Solve Inequalities Using Addition or Subtraction

Objective To solve one-step inequalities using the Addition and Subtraction Properties of Inequality • To graph the solution sets of addition and subtraction inequalities

The J. Bank High School auditorium has a maximum seating capacity. The senior class is planning its commencement exercises and determines that no more than 445 invitations can be distributed, excluding those for students and faculty. If there are 155 students and faculty, what is the maximum seating capacity of the school auditorium?

▶ To find the maximum seating capacity of the school auditorium, write and solve a **subtraction inequality**.

Let s = the seating capacity.

maximum seating capacity	minus	students and faculty	is *no more than*	distributed invitations for seats
↓	↓	↓	↓	↓
s	$-$	155	$\leq$	445

← subtraction inequality

▶ To solve a subtraction inequality, use the **Addition Property of Inequality**. Solve a subtraction inequality *the same way* you solve a subtraction equation.

Solve: $s - 155 \leq 445$

$s - 155 + 155 \leq 445 + 155$ ←— Use the Addition Property of Inequality.

$s \leq 600$

The school auditorium has a maximum seating capacity of 600, which means it can seat up to 600 people.

_____ Key Concept _____

Addition Property of Inequality

If a, b, and c are real numbers and $a > b$, then $a + c > b + c$.

These statements are also true if $>$ is replaced by $<$, $\leq$, or $\geq$.

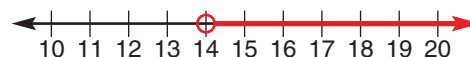▶ You can graph and check the solution set after solving an inequality.

Solve: $n - 26 > -12$

$n - 26 + 26 > -12 + 26$ ←— Use the Addition Property of Inequality.

$n > 14$

Remember that $n > 14$ can also be written as $\{n \mid n > 14\}$ or $(14, \infty)$.

Graph: $n > 14$

10 11 12 13 14 15 16 17 18 19 20

Think
The solution set contains *all the real numbers* greater than 14.

Check: According to the graph, 20 is in the solution set, and 10 is *not*.

Try $n = 20$.

$n - 26 > -12$

$20 - 26 \overset{?}{>} -12$ ←— Substitute 20 for n.

$-6 > -12$ True

Try $n = 10$.

$n - 26 > -12$

$10 - 26 \overset{?}{>} -12$ ←— Substitute 10 for n.

$-16 > -12$ False

Always check using the original inequality.

► To solve an **addition inequality**, use the Subtraction Property of Inequality.
Solve an addition inequality *the same way* you solve an addition equation.

Solve: $10 - 7x + 8x \geq 8$

$$10 + (-7x) + 8x \geq 8 \quad \longleftarrow \text{Identify like terms.}$$

$$10 + x \geq 8 \quad \longleftarrow \text{Simplify; combine like terms.}$$

$$10 - 10 + x \geq 8 - 10 \quad \longleftarrow \text{Use the Subtraction Property of Inequality.}$$

$$x \geq -2$$

Graph: $\{x \mid x \geq -2\}$ or $[-2, \infty)$

$-4\ -3\ -2\ -1\ \ 0\ \ 1\ \ 2\ \ 3\ \ 4$

> ### Key Concept
> **Subtraction Property of Inequality**
>
> If a, b, and c are real numbers and $a > b$, then $a - c > b - c$.
>
> These statements are also true if $>$ is replaced by $<$, $\leq$, or $\geq$.

Check: According to the graph, 0 is in the solution set, and -4 is *not*.

Try $x = 0$.

$$10 - 7x + 8x \geq 8$$
$$10 - 7(0) + 8(0) \overset{?}{\geq} 8$$
$$10 \overset{?}{\geq} 8$$
$$10 \geq 8 \quad \text{True}$$

Try $x = -4$.

$$10 - 7x + 8x \geq 8$$
$$10 - 7(-4) + 8(-4) \overset{?}{\geq} 8$$
$$10 + 28 - 32 \overset{?}{\geq} 8$$
$$6 \geq 8 \quad \text{False}$$

Example

1 **Solve:** $9 < 1 + 6m - 5m + 2$

$$9 < 1 + 6m + (-5m) + 2 \quad \longleftarrow \text{Identify like terms.}$$

$$9 < m + 3 \quad \longleftarrow \text{Simplify; combine like terms.}$$

$$9 - 3 < m + 3 - 3 \quad \longleftarrow \text{Use the Subtraction Property of Inequality.}$$

$$6 < m$$

Graph: $\{m \mid m > 6\}$ or $(6, \infty)$

$4\ \ 5\ \ 6\ \ 7\ \ 8\ \ 9\ \ 10\ 11\ 12$

> **Remember:**
> $6 < m$ is equivalent to $m > 6$.

Check: According to the graph, 7 is in the solution set, and 2 is *not*.

Try $m = 7$.

$$9 < 1 + 6m - 5m + 2$$
$$9 \overset{?}{<} 1 + 6(7) - 5(7) + 2$$
$$9 \overset{?}{<} 1 + 42 - 35 + 2$$
$$9 < 10 \quad \text{True}$$

Try $m = 2$.

$$9 < 1 + 6m - 5m + 2$$
$$9 \overset{?}{<} 1 + 6(2) - 5(2) + 2$$
$$9 \overset{?}{<} 1 + 12 - 10 + 2$$
$$9 < 5 \quad \text{False}$$

Try These

Solve each inequality. Then graph and check the solution.

1. $c - 114 \leq 99$ **2.** $-7 + h > 5$ **3.** $-13.1 < 6x - 16.7 - 5x$ **4.** $-8 + 11 \leq 7 + k$

5. Discuss and Write Explain how the Addition and Subtraction Properties of Inequality are like the Addition and Subtraction Properties of Equality. Use examples to support your statements.

Go to **PRACTICE BOOK** Lesson 3-2 for exercise sets.