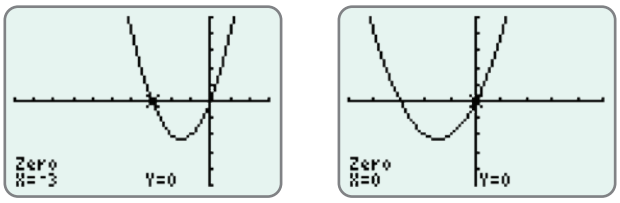
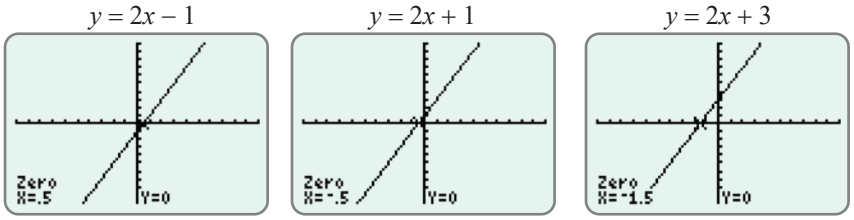
**Note**

The standard window shows 96 pixels across the window and 64 pixels up and down the window. This gives a ratio of 3 to 2 and can give a slightly distorted view of the actual graph because the vertical pixels are squeezed into a smaller space. For Example 9c, the graphs of all three functions are in the standard window. Experiment by changing the window to a square window, say –9 to 9 for $x$ and –6 to 6 for $y$. Then graph the functions and notice the slight differences (and better representation) in the appearances on the display.

**b.** Since the graph of this function has two $x$-intercepts, we have shown the graph twice. Each graph shows the coordinates of a distinct $x$-intercept.




**c.**




***Now work margin exercise 9.***

***Margin Exercise Answers***

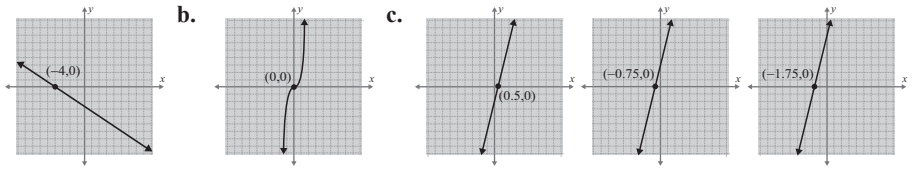
**1. a.** $D=\{4,7,3\}$; $R=\{5,3,6\}$ **b.** $D=\{-2,-4,0\}$; $R=\{3,-3,0\}$ **2. a.** $D=[-5,6]$; $R=[-5,5]$ **b.** $D=(-\infty,3]$; $R=(-\infty,\infty)$

**3. a.** not a function **b.** function **4. a.** not a function; $D=\{-7,-3,0,2,4,5\}$; $R=\{-2,0,2,3,6\}$

**b.** function; $D=(-\infty,\infty)$; $R=[-2,\infty)$ **c.** not a function; $D=[-5,7]$; $R=[-1,5]$ **5.** $D=(-\infty,-3)\cup(-3,\infty)$ or $x\neq -3$

**6. a.** $g(3)=7$ **b.** $g(-2)=-8$ **c.** $g(0)=-2$ **7. a.** $f(1)=4$ **b.** $f(0)=5$ **c.** $f(-3)=-16$ **8. a.** $f(4)=-5$ **b.** $f(-4)=-2$ **c.** $f(-2)=-1$

**9. a.** **b.** **c.**




# 3.5 Exercises

## Concept Check

**Fill-in-the-Blank.** Complete each sentence using information found in this section.

1. The equation $y=mx+b$ represents a linear function and $f(x)=mx+b$ is the same equation written in _____ notation.

2. The _____ line test can be used to determine if a relation is a function.

3. The set of all first coordinates in a relation is the _____, $D$.

4. The set of all second coordinates in a relation is the _____, $R$.

5. In the graph of a relation, the $x$-axis is called the _____ axis.

6. In the graph of a relation, the $y$-axis is called the _____ axis.

**True/False.** Determine whether each statement is true or false. If a statement is false, explain how it can be changed so the statement will be true. (**Note:** There may be more than one acceptable change.)

7. If the domain of a linear function is not explicitly stated, the implied domain is the set of all values of $x$ that produce real values for $y$.

8. A relation is a function in which each domain element has exactly one corresponding range element.

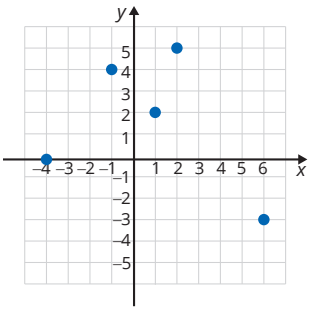
9. In a function, the range elements can have more than one corresponding domain element.

10. If $s = \{(1, -6), (3, 5), (4, 0), (1, 2)\}$, then $s$ is a function.

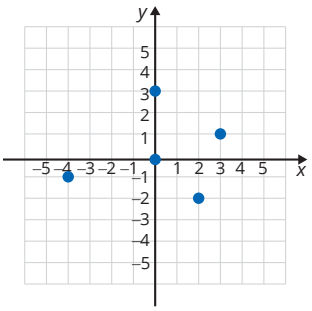
## Practice

List the sets of ordered pairs that correspond to the points. State the domain and range and indicate which of the relations are also functions. See Examples 1 through 3.

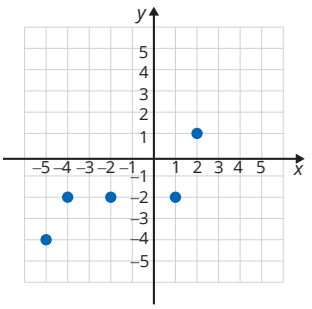
1.



2.



3.



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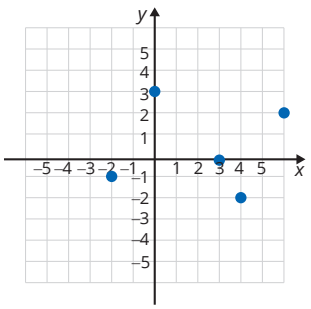
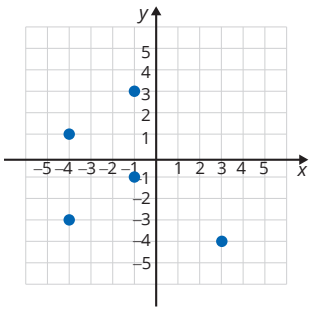
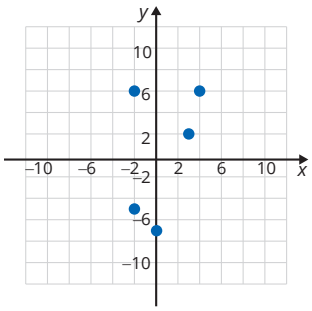


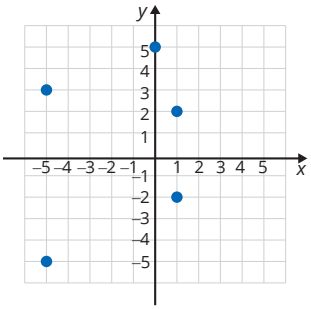
5.



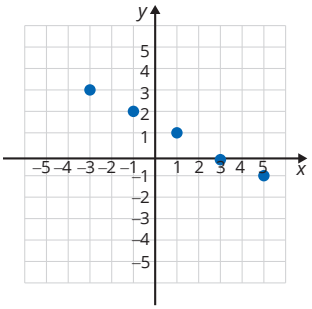
6.



**7.**



**8.**



Graph the relations. State the domain and range and indicate which of the relations are functions. See Examples 1 through 3.

**9.** $f = \{(0, 0), (1, 6), (4, -2), (-3, 5), (2, -1)\}$

**10.** $h = \{(1, -5), (2, -3), (-1, -3), (0, 2), (4, 3)\}$

**11.** $g = \{(-4, 4), (-3, 4), (1, 4), (2, 4), (3, 4)\}$

**12.** $f = \{(-3, -3), (0, 1), (-2, 1), (3, 1), (5, 1)\}$

**13.** $s = \{(0, 2), (-1, 1), (2, 4), (3, 5), (-3, 5)\}$

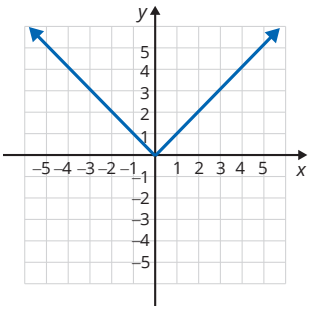
**14.** $t = \{(-1, -4), (0, -3), (2, -1), (4, 1), (1, 1)\}$

**15.** $f = \{(-1, 4), (-1, 2), (-1, 0), (-1, 6), (-1, -2)\}$

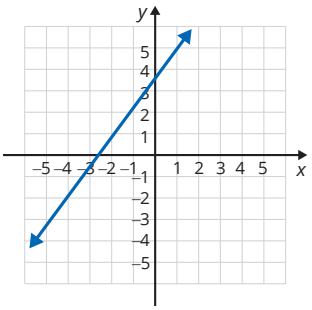
**16.** $g = \{(0, 0), (-2, -5), (2, 0), (4, -6), (5, 2)\}$

Use the vertical line test to determine whether or not each graph represents a function. State the domain and range using interval notation. See Example 4.

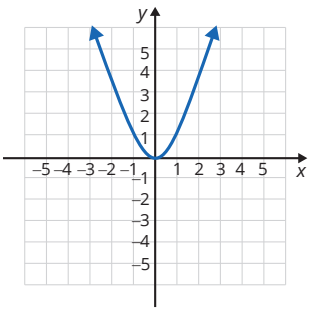
**17.**



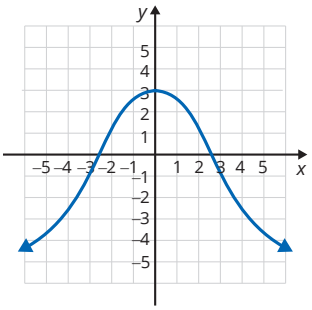
**19.**



**18.**



**20.**



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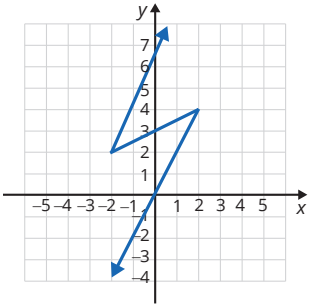
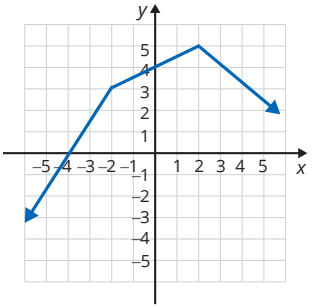
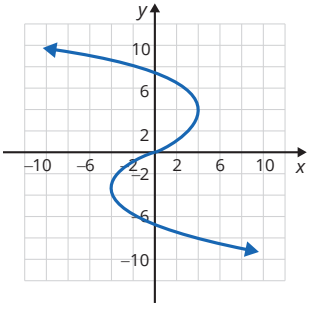


**22.**



**23.**



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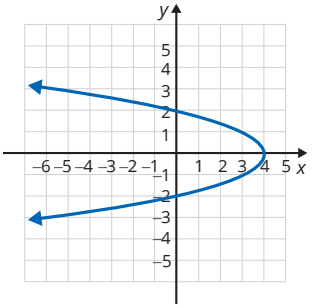
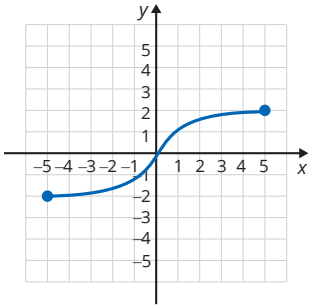
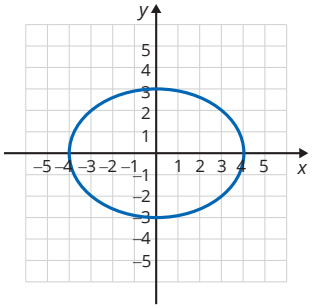


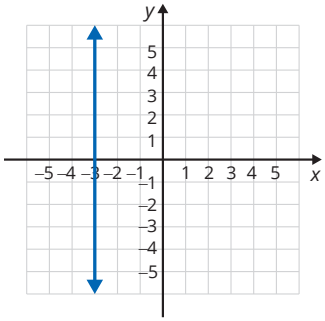
**25.**



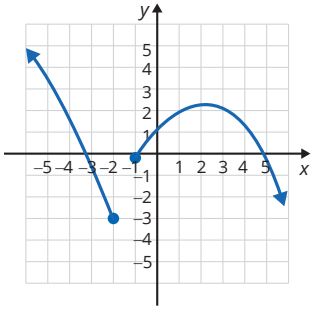
**26.**



**27.**



**28.**



Express the function as a set of ordered pairs for the given equation and given domain. (**Hint:** Substitute each domain element for $x$ and find the corresponding $y$-coordinate.)

**29.** $y = 3x + 1;\ D = \left\{-9, -\frac{1}{3}, 0, \frac{4}{3}, 2\right\}$

**30.** $y = -\frac{3}{4}x + 2;\ D = \{-4, -2, 0, 3, 4\}$

**31.** $y = 1 - 3x^2;\ D = \{-2, -1, 0, 1, 2\}$

**32.** $y = x^3 - 4x;\ D = \left\{-1, 0, \frac{1}{2}, 1, 2\right\}$

State the domains of the functions. See Example 5.

**33.** $y = -5x + 10$

**34.** $2x + y = 14$

**35.** $g(x) = \frac{8}{x}$

**36.** $h(x) = \frac{7}{3x}$

**37.** $y = \dfrac{13x^2 - 5x + 8}{x - 3}$

**38.** $f(x) = \dfrac{35}{x - 6}$

Find the values of the functions as indicated. See Examples 6 and 7.

**39.** $f(x) = 3x - 10$

**a.** $f(2)$

**b.** $f(-2)$

**c.** $f(0)$

**40.** $g(x) = -4x + 7$

**a.** $g(-3)$

**b.** $g(6)$

**c.** $g(0)$

**41.** $G(x) = x^2 + 5x + 6$

**a.** $G(-2)$

**b.** $G(1)$

**c.** $G(5)$

**42.** $F(x) = 6x^2 - 10$

**a.** $F(0)$

**b.** $F(-4)$

**c.** $F(4)$

**43.** $h(x) = x^3 - 8x$

**a.** $h(-3)$

**b.** $h(0)$

**c.** $h(3)$

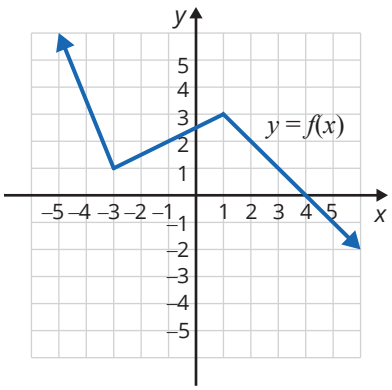
**44.** $P(x) = x^2 + 4x + 4$

**a.** $P(-2)$

**b.** $P(10)$

**c.** $P(-5)$

Using the graph of $f(x)$, find each value. See Example 8.




**45.** $f(1)$

**46.** $f(-3)$

**47.** $f(4)$

**48.** $f(-1)$

Use a graphing calculator to graph the functions. Use the CALC features to find *x*-intercepts, if any. (The value of *y* will be 0 at those points.) For absolute value functions, select the MATH menu, then the NUM menu, and then abs( . Remember to press ) after entering the absolute value. See Example 9.

**49.** $y = 6$

**50.** $y = 4x$

**51.** $y = x + 5$

**52.** $y = -2x + 3$

**53.** $y = x^2 - 4x$

**54.** $y = 1 + 2x - x^2$

**55.** $y = -|3x|$

**56.** $y = |x + 2|$

**57.** $y = |x^2 - 3x|$

**58.** $y = 2x^3 - 5x^2 + 1$

**59.** $y = -x^3 + 3x - 1$

**60.** $y = x^4 - 10x^2 + 9$

Use the CALC features of the calculator to find the coordinates of any points of intersection of the graphs. (**Hint:** The `intersect` item on the CALC menu will help in finding the point (or points) of intersection of two functions, if there is one.) In the Y = menu use both Y1 = and Y2 = to be able to graph both functions at the same time.

**61.** $y = 3x + 2$
$y = 4 - x$

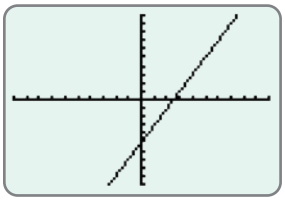
**62.** $y = 2 - x$
$y = x$

**63.** $y = 2x - 1$
$y = x^2$

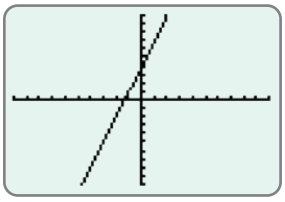
**64.** $y = x + 3$
$y = -x^2 + x + 7$

The calculator display shows an incorrect graph for the corresponding equation. Explain how you know, by just looking at the graph, that a mistake has been made.

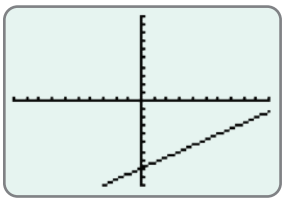
**65.** $y = 2x + 5$



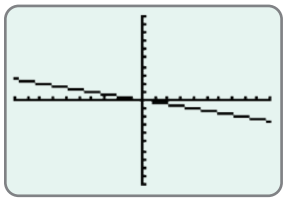
**66.** $y = -3x + 4$



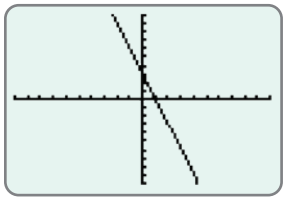
**67.** $y = \frac{2}{3}x - 2$



**68.** $y = -4x$



**69.** $y = -\frac{1}{3}x$



## Applications

Solve.

**70.** A nurse hangs a 1000-milliliter IV bag that is set to drip at 120 milliliters per hour. Create a model of this situation to represent the amount of IV solution left in the bag after $x$ hours.

- **a.** The $y$-intercept is the amount of IV solution in the bag initially (time = 0). What is the $y$-intercept?
- **b.** The slope is equal to the rate that the IV solution is dispensed per hour. What is the slope? (**Hint:** Consider whether the amount of IV solution in the bag is increasing or decreasing and how this would affect the slope.)
- **c.** Write an equation in slope-intercept form to model this situation.
- **d.** Write the equation from part c. using function notation.
- **e.** State the domain and range of the function.
- **f.** State any additional restrictions that should be made on the domain for it to make sense in the context of this problem.
- **g.** How much IV solution is left in the bag after 5 hours?

**71.** Ariella is a full-time sales associate at a clothing store. She earns a weekly salary of $250 and earns 15% commission on all of her sales. Create a model of this situation to represent the amount of money Ariella makes after $x$ dollars in sales.

- **a.** What is the $y$-intercept and what does the $y$-coordinate of the $y$-intercept represent?
- **b.** What is the slope and what does this value represent?
- **c.** Write an equation in slope-intercept form to model this situation using the answers from parts a. and b.
- **d.** Write the equation from part c. using function notation.
- **e.** State the domain and range of the function.
- **f.** State any additional restrictions that should be made on the domain for it to make sense in the context of this problem.
- **g.** How much will Ariella make if she sells $5000 worth of merchandise?

## Writing & Thinking

**72.** Enter a variety of functions in your calculator, investigate your findings, and report these to your class. Certainly, interesting discussions will follow!