CHAPTER 3

LINEAR INEQUALITIES

Background of Chapter

Conceptual Background

- **Basics of Inequalities** — 100%.
- **Types of Questions**
  - Formation of Inequalities — 100%.
  - Inequality is Given → Graph is asked — 100%.
  - Graph is Given → Inequality is asked — 100%.
  - Finding Solutions
- **Modulus function** — ** Imp.

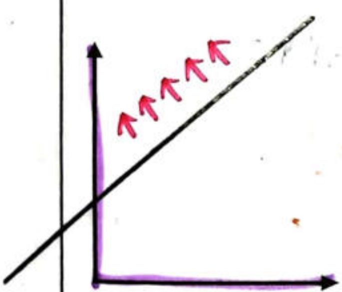
Basics of Inequalities

Any Linear equations formed using sign of any inequalities is termed as Linear Inequalities.

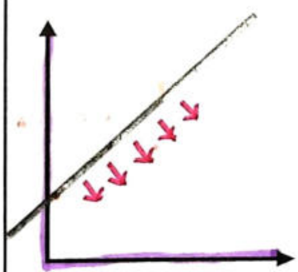
E.g., $2x + 3y > 5$, **E.g.,** $2x + 3y < 5$, **E.g.,** $2x + 3y \geq 5$

Signs of Inequalities: **>, <, ≥, ≤**

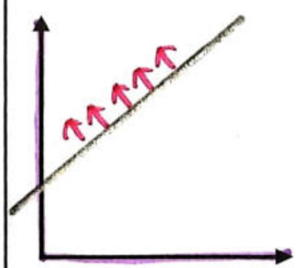
Greater than (>)



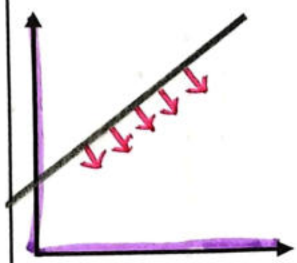
Less than (<)



Greater than equals to (≥)



Greater than equals to (≤)



Inequalities is Given and Graph is Asked

Before starting the question look at the Options, whether all the options have Same Diagram (Geometry) or Different Diagram (Geometry)

Options Have Same Diagram

Just check the "SHADING" In the Given option.

Options Have Different Diagram

Step-1

First of all, draw the geometry of Diagram

How

x	0	2	4
y	–	–	–

Step-2

After geometry is drawn Now look for Shading

Graph is Given and Inequalities is Asked

In this category question consist of graphs and in options we are given with inequalities.

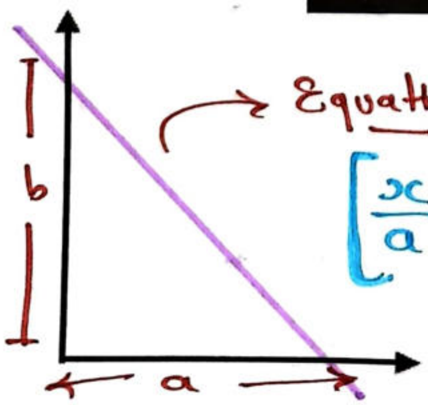
What we need to do is, we need to figure **Out the Sign** of **Inequalities** for given Equations

NOTE

Shading upwards $\geq$

Shading downwards $\leq$

Equation of Straight Line - Intercept form



Equation

$$\left[\frac{x}{a} + \frac{y}{b} = 1\right]$$

↓

formula

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$$\boxed{y = mx + c}$$

slope → [Key Coefficient]

y-intercept → [Key Parameter]

Formation of Inequalities

Under this Category we are given with certain **Statements** [Conditions], what we need to do is, we need to convert them **into** equations with **Inequalities.**

Example: An employer recruits experienced (x) and fresh workmen (y) for his firm under the condition that he cannot employ more than 9 people. X and y can be related by the inequality

$[x + y \leq 9]$

Modulus Functions

$\boxed{|f(x)|}$

$f(x) \geq 0$ → Convert this into Bracket — As it is

$f(x) < 0$ → Convert this into Bracket — with (-)ve sign..

Eg. $|x-2|$

$\boxed{x-2 \geq 0}$ → $(x-2)$

$\boxed{x-2 \leq 0}$ → $-(x-2)$

Example: If $\left|x+\frac{1}{4}\right| > \frac{7}{4}$, then: IMP

(a) $x < \frac{-3}{2}$ or $x > 2$

(b) $x < -2$ or $x > \frac{3}{2}$

(c) $-2 < x < \frac{3}{2}$

(d) none of these

$|x + 1/4| > 7/4$ → CHECK 'NOTE' on last page.

+ve:

$x + 1/4 > 7/4$

$x > 7/4 - 1/4$

$\boxed{x > 6/4}$

$\boxed{x > 3/2}$

-ve:

$-(x + 1/4) > 7/4$

$-x - 1/4 > 7/4$

$-x > 7/4 + 1/4$

$-x > 2$

$\boxed{x < -2}$

Example: If $\left|\frac{3x-4}{4}\right| \leq \frac{5}{12}$, then solution set is: → Common Region. IMP

+ve:

$\frac{3x-4}{\cancel{4}} \leq \frac{5}{\cancel{12}_3}$

$9x - 12 \leq 5$

$9x \leq 17$

$\boxed{x \leq 17/9}$

-ve:

$\frac{-3x+4}{4} \leq \frac{5}{\cancel{12}_3}$

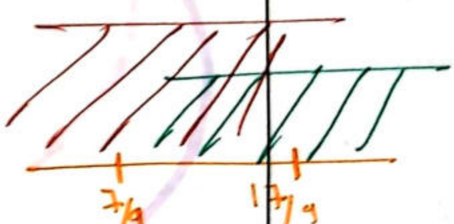
$-9x + 12 \leq 5$

$\cancel{-}9x \leq \cancel{-}7$

$\boxed{x \geq 7/9}$ ✓

[Here's Twist]

When we cancel signs with each other the sign of Inequality changes



$\left[\frac{7}{9}, \frac{17}{9}\right]$ will be Answer

TIP:- $\frac{a+b}{c} = \frac{a}{c} + \frac{b}{c}$

Finding Solutions

Method to Draw Graph

Step-1: 1st of all convert the equations in intercept form. formula. $\frac{x}{a} + \frac{y}{b} = 1$

Step-2: Now **Plot the points**, draw the diagram and then get the corner points of shaded region.

Exam Approach – Shortcut

Go from **Option to Question** and just check 2 things

- **All Points** of Options Should **Justify** the **inequality**
- Each Point should give exact **LHS = RHS** with 2 equations

NOTE

Example: On solving the inequalities 6x + y ≥ 18, x + 4y ≥ 12, 2x + y ≥ 10, we get the following

(a) (0, 18), (12, 0), (4, 2) and (2, 6)

$x \geq 0$, $y \geq 0$

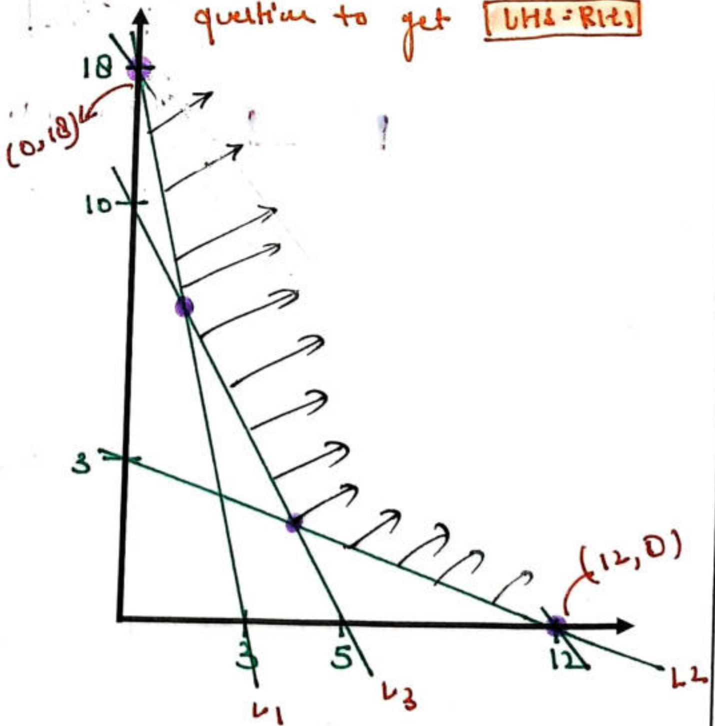
This option milega usmein jo jo tik hoga majority vala tik kar dena.

→ must check that option only which has the majority same & one diff & put that diff one in the question to get $\boxed{\text{LHS = RHS}}$

$6x + y \geq 18 \rightarrow \frac{x}{3} + \frac{y}{18} \geq 1$

$x + 4y \geq 12 \rightarrow \frac{x}{12} + \frac{y}{3} \geq 1$

$2x + y \geq 10 \rightarrow \frac{x}{5} + \frac{y}{10} \geq 1$

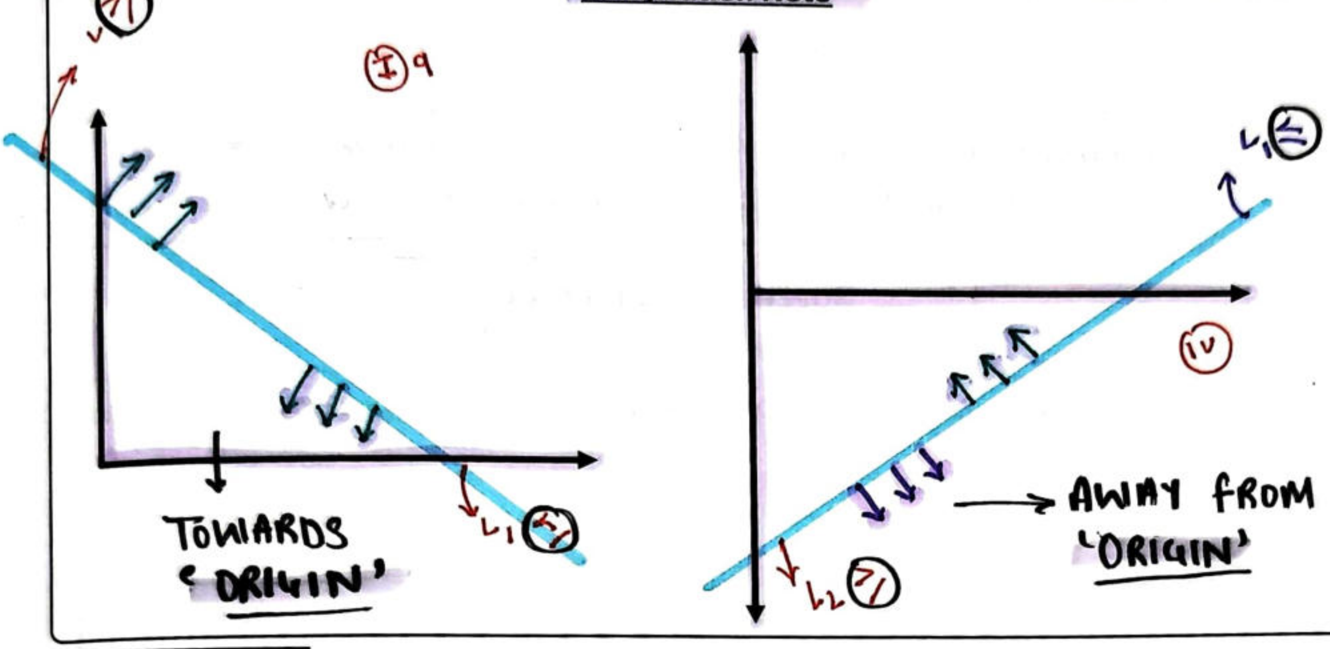


In this Question What we have to do is, that We have to 'Compare' Each option with the Question.

Say :- In above Question We have 'Options' now we have to put that option in the Question & we will 'Pick' the option which give us $\boxed{\text{LHS = RHS}}$ that's all ✓

NOTE :- LESS THEN SIGN $\leq$ MOVE TOWARDS ORIGIN
GREATER THEN SIGN $\geq$ AWAY FROM 'ORIGIN'

Clarification Note



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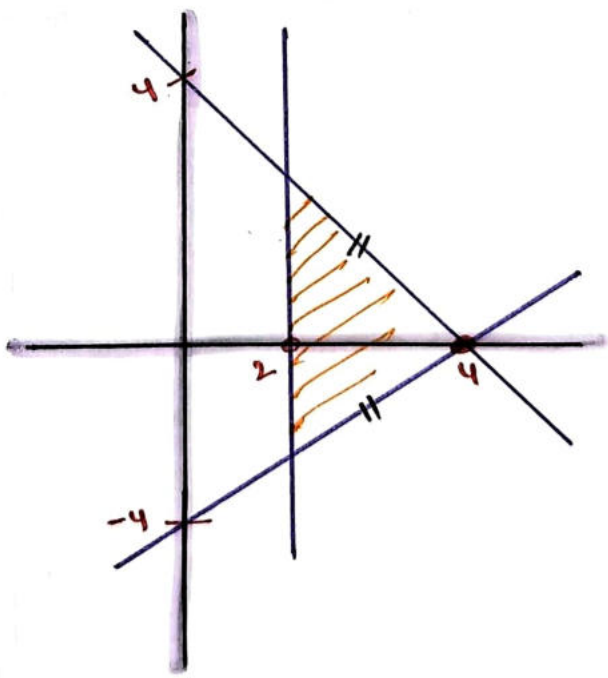
Example: The common region in the graph of the inequalities $x + y \leq 4, x - y \leq 4, x \geq 2$ is

(a) Equilateral triangle (b) Isosceles triangle (c) Quadrilateral (d) Square

$x + y \leq 4 \rightarrow \frac{x}{4} + \frac{y}{4} \leq 1$

$x - y \leq 4 \rightarrow \frac{x}{4} + \frac{y}{(-4)} \leq 1$

$x \geq 2 \rightarrow \frac{x}{2} \leq 1$



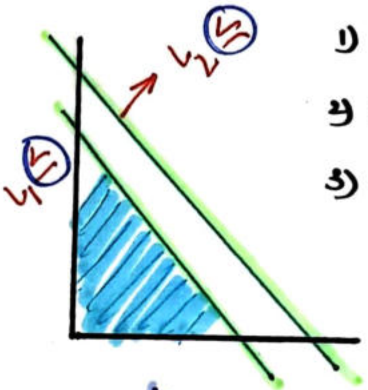
Other Useful Concepts

NOTE:- Whenever We $\boxed{\text{Multiply}}$ (-ve) Sign Both the Sides, then 'Sign of inequality changes'

Eg:- $\boxed{3 > 2}$ $\boxed{-3 < -2}$

[FEASIBLE & INFEASIBLE SOLUTION]

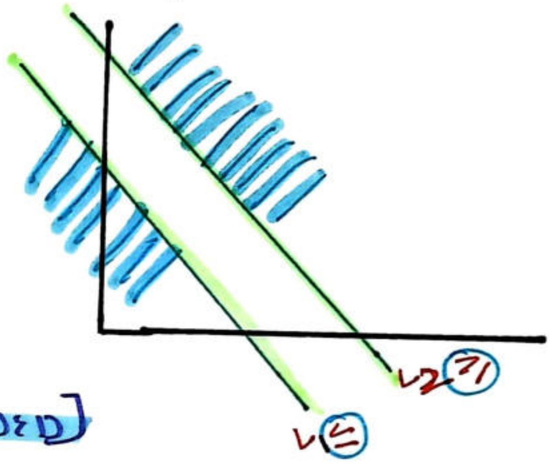
Feasible



NOTE → Always Remember

1) ≥ , ≥ , ≥ → Unbounded
2) ≤ , ≤ , ≥ → Bounded
3) ≤ , ≤ , ≤ → Bounded

Infeasible



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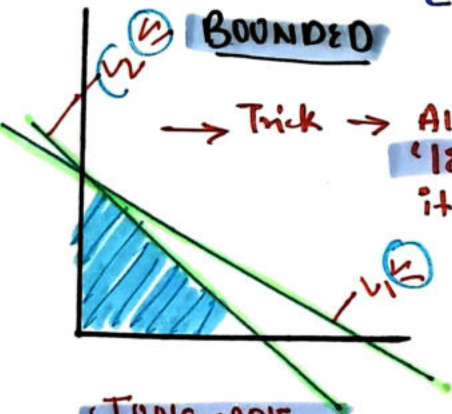
[BOUNDED & UNBOUNDED]

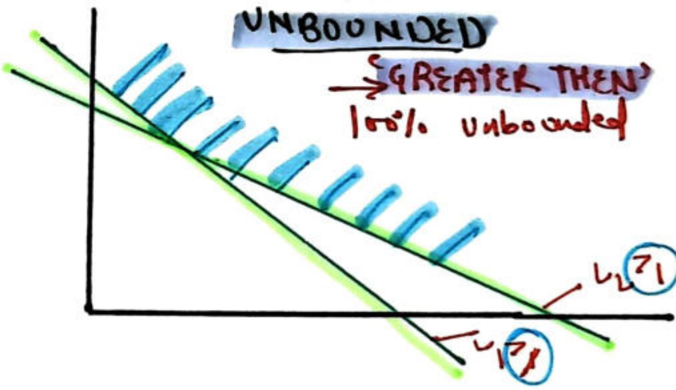
BOUNDED



→ Trick → All three are 'LESS THEN' 100% it will be bounded

UNBOUNDED

→ 'GREATER THEN' 100% unbounded



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The Common region in the Graph of linear inequalities $2x+y \geq 18$, $x+y \geq 12$ and $3x+2y \leq 36$ is:

(a) unbounded
(b) bounded & feasible
(c) Infeasible
(d) feasible and unbounded