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3.4 Graphing Linear Equations in Standard Form
For use with Exploration 3.4

Essential Question   How can you describe the graph of the equation
$Ax + By = C$?

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1   EXPLORATION: Using a Table to Plot Points

Go to *BigIdeasMath.com* for an interactive tool to investigate this exploration.

Work with a partner. You sold a total of $16 worth of tickets to a fundraiser. You lost track of how many of each type of ticket you sold. Adult tickets are $4 each. Child tickets are $2 each.

$$\frac{\boxed{}}{\text{adult}} \cdot \frac{\text{Number of}}{\text{adult tickets}} + \frac{\boxed{}}{\text{child}} \cdot \frac{\text{Number of}}{\text{child tickets}} = \boxed{}$$

a. Let x represent the number of adult tickets. Let y represent the number of child tickets. Use the verbal model to write an equation that relates x and y.

b. Complete the table to show the different combinations of tickets you might have sold.

x					
y					

c. Plot the points from the table. Describe the pattern formed by the points.
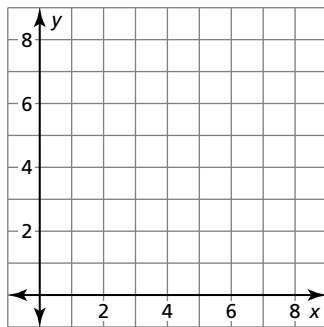
d. If you remember how many adult tickets you sold, can you determine how many child tickets you sold? Explain your reasoning.

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2 **EXPLORATION:** Rewriting and Graphing an Equation

Go to *BigIdeasMath.com* for an interactive tool to investigate this exploration.

Work with a partner. You sold a total of $48 worth of cheese. You forgot how many pounds of each type of cheese you sold. Swiss cheese costs $8 per pound. Cheddar cheese costs $6 per pound.

$$\frac{\boxed{}}{\text{pound}} \cdot \frac{\text{Pounds of}}{\text{Swiss}} + \frac{\boxed{}}{\text{pound}} \cdot \frac{\text{Pounds of}}{\text{cheddar}} = \boxed{}$$

a. Let x represent the number of pounds of Swiss cheese. Let y represent the number of pounds of cheddar cheese. Use the verbal model to write an equation that relates x and y.

b. Solve the equation for y. Then use a graphing calculator to graph the equation. Given the real-life context of the problem, find the domain and range of the function.

c. The **x-intercept** of a graph is the x-coordinate of a point where the graph crosses the x-axis. The **y-intercept** of a graph is the y-coordinate of a point where the graph crosses the y-axis. Use the graph to determine the x- and y-intercepts.

d. How could you use the equation you found in part (a) to determine the x- and y-intercepts? Explain your reasoning.

e. Explain the meaning of the intercepts in the context of the problem.
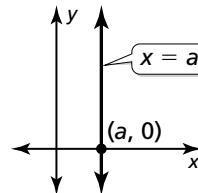
Communicate Your Answer

3. How can you describe the graph of the equation $Ax + By = C$?

4. Write a real-life problem that is similar to those shown in Explorations 1 and 2.

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Core Concepts

Horizontal and Vertical Lines
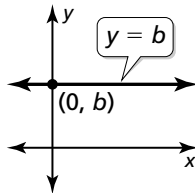
The graph of $y = b$ is a horizontal line.
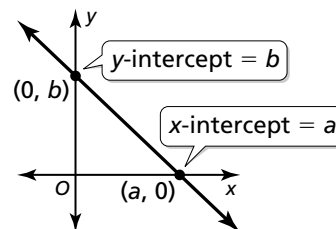The line passes through the point $(0, b)$.

The graph of $x = a$ is a vertical line.
The line passes through the point $(a, 0)$.

Notes:

Using Intercepts to Graph Equations

The **x-intercept** of a graph is the *x*-coordinate of a point where the graph crosses the *x*-axis. It occurs when $y = 0$.

The **y-intercept** of a graph is the *y*-coordinate of a point where the graph crosses the *y*-axis. It occurs when $x = 0$.

To graph the linear equation $Ax + By = C$, find the intercepts and draw the line that passes through the two intercepts.

- To find the *x*-intercept, let $y = 0$ and solve for *x*.

- To find the *y*-intercept, let $x = 0$ and solve for *y*.

Notes:

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Worked-Out Examples

Example #1

Find the x- and y-intercepts of the graph of the linear equation.

$-4x + 8y = -16$

$$-4x + 8y = -16 \qquad\qquad -4x + 8y = -16$$
$$-4x + 8(0) = -16 \qquad\qquad -4(0) + 8y = -16$$
$$-4x = -16 \qquad\qquad\qquad 8y = -16$$
$$\frac{-4x}{-4} = \frac{-16}{-4} \qquad\qquad\qquad \frac{8y}{8} = \frac{-16}{8}$$
$$x = 4 \qquad\qquad\qquad\qquad y = -2$$

The *x*-intercept is 4.   The *y*-intercept is -2.

Example #2

Use intercepts to graph the linear equation. Label the points corresponding to the intercepts.
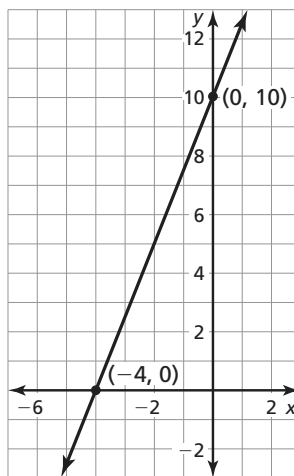
$$-\frac{5}{2}x + y = 10$$

$$-\frac{5}{2}x + y = 10 \qquad\qquad -\frac{5}{2}x + y = 10$$

$$-\frac{5}{2}x + 0 = 10 \qquad\qquad -\frac{5}{2}(0) + y = 10$$
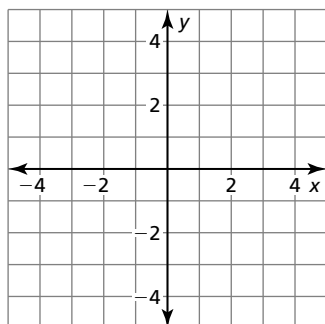
$$-\frac{5}{2}x = 10 \qquad\qquad\qquad y = 10$$

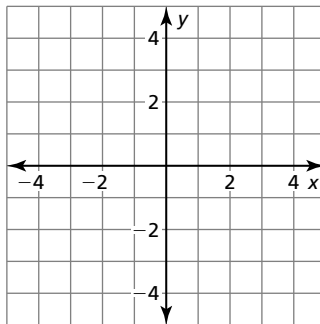$$-\frac{2}{5}\cdot\left(-\frac{5}{2}x\right) = -\frac{2}{5}\cdot 10$$

$$x = -4$$

Practice A

In Exercises 1 and 2, graph the linear equation.

1. $y = -3$

2. $x = 2$

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3.4 **Practice** (continued)

In Exercises 3–5, find the *x*- and *y*-intercepts of the graph of the linear equation.
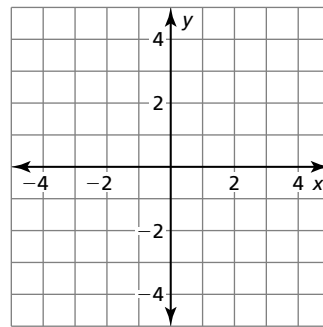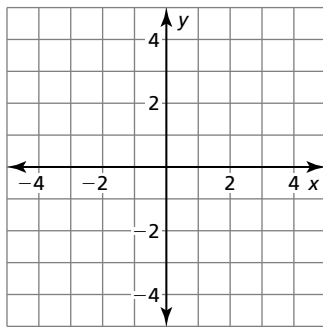
3. $3x + 4y = 12$ **4.** $-x - 4y = 16$ **5.** $5x - 2y = -30$

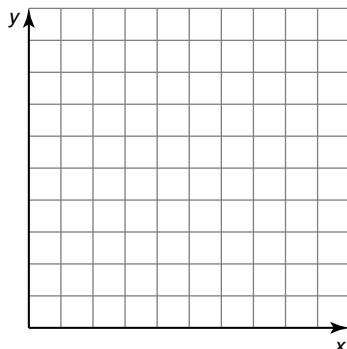**In Exercises 6 and 7, use intercepts to graph the linear equation. Label the points corresponding to the intercepts.**

6. $-8x + 12y = 24$ **7.** $2x + y = 4$

8. The school band is selling sweatshirts and baseball caps to raise $9000 to attend a band competition. Sweatshirts cost $25 each and baseball caps cost $10 each. The equation $25x + 10y = 9000$ models this situation, where x is the number of sweatshirts sold and y is the number of baseball caps sold.

a. Find and interpret the intercepts.

b. If 258 sweatshirts are sold, how many baseball caps are sold?

c. Graph the equation. Find two more possible solutions in the context of the problem.

Practice B

In Exercises 1–3, graph the linear equation.

1. $y = 1$ **2.** $x = -2$ **3.** $y = 0$

In Exercises 4–7, find the *x*- and *y*-intercepts of the graph of the linear equation.

4. $-5x + 7y = -35$ **5.** $-6x - 9y = 54$

6. $4x - 3y = 1$ **7.** $x - 5y = 2$

In Exercises 8–13, use intercepts to graph the linear equation. Label the points corresponding to the intercepts.

8. $-6x + 3y = -18$ **9.** $-3x + 8y = -24$

10. $-x + 4y = 9$ **11.** $2x - y = 3$

12. $-\frac{1}{3}x + y = -3$ **13.** $-\frac{3}{2}x + y = 15$

14. Your club is ordering enrollment gifts engraved with your club logo. Key chains cost $5 each. Wristbands cost $2 each. You have a budget of $150 for the gifts. The equation $5x + 2y = 150$ models the total cost, where x is the number of key chains and y is the number of wristbands.

    a. Graph the equation. Interpret the intercepts.

    b. Your club decides to order 18 key chains. How many wristbands can you order?

15. Describe and correct the error in finding the intercepts of the graph of the equation.

$$
\begin{array}{ll}
\times \quad 6x + 9y = 18 & 6x + 9y = 18 \\
\quad\ 6x + 9(0) = 18 & 6(0) + 9y = 18 \\
\quad\quad\quad\ 6x = 18 & 9y = 18 \\
\quad\quad\quad\ \ x = 3 & y = 2
\end{array}
$$

The x-intercept is at $(0, 3)$, and the y-intercept is at $(2, 0)$.

16. Write an equation in standard form of a line whose x-intercept is an integer and y-intercept is a fraction. Explain how you know that the x-intercept is an integer and the y-intercept is a fraction.