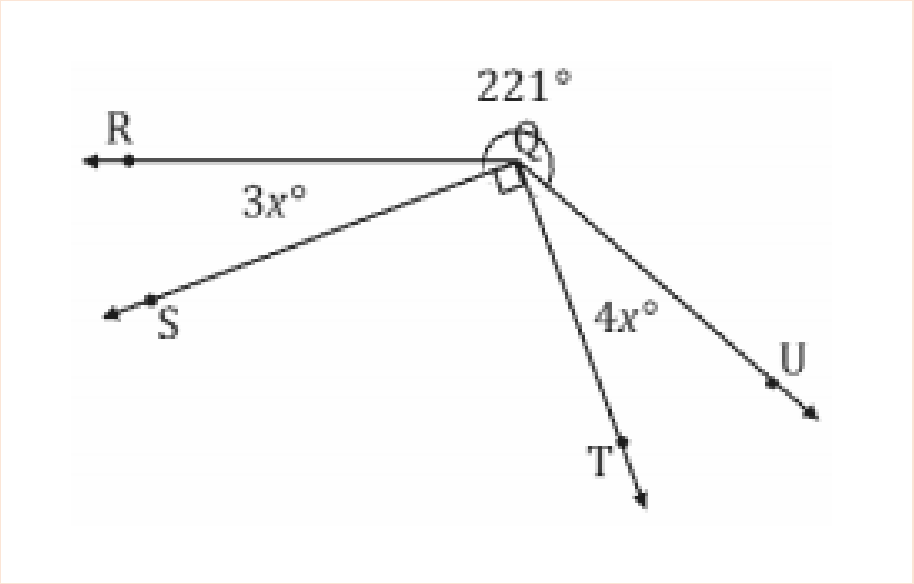
Lesson 12: Properties of Inequalities

Student Outcomes:

- Students justify the properties of inequalities that are denoted by < (less than), ≤ (less than or equal to), > (greater than), and ≥ (greater than or equal to).

Bell Work:

Write an equation for the angle relationship shown in the figure and solve for x. Find the measurements of <RQS and <TQU.



x = 7

m<RQS = 3(7°) = 21°

m<TQU = 4(7°) = 28°

Notes:

Inequalities:

> means greater than

< means less than

≥ means greater than or equal to

≤ means less than or equal to

Rapid Whiteboard Exchange (10 minutes): Equations Students complete a rapid whiteboard exchange where they practice their knowledge of solving linear equations in the form $px + q = r$ and $p(x + q) = r$

Determine the value of the variable. Set 1

1. $x + 1 = 5$ $x = 4$
2. $x + 3 = 5$ $x = 2$
3. $x + 6 = 5$ $x = -1$
4. $x - 5 = 2$ $x = 7$
5. $x - 5 = 8$ $x = 13$

Determine the value of the variable. Set 2

1. $3x = 15$ $x = 5$
2. $3x = 0$ $x = 0$
3. $3x = -3$ $x = -1$
4. $-9x = 18$ $x = -2$
5. $-x = 18$ $x = -18$

Determine the value of the variable. Set 3

1. $\frac{1}{7}x = 5$ x = 35
2. $\frac{2}{7}x = 10$ x = 35
3. $\frac{3}{7}x = 15$ x = 35
4. $\frac{4}{7}x = 20$ x = 35
5. $-\frac{5}{7}x = -25$ x = 35

Determine the value of the variable. Set 4

1. $2x + 4 = 12$ $x = 4$
2. $2x - 5 = 13$ $x = 9$
3. $2x + 6 = 14$ $x = 4$
4. $3x - 6 = 18$ $x = 8$
5. $-4x + 6 = 22$ $x = -4$

Determine the value of the variable. Set 5

1. $2x + 0.5 = 6.5$ $x = 3$
2. $3x - 0.5 = 8.5$ $x = 3$
3. $5x + 3 = 8.5$ $x = 1.1$
4. $5x - 4 = 1.5$ $x = 1.1$
5. $-7x + 1.5 = 5$ $x = -0.5$

Determine the value of the variable. Set 6

1. $2(x + 3) = 4$ $x = -1$
2. $5(x + 3) = 10$ $x = -1$
3. $5(x - 3) = 10$ $x = 5$
4. $-2(x - 3) = 8$ $x = -1$
5. $-3(x + 4) = 3$ $x = -5$

Example 1: (s.81)

Preserve the inequality symbol:

means the inequality symbol stays the same

Reverse the inequality symbol:

means the inequality symbol switches less than with greater than and less than or equal to with greater than or equal to.

Station 1: (s.81)

Examine the results. Make a statement about what you notice, and justify it with evidence.

When a number is added or subtracted to both numbers being compared, the symbol stays the same, and the inequality symbol is preserved.

Station 2: (s.82)

Examine the results. Make a statement about what you notice and justify it with evidence.

When both numbers are multiplied by -1, the symbol changes, and the inequality symbol is reversed.

Station 3: (s.83)

Examine the results. Make a statement about what you notice, and justify it with evidence.

When both numbers being compared are multiplied by or divided by a positive number, the symbol stays the same, and the inequality symbol is preserved.

Station 4: (s.84)

Examine the results. Make a statement about what you notice and justify it with evidence.

When both numbers being compared are multiplied by or divided by a negative number, the symbol changes, and the inequality symbol is reversed.

Exercise: (s.85)

Complete the following chart using the given inequality, and determine an operation in which the inequality symbol is preserved and an operation in which the inequality symbol is reversed. Explain why this occurs.

Inequality	Operation and New Inequality Which Preserves the Inequality Symbol	Operation and New Inequality Which Reverses the Inequality Symbol	Explanation
$2 < 5$	*Add 4 to both sides.* $2 < 5$ $2 + 4 < 5 + 4$ $6 < 9$	*Multiply both sides by −4.* $-8 > -20$	*Adding a number to both sides of an inequality preserves the inequality symbol. Multiplying both sides of an inequality by a negative number reverses the inequality symbol.*
$-4 > -6$	*Subtract 3 from both sides.* $-4 > -6$ $-4 - 3 > -6 - 3$ $-7 > -9$	*Divide both sides by −2.* $2 < 3$	*Subtracting a number from both sides of an inequality preserves the inequality symbol. Dividing both sides of an inequality by a negative number reverses the inequality symbol.*

Inequality	Operation and New Inequality Which Preserves the Inequality Symbol	Operation and New Inequality Which Reverses the Inequality Symbol	Explanation
$-1 \leq 2$	*Multiply both sides by 3.* $-1 \leq 2$ $-1(3) \leq 2(3)$ $-3 \leq 6$	*Multiply both sides by −1.* $1 \geq -2$	*Multiplying both sides of an inequality by a positive number preserves the inequality symbol. Multiplying both sides of an inequality by a negative number reverses the inequality symbol.*
$-2+(-3) < -3-1$	*Add 5 to both sides.* $-2+(-3) < -3-1$ $-2+(-3)+5 < -3-1+5$ $0 < 1$	*Multiply each side by* $-\frac{1}{2}$. $-2+(-3) < -3-1$ $-5 < -4$ $\left(-\frac{1}{2}\right)(-5) > \left(-\frac{1}{2}\right)(-4)$ $\frac{5}{2} > 2$	*Adding a number to both sides of an inequality preserves the inequality symbol. Multiplying both sides of an inequality by a negative number reverses the inequality symbol.*

Closing:

What does it mean for an inequality to be preserved? What does it mean for the inequality to be reversed?

When an operation is done to both sides and the inequality does not change, it is preserved. If the inequality does change, it is reversed. For example, less than would become greater than.

Closing:

When does a greater than become a less than?

When both sides are multiplied or divided by a negative, the inequality is reversed.

Lesson Summary:

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.

Problem Set:
(s.86)