

Summary and Vocabulary

- ▶ Equations involving percents may be written in the form $p \cdot q = r$, where p is the decimal form of the percent, q is the initial quantity, and r is the resulting quantity. The equation can then be solved as you would solve any other equation.
- ▶ Linear sentences are equivalent to sentences of the forms $ax + b = cx + d$ and $ax + b < cx + d$. Graphs, tables, CAS, and algebraic processes all provide ways of solving these sentences. The same algebraic processes and a CAS enable you to solve many formulas for one of their variables.
- ▶ Some sentences like $12 - 30x = -3(10x - 4)$ are true for all real numbers. When solving them, the same number appears on both sides of the equal sign. Other sentences like $2y + 5 = 2y - 3$ have no solution. When solving them, an equation with different numbers on both sides of the equal sign will result.
- ▶ The union and intersection of sets help to describe situations with *or* and *and*, respectively. They can be used to solve compound inequalities.
- ▶ Graphs and algebraic processes are also used to find the solution set for absolute value equations and absolute value inequalities.
- ▶ All of this sentence-solving is for a purpose. Many real situations lead to linear equations or inequalities, and many common formulas involve linear expressions.

Vocabulary

4-1

percent

4-2

horizontal line, $y = k$

vertical line, $x = h$

4-4

general linear equation,

$$ax + b = cx + d$$

4-7

Celsius scale

centigrade scale

Fahrenheit scale

input

output

equivalent formulas

4-8

compound sentence

intersection

union

\pm notation

Chapter

4

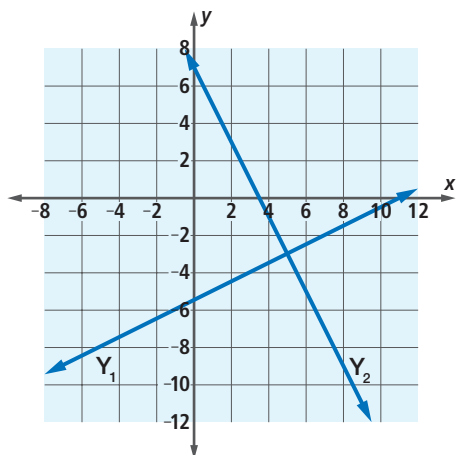
Self-Test

Take this test as you would take a test in class. You will need a calculator. Then use the Selected Answers section in the back of the book to check your work.

- Gloria found a prom dress at a local shop. The price tag said \$262, but Gloria would have to pay 9% sales tax. She found the same dress for \$285 online with no tax. There was no charge for shipping. Find out whether the dress costs less in the shop or online. Explain your process.
- Fill in the Blank** To solve the equation $-8t + 73 = -49 + 4t$, an effective first step is to add $\underline{\quad}$ to each side.
- By what number can each side of $\frac{7}{8}x - \frac{2}{5} = 6 - \frac{1}{8}x$ be multiplied to clear the fractions?

In 4–10, solve each sentence. Show your work.

- $-5m + 21 = 6m - 56$
 - $0.73v + 37.9 = 16 - v$
 - $\frac{x}{4} + \frac{3}{5} = \frac{x}{2}$
 - $-2(3 - d) > 3(2d - 3)$
 - $-29 < 7.5p - 44 \leq 28$
 - $|2x - 3| = 21$
 - $8(4 - 2n) = -16n + 16$
11. Suppose you have graphed Y_1 and Y_2 and the result is the graph below.



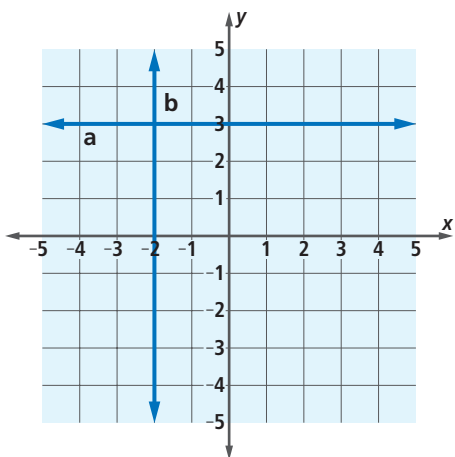
- Estimate the x -value that is the solution to $Y_1 = Y_2$.
 - Write an inequality using x whose solutions tell when $Y_1 \geq Y_2$.
12. Silvia is offered two jobs selling air time for a local cable television station. From TurboTV she could earn a \$30,000 annual salary plus 5% of the amount of her sales. Sparkle Cable offered Silvia a \$25,000 annual salary plus 8% of her sales.

a. Complete the table.

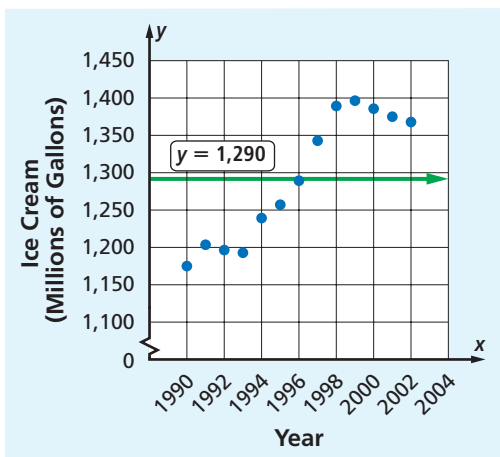
Sales	Total Salary from TurboTV	Total Salary from Sparkle Cable
\$25,000	\$31,250	?
\$50,000	?	\$29,000
\$75,000	?	?
\$100,000	?	?
\$125,000	?	?
\$150,000	?	?
\$175,000	\$38,750	?

- Use the table to find for what sales amount Silvia will earn more money working for Sparkle Cable. Write the answer as an inequality.
 - In her current job, Silvia's sales average \$83,000 per year. If this amount of sales were to continue, which job do you think Silvia should take? Explain your reasoning.
13. Graph in the coordinate plane the solution to $4 - |x + 1| > -2$.

14. Give an equation for each of the lines in the graph.



15. Solve $-6x + 7y = -84$ for x .
16. Use a graphing calculator to determine if there is or is not a solution to $-7.4(x - 3) = 1.2x + 8.1 - 2(4.3x - 8.05)$. Explain how the graph supports your conclusion.
17. The graph below gives the annual consumption of ice cream in the United States from 1990 to 2002 in millions of gallons. The horizontal line shows the mean ice cream consumption, which was approximately 1,290 million gallons.



Source: U.S. Dept. of Agriculture Economic Research Service

- a. Which year had the greatest absolute deviation from the mean?
- b. Which year's ice cream consumption was closest to the mean? What does that tell you about the deviation for that year?
- c. In the last four years of the data, the consumption levels have been getting closer to the mean. Is this situation good or bad for ice cream producers? Why or why not?
18. At Las Sendas Golf Club, Joe's handicap is 9 while Elena's is 18. To level the playing field, the players subtract their handicaps from their stroke totals at the end of the round. Suppose Joe took $\frac{9}{10}$ as many shots as Elena but they ended up with the same score after subtracting their handicaps.
- a. How many strokes did Elena take?
- b. How many strokes did Joe take?
- c. What were their scores with the handicaps?
19. Chandler has a company that produces and sells CDs. He paid \$452.54 in equipment fees, and it costs him \$5.25 to produce each CD. He charges customers \$17.99 per CD.
- a. Write an expression describing Chandler's expenditure based on the number of CDs produced.
- b. Write an expression describing Chandler's revenue based on the number of CDs sold.
- c. How many CDs does Chandler need to sell to make a profit?
20. 30% of what number is 7?

Chapter

4

Chapter
Review
SKILLS
PROPERTIES
USES
REPRESENTATIONS

SKILLS Procedures used to get answers

OBJECTIVE A Solve and check equations of the form $ax + b = cx + d$. (Lesson 4-4)

In 1-8, solve the equation and check your solution.

1. $14 + 8A = 4A - 10$
2. $-5a + 9 = 5a$
3. $3n = n + 7 + 9n$
4. $8x - 21.25 = -0.5x$
5. $4f = 2f - 7(5 - 6f)$
6. $7(2 - y) = 3(y + 2)$
7. $\frac{1}{3}a - 1 = 3a$
8. $\frac{x}{2} + \frac{x}{5} + 20 = x$

OBJECTIVE B Solve and check compound inequalities of the form $ax + b < cx + d$. (Lessons 4-5, 4-8)

In 9 and 10, solve and check the inequality.

9. $14w + 64 \geq 17w - 323$
10. $4(5 + 2t) < 9(2 + t)$

In 11-16, solve and graph all solutions on a number line.

11. $\frac{7}{10}n + \frac{2}{5} > -\frac{1}{2}n - \frac{12}{5}$
12. $0.42h + 3 \leq 0.6h - 0.78$
13. $3p + 4 < 31$ and $8p - 12 \geq 7p - 11$
14. $5s - 7 > 2.5$ or $8 \leq s + 10$
15. $-1 < 4x + 7 < 23$
16. $22 \geq 2d - 40 > -55$

OBJECTIVE C Find equivalent forms of formulas and equations. (Lesson 4-7)

In 17-22, solve the equation for the stated variable.

17. $A = \frac{1}{2}ap$ for p
18. $V = \ell wh$ for h
19. $S = 2\pi r^2 + 2\pi rh$ for h
20. $k = \frac{s}{w}$ for w
21. $6x + 3y = 21$ for y
22. $5y - 7x = 25$ for y

PROPERTIES The principles behind the mathematics

OBJECTIVE D Solve percent problems. (Lesson 4-1)

23. How much tax is there on a \$32 item if the tax rate is 7.5%?
24. According to the Census Bureau about 2% of people in the United States are age 85 or older. In a town of 35,000, about how many people would be expected to be at least 85 years old?
25. To the nearest percent, 10 is what percent of 23?
26. 47 is what percent of 30?
27. 85% of what number is 170?
28. To the nearest whole number, 6.3% of what number is 7?

OBJECTIVE E Solve absolute value equations and inequalities involving linear expressions. (Lesson 4-9)

In 29-31, suppose $|x - 14| = n$.

29. Find all solutions when $n = 2$.
30. Find all solutions when $n = 0$.
31. Find all solutions when $n = -5$.

In 32-34, translate the given English sentence into a mathematical sentence. Then graph the solutions on a number line.

32. The distance between x and 4 is less than 20.
33. Liseli's dog will only go outside when the temperature is within 15 degrees of 60 degrees Fahrenheit.
34. In a math competition, Howard missed the winning score of 180 points by more than 5 points.

OBJECTIVE F Apply and recognize Addition and Multiplication Properties of Equality and Inequality when solving linear sentences.

(Lessons 4-4, 4-5)

35. Consider the equation $3x + 2 = 5x + 12$.
- Solve the equation by first adding $-5x$ to each side.
 - Solve by first adding $-3x$ to each side.
 - Compare your answers to Parts a and b.
36. Consider the inequality $2a + 3 < 5a - 6$.
- Solve the inequality by first adding $-5a$ to each side.
 - Solve by first adding $-2a$ to each side.
 - How are your answers to Parts a and b related?

In 37 and 38, a sentence is solved. State the property that justifies each step.

37. $\frac{2}{3}x - 4 = \frac{1}{6}x + 2$
- $6\left(\frac{2}{3}x - 4\right) = 6\left(\frac{1}{6}x + 2\right)$
 - $6 \cdot \frac{2}{3}x - 6 \cdot 4 = 6 \cdot \frac{1}{6}x + 6 \cdot 2$
 $4x - 24 = x + 12$
 - $3x - 24 = 12$
 - $3x = 36$
 - $x = 12$
38. $-3y + 7 \geq 8y - 5$
- $-3y + 12 \geq 8y$
 - $12 \geq 11y$
 - $\frac{12}{11} \geq y$
39. Alexis is trying to solve the equation $100n + 10 = -90n + 4$. After the first step the resulting equation was $10n + 10 = 4$.
- Identify the mistake Alexis made.
 - Correct the mistake and solve the equation.

OBJECTIVE G Recognize when sentences have no solution or every real number as a solution. (Lesson 4-6)

40. Explain why any real number is a solution to the equation $8y - 30 = 4(2y - 7.5)$.
41. Find all the solutions to the equation $t - t = 1$.
42. Find all solutions to the equation $t - t = 0$.
43. Explain why no real number is a solution to $x + 5 > x + 6$.

USES Applications of mathematics in real-world situations

OBJECTIVE H Use linear equations and inequalities of the form $ax + b = cx + d$ or $ax + b < cx + d$ to solve real-world problems. (Lessons 4-4, 4-5)

44. Sam has \$1,850 in her savings account and adds \$25 each month. Diego has \$2,000 in his account and adds \$20 each month.
- How much will be in each account after n months?
 - After how many months of saving will they have the same amount in their accounts?
45. Taxi, Inc., charges a fee of \$5 for each ride and an additional \$0.75 for each mile you travel. Calling Cabs charges an initial fee of \$3.50 and an additional \$0.85 per mile.
- If you are going to take a cab 10 miles, which company should you use?
 - If you are going to take a cab 15 miles, which company should you use?
 - What is the break-even point?

46. Kim has \$15 and is saving \$9 per week. Alberto has \$100 and is spending \$8 per week.
- Let x = the number of weeks that have passed. Write a linear inequality that can be used to find out when Kim will have more money than Alberto.
 - Solve the inequality.
47. A sign-making company, Signs-R-We, charges a set-up art fee of \$50 plus an additional \$1.50 for each sign printed. Their competitor Sign-Me-Up waives the art fee but charges \$3.50 per sign. What is the largest number of signs you could print so that Sign-Me-Up would be a better deal than Signs-R-We?

OBJECTIVE I Use tables and graphs to solve real-world problems involving linear situations. (Lessons 4-2, 4-3)

48. Two music downloading Web sites offer music discounts. Site 1 has a \$19.95 membership fee and charges \$0.99 per download. Site 2 charges \$14.95 to join and \$1.03 per download.
- Copy and complete the table below.

Number of Downloads	Charges	
	Site 1	Site 2
2	?	?
4	?	?
6	?	?
8	?	?
10	?	?

- How many downloads must you buy for the charges of the two sites to be equal?
- When is the price of Site 1 better?
- When is the price of Site 2 better?

49. Sherita was investigating the number of baby carrots that came pre-packaged. She bought ten bags and recorded her data in a table.

Bag Number	Number of Carrots
1	30
2	35
3	27
4	32
5	39
6	29
7	31
8	35
9	32
10	29

- Make a dot plot of these data.
 - Determine the mean amount of carrots per bag and draw the horizontal line representing the mean on your plot.
 - Which bag(s) is closest to the mean?
 - Which bag has the greatest absolute deviation from the mean?
50. Michael is considering two different sales positions. Rent-A-Vehicle would pay a total salary of \$1,100 per month plus a 6% sales commission. Borrow-Our-Car would pay a total salary of \$900 plus an 8% commission.
- Copy and complete the table below.

Sales	Rent-A-Vehicle	Borrow-Our-Car
\$0	\$1,100	\$900
\$5,000	?	?
\$10,000	?	?
\$15,000	?	?
\$20,000	?	?
\$25,000	?	\$2,900
\$30,000	\$2,900	?

- For what amounts of sales will Borrow-Our-Car pay a greater total salary?

OBJECTIVE J Solve real-world problems involving percents. (Lesson 4-1)

51. According to the *World Almanac and Book of Facts*, there were approximately 217,000 women serving in the Armed Forces of the United States in 2004, accounting for about 15% of total military personnel. In all, about how many persons are serving in the Armed Forces?
52. According to the *Pew Internet & American Life Project*, 17% of United States households used online banking in 2000. In 2005, 35% of U.S. households used online banking. If there were 98,000,000 U.S. households in both years, how many more households used online banking in 2005 than in 2000?
53. After a 30% discount, a mattress sold for \$896. What was its price before the discount?

REPRESENTATIONS Pictures, graphs, or objects that illustrate concepts

OBJECTIVE K Graph horizontal and vertical lines. (Lesson 4-2)

In 54 and 55, graph the points in the coordinate plane satisfying each equation.

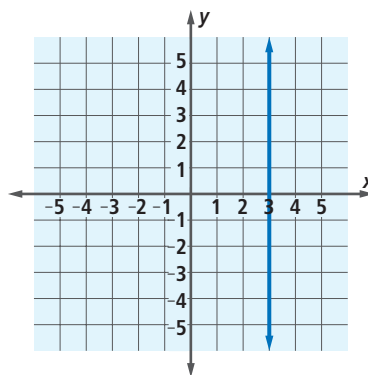
54. $x = -3$

55. $y = 6$

56. **True or False** The graph of all points in the coordinate plane satisfying $y = 23$ is a horizontal line.

57. Write an equation for the line containing the points $(5, 12)$, $(5, -3)$, and $(5, -15)$.

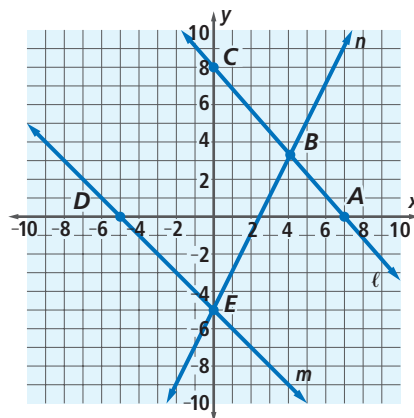
58. Write an equation for the line in the graph below.



OBJECTIVE L Use graphs to solve problems involving linear equations. (Lesson 4-3)

59. An airplane is cruising at 35,000 feet when it begins its descent into an airport at 1,750 feet per minute.
- Write an equation that relates the plane's altitude a in feet and the time m in minutes since it started to descend.
 - Graph your equation from Part a.
 - Use the graph to determine how many minutes it will take to land.

In 60 and 61, lines ℓ , m , and n are graphed below. Line ℓ has equation $y = -\frac{8}{7}x + 8$, line m has equation $y = -5 - x$, and line n has equation $y = 2x - 5$.



60. a. Fill in the blank, then answer the question. The solution to the equation $2x - 5 = -\frac{8}{7}x + 8$ is the -coordinate of which named point?
 b. Estimate a solution to the equation in Part a.
61. Suppose $E = (0, -5)$. Use this information to solve the inequality $2x - 5 \leq -5 - x$.
62. Picture Perfect will develop a roll of film for \$0.35 per photo with no developing charge. You Oughta Be In Pictures charges \$0.10 per photo plus a \$3.50 developing charge. Make a graph to determine the break-even point.

OBJECTIVE M Use graphs to model sentences that have no solution or every real number as a solution. (Lesson 4-6)

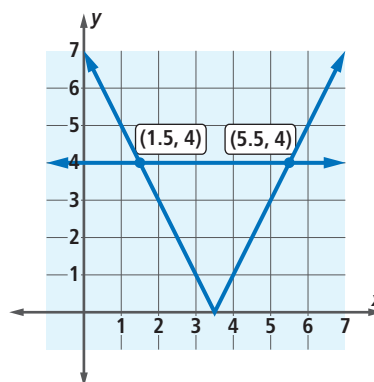
63. Nate starts July with \$80 and decides to mow lawns for \$10 per lawn to earn money. His friend Owen starts with \$65 and also decides to mow lawns for \$10 per lawn.
- How much money will Nathan have after mowing n lawns?
 - How much money will Owen have after mowing n lawns?
 - Let y equal each of your expressions in Parts a and b. Graph the two equations.
 - Using your graph, when will Owen have as much money as Nate?

In 64–66, solve by letting y equal each side of the sentence and by using a graph.

64. $4(h - 7) + 6h < 2(5h - 4)$
 65. $-7g + 4 = 5 - 7g$
 66. $2.5(4.6p - 4) \geq 10p + \frac{3}{2}(p + 20)$

OBJECTIVE N Use graphs to solve absolute value inequalities of the form $|ax + b| < c$ or $|ax + b| > c$. (Lesson 4-9)

67. The air (heat or cooling) in Peggy's house turns on when the temperature varies 5 degrees or more from 70°F .
- On a number line, graph the temperatures corresponding to when the air is on.
 - Using t for temperature, write inequalities describing the temperatures graphed in Part a.
68. Use the graph of $y = |2x - 7|$ and $y = 4$ below to solve each of the following.



- $|2x - 7| = 4$
- $|2x - 7| > 4$
- $|2x - 7| \leq 4$