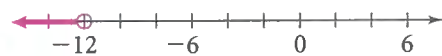


### 3 EXAMPLE Using the Subtraction Property of Inequality

Solve  $y + 5 < -7$ . Graph the solution.

$$y + 5 - 5 < -7 - 5 \quad \text{Subtract 5 from each side.}$$

$$y < -12 \quad \text{Simplify.}$$



### Quick Check

3 Solve  $t + 3 \geq 8$ . Graph and check your solution.

You can use inequalities to model real-world situations.

### 4 EXAMPLE Real-World Problem Solving

**Multiple Choice** The maximum safe load of a chairlift is 680 lb. In the spring, a cyclist and bicycle go to the top of the slope using the chairlift. The weight of the person is 124 lb, and the weight of the bicycle is 32 lb. Which inequality best describes how much additional weight  $w$  the chairlift could safely carry?

(A)  $124 + w \leq 680 + 32$

(B)  $124 + 32 + w \leq 680$

(C)  $32 + w \geq 680 + 124$

(D)  $124 + 32 + w \geq 680$

**Relate** weight of a person and a bicycle plus additional weight is at most safe load

**Define** Let  $w$  = the amount of weight that can be added to the chairlift.

**Write**  $124 + 32 + w \leq 680$

The inequality  $124 + 32 + w \leq 680$  models the situation. So B is the correct answer.

### Quick Check

4 Your baseball team has a goal to collect at least 160 blankets for a shelter. Team members brought 42 blankets on Monday and 65 blankets on Wednesday. Write an inequality to describe how many blankets the team must donate on Friday to make or exceed their goal.



### Test-Taking Tip

You can test inequality choices by substituting a reasonable value for the variable. If the value is NOT a solution of the inequality you can eliminate that choice as the correct answer.

## EXERCISES

For more exercises, see *Extra Skill and Word Problem Practice*.

### Practice and Problem Solving

#### A Practice by Example

Examples 1, 2  
(pages 206, 207)



State what number you would add to each side of the inequality to solve the inequality.

1.  $d - 5 \geq -4$

2.  $0 < c - 8$

3.  $z - 4.3 \geq 1.6$

Solve each inequality. Graph and check your solution.

4.  $x - 1 > 10$

5.  $t - 3 < -2$

6.  $-5 > b - 1$

7.  $7 \leq d - 3$

8.  $s - 2 \geq -6$

9.  $r - 9 \leq 0$

10.  $8 < n - 2$

11.  $-4 \geq w - 2$

12.  $-1 < -4 + d$

13.  $y - \frac{1}{2} \leq -5$

14.  $-\frac{2}{3} > q - 4$

15.  $x - 2 \geq 0.5$

16.  $3.2 > -1.3 + r$

17.  $-3.4 > m - 1.8$

18.  $b - \frac{3}{8} < \frac{1}{8}$

19.  $n - 2\frac{1}{2} > \frac{1}{2}$

**Example 3**  
(page 208)

State what number you would subtract from each side of the inequality to solve the inequality.

20.  $w + 2 > -1$

21.  $8 < \frac{5}{3} + r$

22.  $5.7 \geq k + 3.1$

Solve each inequality. Graph and check your solution.

23.  $w + 4 \leq 9$

24.  $m + 5 > -3$

25.  $1 < 8 + b$

26.  $-2 \geq 4 + a$

27.  $r + 1 \geq -5$

28.  $k + 3 \leq 4$

29.  $3 > 4 + x$

30.  $-5 < 1 + p$

31.  $\frac{3}{5} + z \geq -\frac{2}{5}$

32.  $7.5 + y < 13$

33.  $\frac{1}{2} < m + 2$

34.  $2.7 \geq a + 3$

35.  $-2.9 < 4.1 + p$

36.  $\frac{1}{4} \geq h + \frac{3}{4}$

37.  $5.3 + d > 3.8$

38.  $t + \frac{3}{8} < -\frac{1}{8}$

**Example 4**  
(page 208)

39. **Vacation Budget** Your brother has \$2000 saved for a vacation. His airplane ticket is \$637. Write and solve an inequality to find how much he can spend for everything else.
40. **Weekly Budget** You have an allowance of \$15.00 per week. You are in a bowling league that costs \$6.50 each week, and you save at least \$5.00 each week. Write and solve an inequality to show how much you have left to spend each week.
41. **Fund-Raising** A school club is selling reflectors for Bicycle Safety Day. Each member is encouraged to sell at least 50 reflectors. You sell 17 on Monday and 12 on Tuesday. How many reflectors do you need to sell on Wednesday to meet your goal?

**B Apply Your Skills**

State what you must do to the first inequality in order to get the second.

42.  $36 \leq -4 + y$ ;  $40 \leq y$

43.  $9 + b > 24$ ;  $b > 15$

44.  $m - \frac{1}{2} < \frac{3}{8}$ ;  $m < \frac{7}{8}$

Solve each inequality.

45.  $w - 3 + 1 \geq 9$

46.  $\frac{1}{2} + c \leq 3\frac{1}{2}$

47.  $y - 0.3 < 2.8$

48.  $-6 > n - \frac{1}{5}$

49.  $z + 4.1 < -5.6$

50.  $-4.1 > y - 0.9$

51.  $\frac{2}{3} + t - \frac{5}{6} > 0$

52.  $5 \leq v - 4 - 7$

53.  $3.6 + k \geq -4.5$

54.  $6 + b - 7 < 5$

55.  $m + 2.3 \leq -1.2$

56.  $4 \geq k - \frac{3}{4}$

57.  $h - \frac{1}{2} \geq -1$

58.  $-7.7 \geq x - 2$

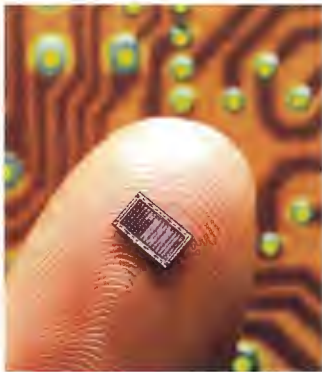
59.  $-2 > 9 + 3 + w$



60. **Banking** Your local bank offers free checking for accounts with a balance of at least \$500. Suppose you have a balance of \$516.46 and you write a check for \$31.96. How much must you deposit to avoid being charged a service fee?
61. a. If  $45 + 47 = t$ , does  $t = 45 + 47$ ?  
b. If  $45 + 47 < r$ , is  $r < 45 + 47$ ?  
c. Discuss the differences between these two examples.
62. **Gymnastics** Suppose your sister wants to qualify for a regional gymnastics competition. At today's competition she must score at least 34.0 points. She scored 8.8 on the vault, 7.9 on the balance beam, and 8.2 on the uneven parallel bars. The event that remains is the floor exercise.  
a. Write and solve an inequality that models the information.  
b. Explain what the solution means in terms of the original situation.  
c. **Open-Ended** Write three scores your sister could make that would allow her to qualify for the regional gymnastics competition.

**Real-World Connection**

More than 71,000 athletes compete in gymnastic programs in the United States.



### Real-World Connection

In 1971, a computer chip could hold 2300 transistors. In 2004, a chip could hold 410,000,000 transistors.

63. **Computers** Suppose your computer has nearly 64 megabytes (MB) of memory. Its basic systems require 12.8 MB. How much memory is available for other programs and functions?
64. To earn an A in Ms. Orlando's math class, students must score a total of at least 135 points on the three tests. On the first two tests, Amy's scores were 47 and 48. What is the minimum score she must get on the third test to earn an A?
65. a. **Open-Ended** Use each of the inequality symbols  $<$ ,  $\leq$ ,  $>$ , and  $\geq$  to write four addition or subtraction inequalities.  
b. Solve each of the inequalities in part (a) and graph your solution.
66. a. Sam says that he can solve  $z - 8.6 \geq 5.2$  by replacing  $z$  with 13, 14, and 15. When  $z = 13$ , the inequality is false. When  $z = 14$  and  $z = 15$ , the inequality is true. So Sam says that the solution is  $z \geq 14$ . Is his reasoning correct? Justify your answer.  
b. **Critical Thinking** Explain why substituting values into the inequality does not guarantee that your solution is correct.

Solve each inequality.

67.  $4x + 4 - 3x \geq 5$

68.  $-5n - 3 + 6n < 2$

69.  $7t - (6t - 2) \leq -1$

70.  $5k - 2(2k + 1) > 8$

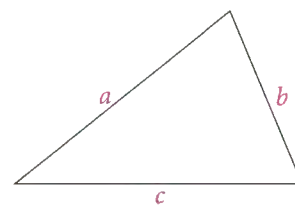
71.  $-6(a + 2) + 7a \leq 12$

72.  $-2(a - 3) + 3(a + 2) < 4$

73. **Geometry** The Triangle Inequality Theorem states that the sum of the lengths of any two sides of a triangle is greater than the length of the third side. Following are inequalities for sides of the triangle shown.

$$a + b > c \quad b + c > a \quad a + c > b$$

- a. Write an inequality using  $c - b$  and  $a$ .  
b. Write an inequality using  $a - c$  and  $b$ .  
c. Write an inequality using  $b - a$  and  $c$ .  
d. **Writing** Write a generalization about the length of the third side and the difference of the lengths of the other two sides.



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### Challenge

**Reasoning** Decide if each inequality is true for all real numbers. If the inequality is not true, give a counterexample.

74.  $a - b < a + b$

75. If  $a \geq b$ , then  $a + c \geq b + c$ .

76. If  $c > d$ , then  $a - c < a - d$ .

77. If  $a < b$ , then  $a < b + c$ .

78. **Reasoning** Find real numbers  $x$ ,  $y$ ,  $z$ , and  $w$  for which it is true that  $x > y$  and  $z > w$ , but it is not true that  $x - z > y - w$ .



### Test Prep

#### Multiple Choice

79. Solve  $x + 5 < 13$ .

A.  $x > 8$

B.  $x < 8$

C.  $x > 18$

D.  $x < 18$

80. Solve  $-12 + n > 20$ .

F.  $n < 32$

G.  $n > 32$

H.  $n < 8$

J.  $n > 8$



- 4 Students in the school band are selling calendars. They earn \$.40 on each calendar they sell. Their goal is to earn more than \$327. Write and solve an inequality to find the fewest number of calendars they can sell and still reach their goal.

## EXERCISES

For more exercises, see *Extra Skill and Word Problem Practice*.

### Practice and Problem Solving

#### A Practice by Example

Examples 1, 2  
(page 213)



Example 3  
(page 214)

Example 4  
(page 214)

Solve each inequality. Graph and check your solution.

- |                                   |                                      |                                   |                                    |
|-----------------------------------|--------------------------------------|-----------------------------------|------------------------------------|
| 1. $\frac{t}{4} \geq -1$          | 2. $\frac{s}{6} < 1$                 | 3. $1 \leq -\frac{w}{2}$          | 4. $2 < -\frac{p}{4}$              |
| 5. $-2 < \frac{y}{2}$             | 6. $-\frac{v}{3} \geq 0.5$           | 7. $4 > \frac{2}{3}x$             | 8. $-5 \leq \frac{5}{2}k$          |
| 9. $0 < -\frac{7}{8}x$            | 10. $\frac{4}{3}y \geq 0$            | 11. $-\frac{5}{7}x > -5$          | 12. $6 \geq -\frac{3}{2}d$         |
| 13. $-\frac{4}{9} < \frac{2}{3}c$ | 14. $\frac{3}{4}b \geq -\frac{9}{8}$ | 15. $-\frac{5}{3}u > \frac{5}{6}$ | 16. $-\frac{5}{8} > -\frac{5}{6}n$ |
| 17. $3t < -9$                     | 18. $4m \geq 8$                      | 19. $10 \leq -2w$                 | 20. $-20 > -5c$                    |
| 21. $-27 \geq 3z$                 | 22. $-7b > 42$                       | 23. $18d < -12$                   | 24. $-3x \leq 16$                  |
| 25. $-7 < 2q$                     | 26. $16 > 3.2h$                      | 27. $-1.5d < -6$                  | 28. $3.6 \leq -0.8m$               |

29. **Fund-Raising** The science club charges \$4.50 per car at their car wash. Write and solve an inequality to find how many cars they have to wash to earn at least \$300.
30. **Earnings** Suppose you earn \$6.15 per hour working part time at a dry cleaner. Write and solve an inequality to find how many full hours you must work to earn at least \$100.

#### B Apply Your Skills

Write four solutions to each inequality.

- |                           |                           |                           |                          |
|---------------------------|---------------------------|---------------------------|--------------------------|
| 31. $\frac{x}{2} \leq -1$ | 32. $\frac{r}{3} \geq -4$ | 33. $-1 \geq \frac{t}{5}$ | 34. $0.5 > \frac{1}{2}c$ |
| 35. $-\frac{3}{4}q > 4$   | 36. $1 < -\frac{5}{7}s$   | 37. $-4.5 \leq -0.9p$     | 38. $-2.7w \geq 28$      |

Tell what you must do to the first inequality in order to get the second.

- |                                 |                                       |
|---------------------------------|---------------------------------------|
| 39. $-\frac{c}{4} > 3; c < -12$ | 40. $\frac{n}{5} \leq -2; n \leq -10$ |
| 41. $5z > -25; z > -5$          | 42. $\frac{3}{4}b \leq 3; b \leq 4$   |
| 43. $-12 < 4a; -3 < a$          | 44. $-b \geq 3.4; b \leq -3.4$        |

Replace each  $\square$  with the number that makes the inequalities equivalent.

- |                                     |                                    |
|-------------------------------------|------------------------------------|
| 45. $s > 14; s < -7$                | 46. $\square x \geq 25; x \leq -5$ |
| 47. $-8u \leq \square; u \geq -0.5$ | 48. $-2a > \square; a < -9$        |
| 49. $36 < \square r; r < -3.6$      | 50. $-k \leq \square; k \geq -7.5$ |

51. **Critical Thinking** If  $x \geq y$  and  $-x \geq -y$ , what can you conclude about  $x$  and  $y$ ?

**Estimation** Estimate the solution of each inequality.



- |                   |                   |                               |                                |
|-------------------|-------------------|-------------------------------|--------------------------------|
| 52. $-2.099r < 4$ | 53. $3.87j > -24$ | 54. $20.95 \geq \frac{1}{2}p$ | 55. $-\frac{20}{39}s \leq -14$ |
|-------------------|-------------------|-------------------------------|--------------------------------|



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-  **56. Safe Load** An elevator like the one at the left can safely lift at most 4400 lb. A concrete block has an average weight of 42 lb. What is the maximum number of concrete blocks that the elevator can lift?
-  **57. Writing** Explain how solving the equation  $-\frac{x}{3} = 4$  is similar to and different from solving the inequality  $-\frac{x}{3} > 4$ .
- 58. Open-Ended** Write four different inequalities with  $x > 3$  as their solution that you can solve using multiplication or division.

**Solve each inequality.**

- 59.**  $4d \leq -28$       **60.**  $\frac{u}{7} > 5$       **61.**  $2 < -8s$       **62.**  $\frac{3}{2}k \geq -45$   
**63.**  $0.3y < 2.7$       **64.**  $9.4 \leq -4t$       **65.**  $-h \geq 4$       **66.**  $\frac{5}{2}x > 5$   
**67.**  $24 < -\frac{8}{3}x$       **68.**  $0 < -\frac{1}{6}b$       **69.**  $\frac{5}{6} > -\frac{1}{3}p$       **70.**  $-0.2m \geq 9.4$   
**71.**  $6 < -9g$       **72.**  $4n \geq 9$       **73.**  $-3.5 < -m$       **74.**  $\frac{2}{5}z \geq -1$



- 75.** Michael solved the inequality  $-2 > \frac{y}{3}$  and got  $6 < y$ . Erica solved the same inequality and got  $y > 6$ . Are they both correct? Explain.
- 76.** A friend calls you and asks you to meet at a location 3 miles from your home in 20 minutes. You set off on your bicycle after the telephone call. Write and solve an inequality to find the average rate in miles per minute you could ride to be at your meeting place within 20 minutes.
- 77. a. Error Analysis** Kia solved  $-15q \leq 135$  by adding 15 to each side of the inequality. What mistake did she make?  
**b.** Kia's solution was  $q \leq 150$ . She checked her work by substituting 150 for  $q$  in the original inequality. Why didn't her check let her know that she had made a mistake?  
**c. Open-Ended** Find a number that satisfies Kia's solution but does not satisfy the original inequality.

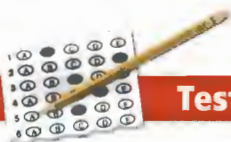
**Real-World Connection**

Depending on its size, an elevator at a construction site can have a maximum load from 900 lb to 20,000 lb.

**C Challenge**

**Reasoning** If  $a$ ,  $b$ , and  $c$  are real numbers, for which values of  $a$  is each statement true?

- 78.** If  $c < 0$ , then  $ac < a$ .      **79.** If  $b > c$ , then  $ab > ac$ .  
**80.** If  $b > c$ , then  $a^2b > a^2c$ .      **81.** If  $b > c$ , then  $\frac{b}{a} < \frac{c}{a}$ .
-  **82. Packaging** Suppose you have a plastic globe that you wish to put into a gift box. The circumference of the globe is 15 in. The edges of cube-shaped boxes are either 3 in., 4 in., 5 in., or 6 in. Write and solve an inequality to find the boxes that will hold the globe. (*Hint:* circumference =  $\pi \cdot$  diameter)
-  **83. Tiling a Floor** The Sumaris' den floor measures 18 ft by 15 ft. They want to cover the floor with square tiles that are  $\frac{9}{16}$  ft<sup>2</sup>. Write and solve an inequality to find the least number of tiles they need to cover the floor.



**Test Prep**



**Gridded Response**

- 84.** Solve  $\frac{2}{5}x = 16$ .  
**85.** Paul expects to pay \$1680 in income taxes. This is no more than  $\frac{1}{5}$  of his salary. What is his least possible earned income?

