Math Inequality

In Algebra, inequality is a mathematical statement that shows the relation between two expressions using the inequality symbol. The expressions on both sides of an inequality sign are not equal. It means that the expression on the left-hand side should be greater than or less than the expression on the right-hand side or vice versa. If the relationship between two algebraic expressions is defined using the inequality symbols, then it is called literal inequalities.

Definition: "If two real numbers or the algebraic expressions are related by the symbols ">", "<", "≥", "≤", then the relation is called an inequality."

For example, x>3 (x should be greater than 3)

Open Sentence: The inequality is said to be an open sentence if it has only one variable.

For example, x < 6 (x is less than 6)

Double Inequalities: The inequality is said to be a double inequality if the statement shows the double relation of the expressions or the numbers.

Example: 3≤x<8 (x is greater than or equal to 3 and less than 8)

Inequality Symbols

The most familiar inequality sign is the "not equal sign (≠)". But to compare the values on the inequalities, the following symbols are used.

Strict Inequality

The strict inequality symbols are less than symbol (<) and greater than symbol (>). These two symbols are called strict inequalities, as it shows the numbers are strictly greater than or less than each other.

For example,

- 5 < 9 (5 is strictly less than 9)
- 10 > 7 (10 is strictly greater than 7)

Slack Inequality

The slack inequalities are less than or equal to symbol (≤) and greater than or equal to symbol (≥). The slack inequalities represent the relation between two inequalities that are not strict.

For example,

- $x \geq 15$ (x is greater than or equal to 15)
- $x \leq 9$ (x is less than or equal to 9)

Properties of Inequalities

The following are the properties of the inequalities:

Transitive Property

The relation between the three numbers is defined using the transitive property.

If a, b and c are the three numbers, then

If $a \geq b$, and $b \geq c$, then $a \geq c$

Similarly,

If $a \leq b$, and $b \leq c$, then $a \leq c$

In the above-mentioned example, if one relation is defined by strict inequality, then the result should also be in strict inequality.

For example,

If $a \geq b$, and $b > c$, then $a > c$.

Addition and Subtraction Property

The addition and subtraction property of inequalities states that adding or subtracting the same constant on both sides of inequalities are equivalent to each other.

Let "m" be constant,

If $x \leq y$, then $x + m \leq y + m$

If $x \geq y$, then $x + m \geq y + m$

Similarly, for the subtraction operation,

If $x \leq y$, then $x - m \leq y - m$

If $x \geq y$, then $x - m \geq y - m$

Multiplication and Division Property

If a positive constant number is multiplied or divided by both sides of an inequality, the inequality remains the same. But, if inequality is multiplied or divided by the negative constant number, the inequality expression will get reversed.

Let "m" be a positive constant,

If $x \leq y$, then $xm \leq ym$ (if $m>0$)

If $x \geq y$, then $xm \geq ym$ (if $m>0$

Let "m" be a negative constant number,

If $x \leq y$, then $xm \geq ym$ (if $m<0$)

If $x \geq y$, then $xm \leq ym$ (if $m<0$)

The above condition holds true for the division operation.

Converse Property

The converse property states that if we flip the number, we have to flip the inequality symbol also.

i.e., If $a \geq b$, then $b \leq a$

Likewise, if $a \leq b$, then $b \geq a$.

Solving Inequalities

Solving inequalities is very much similar to solving an equation. While solving the inequalities, follow the rules provided below, which do not affect the inequality direction:

- Add or subtract the same number on both sides of an inequality.
- Multiply or divide the inequality by the same positive number.
- Simplify a side of the inequality.

EXERCISE

1. The length of a rectangle is three times the breadth. If the minimum perimeter of the rectangle is 160 cm, then

(a) breadth > 20 cm

(b) length < 20 cm

(c) breadth $\geq$ 20 cm

(d) length $\leq$ 20 cm

2. If $-3x + 17 < -13$, then

(a) $x \in (10, \infty)$

(b) $x \in [10, \infty)$

(c) $x \in (-\infty, 10]$

(d) $x \in [-10, 10)$

3. Given that x, y and b are real numbers and x < y, b < 0, then

(a) x/b < y/b

(b) x/b $\leq$ y/b

(c) x/b > y/b

(d) x/b $\geq$ y/b

4. If $|x - 1| > 5$, then

(a) $x \in (-4, 6)$

(b) $x \in [-4, 6]$

(c) $x \in (-\infty, -4) \cup (6, \infty)$

(d) $x \in [-\infty, -4) \cup [6, \infty)$

5. If $|x - 7|/(x - 7) \geq 0$, then

(a) $x \in [7, \infty)$

(b) $x \in (7, \infty)$

(c) $x \in (-\infty, 7)$

(d) $x \in (-\infty, 7]$

Answer Key

1. C

2. A

3. A

4. C

5. B

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