

### Solve & Discuss It!

Alex and Hope were trying to solve  $-6x > 24$ . Whose inequality shows the solution? Show your work.

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Alex's Work

 $x > -4$

Hope's Work

 $x < -4$

**Construct Arguments** Why does more than one value of  $x$  make the inequality true?

### Lesson 5-5

## Solve Inequalities Using Multiplication or Division

**I can...** solve inequalities using multiplication or division.

### Focus on math practices

**Be Precise** What do you notice about the inequality symbols used in the original inequality and in the correct solution?

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### Essential Question

How is solving inequalities with multiplication and division similar to and different from solving equations with multiplication and division?

INTERACTIVE RESOURCES


ASK AN EXPERT

### EXAMPLE 1

#### Solve Inequalities That Involve Multiplication or Division of Positive Values

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Gina's pet pot-bellied pig is on a diet. He can have no more than 18 ounces of pig food per day. How many scoops of pig food can Gina feed the pig without going over 18 ounces?



**STEP 1** Write an inequality to represent the situation.

Ounces per scoop	·	Number of scoops	=	Maximum daily ounces
4	·	s	=	18

The total can be equal to but not more than 18.


**STEP 2** Solve the inequality as you would an equation. Then graph the solution.

$$4s \leq 18$$

$$\frac{4s}{4} \leq \frac{18}{4}$$

$$s \leq 4.5$$

Use the inverse relationship between multiplication and division and the *Division Property of Inequality* to isolate the variable.



Gina can feed her pig up to  $4\frac{1}{2}$  scoops of food.

**Look for Relationships** How can the Multiplication Property of Equality help you solve this problem?

**Try It!** Solve the inequality  $\frac{d}{7} > 15$ . Then graph the solution.

$$\frac{d}{7} > 15$$

□

·

7

>

15


·

□

d

>

□



**Convince Me!** Frances solved the inequality  $5g \geq 35$ . She says that 7 is a solution to the inequality. Is Frances correct? Explain.

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**EXAMPLE 2** Solve Inequalities Using Division by a Negative Value

Solve the inequality  $-3.4m \leq 17$ . Then graph the solution.

$$-3.4m \leq 17$$

$$\frac{-3.4m}{-3.4} \leq \frac{17}{-3.4}$$

$$m \geq -5$$

Use the inverse relationship between multiplication and division and the *Division Property of Inequality* to isolate the variable.

Dividing by a negative value reverses the inequality symbol.



**Try It!**

Solve each inequality. Then graph the solution.

a.  $149.76 > -19.2x$



b.  $-3.25y < -61.75$



**EXAMPLE 3** Solve Inequalities Using Multiplication by a Negative Value

Solve the inequality  $\frac{r}{-2.25} \geq 7$ . Then graph the solution.

$$\frac{r}{-2.25} \geq 7$$

$$-2.25 \cdot \frac{r}{-2.25} \geq 7 \cdot -2.25$$

$$r \leq -15.75$$

Use the inverse relationship between multiplication and division and the *Multiplication Property of Inequality* to isolate the variable.

Multiplying by a negative value reverses the inequality symbol.



**Try It!**

Solve each inequality. Then graph the solution.

a.  $\frac{k}{-0.5} < 12$



b.  $-\frac{5}{4}h \geq 25$



**KEY CONCEPT**

Solving inequalities with multiplication and division is the same as solving equations with multiplication and division when the values are positive. Use the inverse relationship between multiplication and division to isolate the variable.

$$2.5x \geq 15$$

$$\frac{2.5x}{2.5} \geq \frac{15}{2.5}$$

$$x \geq 6$$

Use inverse relationships and properties of inequality to isolate the variable.

When multiplying or dividing by negative values, the inequality symbol is reversed.

$$-2.5x \geq 15$$

$$\frac{-2.5x}{-2.5} \leq \frac{15}{-2.5}$$

$$x \leq -6$$

Multiplying or dividing by a negative value reverses the inequality.

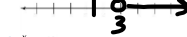
**Do You Understand?**

- Explain a Question** How is solving inequalities with multiplication and division similar to and different from solving equations with multiplication and division?
- Construct Arguments** Why is  $-x < 3$  equivalent to  $x > -3$ ? Provide a convincing argument.
- If  $a$ ,  $b$ , and  $c$  are rational numbers and  $a > b$ , is  $ac > bc$  always true? Justify your answer.

**Do You Know How?**

4. Solve each inequality. Then graph the solution.

a.  $4x > 12$



b.  $\frac{x}{4} \leq -12$



c.  $-4x > 12$



5. Vanna is saving for a trip. The hotel room will be \$298.17 for 3 nights, and there will be additional fees. What is her daily cost?

a. Write an inequality for the problem.

$$3x > 298.17$$

b. Solve the inequality. Then provide a statement that represents the solution of the problem.

Handwritten work for problem 4:

a.  $4x > 12$   
 $\frac{4x}{4} > \frac{12}{4}$   
 $x > 3$

b.  $\frac{x}{4} \leq -12$   
 $\frac{x}{4} \leq -12$   
 $\frac{x}{4} \leq -12$   
 $x \leq -48$

c.  $-4x > 12$   
 $\frac{-4x}{-4} > \frac{12}{-4}$   
 $x < -3$

Handwritten work for problem 5:

a.  $3x > 298.17$

b.  $\frac{3x}{3} > \frac{298.17}{3}$   
 $x > 99.39$

Vanna will spend more than \$99.39 each night.


Name: \_\_\_\_\_

**Practice & Problem Solving**

**Leveled Practice** In 6–9, fill in the boxes to solve the inequality. Then graph the solution.


6.  $8m \leq 56$

$$\frac{8m}{8} \leq \frac{56}{8}$$

$$x \leq \boxed{\phantom{00}}$$



7.  $-\frac{4}{3}x < -8$

$$\boxed{\phantom{00}} \cdot \frac{4}{3}x < -8 \cdot \boxed{\phantom{00}}$$

$$x > \boxed{\phantom{00}}$$



8.  $-7x > 56$

$$\frac{7x}{7} < \frac{56}{7}$$

$$x < \boxed{\phantom{00}}$$


9.  $\frac{m}{5} \geq 2$

$$\boxed{\phantom{00}} \cdot \frac{m}{5} \geq 2 \cdot \boxed{\phantom{00}}$$

$$m \geq \boxed{\phantom{00}}$$


10. Kyra and five friends shared a bag of fruit snacks. Each person got no more than 3 fruit snacks. The inequality  $x \div 6 \leq 3$  represents this situation. Solve the inequality to find the possible numbers of fruit snacks that were in the bag.

$$\begin{array}{r} 3 \\ 17 \\ \times 5 \\ \hline 85 \end{array}$$

$$\begin{array}{r} 4 \\ 17 \\ \times 6 \\ \hline 102 \end{array}$$

11. Over the next 17 months, Eli needs to read more than 102 e-books. The inequality  $17x > 102$  represents the number of e-books he needs to read per month. Solve the inequality to find the number of e-books Eli needs to read per month.

$$\frac{17x}{17} > \frac{102}{17}$$

$$x > 6$$

Eli needs to read more than 6 books per month.

12. Brittany can spend no more than \$15 for new fish in her aquarium.

- Let  $f$  be the number of fish she can buy. What inequality represents the problem?
- How many fish can Brittany buy?



13. Isaac has a bag of  $n$  peanuts. He shares the peanuts with 5 of his friends. Each person gets at least 18 peanuts. The inequality  $18 \leq n \div 6$  represents this situation. Graph the solution of this inequality.

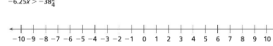
14. a. Solve the inequality  $-3x < 12$ .  
b. Reasoning Describe how you know the direction of the inequality sign without solving the inequality.

15. Higher Order Thinking Benita and her family go through an average of more than 15 cans of sparkling water each day. They buy cases of 24 cans at \$3.50 a case.



- Write an inequality for the number of cases they go through in 30 days.
- Solve the inequality in part a. If they buy only full cases, how much do they spend on sparkling water in 30 days?

16. Solve the inequality. Graph the solution on the number line.



**Assessment Practice**

17. Cyndia plans to build a tree house that is  $\frac{1}{5}$  the size of Andrew's tree house. Cyndia plans to make the area of her tree house at least 13 square feet.

Part A

$$C \geq \frac{1}{5} \text{ of } A$$

$$13 \geq \frac{1}{5} A$$

Part B Describe how you know which tree house is larger without solving the inequality.



at least

$$\frac{1}{5} A \geq \frac{13 \cdot 5}{1}$$

$$A \geq 39$$

Andrew's tree house is at least 39 ft<sup>2</sup>.

