

MATHEMATICS • CLASS 11

CHAPTER 5

Linear Inequalities

CHAPTER NOTES



MEANING AND TYPES OF INEQUALITIES

An inequality compares two real numbers or algebraic expressions using one of these symbols:

$<$: less than $>$: greater than $\leq$: less than or equal to $\geq$: greater than or equal to

NUMERICAL INEQUALITIES

Only numbers appear.

$$3 < 5 \quad 7 > 5$$

LITERAL INEQUALITIES

Variables appear.

$$x < 5 \quad y > 2 \quad x \geq 3 \quad y \leq 4$$

STRICT INEQUALITIES

The boundary value is not included.

$$< \quad >$$

SLACK INEQUALITIES

Equality is also allowed.

$$\leq \quad \geq$$

DOUBLE INEQUALITIES

Two comparisons must hold together.

$$3 < 5 < 7 \quad 3 \leq x < 5$$

The last statement includes three but excludes five.

LINEAR INEQUALITIES AND EVERYDAY SITUATIONS

ONE VARIABLE

A linear inequality has the variable to the first power.

$$ax + b < 0, \quad ax + b > 0, \quad ax + b \leq 0, \quad ax + b \geq 0$$

$$a \neq 0$$

TWO VARIABLES

The following are linear inequalities in two variables:

$$ax + by < c, \quad ax + by > c$$

$$ax + by \leq c, \quad ax + by \geq c$$

$$a \neq 0, \quad b \neq 0$$

NOT LINEAR

$$ax^2 + bx + c > 0, \quad a \neq 0$$

The squared variable makes this quadratic.

REGISTERS AND PENS

Reshma has a fixed budget.

$$\text{Budget} = ₹120$$

$$\text{Cost of one register} = ₹40$$

$$\text{Cost of one pen} = ₹20$$

$$\text{Number of registers} = x; \quad \text{number of pens} = y$$

$$40x + 20y \leq 120$$

$$x, y \in \{0, 1, 2, \dots\}$$

“At most” means the total may equal the budget, but cannot exceed it.

SOLUTION SETS AND THE DOMAIN

A solution is a value that makes an inequality true.
The collection of all solutions is its solution set.
The allowed number system matters.

RICE-PACKET SITUATION

Ravi has a budget and buys whole packets.

Budget = ₹200; packet price = ₹30

Number of packets = x

$$30x < 200$$

$$30(6) = 180 < 200$$

$$30(7) = 210 > 200$$

In this situation, negative or fractional packet counts are not allowed.

$$x \in \{0, 1, 2, 3, 4, 5, 6\}$$

WORKED EXAMPLE

$$30x < 200$$

$$x < \frac{200}{30} = \frac{20}{3}$$

Divide by a positive number, so the sign stays the same.

If natural numbers are required:

$$\{1, 2, 3, 4, 5, 6\}$$

If integers are required:

$$\{\dots, -3, -2, -1, 0, 1, 2, 3, 4, 5, 6\}$$

Unless a different domain is stated, use real numbers in this chapter.

RULES FOR SOLVING INEQUALITIES

ADD OR SUBTRACT

Adding or subtracting the same number on both sides keeps the inequality sign unchanged.

$$a < b \Rightarrow a + c < b + c$$

$$a < b \Rightarrow a - c < b - c$$

MULTIPLY OR DIVIDE BY A POSITIVE NUMBER

The sign stays the same.

$$a < b, c > 0 \Rightarrow ac < bc$$

$$a < b, c > 0 \Rightarrow \frac{a}{c} < \frac{b}{c}$$

MULTIPLY OR DIVIDE BY A NEGATIVE NUMBER

Reverse the inequality sign.

$$a < b, c < 0 \Rightarrow ac > bc$$

$$a < b, c < 0 \Rightarrow \frac{a}{c} > \frac{b}{c}$$

WHY THE SIGN REVERSES

$$3 > 2$$

$$-3 < -2$$

$$-8 < -7$$

$$(-8)(-2) > (-7)(-2)$$

$$16 > 14$$

The same rules apply to the other inequality symbols.

$$< \leftrightarrow > \quad \leq \leftrightarrow \geq$$

Never divide by zero.



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