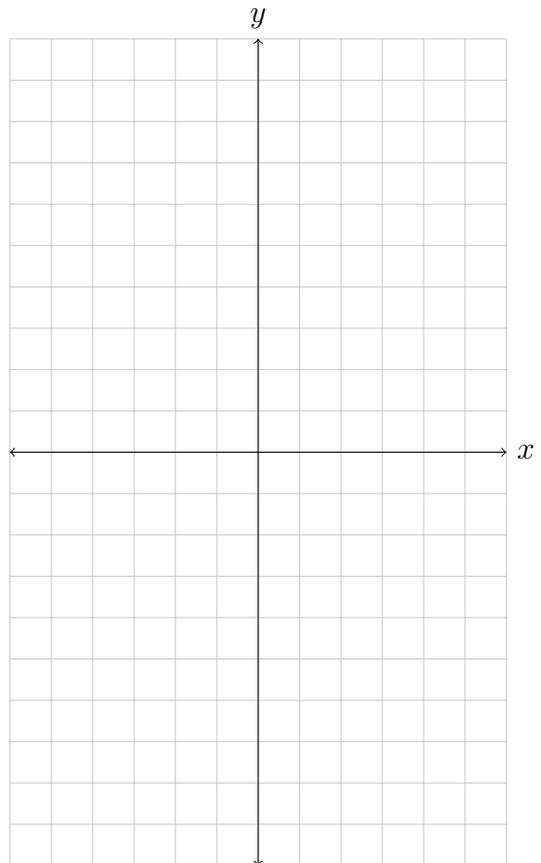
b. What is the  $y$ -intercept?

c. What, if any, are the  $x$ -intercepts?

g. State the domain and range of  $y(x)$ .

h. Graph the equation, labeling each of the items found in part a - f.

d. What is the vertex?



e. What is the equation for the axis of symmetry?

31.  $y(x) = x^2 - 1$

a. Does the graph open up or down?

f. What is the  $y$ -intercept's mirror point or, if there is none, what are 2 other points on the graph?

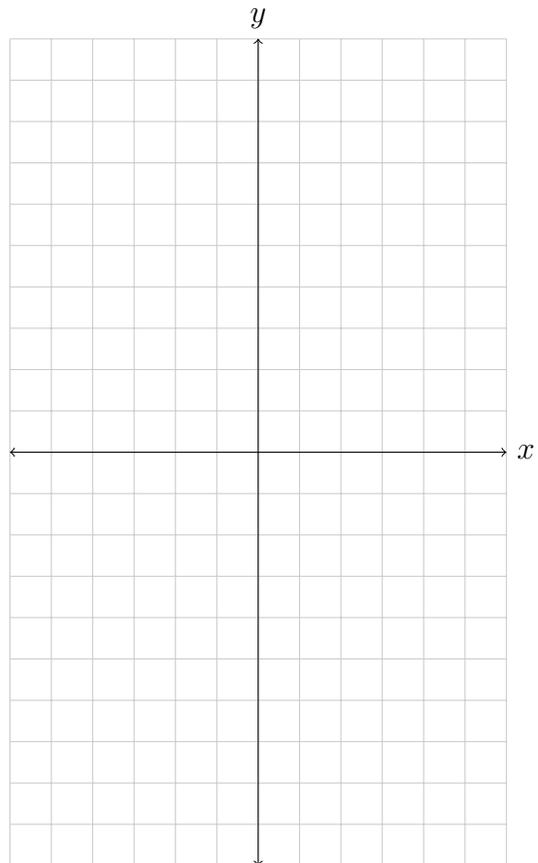
b. What is the  $y$ -intercept?

c. What, if any, are the  $x$ -intercepts?

g. State the domain and range of  $y(x)$ .

h. Graph the equation, labeling each of the items found in part a - f.

d. What is the vertex?



e. What is the equation for the axis of symmetry?

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

a. Does the graph open up or down?

f. What is the  $y$ -intercept's mirror point or, if there is none, what are 2 other points on the graph?

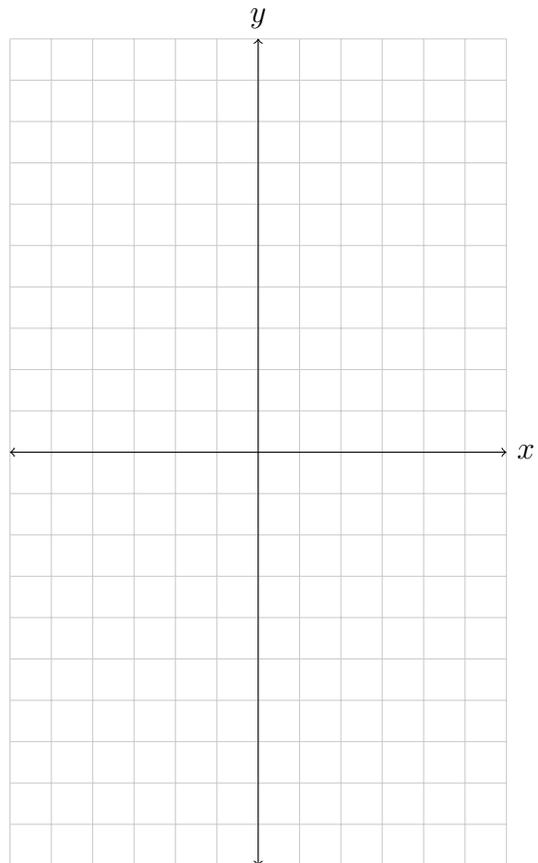
b. What is the  $y$ -intercept?

c. What, if any, are the  $x$ -intercepts?

g. State the domain and range of  $y(x)$ .

h. Graph the equation, labeling each of the items found in part a - f.

d. What is the vertex?



e. What is the equation for the axis of symmetry?

35.  $y(x) = -2x^2 + 4x + 5$

a. Does the graph open up or down?

f. What is the  $y$ -intercept's mirror point or, if there is none, what are 2 other points on the graph?

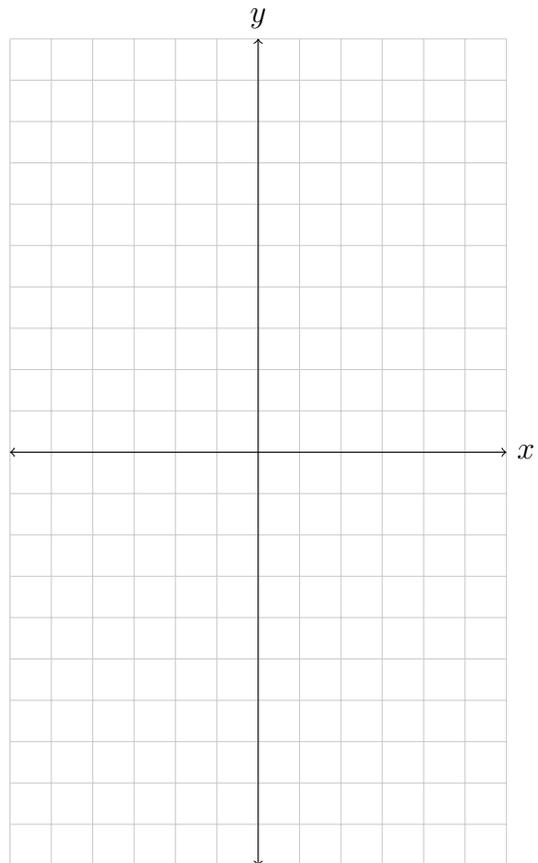
b. What is the  $y$ -intercept?

c. What, if any, are the  $x$ -intercepts?

g. State the domain and range of  $y(x)$ .

h. Graph the equation, labeling each of the items found in part a - f.

d. What is the vertex?



e. What is the equation for the axis of symmetry?



51. The figure shown in the book on page 662 indicates you have 100 yards of fencing to enclose a rectangular area. Find the dimensions of the rectangle that maximize the enclosed area. What is the maximum area? Copy the picture from the book.

**Supplemental Questions:**

**The ANSWERS to these questions are at the end of this homework sheet.**

- S1. If the graph of a function is symmetric about the line  $x = 5$  and the point  $(1, -9)$  is on the graph, what other point must be on the graph? Explain your reasoning.
- S2. If the graph of a quadratic function has the points  $(-3,6)$  and  $(7,6)$  on it, what is the  $x$ -value of the vertex? Explain your reasoning.

S3. During an infrequent rainstorm, the L.A. River collects all the runoff rainwater from the storm and channels it out to sea. The depth of water in the L.A. River,  $D$ , in feet, is a function of time  $t$ , in hours since the storm ended. The function is given by  $D(t) = -t^2 + 2t + 8$ .

a. Evaluate and interpret  $D(3)$ .

c. Find and interpret the  $t$ -intercepts.

b. Find and interpret the  $y$ -intercept.

d. At what time will the water be deepest?  
What is that maximum depth?

S4. A trebuchet is a French catapult originally used to launch large projectiles long distances. North of England a man named Hew Kennedy built a full size one to hurl random objects. Seriously, look it up online after you finish this homework. It's pretty fantastic. Suppose that the height of a piano off the ground,  $h$ , in feet, is a function of the horizontal distance along the ground in the direction it is thrown,  $x$ , also in feet. Given that  $h = f(x) = -0.002x^2 + .6x + 60$ , answer the following questions.

a. Find the vertex. Explain what the vertex means in context of the situation.

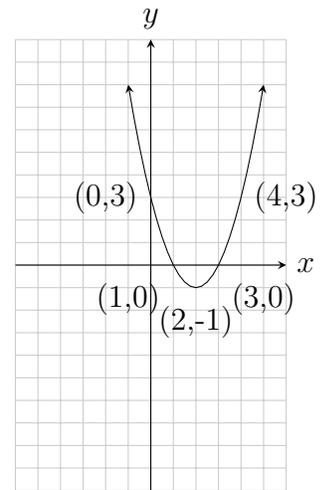
b. If I want to crush a Volkswagen bug with the piano, how far from the trebuchet should I park it?

### Solutions to Practice Exercises:

1. a. The graph opens up.  
 b. The  $y$ -intercept is  $(0,3)$ .  
 c. The  $x$ -intercepts are  $(3,0)$  and  $(1,0)$ .  
 d. The vertex is  $(2,-1)$ .

- e. The axis of symmetry is given by  $x = 2$ .  
 f. The  $y$ -intercept's mirror point is  $(4,3)$ .  
 g. The domain is  $D = \mathbb{R}$  and the range is  $R = [-1, \infty)$ .

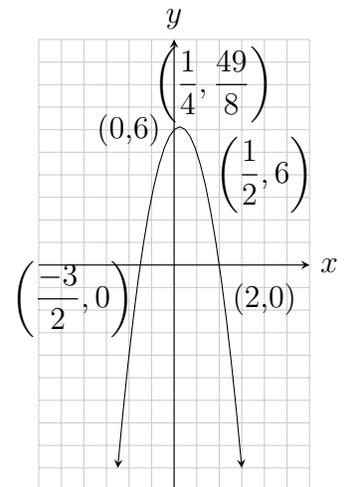
- h. The graph of  $y(x)$  is:



3. a. The graph opens down.  
 b. The  $y$ -intercept is  $(0,6)$ .  
 c. The  $x$ -intercepts are  $(\frac{-3}{2}, 0)$  and  $(2,0)$ .  
 d. The vertex is  $(\frac{1}{4}, \frac{49}{8})$ .

- e. The axis of symmetry is given by  $x = \frac{1}{4}$ .  
 f. The  $y$ -intercept's mirror point is  $(\frac{1}{2}, 6)$ .  
 g. The domain is  $D = \mathbb{R}$  and the range is  $R = (-\infty, \frac{49}{8}]$ .

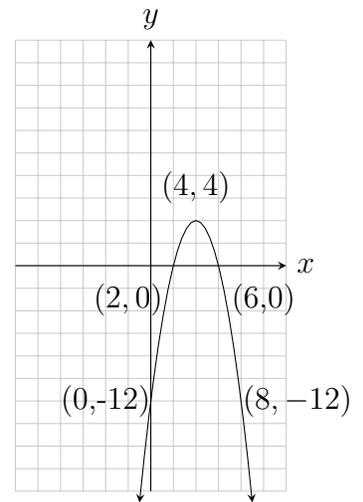
- h. The graph of  $y(x)$  is:



7. a. The graph opens down.  
 b. The  $y$ -intercept is  $(0,-12)$ .  
 c. The  $x$ -intercepts are  $(2,0)$  and  $(6,0)$ .  
 d. The vertex is  $(4,4)$ .

- e. The axis of symmetry is given by  $x = 4$ .  
 f. The  $y$ -intercept's mirror point is  $(8,-12)$ .  
 g. The domain is  $D = \mathbb{R}$  and the range is  $R = (-\infty, 4]$ .

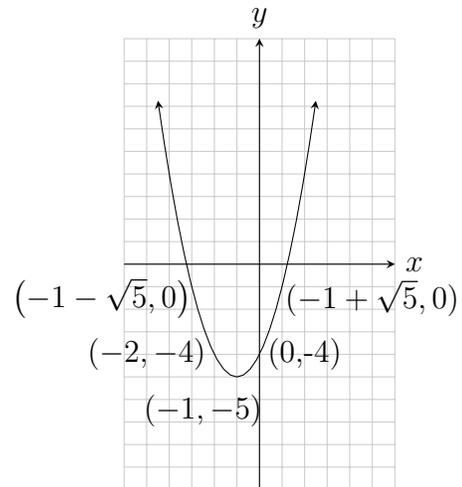
- h. The graph of  $y(x)$  is:



9. a. The graph opens up.  
 b. The  $y$ -intercept is  $(0,-4)$ .  
 c. The  $x$ -intercepts are  $(-1 + \sqrt{5}, 0)$  and  $(-1 - \sqrt{5}, 0)$ .  
 d. The vertex is  $(-1, -5)$ .

- e. The axis of symmetry is given by  $x = -1$ .  
 f. The  $y$ -intercept's mirror point is  $(-2, -4)$ .  
 g. The domain is  $D = \mathbb{R}$  and the range is  $R = [-5, \infty)$ .

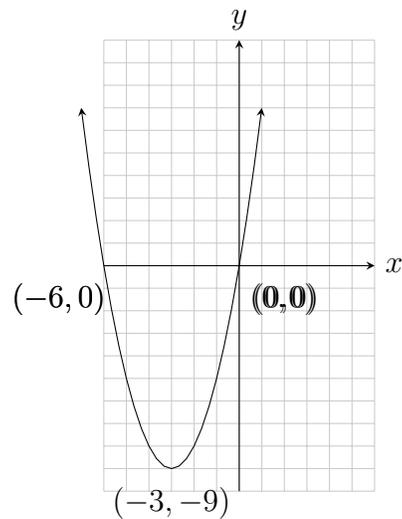
- h. The graph of  $y(x)$  is:



17. a. The graph opens up.  
 b. The  $y$ -intercept is  $(0,0)$ .  
 c. The  $x$ -intercepts are  $(0,0)$  and  $(-6,0)$ .  
 d. The vertex is  $(-3,-9)$ .

- e. The axis of symmetry is given by  $x = -3$ .  
 f. The  $y$ -intercept's mirror point is  $(-6,0)$ .  
 g. The domain is  $D = \mathbb{R}$  and the range is  $R = [-9, \infty)$ .

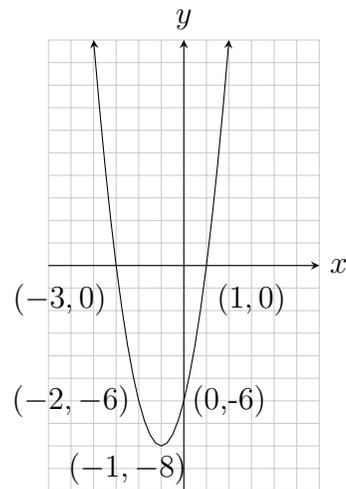
- h. The graph of  $y(x)$  is:



21. a. The graph opens up.  
 b. The  $y$ -intercept is  $(0,-6)$ .  
 c. The  $x$ -intercepts are  $(1,0)$  and  $(-3,0)$ .  
 d. The vertex is  $(-1,-8)$ .

- e. The axis of symmetry is given by  $x = -1$ .  
 f. The  $y$ -intercept's mirror point is  $(-2,-6)$ .  
 g. The domain is  $D = \mathbb{R}$  and the range is  $R = [-8, \infty)$ .

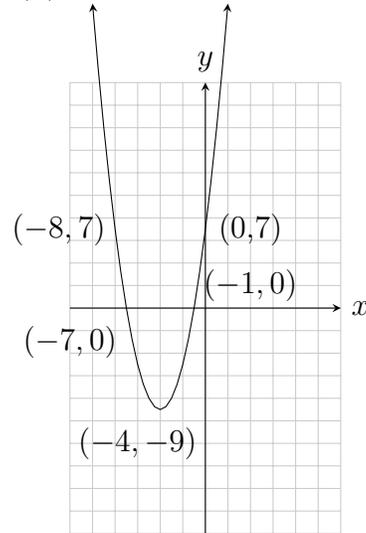
- h. The graph of  $y(x)$  is:



25. a. The graph opens up.
- b. The  $y$ -intercept is  $(0,7)$ .
- c. The  $x$ -intercepts are  $(-7,0)$  and  $(-1,0)$ .
- d. The vertex is  $(-4,-9)$ .

- e. The axis of symmetry is given by  $x = -4$ .
- f. The  $y$ -intercept's mirror point is  $(-8,7)$ .
- g. The domain is  $D = \mathbb{R}$  and the range is  $R = [-9, \infty)$ .

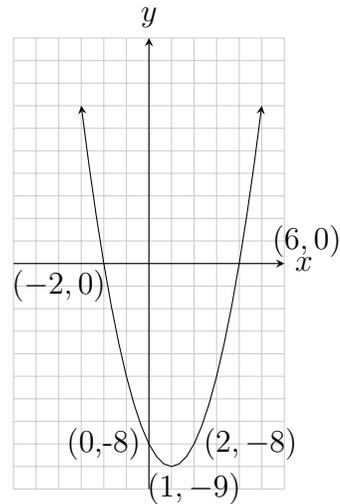
- h. The graph of  $y(x)$  is:



27. a. The graph opens up.
- b. The  $y$ -intercept is  $(0,-8)$ .
- c. The  $x$ -intercepts are  $(4,0)$  and  $(-2,0)$ .
- d. The vertex is  $(1,-9)$ .

- e. The axis of symmetry is given by  $x = 1$ .
- f. The  $y$ -intercept's mirror point is  $(2,-8)$ .
- g. The domain is  $D = \mathbb{R}$  and the range is  $R = [-9, \infty)$ .

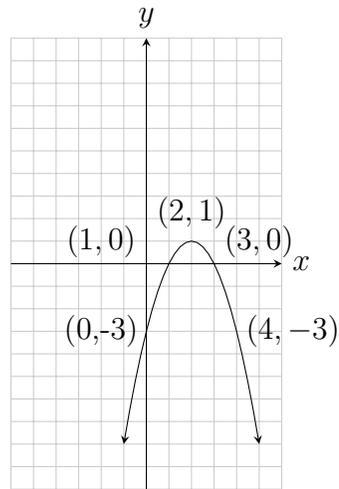
- h. The graph of  $y(x)$  is:



29. a. The graph opens down.  
 b. The  $y$ -intercept is  $(0,-3)$ .  
 c. The  $x$ -intercepts are  $(1,0)$  and  $(3,0)$ .  
 d. The vertex is  $(2,1)$ .

- e. The axis of symmetry is given by  $x = 2$ .  
 f. The  $y$ -intercept's mirror point is  $(4,-3)$ .  
 g. The domain is  $D = \mathbb{R}$  and the range is  $R = (-\infty, 1]$ .

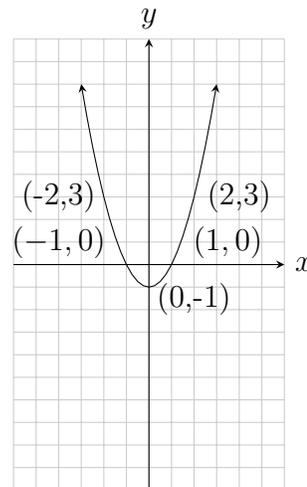
- h. The graph of  $y(x)$  is:



31. a. The graph opens up.  
 b. The  $y$ -intercept is  $(0,-1)$ .  
 c. The  $x$ -intercepts are  $(1,0)$  and  $(-1,0)$ .  
 d. The vertex is  $(0,-1)$ .

- e. The axis of symmetry is given by  $x = 0$ .  
 f. The  $y$ -intercept's mirror point is itself. Two other points on the graph are  $(2,3)$  and  $(-2,3)$ .  
 g. The domain is  $D = \mathbb{R}$  and the range is  $R = [-1, \infty)$ .

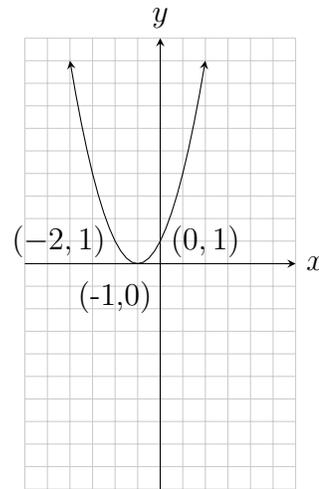
- h. The graph of  $y(x)$  is:



33. a. The graph opens up.
- b. The  $y$ -intercept is  $(0,1)$ .
- c. The  $x$ -intercept is  $(-1,0)$ .
- d. The vertex is  $(-1,0)$ .

- e. The axis of symmetry is given by  $x = -1$ .
- f. The  $y$ -intercept's mirror point is  $(-2,1)$ .
- g. The domain is  $D = \mathbb{R}$  and the range is  $R = [0, \infty)$ .

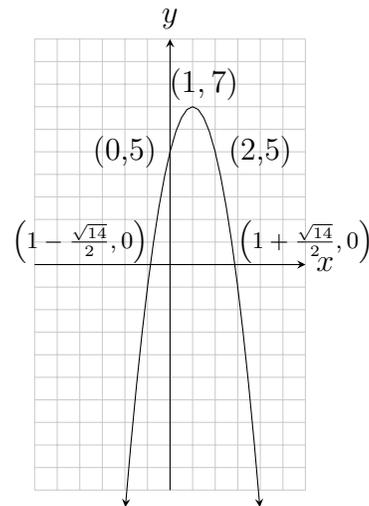
- h. The graph of  $y(x)$  is:



35. a. The graph opens down.
- b. The  $y$ -intercept is  $(0,5)$ .
- c. The  $x$ -intercepts are  $\left(1 - \frac{\sqrt{14}}{2}, 0\right)$  and  $\left(1 + \frac{\sqrt{14}}{2}, 0\right)$ .
- d. The vertex is  $(1,7)$ .

- e. The axis of symmetry is given by  $x = 1$ .
- f. The  $y$ -intercept's mirror point is  $(2,5)$ .
- g. The domain is  $D = \mathbb{R}$  and the range is  $R = (-\infty, 7]$ .

- h. The graph of  $y(x)$  is:



S1. The point  $(9, -9)$  must be on the graph. Explanation: The point  $(1, -9)$  is 4 units to the left of the axis of symmetry. Since the parabola is symmetric about its axis of symmetry  $x = 5$ , the point that corresponds to  $(1, -9)$  will be 4 units to the right of the axis of symmetry and have the same  $y$ -coordinate.

S2. The  $x$ -value of the vertex is 2. Explanation: The given points  $(-3, 6)$  and  $(7, 6)$  both have the same  $y$ -coordinate. This means that the axis of symmetry lies halfway between the two given points. Since 2 is halfway between the  $x$ -values of the two given points, the axis of symmetry must be  $x = 2$  and the  $x$ -coordinate of the vertex is 2 since the vertex is on the axis of symmetry.

S3. For  $D(t) = -t^2 + 2t + 8$ :

- a.  $D(3) = 5$  Represents that 3 hours after the storm ends the L.A. River is 5 feet deep.
- b. The  $y$ -intercept is  $(0, 8)$  meaning that at the end of the storm the river is 8 feet deep.
- c. The  $t$ -intercepts are  $(-2, 0)$  and  $(4, 0)$ . These represent that 2 hours before the storm ends and 4 hours after it ends the river is at 0 feet in depth.
- d. We find the maximum of  $D(t)$  which occurs at the vertex  $(1, 9)$  meaning the water reaches a maximum depth of 9 feet 1 hour after the storm ends.

S4. For  $f(x) = -0.002x^2 + .6x + 60$ :

- a. The vertex is  $(150, 105)$ . This represents the maximum height which the piano will reach of 105 feet and telling that it occurs 150 feet horizontally from the launch point.
- b. If you want to crush a Volkswagen with the piano you should park it about 379.13 feet in front of the trebuchet.