

# 8.1 Writing and Graphing Inequalities

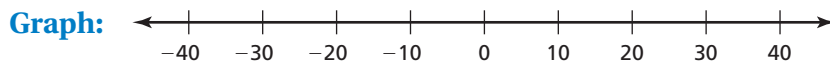
**Essential Question** How can you use an inequality to describe a real-life statement?

## 1 ACTIVITY: Writing and Graphing Inequalities

Work with a partner. Write an inequality for the statement. Then sketch the graph of all the numbers that make the inequality true.

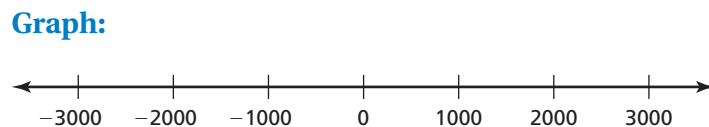
- a. **Statement:** The temperature  $t$  in Minot, North Dakota has never been below  $-36^\circ\text{F}$ .

**Inequality:**



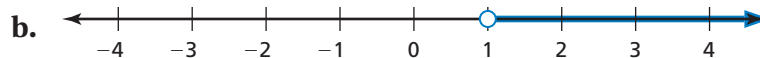
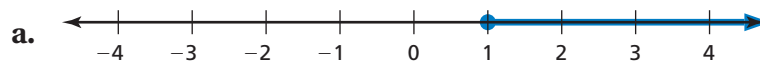
- b. **Statement:** The elevation  $e$  in Wisconsin is at most 1951.5 feet above sea level.

**Inequality:**



## 2 ACTIVITY: Writing and Graphing Inequalities

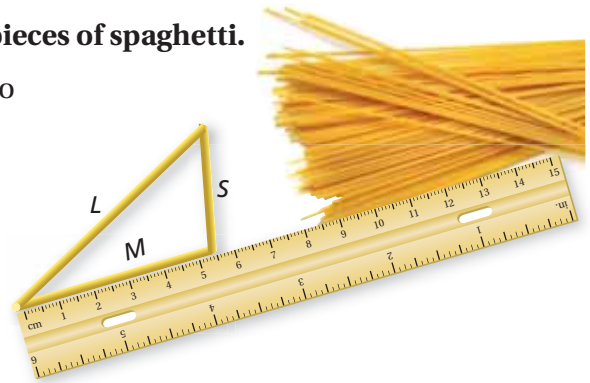
Work with a partner. Write an inequality for the graph. Then, in words, describe all the values of  $x$  that make the inequality true.



### 3 ACTIVITY: Triangle Inequality

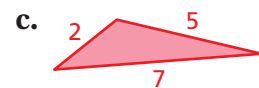
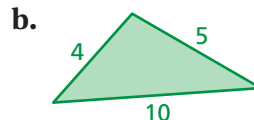
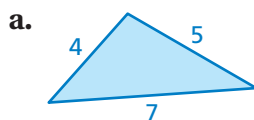
Work with a partner. Use 8 to 10 pieces of spaghetti.

- Break one piece of spaghetti into three parts that can be used to form a triangle.
- Form a triangle and use a centimeter ruler to measure each side. Round the side lengths to the nearest tenth.
- Record the side lengths in a table.
- Repeat the process with two other pieces of spaghetti.
- Repeat the experiment by breaking pieces of spaghetti into three pieces that *do not* form a triangle. Record the lengths in a table.
- **INDUCTIVE REASONING** Write a rule that uses an inequality to compare the lengths of three sides of a triangle.
- Use your rule to decide whether the following triangles are possible. Explain.



Side Lengths That Form a Triangle			
Small	Medium	Large	$S + M$

Side Lengths That Do Not Form a Triangle			
Small	Medium	Large	$S + M$



## What Is Your Answer?

4. **IN YOUR OWN WORDS** How can you use an inequality to describe a real-life statement? Give two examples of real-life statements that can be represented by inequalities.



Use what you learned about writing and graphing inequalities to complete Exercises 4 and 5 on page 316.

# 8.1 Lesson

## Key Vocabulary

inequality, p. 314  
solution of an inequality, p. 314  
solution set, p. 314  
graph of an inequality, p. 315

An **inequality** is a mathematical sentence that compares expressions. It contains the symbols  $<$ ,  $>$ ,  $\leq$ , or  $\geq$ . To write an inequality, look for the following phrases to determine where to place the inequality symbol.

Inequality Symbols				
Symbol	$<$	$>$	$\leq$	$\geq$
Key Phrases	<ul style="list-style-type: none"> <li>is less than</li> </ul>	<ul style="list-style-type: none"> <li>is greater than</li> </ul>	<ul style="list-style-type: none"> <li>is less than or equal to</li> </ul>	<ul style="list-style-type: none"> <li>is greater than or equal to</li> </ul>
	<ul style="list-style-type: none"> <li>is fewer than</li> </ul>	<ul style="list-style-type: none"> <li>is more than</li> </ul>	<ul style="list-style-type: none"> <li>is at most</li> <li>is no more than</li> </ul>	<ul style="list-style-type: none"> <li>is at least</li> <li>is no less than</li> </ul>

## EXAMPLE 1 Writing an Inequality

A number  $w$  minus 3.5 is less than or equal to  $-2$ . Write this sentence as an inequality.

$$\underbrace{\text{A number } w \text{ minus } 3.5}_{w - 3.5} \text{ is less than or equal to } \underbrace{-2}_{-2}.$$

∴ An inequality is  $w - 3.5 \leq -2$ .

## On Your Own

Write the word sentence as an inequality.

- A number  $b$  is fewer than 30.4.
- Twice a number  $k$  is at least  $-\frac{7}{10}$ .

Now You're Ready  
Exercises 6–9

A **solution of an inequality** is a value that makes the inequality true. An inequality can have more than one solution. The set of all solutions of an inequality is called the **solution set**.

Value of $x$	$x + 5 \geq -2$	Is the inequality true?
$-6$	$-6 + 5 \stackrel{?}{\geq} -2$ $-1 \geq -2$ ✓	yes
$-7$	$-7 + 5 \stackrel{?}{\geq} -2$ $-2 \geq -2$ ✓	yes
$-8$	$-8 + 5 \stackrel{?}{\geq} -2$ $-3 \not\geq -2$ ✗	no

## Reading

The symbol  $\nlessgtr$  means "is not greater than or equal to."

## EXAMPLE 2 Checking Solutions

Tell whether  $-4$  is a solution of the inequality.

a.  $x + 8 < -3$

$$x + 8 < -3$$

$$-4 + 8 \stackrel{?}{<} -3$$

$$4 \not< -3 \quad \times$$

4 is *not* less than  $-3$ .

∴ So,  $-4$  is *not* a solution of the inequality.

b.  $-4.5x > -21$

$$-4.5x > -21$$

$$-4.5(-4) \stackrel{?}{>} -21$$

$$18 > -21 \quad \checkmark$$

18 is greater than  $-21$ .

∴ So,  $-4$  is a solution of the inequality.

Now You're Ready  
Exercises 11–16

### On Your Own

Tell whether  $-6$  is a solution of the inequality.

3.  $c + 4 < -1$

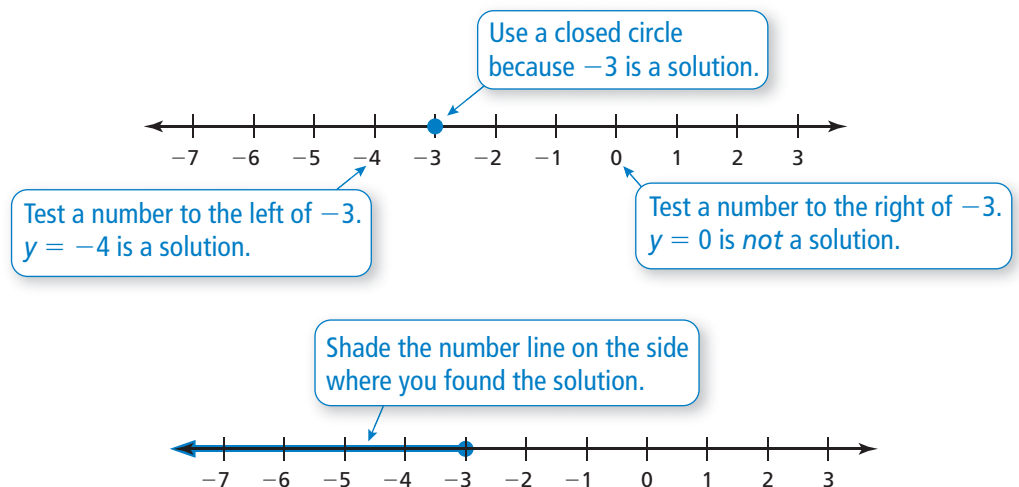
4.  $5 - m \leq 10$

5.  $21 \div x \geq -3.5$

The **graph of an inequality** shows all of the solutions of the inequality on a number line. An open circle  $\circ$  is used when a number is *not* a solution. A closed circle  $\bullet$  is used when a number is a solution. An arrow to the left or right shows that the graph continues in that direction.

## EXAMPLE 3 Graphing an Inequality

Graph  $y \leq -3$ .



### On Your Own

Graph the inequality on a number line.

6.  $b > -8$

7.  $g \leq 1.4$

8.  $r < -\frac{1}{2}$

9.  $v \geq \sqrt{0.09}$

Now You're Ready  
Exercises 17–20

## Vocabulary and Concept Check

- VOCABULARY** Would an open circle or a closed circle be used in the graph of the inequality  $k < 250$ ? Explain.
- DIFFERENT WORDS, SAME QUESTION** Which is different? Write “both” inequalities.

$w$  is greater than or equal to  $-7$ .

$w$  is no less than  $-7$ .

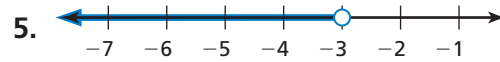
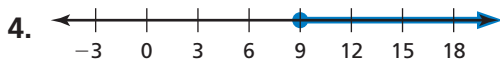
$w$  is no more than  $-7$ .

$w$  is at least  $-7$ .

- REASONING** Do  $x \geq -9$  and  $-9 \geq x$  represent the same inequality? Explain.

## Practice and Problem Solving

Write an inequality for the graph. Then, in words, describe all the values of  $x$  that make the inequality true.



Write the word sentence as an inequality.

6. A number  $x$  is no less than  $-4$ .
7. A number  $y$  added to  $5.2$  is less than  $23$ .
8. A number  $b$  multiplied by  $-5$  is at most  $-\frac{3}{4}$ .
9. A number  $k$  minus  $8.3$  is greater than  $48$ .
- ERROR ANALYSIS** Describe and correct the error in writing the word sentence as an inequality.

**X** Twice a number  $c$  is at least  $-\frac{4}{9}$ .  
 $2c \leq -\frac{4}{9}$

Tell whether the given value is a solution of the inequality.

11.  $s + 6 \leq 12$ ;  $s = 4$
12.  $15n > -3$ ;  $n = -2$
13.  $a - 2.5 \leq 1.6$ ;  $a = 4.1$
14.  $-3.3q > -13$ ;  $q = 4.6$
15.  $\frac{4}{5}h \geq -4$ ;  $h = -15$
16.  $\frac{1}{12} - p < \frac{1}{3}$ ;  $p = \frac{1}{6}$

Graph the inequality on a number line.

17.  $g \geq -6$
18.  $q > 1.25$
19.  $z < 11\frac{1}{4}$
20.  $w \leq -\sqrt{289}$

- DRIVING** When you are driving with a learner’s license, a licensed driver who is 21 years of age or older must be with you. Write an inequality that represents this situation.

Tell whether the given value is a solution of the inequality.

22.  $3p > 5 + p$ ;  $p = 4$

23.  $\frac{y}{2} \geq y - 11$ ;  $y = 18$

24. **VIDEO GAME RATINGS** Each rating is matched with the inequality that represents the recommended ages of players. Your friend is old enough to play “E 10+” games. Is your friend old enough to play “T” games? Explain.



$x \geq 3$

$x \geq 6$

$x \geq 10$

$x \geq 13$

$x \geq 17$

The ESRB rating icons are registered trademarks of the Entertainment Software Association.

25. **SCUBA DIVING** Three requirements for a scuba diving training course are shown.
- Write and graph three inequalities that represent the requirements.
  - You can swim 10 lengths of a 25-yard pool. Do you satisfy the swimming requirement of the course? Explain.

26. **LUGGAGE** On an airplane, the maximum sum of the length, width, and height of a carry-on bag is 45 inches. Find three different sets of dimensions that are reasonable for a carry-on bag.



27. **Critical Thinking** A number  $m$  is less than another number  $n$ . The number  $n$  is less than or equal to a third number  $p$ .
- Write two inequalities representing these relationships.
  - Describe the relationship between  $m$  and  $p$ .
  - Can  $m$  be equal to  $p$ ? Explain.



**Fair Game Review** What you learned in previous grades & lessons

Solve the equation. Check your solution.

28.  $r - 12 = 3$

29.  $4.2 + p = 2.5$

30.  $n - 3\pi = 7\pi$

31. **MULTIPLE CHOICE** Which linear function relates  $y$  to  $x$ ?

(A)  $y = -0.5x - 3$       (B)  $y = 2x + 3$

(C)  $y = 0.5x - 3$       (D)  $y = 2x - 3$

$x$	-1	0	1	2
$y$	-5	-3	-1	1