Lesson 8-6
Inequalities

Pg 361

Essential Question

How are equations and inequalities used to describe and solve multi-step problems?

Common Core State Standards

Content Standards
7.EE.4

Mathematical Practices
1, 3, 4, 5

What You'll Learn

• Write inequalities.
• Graph inequalities on a number line.

Real-World Link

Water Parks Wisconsin Dells, Wisconsin, is known as the Water Park Capital of the World. The town has 20 water parks with more than 200 waterslides and 16 million gallons of water. Most of the water parks offer three different prices of tickets – adults, children, and seniors.

Write Inequalities

Recall that an inequality is a mathematical sentence that compares quantities that are not equal. Inequalities contain the symbols $<$, $>$, $\leq$, or $\geq$. The inequality $w > 200$ represents the number of waterslides in Wisconsin Dells.

Example 1

Write an inequality for each sentence.

a. The DVD costs more than $15.

Words	The DVD costs more than $15.
Variable	Let d = the cost of the DVD in dollars.
Inequality	$d > 15$

b. A dog weighs less than 50 pounds.

Words	A dog weighs less than 50 pounds.
Variable	Let d = the weight of the dog in pounds.
Inequality	$d < 50$

Got It? Do these problems to find out.

1a. Amelia sold more than 40 magazines. $m > 40$

1b. Gino sent less than 35 texts yesterday. $t < 35$

Don Hammond/Design Pics

Page 1

The table below shows some common verbal phrases and the corresponding mathematical inequalities.

Concept Summary ▸ Inequalities

<	>	≤	≥
• is less than • is fewer than	• is greater than • is more than • exceeds	• is less than or equal to • is no more than • is at most	• is greater than or equal to • is no less than • is at least

Inequalities
Notice that ≤ and ≥ are a combination of the < or > symbol with part of the symbol for equals, =.

Example 2

You must be at least 18 years old to vote. Write an inequality to describe this situation.

Words	Your age is at least 18 years.
Variable	Let a = your age.
Inequality	$a \geq 18$

The inequality is $a \geq 18$.

Got It? Do this problem to find out.

2. A student must have at least 10 hours of instructor-assisted driving time to pass the course. Write an inequality to describe this situation.   *h ≥ 10*

Inequalities with variables are open sentences. When the variable in an open sentence is replaced with a number, the inequality may be true or false.

[handwritten margin notes]
< IS LESS THAN
4 < 5
≤ IS LESS THAN OR EQUAL TOO
AT MOST
> IS GREATER THAN
5 > 4
≥ IS GREATER THAN OR EQUAL TOO
AT LEAST

Example 3

For the given value, state whether each inequality is *true* or *false*.

a. $2t + 8 > 7; t = -1$

$2t + 8 > 7$	Write the inequality.
$2(-1) + 8 \overset{?}{>} 7$	Replace t with -1.
$6 \not> 7$	Simplify.

This sentence is false.

b. $p - 42 \leq -2; p = 40$

$p - 42 \leq -2$	Write the inequality.
$40 - 42 \overset{?}{\leq} -2$	Replace p with 40.
$-2 \leq -2$	Simplify.

Although the inequality $-2 < -2$ is false, the equation $-2 = -2$ is true. So, this sentence is true.

Got It? Do these problems to find out.

3a. $3.9 + x \leq 12; x = 6$
3.9 + 6
9.9 ≤ 12 TRUE

3b. $y - \frac{1}{3} < 1; y = \frac{4}{3}$
$\frac{4}{3} - \frac{1}{3} < 1$ FALSE
$1 < 1$

Graph Inequalities

Inequalities can be graphed on a number line. The graph helps you visualize the values that make the inequality true.

Example 4

Tools | Tutor

Graphing Inequalities
When inequalities are graphed, an open dot means the number is not included (< or >) and a closed dot means it is included (≤ or ≥).
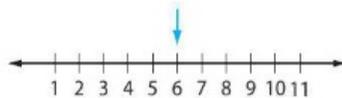
Graph each inequality on a number line.

a. $a > 6$

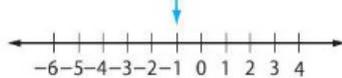Locate 6 on the number line. It is a key point in the inequality.

Draw an *open* circle on 6 because 6 is *not* included.
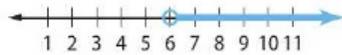
The inequality $a > 6$ means that all numbers *greater than* 6 will make the sentence true. Draw an arrow from the dot pointing to the right.

b. $x \leq -1$

Locate −1 on the number line. It is a key point in the inequality.

Draw a *closed* circle on −1 because −1 *is* included.

The inequality $x \leq -1$ means that all numbers *less than or equal to* −1 will make the sentence true. Draw an arrow from the circle pointing to the left.

Handwritten: > OR < THE CIRCLE IS OPEN BECAUSE THE CIRCLED NUMBER CANNOT BE THE ANSWER

Handwritten: ≥ OR ≤ THE CIRCLE IS FILLED BECAUSE THE CIRCLED NUMBER IS PART OF THE ANSWER

Got It? Do these problems to find out.

4a. $x < 5$

4b. $x \geq -2$

4c. $x > 0$
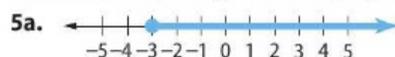
Example 5

Tools | Tutor

Write an inequality for the graph.

An open circle is on 2, so the point 2 is *not* included in the graph. The arrow points to the right, so the graph includes all numbers greater than 2. The inequality is $x > 2$.
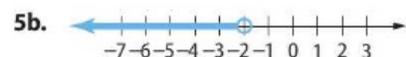

Got It? Do these problems to find out.

Write an inequality for each graph.

5a.

Handwritten: $x \geq -3$

5b.

Handwritten: $m < -2$

Guided Practice

Write an inequality for each sentence. (Example 1)

1. Lacrosse practice will be no more than 45 minutes.

2. Mario is more than 60 inches tall.

3. More than 8000 fans attended the Wizards' opening soccer game. Write an inequality to describe the attendance. (Example 2)

For the given value, state whether the inequality is *true* or *false*. (Example 3)

4. $13 - x < 4; x = 9$

5. $45 > \frac{3}{4}x + 25; x = 20$

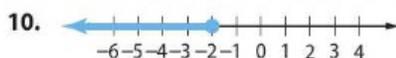**Graph each inequality on a number line.** (Example 4)

6. $x < -1$ **7.** $y \geq 5$ **8.** $w > 9$ **9.** $z \leq 2$

Write an inequality for each graph. (Example 5)
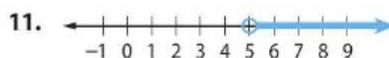
10.

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◄─┼┼┼┼┼●┼┼┼┼┼─►
  -6-5-4-3-2-1 0 1 2 3 4
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11.

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◄─┼┼┼┼┼┼┼⊕┼┼┼─►
  -1 0 1 2 3 4 5 6 7 8 9
```

Independent Practice

Write an inequality for each sentence. (Example 1)

12. The elevators in an office building have been approved for a maximum load of 3600 pounds.

13 Children under the age of 2 fly free.

14. An assignment requires at least 45 minutes.

**15.** While shopping, Abby spent no more than $50.

PG 364-366
PROB 13-47 ODDS

STEM The graph shows the average life span of various animals. (Example 2)

16. The average life span of a Galapagos tortoise is at least 4 times that of a chimpanzee. Write an inequality for the life span of a tortoise.

17. The average life span of a lobster is at most the life span of a cat. Write an inequality for the life span of a lobster.

18. The average life span of a giraffe is at least that of a horse. Write an inequality for the life span of a giraffe.

Average Life Span of Animals
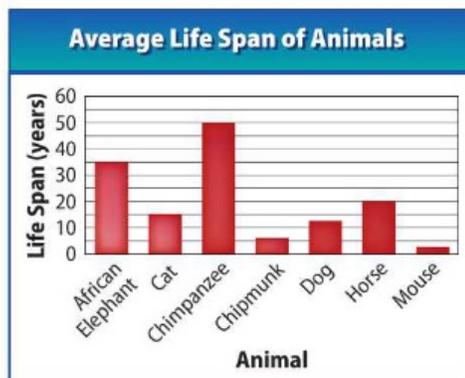
For the given value, state whether the inequality is *true* or *false*. (Example 3)

19. $13 - a < 29; a = -30$

20. $4.5b \geq -12; b = -4$

21. $\frac{2}{5}c + 18 \leq 25; c = 15$

22. $\frac{120}{d} > 40; d = 3$

23. $\frac{55}{f} > -22; f = -5$

24. $c + 19 < 2c; c = 20$

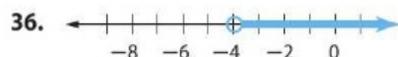**Graph each inequality on a number line.** (Example 4)

25. $x < 0$
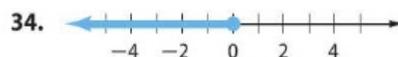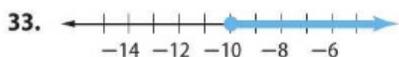
26. $y \geq 3$

27. $p > -4$

28. $t > 6$

29. $s \geq -2$

30. $r \leq -4$

Write an inequality for each graph. (Example 5)

31.

32.

33.

34.

35.

36.
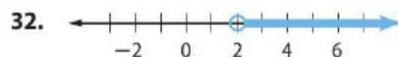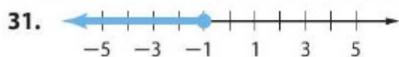
37. **Financial Literacy** Madison Middle School spends $750 per year on club activities. It spends at least twice that amount on after-school activities. Write an inequality that represents how much it spends on after-school activities.

38. In a recent year, a professional football player threw for 4418 yards. This is at most 500 yards more than a second player's passing yards. Write an inequality that represents the second player's passing yards.

39. **CCSS** **Use Math Tools** Use the Internet or another source to find the state or national spending limits on certain government branches, organizations, or projects. Write an inequality to express one or more of these limits.

H.O.T. Problems Higher Order Thinking

40. **CCSS** **Justify Conclusions** State three numbers that could be solutions of the inequality $h \leq -12$. Then justify your response by using a number line.

41. **CCSS** **Model with Mathematics** Write a real-world example for the inequality below.
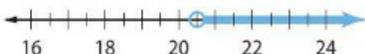
42. **CCSS** **Use a Counterexample** Provide a counterexample to the statement *All numbers less than 0 are negative integers.*

43. **CCSS** **Find the Error** Alex is graphing the inequality $p < 14$. Find his mistake and correct it.

44. **Building on the Essential Question** Explain how to tell the difference between graphing an inequality with a closed circle and one with an open circle. Use examples to clarify your explanation.

Page 5

45. Which of the following best represents the sign shown?

   A $t > 48$

   B $t < 48$

   C $t \geq 48$

   D $t \leq 48$

72"
60" Must be
48" ← over
36" 48 inches
24" tall
12" to ride.

46. Short Response Graph the following inequality on a number line.

$$p < 3$$

47. An elevator's maximum load is 3400 pounds. Which of the following best represents that sentence?

   F $\ell > 3400$ **H** $\ell \geq 3400$

   G $\ell < 3400$ **J** $\ell \leq 3400$

48. The Chess Club is having a bake sale to raise money for a tournament. The club must raise at least three times what they raised at the last bake sale. What is the minimum amount they must raise if the last bake sale raised $45?

   A $15   **C** $90

   B $45   **D** $135

CCSS Common Core Review

Solve each equation. 8.EE.7

49. $3t - 6 = 6t + 30$

50. $2y + 14 = 42 - 5y$

51. $3x = 12 - 3x$

52. $4p = -p - 20$

53. $\frac{2}{3}m + 3 = \frac{4}{3}m - 5$

54. $-\frac{3}{4}x + \frac{1}{4} = \frac{1}{2}x - \frac{3}{4}$

55. $-8.3y - 8 = 10 + 0.7y$

56. $9 - 2.4x = -4.5 + 3x$

Solve each problem by writing and solving an equation. 7.EE.4a

57. Financial Literacy Jordan has $234 in his savings account. He plans to deposit $45.50 into the account each week. If his goal is to save a total of $780, for how many weeks will he need to make deposits into the account?
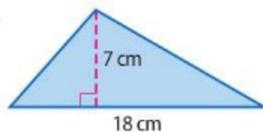
58. In a recent season of major league baseball, the Philadelphia Phillies won 13 more games than the Atlanta Braves. Together, the two teams won a total of 191 games. How many games did the Phillies win?

59. Four friends eat dinner at a restaurant. They decide to share the cost of the meal evenly, and each person also leaves $2.00 for the tip. If each person pays a total of $14.75, what is the total cost of the meal?
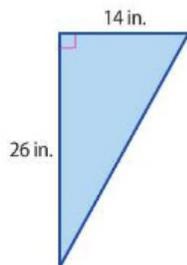
60. A cell phone plan charges $7 per month and $0.10 per minute. If the monthly cost is $25, find the number of minutes you can talk that month.
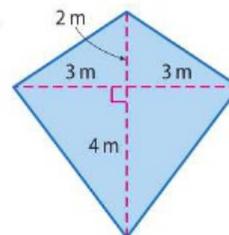
Find the area of each figure. 6.G.1

61.

7 cm
18 cm

62.

14 in.
26 in.

63.

2 m
3 m 3 m
4 m