

Unit 1 Day 4

1-5 Solving Equations with Variables on Both Sides

Warm Up
Simplify.
 1. $4x - 10x = -6x$
 2. $-7(x - 3) = -7x + 21$
 3. $\frac{1}{3}(6x + 9) = 2x + 3$
 4. $15 - (x - 2) = 15 - x + 2 = 17 - x$
Solve.
 5. $3x + \frac{2}{3} = \frac{8}{3}$
 $\frac{3x}{3} = \frac{6}{3}$ $(x = 2)$
 6. $\frac{1}{3}x - \frac{1}{3} = 9$
 $+\frac{1}{3} + \frac{1}{3}$

1-5 Solving Equations with Variables on Both Sides

To solve an equation with variables on both sides, use inverse operations to "collect" variable terms on one side of the equation.

Combine like terms using the inverse properties we've already used.

$$\frac{1}{3}x = \frac{27}{3} + \frac{1}{3}$$

$$\frac{\frac{1}{3}x}{\frac{1}{3}} = \frac{\frac{28}{3}}{\frac{1}{3}} \quad x = \frac{28}{3} \cdot \frac{3}{1} = (28)$$

1-5 Solving Equations with Variables on Both Sides

Example 1: Solving Equations with Variables on Both Sides

$$7n - 2 = 5n + 6$$

$$-5n \quad -5n$$

$$2n - 2 = 6$$

$$+2 \quad +2$$

$$\frac{2n}{2} = \frac{8}{2} \quad (n = 4)$$

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Check It Out! Example 1a

$$4b + 2 = 3b$$

$$-4b \quad -4b$$

$$2 = -b$$

$$(b = -2)$$

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Check It Out! Example 1b

$$0.5 + 0.3y = 0.7y - 0.3$$

$$-0.3y \quad -0.3y$$

$$.5 = .4y - .3$$

$$+.3 \quad +.3$$

$$\frac{.8}{.4} = \frac{.4y}{.4}$$

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To solve more complicated equations, you may need to first simplify by using the Distributive Property or combining like terms.

$$(y = 2)$$

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Example 2: Simplifying Each Side Before Solving Equations

$$4 - 6a + 4a = -1 - 5(7 - 2a)$$

$$4 - 2a = -1 - 35 + 10a$$

$$\begin{array}{r} 4 - 2a = -1 - 35 + 10a \\ +2a \qquad \qquad \qquad +2a \end{array}$$

$$4 = -36 + 12a$$

$$\begin{array}{r} 4 = -36 + 12a \\ +36 \qquad \qquad +36 \end{array}$$

$$\frac{40}{12} = \frac{12a}{12} \quad a = \frac{10}{3}$$

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Example 2 Continued

~~$$4 - 6a + 4a = -1 - 5(7 - 2a)$$~~

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Check It Out! Example 2a

$$\frac{1}{2}(b+6) = \frac{3}{2}b - 1$$

$$\frac{b}{2} + 3 = \frac{3}{2}b - 1$$

$$\begin{array}{r} \frac{b}{2} + 3 = \frac{3}{2}b - 1 \\ -\frac{b}{2} \qquad \qquad \qquad -\frac{b}{2} \\ \hline 3 = b - 1 \end{array}$$

$$4 = b$$

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Check It Out! Example 2b

$$3x + 15 - 9 = 2(x + 2)$$

$$3x + 6 = 2x + 4$$

$$\begin{array}{r} 3x + 6 = 2x + 4 \\ -2x \qquad \qquad \qquad -2x \\ \hline x + 6 = 4 \\ -6 \qquad \qquad \qquad -6 \\ \hline x = -2 \end{array}$$

1-5 Solving Equations with Variables on Both Sides

An **identity** is an equation that is true for all values of the variable. An equation that is an identity has infinitely many solutions.

Some equations are always false. These equations have no solutions.

1-5 Solving Equations with Variables on Both Sides

Identities and False Equations

WORDS	Identity When solving an equation, if you get an equation that is always true, the original equation is an identity, and it has infinitely many solutions.
NUMBERS	$2 + 1 = 2 + 1$ $3 = 3 \checkmark$
ALGEBRA	$2 + x = 2 + x$ $\frac{-x}{-x} \quad \frac{-x}{-x}$ $2 = 2 \checkmark$

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Identities and False Equations

WORDS	False Equations When solving an equation, if you get a false equation, the original equation has no solutions.
NUMBERS	$1 = 1 + 2$ $1 = 3x$
ALGEBRA	$x = x + 3$ $\frac{-x}{-x} = \frac{-x}{-x}$ $0 = 3x$

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Example 3A: Infinitely Many Solutions or No Solutions

$$10 - 5x + 1 = 7x + 11 - 12x$$

$$11 - 5x = -5x + 11$$

$$\begin{array}{r} +5x \\ +5x \end{array}$$

$$11 = 11 \quad \checkmark \quad \text{identity}$$

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Example 3B: Infinitely Many Solutions or No Solutions

$$12x - 3 + x = 5x - 4 + 8x$$

$$13x - 3 = 13x - 4$$

$$\begin{array}{r} -13x \\ -13x \end{array}$$

$$-3 = -4 \quad \otimes \quad \text{no solution}$$

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Check It Out! Example 3a

$$4y + 7 - y = 10 + 3y$$

$$3y + 7 = 10 + 3y$$

$$\begin{array}{r} -3y \\ -3y \end{array}$$

$$7 = 10 \quad \otimes \quad \text{no solution}$$

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Check It Out! Example 3b

$$2c + 7 + c = -14 + 3c + 21$$

$$3c + 7 = 7 + 3c$$

$$\begin{array}{r} -3c \\ -3c \end{array}$$

$$7 = 7 \quad \checkmark \quad \text{identity}$$

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Example 4: Application

Jon and Sara are planting tulip bulbs. Jon has planted 60 bulbs and is planting at a rate of 44 bulbs per hour. Sara has planted 96 bulbs and is planting at a rate of 32 bulbs per hour. In how many hours will Jon and Sara have planted the same number of bulbs? How many bulbs will that be?

Person	Bulbs
Jon	60 bulbs plus 44 bulbs per hour
Sara	96 bulbs plus 32 bulbs per hour

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$$60 + 44(3)$$

$$60 + 132$$

$$(192)$$

$$60 + 44h = 96 + 32h$$

$$\begin{array}{r} -32h \\ -32h \end{array}$$

$$60 + 12h = 96$$

$$\begin{array}{r} -60 \\ -60 \end{array}$$

$$12h = 36$$

$$(h = 3)$$

* what do we need to know?
- when they are the same -

* How could we find answer?
- set them equal

3

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Check It Out! Example 4

Four times Greg's age, decreased by 3 is equal to 3 times Greg's age increased by 7. How old is Greg?

$g = \text{greg's age}$

$$\begin{array}{r} 4g - 3 = 3g + 7 \\ -3g \quad -3g \\ \hline g - 3 = 7 \\ +3 \quad +3 \end{array}$$

$g = 10$

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A painting company charges \$250 base plus \$16 per hour. Another painting company charges \$210 base plus \$18 per hour. How long is a job for which the two companies costs are the same?

$$\begin{array}{r} 250 + 16h = 210 + 18h \\ -16h \quad -16h \\ \hline 250 = 210 + 2h \\ -210 \quad -210 \end{array}$$

$\frac{40}{2} = \frac{2h}{2}$

$20 = h$

1-5

Homework

- Page 43
- 21 – 29 (odd)
- Page 44
- 33, 35

THINK AND DISCUSS

1. Tell which of the following is an identity. Explain your answer.
 a. $4(a + 3) - 6 = 3(a + 3) - 6$ b. $8.3x - 9 + 0.7x = 2 + 9x - 11$
2. **GET ORGANIZED** Copy and complete the graphic organizer. In each box, write an example of an equation that has the indicated number of solutions.



An equation with variables on both sides can have...

- one solution:
- many solutions:
- no solution:

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Exercises

Learn It Online
 Homework Help Online
 Parent Resources Online

GUIDED PRACTICE

1. **Vocabulary** How can you recognize an identity?

Solve each equation. Check your answer.

SEE EXAMPLE 1

2. $2c - 5 = c + 4$

3. $8r + 4 = 10 + 2r$

4. $2x - 1 = x + 11$

5. $28 - 0.3y = 0.7y - 12$

SEE EXAMPLE 2

6. $-2(x + 3) = 4x - 3$

7. $3c - 4c + 1 = 5c + 2 + 3$

8. $5 + 3(q - 4) = 2(q + 1)$

9. $5 - (t + 3) = -1 + 2(t - 3)$

SEE EXAMPLE 3

10. $7x - 4 = -2x + 1 + 9x - 5$

11. $8x + 6 - 9x = 2 - x - 15$

12. $6y = 8 - 9 + 6y$

13. $6 - 2x - 1 = 4x + 8 - 6x - 3$

SEE EXAMPLE 4

14. **Consumer Economics** A house-painting company charges \$376 plus \$12 per hour. Another painting company charges \$280 plus \$15 per hour.

- a. How long is a job for which both companies will charge the same amount?
- b. What will that cost be?

PRACTICE AND PROBLEM SOLVING

Solve each equation. Check your answer.

15. $7a - 17 = 4a + 1$

16. $2b - 5 = 8b + 1$

17. $4x - 2 = 3x + 4$

18. $2x - 5 = 4x - 1$

19. $8x - 2 = 3x + 12.25$

20. $5x + 2 = 3x$

21. $3c - 5 = 2c + 5$

22. $-17 - 2x = 6 - x$

23. $3(t - 1) = 9 + t$

24. $5 - x - 2 = 3 + 4x + 5$

25. $2(x + 4) = 3(x - 2)$

26. $3m - 10 = 2(4m - 5)$

27. $5 - (n - 4) = 3(n + 2)$

28. $6(x + 7) - 20 = 6x$

29. $8(x + 1) = 4x - 8$

30. $x - 4 - 3x = -2x - 3 - 1$

31. $-2(x + 2) = -2x + 1$

32. $2(x + 4) - 5 = 2x + 3$

Independent Practice

For Exercises	See Example
15–22	1
23–29	2
30–32	3
33	4

Extra Practice

See Extra Practice for more Skills Practice and Applications Practice exercises.

- 33. Sports** Justin and Tyson are beginning an exercise program to train for football season. Justin weighs 150 lb and hopes to gain 2 lb per week. Tyson weighs 195 lb and hopes to lose 1 lb per week.
- If the plan works, in how many weeks will the boys weigh the same amount?
 - What will that weight be?


Write an equation to represent each relationship. Then solve the equation.

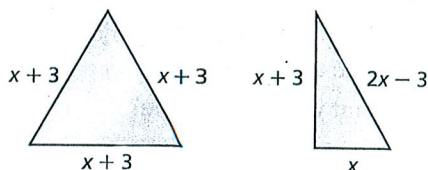
34. Three times the sum of a number and 4 is the same as 18 more than the number.
- 35.** A number decreased by 30 is the same as 14 minus 3 times the number.
36. Two less than 2 times a number is the same as the number plus 64.

Solve each equation. Check your answer.

37. $2x - 2 = 4x + 6$ 38. $3x + 5 = 2x + 2$ 39. $4x + 3 = 5x - 4$
40. $-\frac{2}{5}p + 2 = \frac{1}{5}p + 11$ 41. $5x + 24 = 2x + 15$ 42. $5x - 10 = 14 - 3x$
43. $12 - 6x = 10 - 5x$ 44. $5x - 7 = -6x - 29$ 45. $1.8x + 2.8 = 2.5x + 2.1$
46. $2.6x + 18 = 2.4x + 22$ 47. $1 - 3x = 2x + 8$ 48. $\frac{1}{2}(8 - 6h) = h$
49. $3(x + 1) = 2x + 7$ 50. $9x - 8 + 4x = 7x + 16$ 51. $3(2x - 1) + 5 = 6(x + 1)$

- 52. Travel** Rapid Rental Car company charges a \$40 rental fee, \$15 for gas, and \$0.25 per mile driven. For the same car, Capital Cars charges \$45 for rental and gas and \$0.35 per mile.
- Find the number of miles for which the companies' charges will be the same. Then find that charge. Show that your answers are reasonable.
 - The Barre family estimates that they will drive about 95 miles during their vacation to Hershey, Pennsylvania. Which company should they rent their car from? Explain.
 - What if...?** The Barres have extended their vacation and now estimate that they will drive about 120 miles. Should they still rent from the same company as in part b? Why or why not?
 - Give a general rule for deciding which company to rent from.

-  **53. Geometry** The triangles shown have the same perimeter. What is the value of x ?



MULTI-STEP TEST PREP



- 54. a.** A fire currently covers 420 acres and continues to spread at a rate of 60 acres per day. How many total acres will be covered in the next 2 days? Show that your answer is reasonable.
- b.** Write an expression for the total area covered by the fire in d days.
- c.** The firefighters estimate that they can put out the fire at a rate of 80 acres per day. Write an expression for the total area that the firefighters can put out in d days.
- d.** Set the expressions in parts b and c equal. Solve for d . What does d represent?

Selected Answers Chapter 1

1-1

Check It Out! 1a. 4 decreased by n ; n less than 4 1b. the quotient of t and 5; t divided by 5 1c. the sum of 9 and q ; q added to 9 1d. the product of 3 and h ; 3 times h
2a. $65t$ 2b. $m + 5$ 2c. $32d$ 3a. 6
3b. 7 3c. 3 4. a. 63s. b. 756 bottles; 1575 bottles; 3150 bottles

Exercises 1. variable 3. the quotient of f and 3; f divided by 3 5. 9 decreased by y ; y less than 9 7. the sum of t and 12; t increased by 12 9. x decreased by 3; the difference of x and 3
11. $w + 4$ 13. 12 15. 6 17. the product of 5 and p ; 5 groups of p 19. the sum of 3 and x ; 3 increased by x 21. negative 3 times s ; the product of negative 3 and s 23. 14 decreased by t ; the difference of 14 and t 25. $t + 20$
27. 1 29. 2 31a. $h - 40$, b. 0; 4; 8; 12 33. $2x$ 35. $y + 10$ 37. $9w$; 9 in^2 ; 72 in^2 ; 81 in^2 ; 99 in^2 39. 13; 14; 15; 16 41. 6; 10; 13; 15 43a. $47.84 + m$; b. $58.53 - s$ 45. $x + 7$; 19; 21
47. $x + 3$; 15; 17 49. F 51. 36
53. 1. 55. 45° 57. 90° 59. $\frac{1}{2}$ 61. 1
63. Multiply the previous term by 3; 729, 2187, 6561.

1-2

Check It Out! 1a. 8.8 1b. 0 1c. 25
2a. $\frac{1}{2}$ 2b. -10 2c. 8 3a. 9.3 3b. 2
3c. 44 4. 35 years old

Exercises 3. 21 5. 16.3 7. $\frac{1}{2}$ 9. 0
11. 2.3 13. 1.2 15. 32 17. 3.7 19. $\frac{17}{6}$
21. 9 23. 17 25. $\frac{4}{7}$ 27. 10.5 29. 9
31. 0 33. -17 35. -3100 37. -0.5
39. 0.05 41. 15 43. 1545 45. 30
47. $\frac{1}{3}$ 49. $a + 500 = 4732$; \$4232
51. $x - 10 = 12$; $x = 22$ 53. $x + 8 = 16$; $x = 8$ 55. $5 + x = 6$; $x = 1$
57. $x - 4 = 9$; $x = 13$ 59. $m + 560 = 1680$; \$1120 61. $63 + x = 90$; $x = 27$ 63. $x + 15 = 90$; $x = 75$
65. $h - 47 = 28$; 75 69. J 71. $-\frac{12}{5}$
73. $-\frac{13}{12}$ 75. 10 77. 90

1-3

Check It Out! 1a. 50 1b. -39
1c. 56 2a. 4 2b. -20 2c. 5 3a. $-\frac{5}{4}$
3b. 1 3c. 612 4. 15,000 ft

Exercises 1. 32 3. 14 5. 19 7. 7
9. 5 11. 2.5 13. 14 15. -9 17. $\frac{1}{8}$
19. $16c = 192$; \$12 21. 24 23. -36
25. 150 27. 55 29. 3 31. 1
33. 13 35. 0.3 37. 2 39. -16 41. -3.5
43. -2 45. $\frac{7}{10}s = 392$; \$560
49. $4s = 84$; 21 in. 51. $4s = 16.4$;
4.1 cm 53. $-3x = 12$; $x = -4$
55. $\frac{x}{3} = -8$; $x = -24$ 57. $6.25h = 50$;
8 h 59. $0.05m = 13.80$; 276 min
61. -2 63. 0; $8y = 0$; 0 65a. number
of data values c. 185,300 acres
67. 7 69. 605 71. $\frac{3}{16}$ 73. 5.7
75. $\frac{2}{3}g = 2$; 3 g 77. D 79. B
81a. $6c = 4.80$ b. $c = \$0.80$ 83. 2
85. 9 87. 2 89. -20 91. -132
93. Multiply both sides by a .

1-4

Check It Out! 1a. 1 1b. 6 1c. 0
2a. $\frac{55}{4}$ 2b. $\frac{1}{2}$ 2c. 15 3a. $-\frac{5}{6}$ 3b. 5
3c. 8 4. \$60 5. -42

Exercises 1. 2 3. -18 5. 2 7. 66
9. $\frac{5}{4}$ 11. -12 13. 16 15. -3.2 17. 4
19. 15 passes 21. 4 23. -4 25. 4
27. 5 29. -9 31. $\frac{1}{4}$ 33. 1 35. 3
37. $\frac{28}{5}$ 39. 3 41. 8 43. 7 45. $-\frac{1}{2}$

47. $x = 40$ 49. $x = 35$
51. $8 - 3n = 2$; $n = 2$
53a. $1963 - 5s = 1863$; $s = 20$ 53b. 3
55. 8 57. 4.5 59. -10 61. 10
63. $5k - 70 = 60$; 26 in. 65. Stan: 36;
Mark: 37; Wayne: 38 67a. 45,000;
112,500; 225,000; 337,500; 225n
67b. $c = 225n$ 71. H 73. 27 75. $6\frac{1}{5}$
77. 14.5 79. -6

1-5

Check It Out! 1a. -2 1b. 2
2a. 4 2b. -2 3a. no solution
3b. all real numbers 4. 10 years old

Exercises 3. 1 5. 40 7. $-\frac{2}{3}$
9. 3 11. no solution 13. all real
numbers 15. 6 17. 6 19. 2.85

21. 10 23. 6 25. 14 27. $\frac{3}{4}$
29. -4 31. no solution 33a. 15 weeks
33b. 180 lb 35. $x - 30 = 14 - 3x$;
 $x = 11$ 37. -4 39. 7 41. -3 43. 2
45. 1 47. $-\frac{7}{5}$ 49. 4 51. no solution
53. 9 59. F 61. H 63. 2 65. no
solution 67. -20 69. 6, 7, 8 71. \$1.68

1-6

Check It Out! 1. about 1.46 h
2. $i = f + gt$ 3a. $t = \frac{5-b}{2}$ 3b. $V = \frac{m}{D}$

Exercises 3. $w = \frac{V}{th}$ 5. $m = 4n + 8$
7. $a = \frac{10}{b+c}$ 9. $I = A - P$
11. $x = \frac{k+5}{y}$ 13. $\frac{x-2}{z} = y$
15. $x = 5(a + g)$ 17. $x = \frac{y-b}{m}$
19. $T = \frac{PV}{nR}$ 21. $T = M + R$
23. $b = \frac{c-2a}{2}$ 25. $r = 7 - ax$
27. $x = \frac{5-4y}{3}$ 31. $a = \frac{t-g}{-0.0035}$
35. C 37. D 39. $a = \frac{5}{2}(c + \frac{3}{4}b)$
41. $d = 500(t - \frac{1}{2})$ 43. $s = \frac{v^2 - u^2}{2a}$
45. 120 s

1-7

Check It Out! 1a. -7, 7 1b. -5.5,
10.5 2a. no solutions 2b. 4
3. $|x - 134| = 0.18$; minimum
height: 133.82 m; maximum
height: 134.18 m

Exercises 1. -6, 6 3. -2, 2
5. $-\frac{3}{2}, \frac{1}{2}$ 7. no solutions 9. no
solutions 11. 2.8 13. $|x - 207| = 2$;
mile markers 205 and 209 15. -9,
13 ft 17. -2, 2 19. 18.8, 65.28
21. $-\frac{14}{3}, 4$ 23. 0 25. 0 27. $\frac{2}{3}$
29. $|x - 5| = 0.001$; 4.999 mm;
5.001 mm 31. $|x - 7| = 2$; 5, 9
33. $|x - 1500| = 75$; 1575 bricks;
1425 bricks 35. $|x| = 3$
37. $|x - 2| = 3$ 39. sometimes
41. always 43a. $|t - 24| = 5$
43b. 19; 29 43c. yes 43d. The
measurements are correct to within
5 mi/h. 47. C 49. B 51. Division
Property of Equality; Subtraction
Property of Equality; Division
Property of Equality