

# Lesson 11.3:

## Solving Inequalities Using Multiplication or Division

### Essential Question

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

## Key Idea

### Multiplication and Division Properties of Inequality (Case 1)

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

**Numbers**  $-4 < 6$   $4 > -6$

$$2 \cdot (-4) < 2 \cdot 6 \qquad \frac{4}{2} > \frac{-6}{2}$$

$$-8 < 12 \qquad 2 > -3$$

**Algebra** If  $a < b$  and  $c$  is positive, then

$$a \cdot c < b \cdot c \quad \text{and} \quad \frac{a}{c} < \frac{b}{c}$$

If  $a > b$  and  $c$  is positive, then

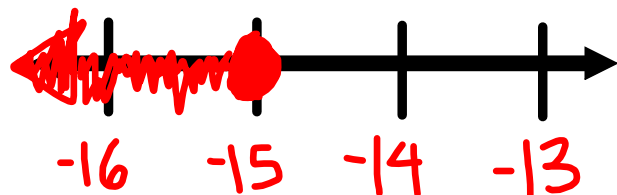
$$a \cdot c > b \cdot c \quad \text{and} \quad \frac{a}{c} > \frac{b}{c}$$

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

Solve  $\frac{x}{5} \leq -3$ . Graph the solution.

$$\begin{array}{r} .5 \cdot 5 \\ \hline x \leq -15 \end{array}$$

Check:  $\frac{-20}{5} \leq -3$   
 $-4 \leq -3$  ✓



Solve the inequality. Graph the solution.

$$1. n \div 3 < 1$$

$$\begin{array}{r} \cdot 3 \quad | \quad \cdot 3 \\ \hline n < 3 \end{array}$$

$$2. -0.5 \leq \frac{m}{10}$$

$$\cdot 10 \quad \cdot 10$$

$$-5 \leq m$$

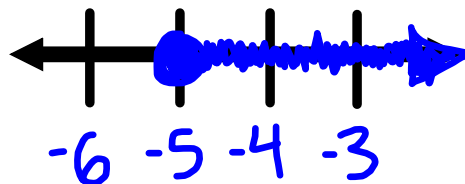
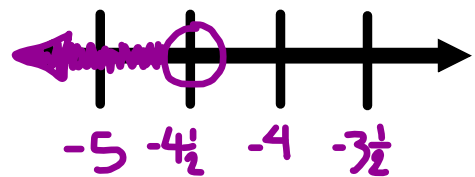
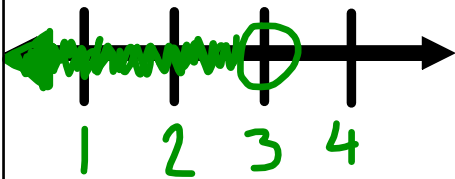
$$m \geq -5$$

$$3. -3 > \frac{2}{3}p$$

$$\div \frac{2}{3} \quad \div \frac{2}{3}$$

$$-3 \cdot \frac{3}{2} = -\frac{9}{2} = -4\frac{1}{2}$$

$$-4\frac{1}{2} > p \quad p < -4\frac{1}{2}$$



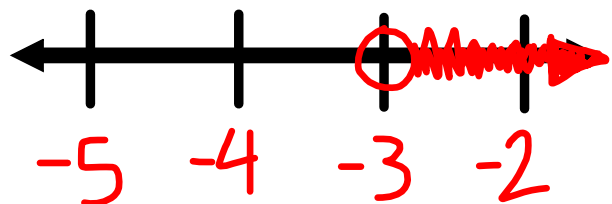
Solve  $6x > -18$ . Graph the solution.

$$\frac{6x}{6} > \frac{-18}{6}$$

$$x > -3$$

Check:  $6(-2) > -18$

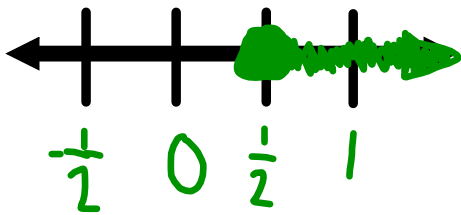
$$-12 > -18 \quad \checkmark$$



Solve the inequality. Graph the solution.

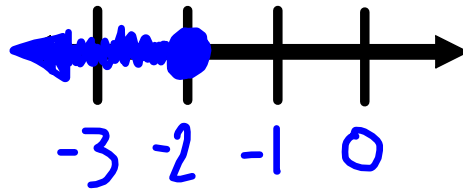
$$4. \frac{4b}{4} \geq \frac{2}{4}$$

$$b \geq \frac{1}{2}$$



$$5. \frac{12k}{12} \leq \frac{-24}{12}$$

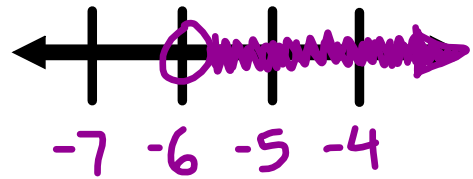
$$k \leq -2$$



$$6. \frac{-15}{25} < \frac{2.5q}{2.5}$$

$$-6 < q$$

$$q > -6$$



### Key Idea

#### Multiplication and Division Properties of Inequality (Case 2)

**Words** When you multiply or divide each side of an inequality by the same *negative* number, the direction of the inequality symbol must be reversed for the inequality to remain true.

<b>Numbers</b>	$-4 < 6$	$4 > -6$
	$-2 \cdot (-4) > -2 \cdot 6$	$\frac{4}{-2} < \frac{-6}{-2}$
	$8 > -12$	$-2 < 3$

**Algebra** If  $a < b$  and  $c$  is negative, then

$$a \cdot c > b \cdot c \quad \text{and} \quad \frac{a}{c} > \frac{b}{c}$$

If  $a > b$  and  $c$  is negative, then

$$a \cdot c < b \cdot c \quad \text{and} \quad \frac{a}{c} < \frac{b}{c}$$

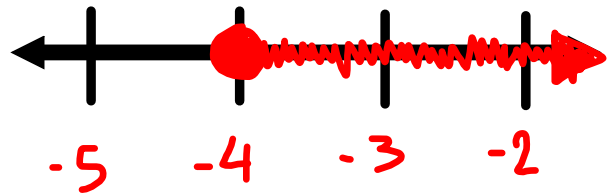
These properties are also true for  $\leq$  and  $\geq$ .

Solve  $-\frac{3}{2}n \leq 6$ . Graph the solution.

$$\begin{array}{r} \div -\frac{3}{2} \quad \div -\frac{3}{2} \\ \hline n \geq -4 \end{array}$$

Check:  $-\frac{3}{2}(-2) \leq 6$   
 $3 \leq 6 \checkmark$

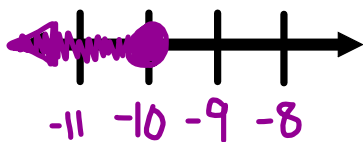
$$6 \cdot \left(-\frac{2}{3}\right) = -4$$



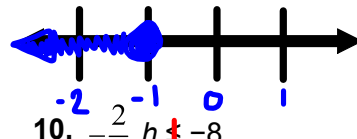
7.  $\frac{x}{-3} > -4$   
 $\cdot -3 \quad \cdot -3$   
 $\hline x < 12$   
 $\frac{9}{-3} > -4$   
 $-3 > -4 \checkmark$



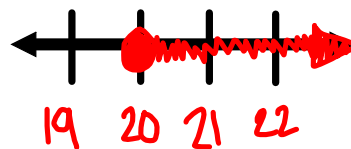
9.  $-12 \geq \frac{6}{5}m$   
 $\div \frac{6}{5} \quad \div \frac{6}{5}$   
 $\hline -10 \geq m$   
 $m \leq -10$   
 $-12 \cdot \frac{5}{6} = -10$



8.  $0.5 \leq -\frac{y}{2}$   
 $\cdot -2 \quad \cdot -2$   
 $\hline -1 \geq y$   
 $y \leq -1$   
 $0.5 \leq -\frac{(-2)}{2}$   
 $0.5 \leq 1 \checkmark$



10.  $-\frac{2}{5}h \leq -8$   
 $\div -\frac{2}{5} \quad \div -\frac{2}{5}$   
 $\hline h \geq 20$   
 $-8 \cdot \left(-\frac{5}{2}\right) = 20$

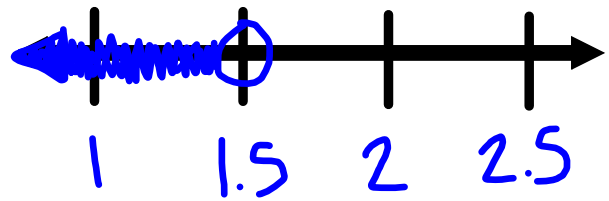


Solve  $-3z > -4.5$ . Graph the solution.

$$\frac{-3}{-3} \quad \frac{-4.5}{-3}$$

$$z < 1.5$$

$$\begin{array}{r} 1.5 \\ 3 \overline{)4.5} \\ \underline{-3} \phantom{0} \\ 15 \\ \underline{-15} \\ 0 \end{array}$$

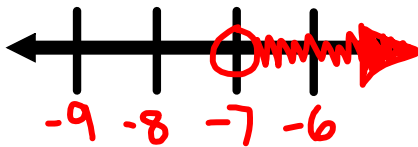


Solve the inequality. Graph the solution.

11.  $-5z < 35$

$$\frac{-5}{-5} \quad \frac{35}{-5}$$

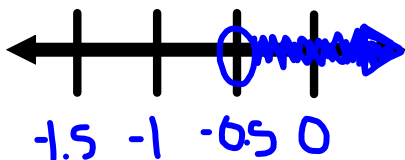
$$z > -7$$



13.  $-1.5 < 3n$

$$\frac{-1.5}{3} \quad \frac{3n}{3}$$

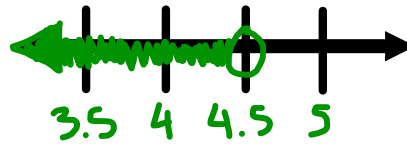
$$-0.5 < n \quad n > -0.5$$



12.  $-2a > -9$

$$\frac{-2}{-2} \quad \frac{-9}{-2}$$

$$a < 4.5$$



14.  $-4.2 \geq -0.7w$

$$\frac{-4.2}{-0.7} \quad \frac{-0.7w}{-0.7}$$

$$6 \leq w \quad w \geq 6$$

