3-4 Solving Two-Step Inequalities

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7.EE.4.b

What You'll Learn

To solve two-step inequalities using inverse operations

You will need your notebooks today to record the steps needed to solve two-step inequalities.

Why Learn This?

When you lose something, you often undo or trace your steps in reverse order to find it.

You can solve a two-step inequality by using inverse operations and the properties of inequality to get the variable alone on one side of the inequality.

For many inequalities, you undo the addition or subtraction first. Then you undo the multiplication or division. These are the same steps you followed when solving a two-step equation.

EXAMPLE **Undoing Addition First**

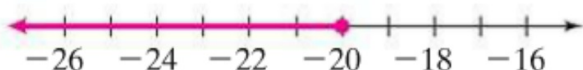**1** Solve $\frac{a}{4} + 3 \le -2$. Graph the solution.

$$\frac{a}{4} + 3 \le -2$$

$$\frac{a}{4} + 3 - 3 \le -2 - 3 \qquad \leftarrow \text{Subtract 3 from each side.}$$

$$\frac{a}{4} \le -5 \qquad \leftarrow \text{Simplify.}$$

$$4 \cdot \frac{a}{4} \le 4 \cdot (-5) \qquad \leftarrow \text{Multiply each side by 4.}$$

$$a \le -20 \qquad \leftarrow \text{Simplify.}$$

1 **Undoing Subtraction First** Solve $\frac{n}{3} - 5 \ge -4$. Graph the solution.

$$\frac{n}{3} - 5 \ge -4$$

$$\frac{n}{3} - 5 + \boxed{5} \ge -4 + \boxed{5} \qquad \leftarrow \text{Add } \boxed{5} \text{ to each side.}$$

$$\frac{n}{3} \ge \boxed{1} \qquad \leftarrow \text{Simplify.}$$

$$\boxed{3} \cdot \frac{n}{3} \ge \boxed{3} \cdot 1 \qquad \leftarrow \text{Multiply each side by } \boxed{3}.$$

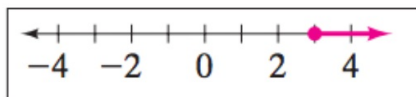$$n \ge \boxed{3} \qquad \leftarrow \text{Simplify.}$$

Table talk through this problem:

1 Solve $4z + 1 > 5$. ⬜

✓ Quick Check   Try this on your own.

1. Solve the inequality $-5 + \frac{c}{3} > -1$. Graph the solution.

⬜

EXAMPLE **Undoing Subtraction First**

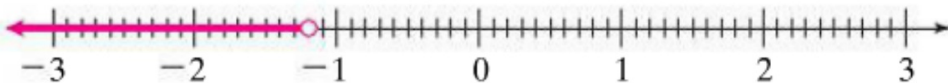**2** Solve $-3.5x - 6 > -1.8$. Graph the solution.

$-3.5x - 6 > -1.8$

$-3.5x - 6 + 6 > -1.8 + 6$ ← **Add 6 to each side.**

$-3.5x > 4.2$ ← **Simplify.**

$\dfrac{-3.5x}{-3.5} < \dfrac{4.2}{-3.5}$ ← **Divide each side by −3.5.**

$x < -1.2$ ← **Simplify.**

❷ Undoing Addition First Solve $-4.4x + 2 > 8.6$. Graph the solution.

$-4.4x + 2 > 8.6$

$-4.4x + 2 - \boxed{2} > 8.6 - \boxed{2}$ ← **Subtract** $\boxed{2}$ **from each side.**

$\boxed{-4.4x} > 6.6$ ← **Simplify.**

$\dfrac{-4.4x}{\boxed{-4.4}} < \dfrac{6.6}{\boxed{-4.4}}$ ← **Divide each side by −4.4.**

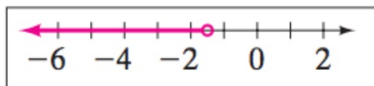$x < \boxed{-1.5}$ ← **Simplify.**

Table Talk through this one:

2 Solve $-6.1 + 3.4d < 7.5.$ [ ]

✓ **Quick Check** Try this problem on your own.

2. Solve $\frac{1}{5} \geq -\frac{1}{3}a + \frac{1}{2}$. Graph the solution on a number line.

[ ]

Application: Music Downloads

3 **Multiple Choice** A music club charges $.75 per song download plus a membership fee of $5.70. Diego can spend at most $15. What is the greatest number of songs that Diego can download?

Ⓐ 14   Ⓑ 13   Ⓒ 12   Ⓓ 11

Words $0.75 times | number of songs | plus | monthly fee | is at most | $15

Let s = the number of songs

Expression 0.75 · s + 5.7 ≤ 15

$0.75s + 5.7 \le 15$

$0.75s + 5.7 - 5.7 \le 15 - 5.7$ ← Subtract 5.7 from each side.

$0.75s \le 9.3$ ← Simplify.

$\dfrac{0.75s}{0.75} \le \dfrac{9.3}{0.75}$ ← Divide each side by 0.75.

$s \le 12.4$ ← Simplify.

Only whole-number solutions are reasonable in this context, so Diego can download at least 0 songs and no more than 12 songs. The correct answer is choice C.

3 **Archery** An archery range charges $50 for membership plus $5 per round. Vivian wants to join the range and shoot as many rounds as possible, but she has only $75. What is the greatest number of rounds she can shoot?

Words   cost per round | times | number of rounds | plus | membership fee | is at most | total cost

Let r = the number of rounds

Expression 5 · r + 50 = 75

$5r + 50 \le 75$

$5r + 50 - 50 \le 75 - 50$ ← Subtract 50 from each side.

$5r \le 25$ ← Simplify.

$\dfrac{5r}{5} \le \dfrac{25}{5}$ ← Divide each side by 5.

$r \le 5$ ← Simplify.

3 The Fun Zone charges $5 for admission plus $.25 per token for arcade games. Eric has saved at least $10 from doing chores. How many tokens can Eric buy?

3. A phone plan charges $.20 per text message plus a monthly fee of $42.50. Lin can spend at most $50. Write an inequality for the number of text messages Lin can send. Describe the solution.

You want to buy a new tablet that costs at least $450. You have already saved $130. You want to save the same amount each month for the next 4 months to have enough money for the tablet. What is the least amount of money you need to save each month?

Lee's Method

I'll use number sense. I know that I have saved $130 already. Since a tablet costs at least $450, I still need at least $450 − $130, or at least $320. I will save the same amount for 4 months. So, each month I must save at least $320 ÷ 4, or at least $80.

Olivia's Method

I'll write and solve an inequality. Let s = amount of money I still need to save each month. Then $4s$ is the total amount I still need to save.

savings needed + savings on hand ≥ cost of tablet

$$4s \quad + \quad 130 \quad \geq \quad 450$$

I'll work backward through the order of operations.

$4s + 130 - 130 \geq 450 - 130$ ← Subtract 130 from each side.

$4s \geq 320$ ← Simplify.

$\dfrac{4s}{4} \geq \dfrac{320}{4}$ ← Divide each side by 4.

$s \geq 80$ ← Simplify.

I need to save at least $80 each week.

✓ Check Your Understanding

Describe the first step in solving each inequality.

1. $-3t + 7 > 1$

2. $-3.4 - 1.5h \leq 2.6$

3. $\dfrac{7}{10} s + \dfrac{1}{5} \geq \dfrac{3}{10}$

Solve each inequality. Graph the solution. Write your answer in simplest form.

4. $2z \leq -10$

5. $\dfrac{a}{3} > \dfrac{1}{2}$

6. $-4 < -0.8k$

You have an assignment worksheet.

You will have to draw in your own numberlines for the first group of problems.

Name _____ Class _____ Date _____

Practice 3-4

Solve each inequality. Graph the solution. Write your answer in simplest form.
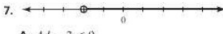
1. $-3 + 5n > -13$

2. $4 \geq \frac{z}{3} - 1$
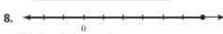
3. $6 - 4b \leq 14$

4. $5t + 2 < 7$

5. $\frac{x}{4} + 3 \geq 9$

6. $-7b + 2 < 16$

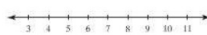Solve each inequality. Circle the letter of the inequality that is represented by each graph.

7.

A. $4d - 3 < 9$

B. $-2d + 4 < 8$

8.

A. $6 - 1.5x \geq -3$

B. $-2.4x + 3.2 \geq -4$

9. Tasha gets $7.50 every week for walking the neighbor's dog daily. She also makes and sells bracelets for $2.50 each. She wants to earn at least $25 this week as vacation money. Write an inequality to find the number of bracelets she needs to make. Graph and describe the solutions.

3 4 5 6 7 8 9 10 11