English Spanish

8.2 Solving Inequalities Using Addition or Subtraction

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

1 ACTIVITY: Writing an Inequality

Work with a partner. In 3 years, your friend will still not be old enough to apply for a driver's license.

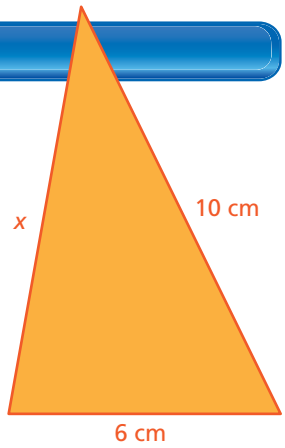
a. Which of the following represents your friend's situation? What does x represent? Explain your reasoning.

$x + 3 < 16$ $x + 3 \leq 16$ $x + 3 > 16$ $x + 3 \geq 16$

b. Graph the possible ages of your friend on a number line.

2 ACTIVITY: The Triangle Inequality

Work with a partner. Draw different triangles whose sides have lengths 10 cm, 6 cm, and x cm.



a. Which of the following describes how *small* x can be?

$6 + x < 10$ $6 + x \leq 10$

$6 + x > 10$ $6 + x \geq 10$

b. Which of the following describes how *large* x can be?

$x - 6 < 10$ $x - 6 \leq 10$ $x - 6 > 10$ $x - 6 \geq 10$

3 ACTIVITY: Writing an Inequality

Work with a partner. Baby manatees are about 4 feet long at birth. They grow to a maximum length of 13 feet.

a. Which of the following can represent a baby manatee's growth? What does x represent? Explain your reasoning.

$x + 4 < 13$ $x + 4 \leq 13$ $x - 4 > 13$ $x - 4 \geq 13$

b. Graph the solution on a number line.

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4 ACTIVITY: Puzzles

Work with a partner.

a. Use the clues to find the word that is spelled by . Assume A = 1, B = 2, and so on.

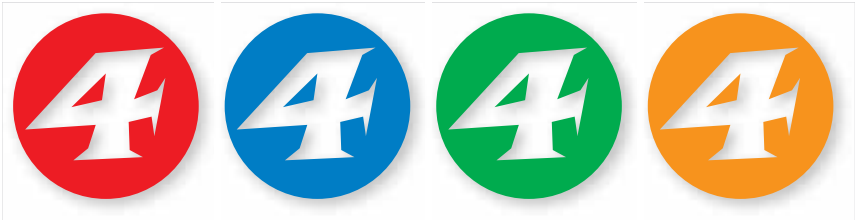
CLUES	CLUES	CLUES	CLUES
$4 + h \leq 7$	$9 \leq h - 6$	$h - 5 \leq 10$	$7 > h - 6$
$h + 1 > 3$	$3 + h < 19$	$h + 12 > 26$	$11 + h \geq 23$

b. Trace the pieces and cut them out. Rearrange them to make a square without overlapping the pieces.

Pentagon to Square

Hexagon to Square

c. Use exactly four 4's and the operations +, −, ×, and ÷ to write expressions that have values of 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, and 10. For instance, 44 − 44 = 0.



What Is Your Answer?

5. **IN YOUR OWN WORDS** How can you use an inequality to describe a real-life situation?

6. Write a real-life situation that you can represent with an inequality. Write the inequality. Graph the solution on a number line.

Practice Use what you learned about solving inequalities using addition or subtraction to complete Exercises 5–7 on page 340.

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8.2 Lesson

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Lesson Tutorials
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Study Tip

You can solve inequalities the same way you solve equations. Use inverse operations to get the variable by itself.

Key Ideas

Addition Property of Inequality

Words If you add the same number to each side of an inequality, the inequality remains true.

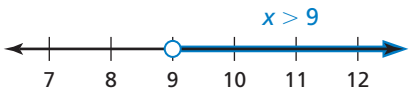
Numbers

$$\begin{array}{rr} 3 < & 5 \\ +2 & +2 \\ \hline 5 < & 7 \end{array}$$

Algebra

$$\begin{array}{rr} x - 4 > & 5 \\ +4 & +4 \\ \hline x > & 9 \end{array}$$

Graph



Subtraction Property of Inequality

Words If you subtract the same number from each side of an inequality, the inequality remains true.

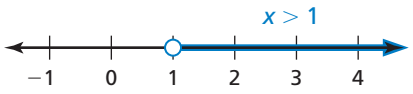
Numbers

$$\begin{array}{rr} 3 < & 5 \\ -2 & -2 \\ \hline 1 < & 3 \end{array}$$

Algebra

$$\begin{array}{rr} x + 4 > & 5 \\ -4 & -4 \\ \hline x > & 1 \end{array}$$

Graph



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

EXAMPLE 1 Solving an Inequality Using Addition

Solve $x - 3 > 1$. Graph the solution.

Undo the subtraction.

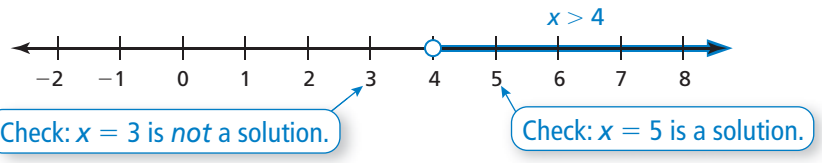
$$\begin{array}{rr} x - 3 > & 1 \\ +3 & +3 \\ \hline x > & 4 \end{array}$$

Write the inequality.
Add 3 to each side.
Simplify.

Study Tip

To check a solution, you check some numbers that are solutions and some that are not.

The solution is $x > 4$.



On Your Own

Solve the inequality. Graph the solution.

1. $x - 2 < 3$
2. $x - 6 \geq 4$
3. $10 \geq x - 1$

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EXAMPLE 2 Solving an Inequality Using Subtraction

Solve $15 \geq 6 + x$. Graph the solution.

Undo the addition.

$$\begin{aligned} 15 &\geq 6 + x && \text{Write the inequality.} \\ -6 \quad &-6 && \text{Subtract 6 from each side.} \\ 9 &\geq x && \text{Simplify.} \end{aligned}$$

The solution is $x \leq 9$.

Reading

The inequality $x \leq 9$ is the same as $9 \geq x$.

On Your Own

Now You're Ready
Exercises 5–16

Solve the inequality. Graph the solution.

4. $x + 3 > 7$ **5.** $y + 2 < 17$ **6.** $16 \leq m + 9$

EXAMPLE 3 Real-Life Application

A flea market advertises that it has more than 250 vending booths. Of these, 184 are currently filled. Write and solve an inequality to represent the number of vending booths still available.

Words Booths filled | plus | the number of remaining booths | is greater than | the total number of booths.

Variable Let b be the number of remaining booths.

Inequality $184 + b > 250$

$$\begin{aligned} 184 + b &> 250 && \text{Write the inequality.} \\ -184 \quad &-184 && \text{Subtract 184 from each side.} \\ b &> 66 && \text{Simplify.} \end{aligned}$$

More than 66 vending booths are still available.

On Your Own

7. You have already spent \$24 shopping online for clothes. Write and solve an inequality to represent the additional amount you must spend to get free shipping.

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8.2 Exercises

Check It Out
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Vocabulary and Concept Check

1. **OPEN-ENDED** Write an inequality that can be solved by subtracting 7 from each side.
2. **WRITING** Explain how to solve the inequality $x - 6 > 3$.
3. **WRITING** Describe the graph of the solution of $x + 3 \leq 4$.
4. **OPEN-ENDED** Write an inequality represented by the graph. Then use the Subtraction Property of Inequality to write another inequality represented by the graph.

Practice and Problem Solving

Solve the inequality. Graph the solution.

1 2 5. $x - 4 < 5$

6. $5 + h > 7$

7. $3 \geq y - 2$

8. $9 \leq c + 1$

9. $18 > 12 + x$

10. $37 + z \leq 54$

11. $y - 21 < 85$

12. $g - 17 \geq 17$

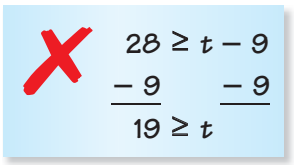
13. $7.2 < x + 4.2$

14. $12.7 \geq s - 5.3$

15. $\frac{3}{4} \leq \frac{1}{2} + n$

16. $\frac{1}{3} + b > \frac{3}{4}$

17. **ERROR ANALYSIS** Describe and correct the error in solving the inequality.



18. **AIR TRAVEL** Your carry-on bag can weigh at most 40 pounds. Write and solve an inequality to represent how much more weight you can add to the bag and still meet the requirement.

19. **SHOPPING** It costs $\$x$ for a round-trip bus ticket to the mall. You have $24. Write and solve an inequality to represent the greatest amount of money you can spend for the bus fare and still have enough to buy the baseball cap.

Write the word sentence as an inequality. Then solve the inequality.

20. Five more than a number is less than 17.
21. Three less than a number is more than 15.

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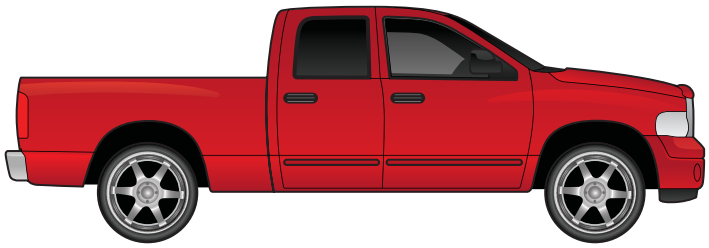
Solve the inequality. Graph the solution.

22. $x + 9 - 3 \leq 14$ **23.** $44 > 7 + s + 26$ **24.** $6.1 - 0.3 \geq c + 1$

25. VIDEO GAME The high score for a video game is 36,480. Your current score is 34,280. Each dragonfly you catch is worth 1 point. You also get a 1000-point bonus for reaching 35,000 points. Write and solve an inequality to represent the number of dragonflies you must catch to earn a new high score.

26. PICKUP TRUCKS You can register a pickup truck as a passenger vehicle if the truck is not used for commercial purposes and the weight of the truck with its contents does not exceed 8500 pounds.

a. Your pickup truck weighs 4200 pounds. Write an inequality to represent the number of pounds your truck can carry and still qualify as a passenger vehicle. Then solve the inequality.



b. A cubic yard of sand weighs about 1600 pounds. How many cubic yards of sand can you haul in your truck and still qualify as a passenger vehicle? Explain your reasoning.

27. TRIATHLON You complete two events of a triathlon. Your goal is to finish with an overall time of less than 100 minutes.

a. Write and solve an inequality to represent how many minutes you can take to finish the running event and still meet your goal.

b. The running event is 3.1 miles long. Estimate how many minutes it would take you to run 3.1 miles. Would this time allow you to reach your goal? Explain your reasoning.

Triathlon	
Event	**Your Time (minutes)**
Swimming	18.2
Biking	45.4
Running	?

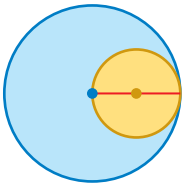
28. Number Sense The possible values of x are given by $x - 3 \geq 2$. What is the least possible value of $5x$?

Fair Game Review What you learned in previous grades & lessons

Solve the equation. Check your solution. SECTION 7.3

29. $\frac{t}{12} = 4$ **30.** $6 = \frac{s}{9}$ **31.** $8x = 72$ **32.** $9 = 1.5z$

33. MULTIPLE CHOICE How many times greater is the circumference of the large circle than the circumference of the small circle? SECTION 6.1



(A) 2 (B) 3.14 (C) 4 (D) 6.28