

## 5-2 Solving Inequalities by Multiplication and Division

**1 Solve Inequalities by Multiplication** If you multiply each side of an inequality by a positive number, then the inequality remains true.

$$4 > 2 \quad \text{Original inequality}$$

$$4(3) \stackrel{?}{=} 2(3) \quad \text{Multiply each side by 3.}$$

$$12 > 6 \quad \text{Simplify.}$$

Notice that the direction of the inequality remains the same.

If you multiply each side of an inequality by a negative number, the inequality symbol changes direction.

$$7 < 9 \quad \text{Original inequality}$$

$$7(-2) \stackrel{?}{=} 9(-2) \quad \text{Multiply each side by } -2.$$

$$-14 > -18 \quad \text{Simplify.}$$



 Real-World Example 1

## Write and Solve an Inequality

**HIKING** Mateo is walking at a rate of  $\frac{3}{4}$  mile per hour. He knows that it is at least 9 miles to Onyx Lake. How long will it take Mateo to get there? Write and solve an inequality to find the length of time.

**Understand** You know the rate that Mateo is walking and the approximate distance to the lake.

**Plan** The formula for distance is  $d = rt$ . Write an inequality that represents this situation.

Words

Three fourths mph times time is at least 9 miles.

Inequality

$\frac{3}{4}$

.

$t$

$\geq$

9.

**Solve**

$$\frac{3}{4}t \geq 9$$

Original inequality

$$\left(\frac{4}{3}\right)\frac{3}{4}t \geq \left(\frac{4}{3}\right)9$$

Multiply each side by  $\frac{4}{3}$ .

$$t \geq 12$$

Simplify.

## Real-World Example 1

## Check Your Progress

**SCHOOL** At Midpark High School,  $\frac{2}{3}$  of the junior class attended the dance. There were at least 200 juniors at the dance. How many students are in the junior class?

- A.  $j \leq 300$
- B.  $j \geq 300$
- C.  $j \geq 200$
- D.  $j \leq 200$

$$\frac{2}{3} \cdot \frac{3}{2} \cdot x \geq \frac{200}{\cancel{2}} \cdot \frac{3}{2}$$
$$x \geq 300$$

 Real-World Example 1 Check Your Progress

**SCHOOL** At Midpark High School,  $\frac{2}{3}$  of the junior class attended the dance. There were at least 200 juniors at the dance. How many students are in the junior class?

A.  $j \leq 300$

B.  $j \geq 300$

C.  $j \geq 200$

D.  $j \leq 200$



## EXAMPLE 2

## Solve by Multiplying

Solve  $-\frac{3}{5}d \geq 6$ .

$$-\frac{3}{5}d \geq 6$$

Original inequality

$$\left(-\frac{5}{3}\right)\left(-\frac{3}{5}\right)d \leq 6\left(-\frac{5}{3}\right)$$

Multiply each side by  $-\frac{5}{3}$  and change  $\geq$  to  $\leq$ .

$$d \leq -10$$

Simplify.

## EXAMPLE 2



## Check Your Progress

Solve  $-\frac{1}{3}x > 10$ .

A.  $x > \frac{10}{3}$

B.  $x > -\frac{10}{3}$

C.  $x < -30$

D.  $x > -30$

## EXAMPLE 2



## Check Your Progress

Solve  $-\frac{1}{3}x > 10$ .

A.  $x > \frac{10}{3}$

B.  $x > -\frac{10}{3}$

**C.**  $x < -30$

D.  $x > -30$



**EXAMPLE 3****Divide to Solve an Inequality**

**A. Solve**  $12k \geq 60$ .

$$12k \geq 60$$

Original inequality

$$\frac{12k}{12} \geq \frac{60}{12}$$

Divide each side by 12 and do not change the direction of the inequality sign.

$$k \geq 5$$

Simplify.

## EXAMPLE 3

## Divide to Solve an Inequality

**B. Solve  $-8q < 136$ .**

$$-8q < 136$$

$$\frac{-8q}{-8} > \frac{136}{-8}$$

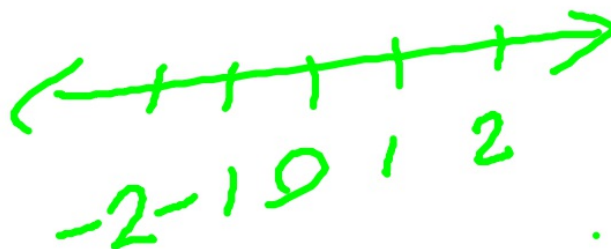
$$q > -17$$

Original inequality

Divide each side by  $-8$  and  
change  $<$  to  $>$ .

Simplify.

$$\begin{array}{l} -8q < 136 \\ q > -17 \end{array}$$



$$\frac{5}{5}x > \frac{-15}{5}$$

~~$$x > -3$$~~

$$\Rightarrow x > -3$$

## EXAMPLE 3



## Check Your Progress

A. Solve  $15p < 60$ .

A.  $\{p \mid p < 4\}$

B.  $\{p \mid p < 45\}$

C.  $\{p \mid p < 75\}$

D.  $\{p \mid p > 4\}$

## EXAMPLE 3



## Check Your Progress

A. Solve  $15p < 60$ .

A.  $\{p \mid p < 4\}$

B.  $\{p \mid p < 45\}$

C.  $\{p \mid p < 75\}$

D.  $\{p \mid p > 4\}$

## EXAMPLE 3



## Check Your Progress

**B.** Solve  $-4z > 64$ .

A.  $\{z \mid z < 16\}$

B.  $\{z \mid z < -16\}$

C.  $\{z \mid z > -16\}$

D.  $\{z \mid z > 16\}$



## EXAMPLE 3



## Check Your Progress

**B.** Solve  $-4z > 64$ .

A.  $\{z \mid z < 16\}$

**B.**  $\{z \mid z < -16\}$

C.  $\{z \mid z > -16\}$

D.  $\{z \mid z > 16\}$

$$15x > 5500$$

### Check Your Understanding



 = Step-by-Step Solutions begin on page R13.

#### Example 1

1. **FUNDRAISING** The Jefferson Band Boosters raised more than \$5500 from sales of their \$15 band DVD. Define a variable, and write an inequality to represent the number of DVDs they sold. Solve the inequality and interpret your solution.

Let  $d$  = the number of DVDs sold;  $15d > 5500$ ;  $d > 366.67$ ; the band sold at least 367 DVDs.

**Examples 2–3** Solve each inequality. Graph the solution on a number line.

2.  $30 > \frac{1}{2}n$   $\{n | n < 60\}$     3.  $-\frac{3}{4}r \leq -6$   $\{r | r \geq 8\}$     4.  $-\frac{c}{6} \geq 7$   $\{c | c \leq -42\}$     5.  $\frac{h}{2} < -5$   $\{h | h < -10\}$  
6.  $9t > 108$   $\{t | t > 12\}$     7.  $-84 < 7v$   $\{v | v > -12\}$     8.  $-28 \leq -6x$   $\{x | x \leq 4\frac{2}{3}\}$     9.  $40 \geq -5z$   $\{z | z \geq -8\}$  

### Practice and Problem Solving

Extra Practice is on page R5.

#### Example 1

Define a variable, write an inequality, and solve each problem. Then interpret your solution.

10. Let  $m$  = the number of minutes that Mario can talk;  $0.13m \leq 50$ ;  $m \leq 384.6$ ; Mario can talk up to 384 minutes.

10. **CELL PHONE PLAN** Mario purchases a prepaid phone plan for \$50 at \$0.13 per minute. How many minutes can Mario talk on this plan?

$$\left(-\frac{4}{3}\right) \left(-\frac{3}{4}r\right) = \left(\frac{4}{3}\right) (-6)$$

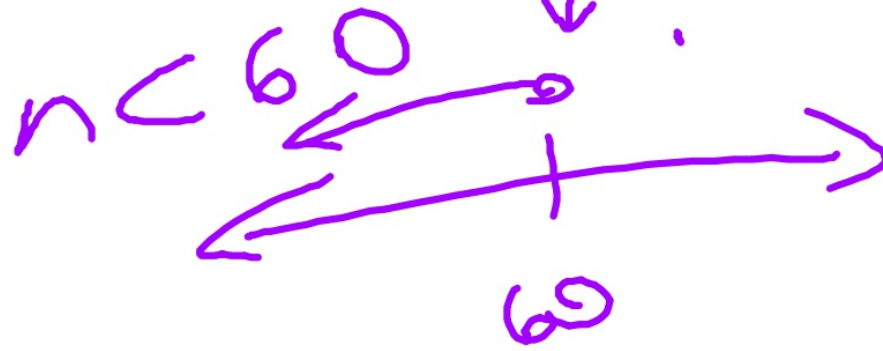
$$r \geq 8$$



$$2. 30 > \frac{1}{2}n \quad \{n | n < 60\}$$

$$2 \cdot 30 > \frac{1}{2}n \cdot 2$$

$$60 > n$$



$$25x \geq 560$$

11. **FINANCIAL LITERACY** Rodrigo needs at least \$560 to pay for his spring break expenses, and he is saving \$25 from each of his weekly paychecks. How long will it be before he can pay for his trip? **See margin.**

**Examples 2–3** Solve each inequality. Graph the solution on a number line.

**12–29.** See Chapter 5 Answer Appendix for graphs.

12.  $\frac{1}{4}m \leq -17$   $\{m | m \leq -68\}$  13.  $\frac{1}{2}a < 20$   $\{a | a < 40\}$  14.  $-11 > -\frac{c}{11}$   $\{c | c > 121\}$   
 15.  $-2 \geq -\frac{d}{34}$   $\{d | d \geq 68\}$  16.  $-10 \leq \frac{x}{-2}$   $\{x | x \leq 20\}$  17.  $-72 < \frac{f}{-6}$   $\{f | f < 432\}$   
 18.  $\frac{2}{3}h > 14$   $\{h | h > 21\}$  19.  $-\frac{3}{4}j \geq 12$   $\{j | j \leq -16\}$  20.  $-\frac{1}{6}n \leq -18$   $\{n | n \geq 108\}$   
 21.  $6p \leq 96$   $\{p | p \leq 16\}$  22.  $4r < 64$   $\{r | r < 16\}$  23.  $32 > -2y$   $\{y | y > -16\}$   
 24.  $-26 < 26t$   $\{t | t > -1\}$  25.  $-6v > -72$   $\{v | v < 12\}$  26.  $-33 \geq -3z$   $\{z | z \geq 11\}$   
 27.  $4b \leq -3$   $\{b | b \leq -\frac{3}{4}\}$  28.  $-2d < 5$   $\{d | d > -2\frac{1}{2}\}$  29.  $-7f > 5$   $\{f | f < -\frac{5}{7}\}$

19.  $-\frac{3}{4}j \geq 12$   $\left(\frac{-4}{3}\right)\left(\frac{-4}{3}\right)$

$j \leq -16$