

Solving Inequalities Using Multiplication or Division

Essential Question How can you use multiplication or division to solve an inequality?

1 ACTIVITY: Matching Inequalities

Work with a partner. Match the inequality with its graph.

a. $3x < 9$

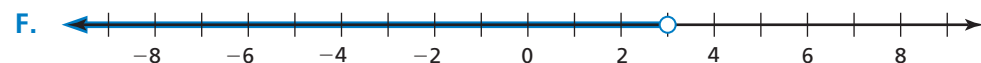
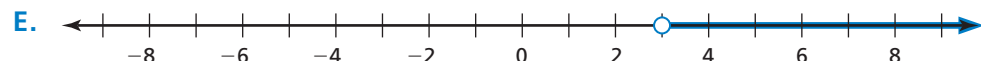
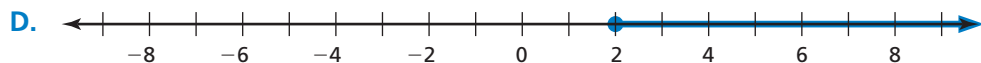
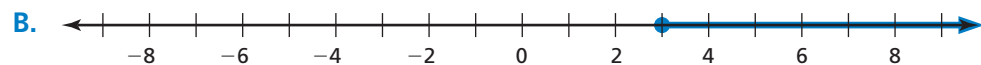
b. $3x \leq 9$

c. $\frac{x}{2} \geq 1$

d. $6 < 2x$

e. $12 \leq 4x$

f. $\frac{x}{2} < 2$



2 ACTIVITY: Writing an Inequality

Work with a partner. One of your favorite stores is having a 75% off sale. You have \$20. You want to buy a pair of jeans.

- a. Which of the following represents your ability to buy the jeans with \$20?

$0.25x < 20$

$0.25x \leq 20$

$0.25x > 20$

$0.25x \geq 20$



- b. What does x represent? Graph the possible values of x on a number line.
- c. Can you afford a pair of jeans that originally costs \$100? Explain.

3 ACTIVITY: Spaceman Game

$$\begin{aligned}
 x + 13 &\geq 90 \\
 x - 2 &\geq 5 \\
 39 &< 3x \\
 65 &< x + 10 \\
 2x &\geq 22 \\
 x + 5 &> 24 \\
 33 &\leq x - 5 \\
 3x &> 126 \\
 6 &< x - 2 \\
 x + 2 &\geq 3 \\
 x + 30 &\geq 84 \\
 35 &\leq x + 6 \\
 32 &\leq x - 29 \\
 7x &> 441 \\
 110 &< x + 32 \\
 180 &\leq 4x \\
 x - 52 &\geq 32 \\
 x - 9 &> 21 \\
 2x &\geq 178 \\
 4 &< x + 1 \\
 x - 24 &> 34 \\
 58 &< x - 28 \\
 134 &< 2x \\
 \frac{x}{2} &\geq 45 \\
 17 &< \frac{x}{3} \\
 \frac{x}{3} &\geq 5 \\
 8 &\leq \frac{x}{2} \\
 \frac{x}{4} &\geq 12 \\
 \frac{x}{5} &> 14 \\
 37 &\leq \frac{x}{2}
 \end{aligned}$$

Play with a partner.

- Player 1: Start the game by choosing an inequality from the list that has a solution of $x \geq 1$. This allows you to destroy Asteroids 1, 2, and 3.
- Player 2: Asteroid 3 is destroyed. Choose an inequality from the list that has a solution of $x > 3$ or $x \geq 4$. This allows you to destroy Asteroid 4, an alien, and Asteroid 6.
- You can only destroy asteroids and aliens in a straight line.
- Each asteroid is worth 1 point. Each alien is worth 2 points.
- Take turns until someone reaches the end of the maze. The player with the most points wins.
- If an incorrect inequality is chosen, then the player loses that turn.



What Is Your Answer?

4. **IN YOUR OWN WORDS** How can you use multiplication or division to solve an inequality?

Practice →

Use what you learned about solving inequalities using multiplication or division to complete Exercises 8–11 on page 348.

Key Ideas
Remember

Multiplication and division are inverse operations.

Multiplication Property of Inequality

Words If you multiply each side of an inequality by the same *positive* number, the inequality remains true.

Numbers $8 > 6$

$$8 \times 2 > 6 \times 2$$

$$16 > 12$$

Algebra $\frac{x}{4} < 2$

$$\frac{x}{4} \cdot 4 < 2 \cdot 4$$

$$x < 8$$

Division Property of Inequality

Words If you divide each side of an inequality by the same *positive* number, the inequality remains true.

Numbers $8 > 6$

$$8 \div 2 > 6 \div 2$$

$$4 > 3$$

Algebra $4x < 8$

$$\frac{4x}{4} < \frac{8}{4}$$

$$x < 2$$

These properties are also true for \leq and \geq .

EXAMPLE 1 Solving an Inequality Using Multiplication

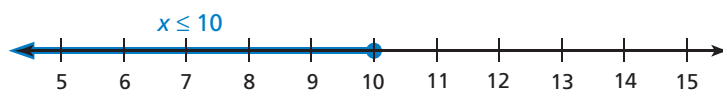
Solve $\frac{x}{5} \leq 2$. Graph the solution.

$$\frac{x}{5} \leq 2 \quad \text{Write the inequality.}$$

Undo the division. $\rightarrow \frac{x}{5} \cdot 5 \leq 2 \cdot 5$ Multiply each side by 5.

$$x \leq 10 \quad \text{Simplify.}$$

∴ The solution is $x \leq 10$.



Check: $x = 5$ is a solution.

Check: $x = 15$ is *not* a solution.

On Your Own

Solve the inequality. Graph the solution.

1. $p \div 3 > 2$

2. $\frac{q}{6} \leq 5$

3. $1 < \frac{s}{7}$

Now You're Ready
Exercises 6–9

EXAMPLE 2 Solving an Inequality Using Division

Solve $4n > 32$. Graph the solution.

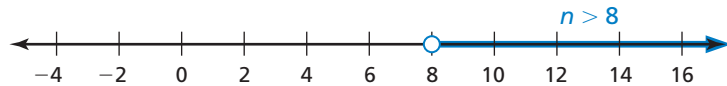
$$4n > 32 \quad \text{Write the inequality.}$$

Undo the multiplication.

$$\frac{4n}{4} > \frac{32}{4} \quad \text{Divide each side by 4.}$$

$$n > 8 \quad \text{Simplify.}$$

••• The solution is $n > 8$.



EXAMPLE 3 Real-Life Application

A one-way bus ride costs \$1.75. A 30-day bus pass costs \$42.

- Write and solve an inequality to find the least number of one-way rides you must take for the 30-day pass to be a better deal.
- You ride the bus an average of 20 times each month. Is the pass a better deal? Explain.

a. **Words** The price of a one-way ride times the number of one-way rides is more than \$42.

Variable Let r be the number of one-way rides.

Inequality $1.75 \cdot r > 42$

$$1.75r > 42 \quad \text{Write the inequality.}$$

$$\frac{1.75r}{1.75} > \frac{42}{1.75} \quad \text{Divide each side by 1.75.}$$

$$r > 24 \quad \text{Simplify.}$$

••• You need to take more than 24 one-way rides for the pass to be a better deal.

- No. The cost of 20 one-way rides is less than \$42. So, the pass is not a better deal.

On Your Own

Solve the inequality. Graph the solution.

4. $11k \leq 33$

5. $5 \cdot j > 20$

6. $50 \leq 2m$

- The sign shows the toll for driving on Alligator Alley. Write and solve an inequality to represent the number of times someone can drive on Alligator Alley with \$15.

**Passenger Cars
Toll \$2.50**



Vocabulary and Concept Check

1. **REASONING** How is the graph of the solution of $2x \geq 10$ different from the graph of the solution of $2x = 10$?

Name the property you should use to solve the inequality.

2. $3x \leq 27$

3. $7x > 49$

4. $\frac{x}{2} < 36$

5. **OPEN-ENDED** Write two inequalities that have the same solution set: one that can be solved using division and one that can be solved using multiplication.



Practice and Problem Solving

Solve the inequality. Graph the solution.

1 6. $\frac{m}{8} < 4$

7. $\frac{n}{6} > 2$

8. $\frac{t}{3} \geq 15$

9. $\frac{c}{11} \geq 9$

2 10. $12x < 96$

11. $5x \geq 25$

12. $8w \leq 72$

13. $7p \leq 42$

14. $\frac{b}{4} > 13$

15. $6x < 90$

16. $3s \geq 36$

17. $\frac{v}{9} \leq 45$

18. $4t > 72$

19. $\frac{q}{5} \leq 35$

20. $12m < 132$

21. $\frac{x}{9} \geq 18$


22. **ERROR ANALYSIS** Describe and correct the error in solving the inequality.

23. **GEOMETRY** The length of a rectangle is 8 feet and its area is less than 168 square feet. Write and solve an inequality to represent the width of the rectangle.

24. **PLAYGROUND** Students at a playground are divided into five equal groups with at least six students in each group. Write and solve an inequality to represent the number of students at the playground.

Write the word sentence as an inequality. Then solve the inequality.

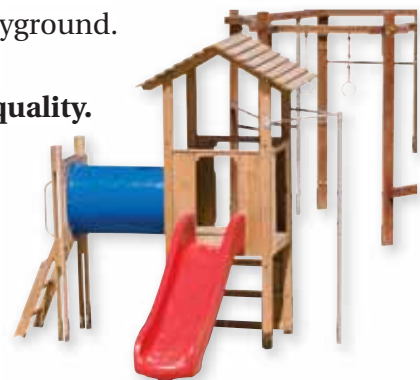
25. Eight times a number n is less than 72.
 26. A number t divided by 32 is at most 4.25.
 27. 225 is no less than 12 times a number w .



$$\frac{x}{6} \leq 30$$

$$\frac{x}{6} \cdot 6 \leq \frac{30}{6}$$

$$x \leq 5$$



Graph the numbers that are solutions to both inequalities.

28. $x + 7 > 9$ and $8x \leq 64$

29. $x - 3 \leq 8$ and $6x < 72$

30. **THRILL RIDE** A thrill ride at an amusement park holds a maximum of 12 people per ride.

- a. Write and solve an inequality to find the least number of rides needed for 15,000 people.
- b. Do you think it is possible for 15,000 people to ride the thrill ride in one day? Explain.

31. **FOOTBALL** A winning football team more than doubled the offensive yards gained by its opponent. The opponent gained 272 offensive yards. The winning team had 80 offensive plays. Write and solve an inequality to find the possible number of yards per play for the winning team.

32. **CRITICAL THINKING** Explain how you know that $7x < 7x$ has no solution.

33. **OPEN-ENDED** Give an example of a real-life situation in which you can list all the solutions of an inequality. Give an example of a real-life situation in which you cannot list all the solutions of an inequality.



Park Hours
10:00 A.M.–10:00 P.M.



34. **FUNDRAISER** You are selling items from a catalog for a school fundraiser. Write and solve two inequalities to find the range of sales that will earn you between \$40 and \$50.

Critical Thinking Let $a > b$ and $x > y$. Tell whether the statement is *always* true. Explain your reasoning.

35. $a + x > b + y$

36. $a - x > b - y$

37. $ax > by$

38. $\frac{a}{x} > \frac{y}{b}$



Fair Game Review what you learned in previous grades & lessons

Solve the equation. Check your solution. (Section 7.4)

39. $3x - 8 = 7$

40. $\frac{w}{4} - 3 = 21$

41. $4x + 5 = 53$

42. **MULTIPLE CHOICE** On a normal day, 12 airplanes arrive at an airport every 15 minutes. Which rate does not represent this situation? (Section 5.2)

(A) $\frac{12 \text{ airplanes}}{15 \text{ minutes}}$

(B) $\frac{4 \text{ airplanes}}{5 \text{ minutes}}$

(C) $\frac{6 \text{ airplanes}}{9 \text{ minutes}}$

(D) $\frac{48 \text{ airplanes}}{1 \text{ hour}}$