

Lesson 13:

Inequalities

Student Outcomes:

- Students understand that an inequality is a statement that one expression is less than (or equal to) or greater than (or equal to) another expression, such as $2x + 3 < 5$ or $3x + 50 \geq 100$.
- Students interpret a solution to an inequality as a number that makes the inequality true when substituted for the variable.
- Students convert arithmetic inequalities into a new inequality with variables (e.g., $2 \times 6 + 3 > 12$ to $2m + 3 > 12$) and give a solution, such as $m=6$, to the new inequality. They check to see if different values of the variable make an inequality true or false.

Bell Work:

Given the initial inequality $2 > -4$, identify which operation preserves the inequality symbol and which operation reverses the inequality symbol. Write the new inequality after the operation is performed.

- a. Multiply both sides by -2 .
- b. Add -2 to both sides.
- c. Divide both sides by 2 .
- d. Multiply both sides by $-\frac{1}{2}$.
- e. Subtract -3 from both sides.

Notes:

- When both sides of an inequality are added or subtracted by a number, the inequality symbol stays the same, and the inequality symbol is said to be **preserved**.
- When both sides of an inequality are multiplied or divided by a positive number, the inequality symbol stays the same, and the inequality symbol is said to be **preserved**.
- When both sides of an inequality are multiplied or divided by a negative number, the inequality symbol switches from $<$ to $>$ or from $>$ to $<$. The inequality symbol is **reversed**.

Tarik is trying to save \$265.49 to buy a new tablet. Right now, he has \$40 and can save \$38 a week from his allowance. Write and evaluate an expression to represent the amount of money saved after ...

$$2 \text{ weeks: } 40 + 38(2) = 40 + 76 = 116$$

$$3 \text{ weeks: } 40 + 38(3) = 40 + 114 = 154$$

$$4 \text{ weeks: } 40 + 38(4) = 40 + 152 = 192$$

5 weeks: $40 + 38(5) = 40 + 190 = 230$

6 weeks: $40 + 38(6) = 40 + 228 = 268$

7 weeks: $40 + 38(7) = 40 + 266 = 306$

8 weeks: $40 + 38(8) = 40 + 304 = 344$

When will Tarik have enough money to buy the tablet?

From 6 weeks and onward

Write an inequality that will generalize the problem.

$$38w + 40 \geq 265.49$$

- Where w represents the number of weeks it will take to save the money.

Example 1: (s.88- 89)

The sum of two consecutive odd integers is more than -12.
Write several true numerical inequality expressions.

$$5 + 7 > -12$$

$$12 > -12$$

$$3 + 5 > -12$$

$$8 > -12$$

$$1 + 3 > -12$$

$$4 > -12$$

$$-1 + 1 > -12$$

$$0 > -12$$

$$-3 + -1 > -12$$

$$-4 > -12$$

The sum of two consecutive odd integers is more than -12. What is the smallest value that will make this true?

a. Write an inequality that can be used to find the smallest value that will make the statement true.

x : an integer

$2x + 1$: odd integer

$2x + 3$: next odd integer

$$2x + 1 + 2x + 3 > -12$$

b. Use if-then moves to solve the inequality written in part (a). Identify where the 0's and 1's were made using the if-then moves.

$$4x + 4 > -12$$

$$4x + 4 - 4 > -12 - 4 \quad \text{If } a > b, \text{ then } a - 4 > b - 4.$$

0 is the result.

$$4x + 0 > -16$$

$$\left(\frac{1}{4}\right)(4x) > \left(\frac{1}{4}\right)(-16) \quad \text{If } a > b, \text{ then } a \left(\frac{1}{4}\right) = b \left(\frac{1}{4}\right).$$

The result is 1.

$$x > -4$$

c. What is the smallest value that will make this true?

To find the odd integer, substitute -4 for x in $2x + 1$.

$$2(-4) + 1$$

$$-8 + 1$$

$$-7$$

The values that will solve the original inequality are all the odd integers greater than -7. Therefore, the smallest values that will make this true are -5 and -3.

Exercises: (s.89- 90)

1. Connor went to the county fair with \$22.50 in his pocket. He bought a hot dog and drink for \$3.75 and then wanted to spend the rest of his money on ride tickets, which cost \$1.25 each.

a. Write an inequality to represent the total spent where r is the number of tickets purchased.

$$1.25r + 3.75 \leq 22.50$$

b. Connor wants to use this inequality to determine whether he can purchase 10 tickets. Use substitution to show whether he will have enough money.

$$1.25r + 3.75 \leq 22.50$$

$$1.25 (10) + 3.75 \leq 22.50$$

$$12.5 + 3.75 \leq 22.50$$

$$16.25 \leq 22.50$$

He will have enough money since a purchase of 10 tickets brings his total spending to \$16.25.

c. What is the total maximum number of tickets he can buy based upon the given information?

$$1.25r + 3.75 \leq 22.50$$

$$1.25r + 3.75 - 3.75 \leq 22.50 - 3.75$$

$$1.25r + 0 \leq 18.75$$

$$\left(\frac{1}{1.25}\right)(1.25r) \leq \left(\frac{1}{1.25}\right)(18.75)$$

$$r \leq 15$$

The maximum number of tickets he can buy is 15.

Exercise 2: (s90)

2. Write and solve an inequality statement to represent the following problem:

On a particular airline, checked bags can weigh no more than 50 pounds. Sally packed 32 pounds of clothes and five identical gifts in a suitcase that weighs 8 pounds. Write an inequality to represent this situation.

$$5x + 8 + 32 \leq 50$$

$$5x + 8 + 32 \leq 50$$

$$5x + 40 \leq 50$$

$$5x + 40 - 40 \leq 50 - 40$$

$$5x \leq 10$$

$$\left(\frac{1}{5}\right)(5x) \leq \left(\frac{1}{5}\right)(10)$$

$$x \leq 2$$

Each of the 5 gifts can weigh 2 pounds or less.

Closing:

How do you know when you need to use an inequality instead of an equation to model a given situation?

Is it possible for an inequality to have exactly one solution? Exactly two solutions? Why or why not?

Problem Set:

(s.91)