English Spanish

8.2 Solving Inequalities Using Addition or Subtraction

STATE STANDARDS
MA.8.A.4.2

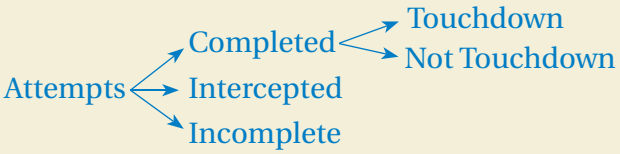
Essential Question How can you use addition or subtraction to solve an inequality?

1 ACTIVITY: Quarterback Passing Efficiency

Work with a partner. The National Collegiate Athletic Association (NCAA) uses the following formula to rank the passing efficiency P of quarterbacks.

$$P = \frac{8.4Y + 100C + 330T - 200N}{A}$$

Y = total length of all completed passes (in Yards)
C = Completed passes
T = passes resulting in a Touchdown
N = iNtercepted passes
A = Attempted passes
M = incoMplete passes



Which of the following equations or inequalities are true relationships among the variables? Explain your reasoning.

a. $C + N < A$ **b.** $C + N \leq A$ **c.** $T < C$ **d.** $T \leq C$

e. $N < A$ **f.** $A > T$ **g.** $A - C \geq M$ **h.** $A = C + N + M$

2 ACTIVITY: Quarterback Passing Efficiency

Work with a partner. Which of the following quarterbacks has a passing efficiency rating that satisfies the inequality $P > 100$? Show your work.

Player	Attempts	Completions	Yards	Touchdowns	Interceptions
A	149	88	1065	7	9
B	400	205	2000	10	3
C	426	244	3105	30	9
D	188	89	1167	6	15

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3 ACTIVITY: Finding Solutions of Inequalities

Work with a partner. Use the passing efficiency formula to create a passing record that makes the inequality true. Then describe the values of P that make the inequality true.

a. $P < 0$

Attempts	Completions	Yards	Touchdowns	Interceptions

b. $P + 100 \geq 250$

Attempts	Completions	Yards	Touchdowns	Interceptions

c. $180 < P - 50$

Attempts	Completions	Yards	Touchdowns	Interceptions

d. $P + 30 \geq 120$

Attempts	Completions	Yards	Touchdowns	Interceptions

e. $P - 250 > -80$

Attempts	Completions	Yards	Touchdowns	Interceptions

What Is Your Answer?

4. Write a rule that describes how to solve inequalities like those in Activity 3. Then use your rule to solve each of the inequalities in Activity 3.

5. **IN YOUR OWN WORDS** How can you use addition or subtraction to solve an inequality?

6. How is solving the inequality $x + 3 < 4$ similar to solving the equation $x + 3 = 4$? How is it different?

Practice Use what you learned about solving inequalities using addition or subtraction to complete Exercises 3–5 on page 322.

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8.2 Lesson

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Key Ideas

Addition Property of Inequality

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

Numbers
$$\begin{array}{r} -3 < 2 \\ \underline{+4 \quad +4} \\ 1 < 6 \end{array}$$

Algebra
$$\begin{array}{r} x - 3 > -10 \\ \underline{+3 \quad +3} \\ x > -7 \end{array}$$

Subtraction Property of Inequality

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

Numbers
$$\begin{array}{r} -3 < 1 \\ \underline{-5 \quad -5} \\ -8 < -4 \end{array}$$

Algebra
$$\begin{array}{r} x + 7 > -20 \\ \underline{-7 \quad -7} \\ x > -27 \end{array}$$

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

Study Tip

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

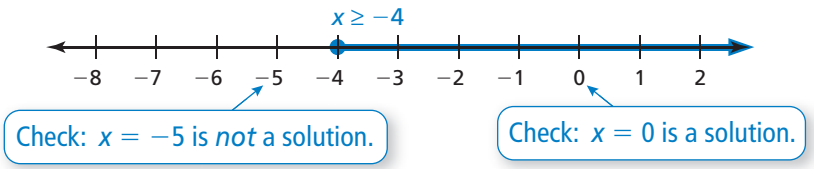
EXAMPLE 1 Solving an Inequality Using Addition

Solve $x - 6 \geq -10$. Graph the solution.

$$\begin{array}{rl} x - 6 \geq -10 & \text{Write the inequality.} \\ \underline{+6 \quad +6} & \text{Add 6 to each side.} \\ x \geq -4 & \text{Simplify.} \end{array}$$

Undo the subtraction.

The solution is $x \geq -4$.



Study Tip

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

On Your Own

Solve the inequality. Graph the solution.

1. $b - 2 > -9$
2. $m - 3.8 \leq 5$
3. $\frac{1}{4} > y - \frac{1}{4}$

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EXAMPLE 2 Solving an Inequality Using Subtraction

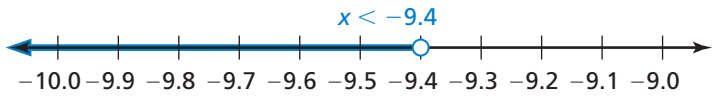
Solve $-8 > 1.4 + x$. Graph the solution.

$-8 > 1.4 + x$ Write the inequality.

Undo the addition. → $-1.4 \quad -1.4$ Subtract 1.4 from each side.

$-9.4 > x$ Simplify.

∴ The solution is $x < -9.4$.



Reading

The inequality $-9.4 > x$ is the same as $x < -9.4$.

On Your Own

Now You're Ready
Exercises 6–17

Solve the inequality. Graph the solution.

4. $k + 5 \leq -3$ **5.** $\frac{5}{6} \leq z + \frac{2}{3}$ **6.** $p + 0.7 > -2.3$

EXAMPLE 3 Real-Life Application

On a train, carry-on bags can weigh no more than 50 pounds. Your bag weighs 24.8 pounds. Write and solve an inequality that represents the amount of weight you can add to your bag.

Words Weight of your bag | plus | amount of weight you can add | is no more than | the weight limit.

Variable Let w be the possible weight you can add.

Inequality $24.8 \quad + \quad w \quad \leq \quad 50$

$24.8 + w \leq 50$ Write the inequality.

$-24.8 \quad -24.8$ Subtract 24.8 from each side.

$w \leq 25.2$ Simplify.

∴ You can add no more than 25.2 pounds to your bag.

On Your Own

7. WHAT IF? Your carry-on bag weighs 32.5 pounds. Write and solve an inequality that represents the possible weight you can add to your bag.

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8.2 Exercises

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Vocabulary and Concept Check

1. **REASONING** Is the inequality $r - 5 \leq 8$ the same as $8 \leq r - 5$? Explain.

2. **WHICH ONE DOESN'T BELONG?** Which inequality does *not* belong with the other three? Explain your reasoning.

$c + \frac{7}{2} \leq \frac{3}{2}$ $\quad$ $c + \frac{7}{2} \geq \frac{3}{2}$ $\quad$ $\frac{3}{2} \geq c + \frac{7}{2}$ $\quad$ $c - \frac{3}{2} \leq -\frac{7}{2}$

Practice and Problem Solving

Use the formula in Activity 1 to create a passing record that makes the inequality true.

3. $P \geq 180$

4. $P + 40 < 110$

5. $280 \leq P - 20$

Solve the inequality. Graph the solution.

1 2 6. $y - 3 \geq 7$

7. $t - 8 > -4$

8. $n + 11 \leq 20$

9. $a + 7 > -1$

10. $5 < v - \frac{1}{2}$

11. $\frac{1}{5} > d + \frac{4}{5}$

12. $-\frac{2}{3} \leq g - \frac{1}{3}$

13. $m + \frac{7}{4} \leq \frac{11}{4}$

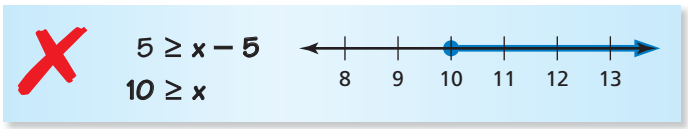
14. $11.2 \leq k + 9.8$

15. $h - 1.7 < -3.2$

16. $0 > s + \pi$

17. $5 \geq u - 4.5$

18. **ERROR ANALYSIS** Describe and correct the error in graphing the solution of the inequality.



19. **PELICAN** The maximum volume of a great white pelican's bill is about 700 cubic inches.

   a. A pelican scoops up 100 cubic inches of water. Write and solve an inequality that represents the additional volume the bill can contain.

   b. A pelican's stomach can contain about one-third the maximum amount that its bill can contain. Write an inequality that represents the volume of the pelican's stomach.

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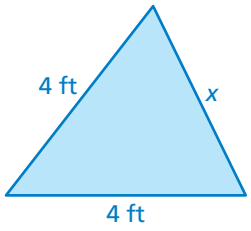
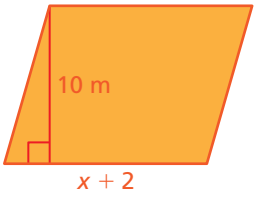
Write and solve an inequality that represents the value of x.

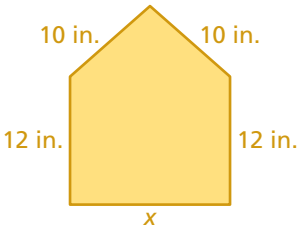
20. The perimeter is less than 16 feet.



21. The base is greater than the height.

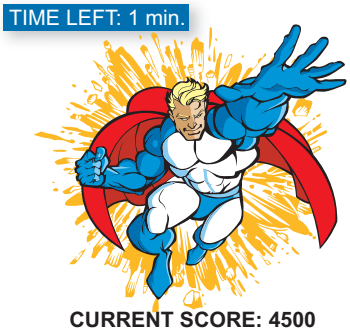


22. The perimeter is less than or equal to 5 feet.



23. **REASONING** The solution of $w + c \leq 8$ is $w \leq 3$. What is the value of c?

24. **FENCE** The hole for a fence post is 2 feet deep. The top of the fence post needs to be at least 4 feet above the ground. Write and solve an inequality that represents the required length of the fence post.



25. **VIDEO GAME** You need at least 12,000 points to advance to the next level of a video game.

a. Write and solve an inequality that represents the number of points you need to advance.

b. You find a treasure chest that increases your score by 60%. How does this change the inequality?

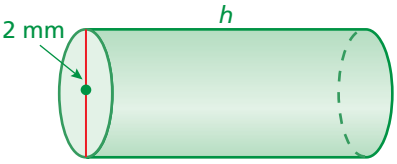
26. **POWER** A circuit overloads at 1800 watts of electricity. A microwave that uses 1100 watts of electricity is plugged into the circuit.

a. Write and solve an inequality that represents the additional number of watts you can plug in without overloading the circuit.

b. In addition to the microwave, what two appliances in the table can you plug in without overloading the circuit?

Appliance	Watts
Clock radio	50
Blender	300
Hot plate	1200
Toaster	800

27. Critical Thinking The maximum surface area of the solid is 15π square millimeters. Write and solve an inequality that represents the height of the cylinder.



Fair Game Review What you learned in previous grades & lessons

Solve the equation. SECTION 1.1

28. $6 = 3x$

29. $\frac{r}{5} = 2$

30. $4c = 15$

31. $8 = \frac{2}{3}b$

32. **MULTIPLE CHOICE** Which fraction is equivalent to 3.8? SKILLS REVIEW HANDBOOK

(A) $\frac{5}{19}$ (B) $\frac{19}{5}$ (C) $\frac{12}{15}$ (D) $\frac{12}{5}$