3.4 Graphing Linear Equations in Standard Form:
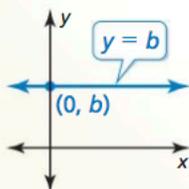
Standard form of a linear equation is written as $Ax + By = C$,

1) A, B and C are real numbers
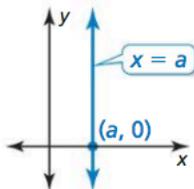2) A and B are not both zero
3) A must be positive

Horizontal and Vertical Lines

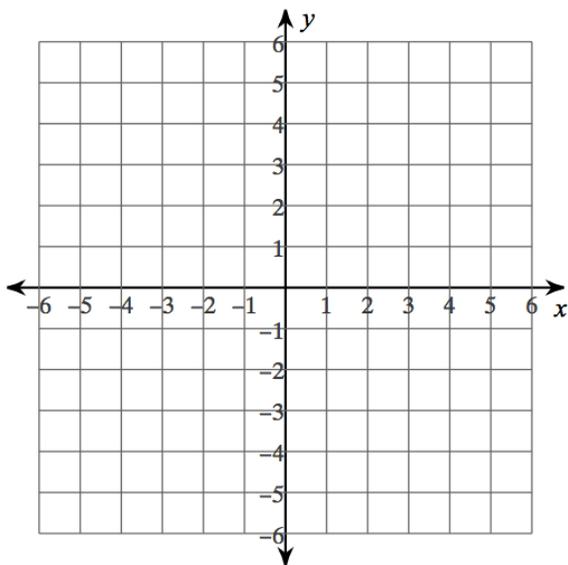### Core Concept

Horizontal and Vertical Lines

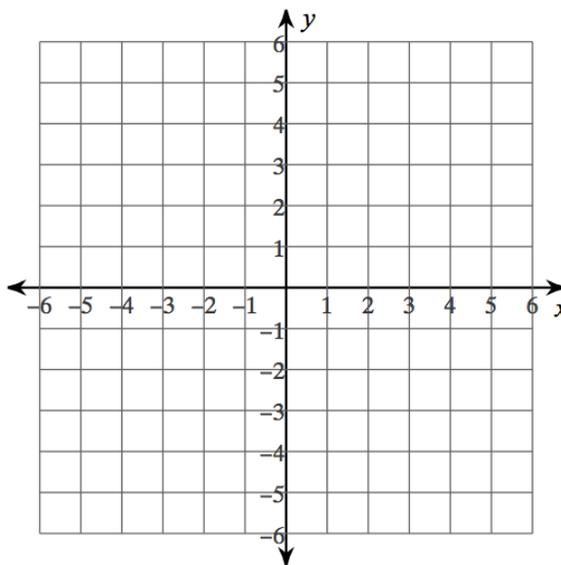The graph of $y = b$ is a horizontal line. The line passes through the point $(0, b)$.

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

Guided Practice:

A) Graph $y = 3$

B) Graph $x = -2$

Graphing an Equation using X & Y-intercepts

Critical Thinking:

What do you know about any point on the Y-axis? on the X-axis?
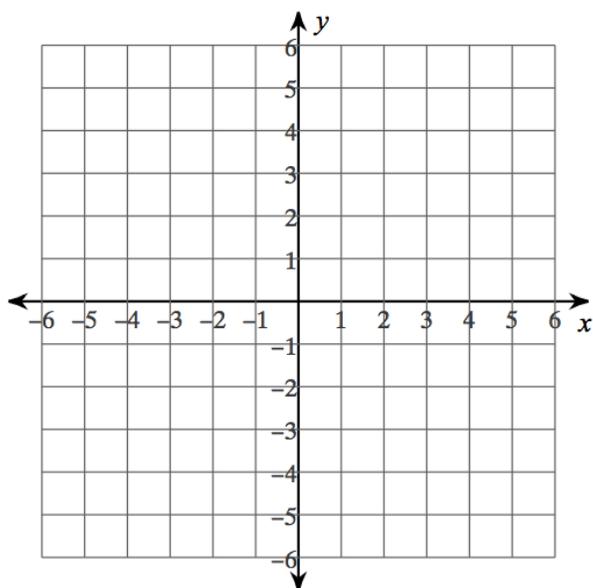
Guided Practice:
Determine the X-intercept and Y-intercept of the equation: $3x + 4y = 12$

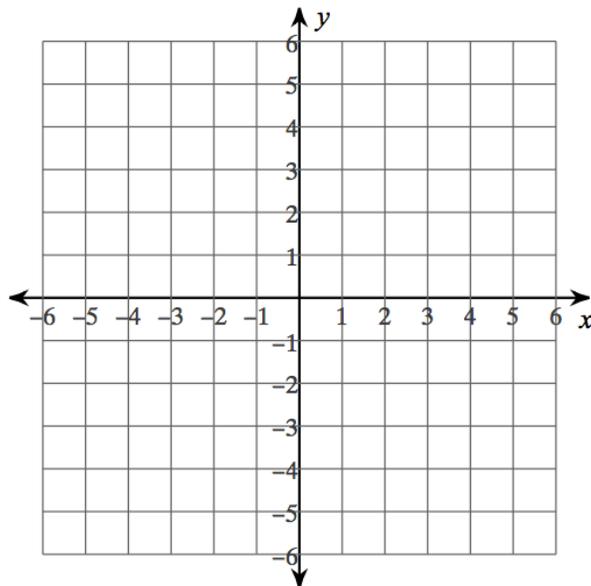X-intercept   Y-intercept

Graph the equation:

Practice Problems: Graph using intercepts
1) $5x + 10y = 20$ 2) $8x - 6y = -42$
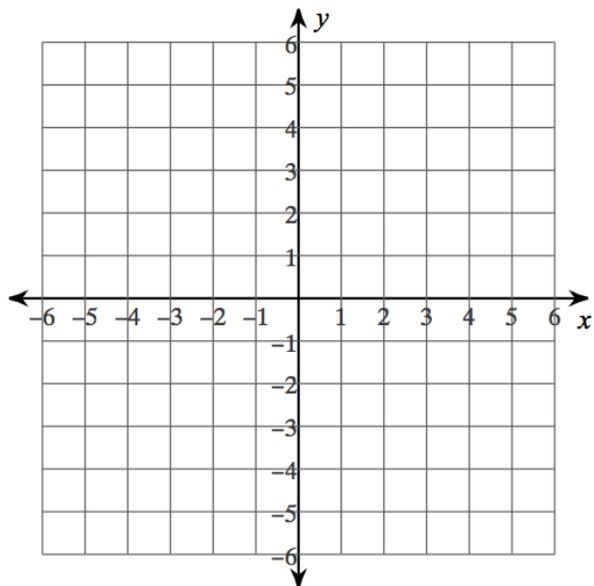
Real World Problem

You are planning a party at a banquet hall for your school. You need to rent tables to seat 180 people. Tables come in two sizes; small tables (x) seat 6 and large tables (y) seat 10. Write an equation to represent this information. Then graph the equation.

Equation:

X-intercept: Y-Intercept:

Homework:
3, 5, 7, 9, 11, 13, 17, 21, 23, 24, 28

Vocabulary and Core Concept Check

1. **WRITING** How are x-intercepts and y-intercepts alike? How are they different?

2. **WHICH ONE DOESN'T BELONG?** Which point does not belong with the other three? Explain your reasoning.

   $(0, -3)$ $(0, 0)$ $(4, -3)$ $(4, 0)$

Monitoring Progress and Modeling with Mathematics

In Exercises 3–6, graph the linear equation. *(See Example 1.)*

3. $x = 4$

4. $y = 2$

5. $y = -3$

6. $x = -1$

In Exercises 7–12, find the x- and y-intercepts of the graph of the linear equation.

7. $2x + 3y = 12$

8. $3x + 6y = 24$

9. $-4x + 8y = -16$

10. $-6x + 9y = -18$

11. $3x - 6y = 2$

12. $-x + 8y = 4$

In Exercises 13–22, use intercepts to graph the linear equation. Label the points corresponding to the intercepts. *(See Example 2.)*

13. $5x + 3y = 30$

14. $4x + 6y = 12$

15. $-12x + 3y = 24$

16. $-2x + 6y = 18$

17. $-4x + 3y = -30$

18. $-2x + 7y = -21$

19. $-x + 2y = 7$

20. $3x - y = -5$

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

22. $-\frac{1}{2}x + y = -4$

23. **MODELING WITH MATHEMATICS** A football team has an away game, and the bus breaks down. The coaches decide to drive the players to the game in cars and vans. Four players can ride in each car. Six players can ride in each van. There are 48 players on the team. The equation $4x + 6y = 48$ models this situation, where x is the number of cars and y is the number of vans. *(See Example 3.)*

    a. Graph the equation. Interpret the intercepts.

    b. Find four possible solutions in the context of the problem.

24. **MODELING WITH MATHEMATICS** You are ordering shirts for the math club at your school. Short-sleeved shirts cost $10 each. Long-sleeved shirts cost $12 each. You have a budget of $300 for the shirts. The equation $10x + 12y = 300$ models the total cost, where x is the number of short-sleeved shirts and y is the number of long-sleeved shirts.

    a. Graph the equation. Interpret the intercepts.

    b. Twelve students decide they want short-sleeved shirts. How many long-sleeved shirts can you order?

ERROR ANALYSIS In Exercises 25 and 26, describe and correct the error in finding the intercepts of the graph of the equation.

25.
$$3x + 12y = 24 \qquad 3x + 12y = 24$$
$$3x + 12(0) = 24 \qquad 3(0) + 12y = 24$$
$$3x = 24 \qquad\qquad 12y = 24$$
$$x = 8 \qquad\qquad\quad y = 2$$
The intercept is at $(8, 2)$.

26.
$$4x + 10y = 20 \qquad 4x + 10y = 20$$
$$4x + 10(0) = 20 \qquad 4(0) + 10y = 20$$
$$4x = 20 \qquad\qquad 10y = 20$$
$$x = 5 \qquad\qquad\quad y = 2$$
The x-intercept is at $(0, 5)$, and the y-intercept is at $(2, 0)$.

27. MAKING AN ARGUMENT You overhear your friend explaining how to find intercepts to a classmate. Your friend says, "When you want to find the x-intercept, just substitute 0 for x and continue to solve the equation." Is your friend's explanation correct? Explain.

28. ANALYZING RELATIONSHIPS You lose track of how many 2-point baskets and 3-point baskets a team makes in a basketball game. The team misses all the 1-point baskets and still scores 54 points. The equation $2x + 3y = 54$ models the total points scored, where x is the number of 2-point baskets made and y is the number of 3-point baskets made.

   a. Find and interpret the intercepts.

   b. Can the number of 3-point baskets made be odd? Explain your reasoning.

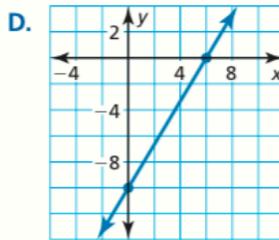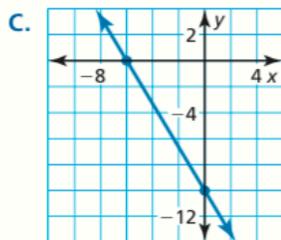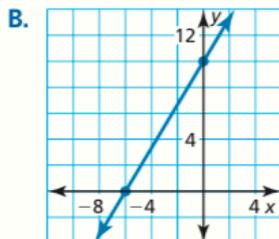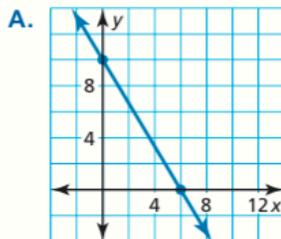   **c.** Graph the equation. Find two more possible solutions in the context of the problem.

MULTIPLE REPRESENTATIONS In Exercises 29–32, match the equation with its graph.

29. $5x + 3y = 30$

30. $5x + 3y = -30$

31. $5x - 3y = 30$

32. $5x - 3y = -30$

A.

B.

C.

D.

33. MATHEMATICAL CONNECTIONS Graph the equations $x = 5$, $x = 2$, $y = -2$, and $y = 1$. What enclosed shape do the lines form? Explain your reasoning.

34. HOW DO YOU SEE IT? You are organizing a class trip to an amusement park. The cost to enter the park is $30. The cost to enter with a meal plan is $45. You have a budget of $2700 for the trip. The equation $30x + 45y = 2700$ models the total cost for the class to go on the trip, where x is the number of students who do not choose the meal plan and y is the number of students who do choose the meal plan.

Class Trip

Number of students who do choose the meal plan

(0, 60)

(90, 0)

Number of students who do not choose the meal plan
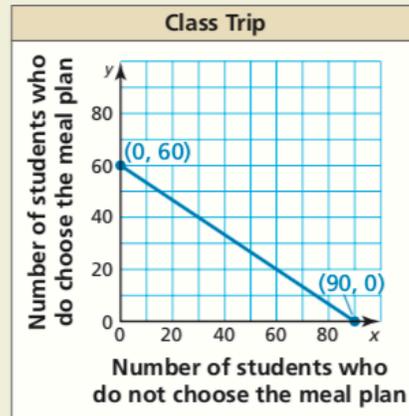
   a. Interpret the intercepts of the graph.

   b. Describe the domain and range in the context of the problem.

35. REASONING Use the values to fill in the equation $\underline{\quad}x + \underline{\quad}y = 30$ so that the x-intercept of the graph is -10 and the y-intercept of the graph is 5.

| -10 | -3 | 1 | 5 | 6 |

36. THOUGHT PROVOKING Write an equation in standard form of a line whose intercepts are integers. Explain how you know the intercepts are integers.

37. WRITING Are the equations of horizontal and vertical lines written in standard form? Explain your reasoning.

38. ABSTRACT REASONING The x- and y-intercepts of the graph of the equation $3x + 5y = k$ are integers. Describe the values of k. Explain your reasoning.

Maintaining Mathematical Proficiency
Reviewing what you learned in previous grades and lessons

Simplify the expression. *(Skills Review Handbook)*

39. $\dfrac{2 - (-2)}{4 - (-4)}$

40. $\dfrac{14 - 18}{0 - 2}$

41. $\dfrac{-3 - 9}{8 - (-7)}$

42. $\dfrac{12 - 17}{-5 - (-2)}$