

### 1.3 Solving equations with variables on both sides

#### Do Now:

A bathtub is in the shape of a rectangular prism. Its dimensions are 5 feet by 3 feet by 18 inches. The bathtub is three-fourths full of water. You start to drain the water at a rate of 1 cubic foot per minute. About how long does it take for all the water to drain?

#### Example 1: Solving an equation with Variables on both sides

Solve  $10 - 4x = -9x$ . Check your solution

#### Example 2: Solving equations with grouping

Solve  $3(3x - 4) = \frac{1}{4}(32x + 56)$

#### Example 3: Identifying the number of solutions

Solve each equation:

a)  $3x(5x + 2) = 15x$

b)  $-2(4y + 1) = -8y - 2$

**Try on your own!**

Solve the equation.

$$4. \ 4(1 - p) = -4p + 4$$

$$5. \ 6m - m = \frac{5}{6}(6m - 10)$$

$$6. \ 10k + 7 = -3 - 10k$$

$$7. \ 3(2a - 2) = 2(3a - 3)$$

**Example 4: Solving real-life problems**

A boat leaves New Orleans and travels upstream on the Mississippi River for 4 hours. The return trip takes 2.8 hours because the boat travels 3 mph faster downstream due to the current. How far does the boat travel upstream?

Homework:

3, 9, 13, 14, 16, 18, 20, 23, 24, 27\*, 33-35

# 1.3 Exercises

Dynamic Solutions available at [BigIdeasMath.com](http://BigIdeasMath.com)

## Vocabulary and Core Concept Check

- VOCABULARY** Is the equation  $-2(4 - x) = 2x + 8$  an identity? Explain your reasoning.
- WRITING** Describe the steps in solving the linear equation  $3(3x - 8) = 4x + 6$ .

## Monitoring Progress and Modeling with Mathematics

In Exercises 3–16, solve the equation. Check your solution. (See Examples 1 and 2.)

- $15 - 2x = 3x$
- $26 - 4s = 9s$
- $5p - 9 = 2p + 12$
- $8g + 10 = 35 + 3g$
- $5t + 16 = 6 - 5t$
- $-3r + 10 = 15r - 8$
- $7 + 3x - 12x = 3x + 1$
- $w - 2 + 2w = 6 + 5w$
- $10(g + 5) = 2(g + 9)$
- $-9(t - 2) = 4(t - 15)$
- $\frac{2}{3}(3x + 9) = -2(2x + 6)$
- $2(2t + 4) = \frac{3}{4}(24 - 8t)$
- $10(2y + 2) - y = 2(8y - 8)$
- $2(4x + 2) = 4x - 12(x - 1)$

- MODELING WITH MATHEMATICS** You and your friend drive toward each other. The equation  $50h = 190 - 45h$  represents the number  $h$  of hours until you and your friend meet. When will you meet?
- MODELING WITH MATHEMATICS** The equation  $1.5r + 15 = 2.25r$  represents the number  $r$  of movies you must rent to spend the same amount at each movie store. How many movies must you rent to spend the same amount at each movie store?



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In Exercises 19–24, solve the equation. Determine whether the equation has *one solution*, *no solution*, or *infinitely many solutions*. (See Example 3.)

- $3t + 4 = 12 + 3t$
- $6d + 8 = 14 + 3d$
- $2(h + 1) = 5h - 7$
- $12y + 6 = 6(2y + 1)$
- $3(4g + 6) = 2(6g + 9)$
- $5(1 + 2m) = \frac{1}{2}(8 + 20m)$

**ERROR ANALYSIS** In Exercises 25 and 26, describe and correct the error in solving the equation.

25.

A light blue box containing a large red X. To the right of the X are the steps:
$$5c - 6 = 4 - 3c \\ 2c - 6 = 4 \\ 2c = 10 \\ c = 5$$

26.

A light blue box containing a large red X. To the right of the X are the steps:
$$6(2y + 6) = 4(9 + 3y) \\ 12y + 36 = 36 + 12y \\ 12y = 12y \\ 0 = 0$$

The equation has no solution.

27. **MODELING WITH MATHEMATICS** Write and solve an equation to find the month when you would pay the same total amount for each Internet service.

	Installation fee	Price per month
Company A	\$60.00	\$42.95
Company B	\$25.00	\$49.95

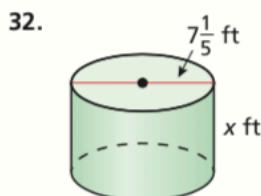
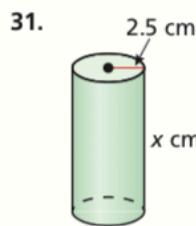
**28. PROBLEM SOLVING** One serving of granola provides 4% of the protein you need daily. You must get the remaining 48 grams of protein from other sources. How many grams of protein do you need daily?

**USING STRUCTURE** In Exercises 29 and 30, find the value of  $r$ .

29.  $8(x + 6) - 10 + r = 3(x + 12) + 5x$

30.  $4(x - 3) - r + 2x = 5(3x - 7) - 9x$

**MATHEMATICAL CONNECTIONS** In Exercises 31 and 32, the value of the surface area of the cylinder is equal to the value of the volume of the cylinder. Find the value of  $x$ . Then find the surface area and volume of the cylinder.



**33. MODELING WITH MATHEMATICS** A cheetah that is running 90 feet per second is 120 feet behind an antelope that is running 60 feet per second. How long will it take the cheetah to catch up to the antelope? (See Example 4.)

**34. MAKING AN ARGUMENT** A cheetah can run at top speed for only about 20 seconds. If an antelope is too far away for a cheetah to catch it in 20 seconds, the antelope is probably safe. Your friend claims the antelope in Exercise 33 will not be safe if the cheetah starts running 650 feet behind it. Is your friend correct? Explain.

**REASONING** In Exercises 35 and 36, for what value of  $a$  is the equation an identity? Explain your reasoning.

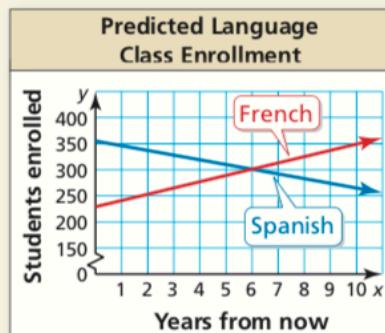
35.  $a(2x + 3) = 9x + 15 + x$

36.  $8x - 8 + 3ax = 5ax - 2a$

**37. REASONING** Two times the greater of two consecutive integers is 9 less than three times the lesser integer. What are the integers?

**38. HOW DO YOU SEE IT?** The table and the graph show information about students enrolled in Spanish and French classes at a high school.

	Students enrolled this year	Average rate of change
Spanish	355	9 fewer students each year
French	229	12 more students each year

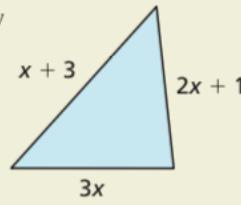


- Use the graph to determine after how many years there will be equal enrollment in Spanish and French classes.
- How does the equation  $355 - 9x = 229 + 12x$  relate to the table and the graph? How can you use this equation to determine whether your answer in part (a) is reasonable?

**39. WRITING EQUATIONS** Give an example of a linear equation that has (a) no solution and (b) infinitely many solutions. Justify your answers.

**40. THOUGHT PROVOKING** Draw

a different figure that has the same perimeter as the triangle shown. Explain why your figure has the same perimeter.



## Maintaining Mathematical Proficiency

Reviewing what you learned in previous grades and lessons

Order the values from least to greatest. (*Skills Review Handbook*)

41.  $9, |-4|, -4, 5, |2|$

42.  $|-32|, 22, -16, -|21|, |-10|$

43.  $-18, |-24|, -19, |-18|, |22|$

44.  $-|-3|, |0|, -1, |2|, -2$