

## Chapter 6. Linear Inequalities

### Question-1

Solve the inequation:  $3x - 7 > x + 3$

**Solution:**

$$3x - 7 > x + 3$$

$$3x - 7 + 7 > x + 3 + 7$$

$$3x > x + 10$$

$$3x - x > x + 10 - x$$

$$2x > 10$$

$$x > 5$$

### Question-2

Solve the inequation:  $x + 12 < 4x - 2$

**Solution:**

$$x + 12 < 4x - 2$$

$$x + 12 - 12 < 4x - 2 - 12$$

$$x < 4x - 14$$

$$x - 4x < 4x - 14 - 4x$$

$$-3x < -14$$

$$-3x/-3 > -14/-3$$

$$x > 14/3$$

### Question-3

Solve the inequation:  $4x - 7 < 3 - x$

**Solution:**

$$4x - 7 < 3 - x$$

$$4x - 7 + 7 < 3 - x + 7$$

$$4x < 10 - x$$

$$4x + x < 10 - x + x$$

$$5x < 10$$

$$x < 2$$

#### Question-4

Solve the inequation:  $3x + 17 \leq 2(1 - x)$

**Solution:**

$$3x + 17 \leq 2(1 - x)$$

$$3x \leq -2x - 15$$

$$3x + 2x \leq -2x - 15 + 2x$$

$$5x \leq -15$$

$$5x/5 \leq -15/5$$

$$x \leq -3$$

#### Question-5

Solve the inequation:  $-2x + 6 \geq 5x - 4$

**Solution:**

$$-2x + 6 \geq 5x - 4$$

$$-2x \geq 5x - 10$$

$$-2x - 5x \geq 5x - 10 - 5x$$

$$-7x \geq -10$$

$$-7x/-7 \leq -10/-7$$

$$x \leq 10/7$$

#### Question-6

Solve the inequation:  $-(x - 3) + 4 > -2x + 5$

**Solution:**

$$-(x - 3) + 4 > -2x + 5$$

$$-x + 7 > -2x + 5$$

$$-x + 7 - 7 > -2x + 5 - 7$$

$$-x > -2x - 2$$

$$x < 2x + 2$$

$$x - 2x < 2x + 2 - 2x$$

$$-x < 2$$

$$x > -2$$

### Question-7

Solve the inequation:  $2(2x + 3) - 10 < 6(x - 2)$

**Solution:**

$$2(2x + 3) - 10 < 6(x - 2)$$

$$4x + 6 - 10 < 6x - 12$$

$$4x - 4 < 6x - 12$$

$$4x - 4 + 4 < 6x - 12 + 4$$

$$4x < 6x - 8$$

$$4x - 6x < 6x - 8 - 6x$$

$$-2x < -8$$

$$-2x/-2 > -8/-2$$

$$x > 4$$

### Question-8

Solve the inequation:  $2 - 3x \geq 2(x + 6)$

**Solution:**

$$2 - 3x \geq 2x + 12$$

$$2 - 3x - 2 \geq 2x + 12 - 2$$

$$-3x \geq 2x + 10$$

$$-3x - 2x \geq 2x + 10 - 2x$$

$$-5x \geq 10$$

$$-5x/-5 \leq 10/-5$$

$$x \leq -2$$

### Question-8

Solve the inequation:  $2 - 3x \geq 2(x + 6)$

**Solution:**

$$2 - 3x \geq 2x + 12$$

$$2 - 3x - 2 \geq 2x + 12 - 2$$

$$-3x \geq 2x + 10$$

$$-3x - 2x \geq 2x + 10 - 2x$$

$$-5x \geq 10$$

$$-5x/-5 \leq 10/-5$$

$$x \leq -2$$

### Question-9

Solve the inequation:  $37 - (3x + 5) \geq 9x - 8(x - 3)$

**Solution:**

$$37 - 3x - 5 \geq 9x - 8x + 24$$

$$32 - 3x \geq x + 24$$

$$32 - 3x - 32 \geq x + 24 - 32$$

$$-3x \geq x - 8$$

$$-3x - x \geq x - 8 - x$$

$$-4x \geq -8$$

$$-4x/-4 \geq -8/-4$$

$$x \geq 2$$

### Question-10

Solve the inequation:  $\frac{5x}{2} + \frac{3x}{4} \geq \frac{39}{4}$

**Solution:**

$$\frac{5x}{2} + \frac{3x}{4} \geq \frac{39}{4}$$

$$10x + 3x \geq 39$$

$$13x \geq 39$$

$$13x/13 \geq 39/13$$

$$x \geq 3$$

### Question-11

Solve the inequation:  $\frac{4+2x}{3} \geq \frac{x}{2} - 3$

**Solution:**

$$\frac{4+2x}{3} \geq \frac{x}{2} - 3$$

$$2(4 + 2x) \geq 3x - 18 \text{ (Multiplying by 6 both sides)}$$

$$8 + 4x \geq 3x - 18$$

$$8 + 4x - 8 \geq 3x - 18 - 8$$

$$4x \geq 3x - 26$$

$$4x - 3x \geq 3x - 26 - 3x$$

$$x \geq -26$$

### Question-12

Solve the inequality:  $\frac{3(x-2)}{5} \geq \frac{5(2-x)}{3}$

**Solution:**

$$\frac{3(x-2)}{5} \geq \frac{5(2-x)}{3}$$

$9(x-2) \geq 25(2-x)$  (Multiplying by 15 both sides)

$$9x - 18 \geq 50 - 25x$$

$$9x - 18 + 18 \geq 50 - 25x + 18$$

$$9x \geq 68 - 25x$$

$$9x + 25x \geq 68 - 25x + 25x$$

$$34x \geq 68$$

$$34x/34 \geq 68/34$$

$$x \geq 2$$

### Question-13

Solve the inequality:  $\frac{x}{4} < \frac{5x-2}{3} - \frac{7x-3}{5}$

**Solution:**

$$\frac{x}{4} < \frac{5x-2}{3} - \frac{7x-3}{5}$$

$15x < 20(5x-2) - 12(7x-3)$  (Multiplying by 60 both sides)

$$15x < 100x - 40 - 84x + 36$$

$$15x < 16x - 4$$

$$15x - 16x < 16x - 4 - 16x$$

$$-x < -4$$

$$x > 4$$

### Question-14

Solve the inequality:  $\frac{5-2x}{3} \leq \frac{x}{6} - 5$

**Solution:**

$$\frac{5-2x}{3} \leq \frac{x}{6} - 5$$

$2(5-2x) \leq x - 30$  (Multiplying by 6 both sides)

$$10 - 4x \leq x - 30$$

$$10 - 4x - 10 \leq x - 30 - 10$$

$$-4x \leq x - 40$$

$$-4x - x \leq x - 40 - x$$

$$-5x \leq -40$$

$$-5x/-5 \leq -40/-5$$

$$x \geq 8$$

### Question-15

Solve the inequation:  $\frac{1}{2}\left(\frac{3}{5}x+4\right) \geq \frac{1}{3}(x-6)$

**Solution:**

$$\frac{1}{2}\left(\frac{3}{5}x+4\right) \geq \frac{1}{3}(x-6)$$

$$3\left(\frac{3}{5}x+4\right) \geq 2(x-6) \text{ (Multiplying by 6 both sides)}$$

$$3(3x+20) \geq 10(x-6) \text{ (Multiplying by 5 both sides)}$$

$$9x+60 \geq 10x-60$$

$$9x+60-60 \geq 10x-60-60$$

$$9x \geq 10x-120$$

$$9x-10x \geq 10x-120-10x$$

$$-x \geq -120$$

$$x \leq 120$$

### Question-16

Solve the following system of inequations:  $x-2 > 0$ ,  $3x < 18$

**Solution:**

$$x-2 > 0$$

$$3x < 18$$

$$x-2 > 0$$

$$x > 2 \dots\dots\dots(1)$$

$$3x < 18$$

$$x < 6 \dots\dots\dots(2)$$

From (1) and (2), solutions of the given system are, therefore, given by  $2 < x < 6$

Hence the solution of the system is  $2 < x < 6$ .

### Question-17

Solve the following system of inequations:  $5x + 1 > -24$ ,  $5x - 1 < 24$

**Solution:**

$$5x + 1 > -24$$

$$5x - 1 < 24$$

$$5x + 1 > -24$$

$$5x > -25$$

$$x > -5 \dots\dots\dots(1)$$

$$5x - 1 < 24$$

$$5x < 25$$

$$x < 5 \dots\dots\dots(2)$$

From (1) and (2), solutions of the given system are, therefore, given by  $-5 < x < 5$

Hence the solution of the system of is  $-5 < x < 5$ .

### Question-18

Solve the following system of inequations:  $x + 2 \leq 5$ ,  $3x - 4 > -2 + x$

**Solution:**

$$x + 2 \leq 5$$

$$3x - 4 > -2 + x$$

$$x + 2 \leq 5$$

$$x \leq 3 \dots\dots\dots(1)$$

$$3x - 4 > -2 + x$$

$$3x > 2 + x$$

$$2x > 2$$

$$x > 1 \dots\dots\dots(2)$$

From (1) and (2), solutions of the given system are, therefore, given by  $1 < x \leq 3$ .

Hence the solution of the system of is  $1 < x \leq 3$ .

### Question-19

Solve the following system of inequations:  $4x + 5 > 3x$ ,  $-(x + 3) + 4 \leq -2x + 5$

#### Solution:

$$4x + 5 > 3x$$

$$-(x + 3) + 4 \leq -2x + 5$$

$$4x + 5 > 3x$$

$$4x > 3x - 5$$

$$x > -5 \dots\dots\dots(1)$$

$$-(x + 3) + 4 \leq -2x + 5$$

$$-x - 3 + 4 \leq -2x + 5$$

$$-x + 1 \leq -2x + 5$$

$$-x \leq -2x + 4$$

$$x \leq 4 \dots\dots\dots(2)$$

From (1) and (2), solutions of the given system are, therefore, given by  $-5 < x \leq 4$

Hence the solution of the system of is  $-5 < x \leq 4$ .

### Question-20

Solve the following system of inequations:  $\frac{4x}{3} - \frac{9}{4} < x + \frac{3}{4}$ ,  $\frac{7x-1}{3} - \frac{7x+2}{6} > x$

#### Solution:

$$\frac{4x}{3} - \frac{9}{4} < x + \frac{3}{4}$$

$$\frac{7x-1}{3} - \frac{7x+2}{6} > x$$

$$\frac{4x}{3} - \frac{9}{4} < x + \frac{3}{4}$$

$$16x - 27 < 12x + 9 \quad \text{(Multiplying by 12 both sides)}$$

$$16x < 12x + 36$$

$$4x < 36$$

$$x < 9 \dots\dots\dots(1)$$

$$\frac{7x-1}{3} - \frac{7x+2}{6} > x$$

$$2(7x - 1) - (7x + 2) > 6x \quad \text{(Multiplying by 6 both sides)}$$

$$14x - 2 - 7x - 2 > 6x$$

$$7x - 4 > 6x$$

$$7x > 6x + 4$$

$$x > 4 \dots\dots\dots(2)$$

From (3) and (4), solutions of the given system are, therefore, given by  $4 < x < 9$

Hence the solution of the system of is  $4 < x < 9$ .



### Question-21

Solve the following system of inequations:  $2(x + 1) < x + 5$ ,  $3(x + 2) > 2 - x$ .

#### Solution:

$$2(x + 1) < x + 5$$

$$3(x + 2) > 2 - x$$

$$2(x + 1) < x + 5$$

$$2x + 2 < x + 5$$

$$2x < x + 3$$

$$x < 3 \dots\dots\dots (1)$$

$$3(x + 2) > 2 - x$$

$$3x + 6 > 2 - x$$

$$3x > -4 - x$$

$$4x > -4$$

$$x > -1 \dots\dots\dots (2)$$

From (1) and (2), solutions of the given system are, therefore, given by  $-1 < x < 3$

Hence the solution of the system of is  $-1 < x < 3$ .

### Question-22

Solve the following system of inequations:  $3x - 1 \geq 5$ ,  $x + 2 > -1$

#### Solution:

$$3x - 1 \geq 5$$

$$x + 2 > -1$$

$$3x - 1 \geq 5$$

$$3x \geq 5 + 1$$

$$3x \geq 6$$

$$x \geq 2 \dots\dots\dots (1)$$

$$x + 2 > -1$$

$$x > -1 - 2$$

$$x > -3 \dots\dots\dots (2)$$

From (1) and (2), solutions of the given system are, therefore, given by  $x \geq 2$

Hence the solution of the system of is  $x \geq 2$ .

### Question-23

Solve the following system of inequations:  $3x - 7 > 2(x - 6)$ ,  $6 - x > 11 - 2x$

**Solution:**

$$3x - 7 > 2(x - 6)$$

$$6 - x > 11 - 2x$$

$$3x - 7 > 2x - 12$$

$$3x - 7 + 7 > 2x - 12 + 7$$

$$3x > 2x - 5$$

$$3x - 2x > 2x - 5 - 2x$$

$$x > -5 \dots\dots\dots(1)$$

$$6 - x > 11 - 2x$$

$$6 - x - 6 > 11 - 2x - 6$$

$$-x > 5 - 2x$$

$$-x + 2x > 5 - 2x + 2x$$

$$x > 5 \dots\dots\dots(2)$$

From (1) and (2), solutions of the given system are, therefore, given by  $x > 5$

Hence the solution of the system is  $x > 5$ .

### Question-24

Solve the following system of inequations:  $-2 - \frac{x}{4} \leq \frac{1+x}{3}$ ,  $3 - x < 4(x - 3)$

**Solution:**

$$-2 - \frac{x}{4} \leq \frac{1+x}{3}$$

$$3 - x < 4(x - 3)$$

$$-2 - \frac{x}{4} \leq \frac{1+x}{3}$$

$$-24 - 3x \leq 4(1 + x) \quad (\text{Multiplying by 12 both sides})$$

$$-24 - 3x \leq 4 + 4x$$

$$-3x \leq 4x + 28$$

$$-7x \leq 28$$

$$x \geq -4 \dots\dots\dots(1)$$

$$3 - x < 4x - 12$$

$$-x < 4x - 15$$

$$-5x < -15$$

$$x > 3 \dots\dots\dots(2)$$

From (1) and (2), solutions of the given system are, therefore, given by  $x > 3$

Hence the solution of the system is  $x > 3$ .

### Question-25

Solve the following system of inequations:

$$5(2x - 7) - 3(2x + 3) \leq 0, 2x + 19 \leq 6x + 47$$

**Solution:**

$$5(2x - 7) - 3(2x + 3) \leq 0$$

$$2x + 19 \leq 6x + 47$$

$$5(2x - 7) - 3(2x + 3) \leq 0$$

$$10x - 35 - 6x - 9 \leq 0$$

$$4x - 44 \leq 0$$

$$4x \leq 44$$

$$x \leq 11 \dots\dots\dots (3)$$

$$2x + 19 \leq 6x + 47$$

$$2x \leq 6x + 28$$

$$-4x \leq 28$$

$$x \geq -7 \dots\dots\dots (4)$$

From (1) and (2), solutions of the given system are, therefore, given by  $-7 \leq$

$$x \leq 11$$

Hence the solution of the system is  $-7 \leq x \leq 11$ .

### Question-26

Solve the following system of inequations:  $2x - 7 < 11, 3x + 4 < - 5$

**Solution:**

$$2x - 7 < 11$$

$$3x + 4 < - 5$$

$$2x - 7 < 11$$

$$2x < 18$$

$$x < 9 \dots\dots\dots(1)$$

$$3x + 4 < - 5$$

$$3x < - 9$$

$$x < - 3 \dots\dots\dots(2)$$

From (1) and (2), solutions of the given system are, therefore, given by  $x < -$

$$3$$

Hence the solution of the system is  $x < - 3$ .

### Question-27

Solve the following system of inequations:  $4 - 5x > -11$ ,  $4x + 11 \leq -13$

**Solution:**

$$4 - 5x > -11$$

$$4x + 11 \leq -13$$

$$4 - 5x > -11$$

$$- 5x > -15$$

$$x < 3 \dots\dots\dots (1)$$

$$4x + 11 \leq -13$$

$$4x \leq - 24$$

$$x \leq - 6 \dots\dots\dots (2)$$

From (1) and (2), solutions of the given system are, therefore, given by  $x \leq - 6$ .

Hence the solution of the system is  $x \leq - 6$

### Question-28

Solve the following system of inequations:  $4x - 5 < 11$ ,  $-3x - 4 \geq 8$ .

**Solution:**

$$4x - 5 < 11$$

$$-3x - 4 \geq 8$$

$$4x - 5 < 11$$

$$4x < 16$$

$$x < 4 \dots\dots\dots(1)$$

$$-3x - 4 \geq 8$$

$$-3x \geq 12$$

$$x \leq -4 \dots\dots\dots(2)$$

From (1) and (2), solutions of the given system are, therefore, given by  $x \leq -4$ .

Hence the solution of the system is  $x \leq -4$ .

### Question-29

Solve the following system of inequations:  $5x - 7 < 3(x + 3)$ ,  $1 - \frac{3x}{2} \geq x - 4$

#### Solution:

$$5x - 7 < 3(x + 3)$$

$$1 - \frac{3x}{2} \geq x - 4$$

$$5x - 7 < 3(x + 3)$$

$$5x - 7 < 3x + 9$$

$$5x < 3x + 16$$

$$2x < 16$$

$$x < 8 \dots\dots\dots(1)$$

$$1 - \frac{3x}{2} \geq x - 4 \quad (\text{Multiplying both sides by 2})$$

$$2 - 3x \geq 2x - 8$$

$$-3x \geq 2x - 10$$

$$-5x \geq -10$$

$$x \leq 2 \dots\dots\dots(2)$$

From (1) and (2), solutions of the given system are, therefore, given by  $x \leq 2$ .

Hence the solution of the system is  $x \leq 2$ .

### Question-30

Solve the following system of inequations:  $2(2x + 3) - 10 < 6(x - 2)$ ,

$$\frac{2x-3}{4} + 6 \geq 2 + \frac{4x}{3}$$

#### Solution:

$$2(2x + 3) - 10 < 6(x - 2)$$

$$\frac{2x-3}{4} + 6 \geq 2 + \frac{4x}{3}$$

$$2(2x + 3) - 10 < 6(x - 2)$$

$$4x + 6 - 10 < 6x - 12$$

$$4x - 4 < 6x - 12$$

$$4x < 6x - 8$$

$$-2x < -8$$

$$x > 4 \dots\dots\dots(1)$$

$$\frac{2x-3}{4} + 6 \geq 2 + \frac{4x}{3}$$

$$3(2x - 3) + 72 \geq 24 + 16x \quad (\text{Multiplying both sides by 12})$$

$$6x - 9 + 72 \geq 24 + 16x$$

$$6x + 63 \geq 24 + 16x$$

$$6x \geq 16x - 39$$

$$-10x \geq -39$$

$$x \leq 39/10 \dots \dots \dots (2)$$

From (1) and (2), the system has no solution.

**Question-31**

Represent the following inequation graphically in two dimensional plane and hence solve them:  $x - 2y + 4 \leq 0$

**Solution:**

We draw the graph of the equation  $x - 2y + 4 = 0$

x	0	-4
y	2	0

Put  $x = 0$

$$\text{Then } 0 - 2y + 4 \leq 0$$

$$\text{or } -2y \leq -4$$

$$\text{or } y \geq 2$$

Put  $x = 0, y = 0$

$$\text{Then } 0 - 2(0) + 4 \leq 0$$

or  $4 \leq 0$ , which is false.

Hence, half plane II is not the solution of the given inequation.

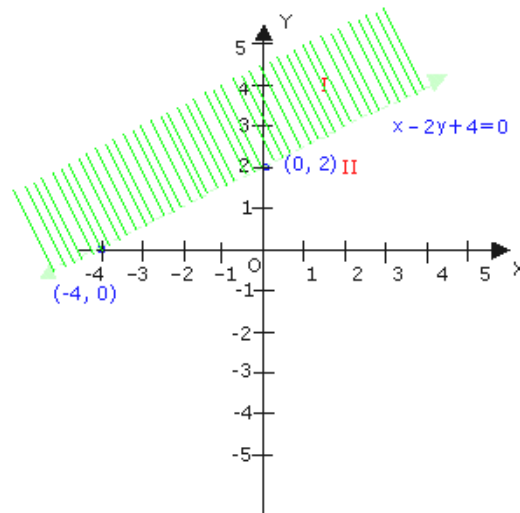
Therefore, the shaded half plane I is the solution region of the inequation including points on the line

$$x - 2y + 4 = 0.$$

Scale

1 cm = 1 unit along x-axis

1 cm = 1 unit along y-axis



### Question-32

Represent the following inequation graphically in two dimensional plane and hence solve them:  $2x + y > 3$

#### Solution:

We draw the graph of the equation  $2x + y = 3$

X	0	$\frac{3}{2}$
Y	3	0

Put  $x = 0$

Then  $2(0) + y > 3$

or  $y > 3$

Put  $x = 0, y = 0$

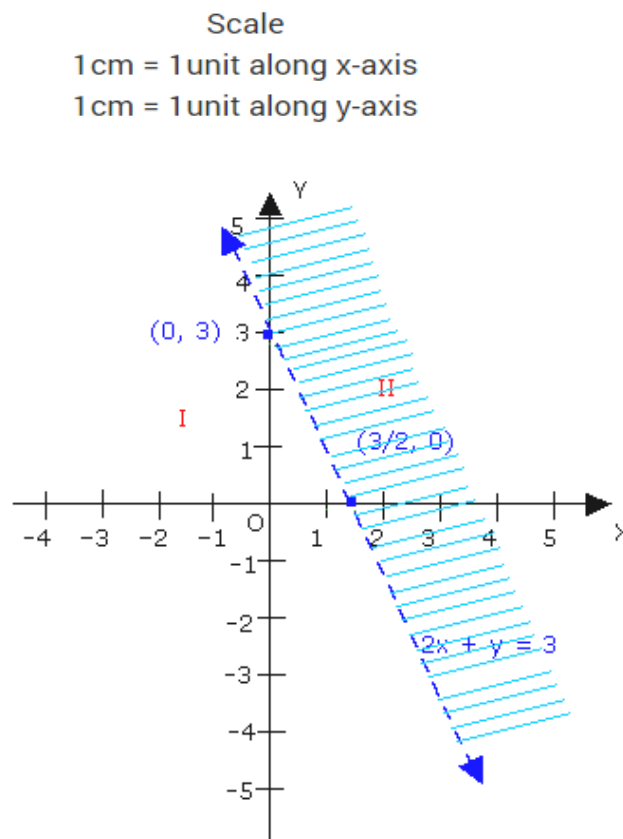
Then  $2(0) + 0 > 3$

or  $0 > 3$ , which is false.

Hence, half plane I is not the solution of the given inequation.

Therefore, the shaded half plane II is the solution region of the inequation excluding points on the line

$2x + y = 3$ .



### Question-33

Represent the following inequation graphically in two dimensional plane and hence solve them:  $3x - 4y < 12$

#### Solution:

We draw the graph of the equation  $3x - 4y = 12$

x	0	4
y	-3	0

Put  $x = 0$

$$\text{Then } 3(0) - 4y < 12$$

$$\text{or } -y < 3$$

$$\text{or } y > -3$$

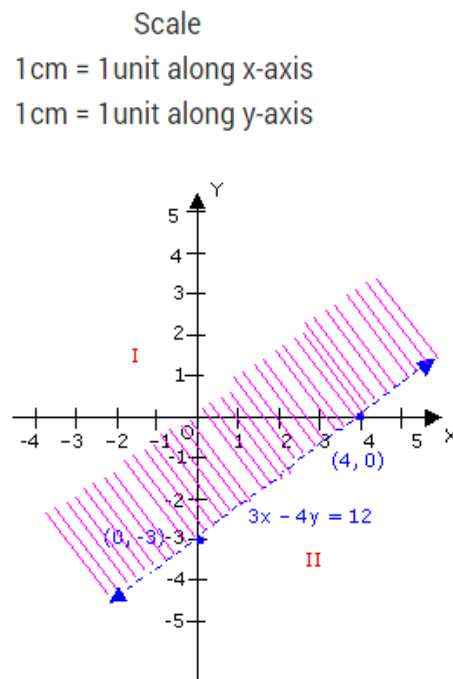
Put  $x = 0, y = 0$

$$\text{Then } 3(0) - 4(0) < 12$$

or  $0 < 12$ , which is true.

Hence, half plane II is not the solution of the given inequation.

Therefore, the shaded half plane I is the solution region of the inequation excluding points on the line  $3x - 4y = 12$ .





### Question-34

Represent the following inequation graphically in two dimensional plane and hence solve them:  $y + 8 \geq 2x$

#### Solution:

We draw the graph of the equation  $y + 8 = 2x$

x	2	4
y	-4	0

Put  $x = 0$

Then  $y + 8 \geq 2x$

or  $y + 8 \geq 0$

Put  $x = 0, y = 0$

Then  $0 + 8 \geq 2(0)$

or  $8 \geq 0$ , which is true.

Hence, half plane I is not the solution of the given inequation.

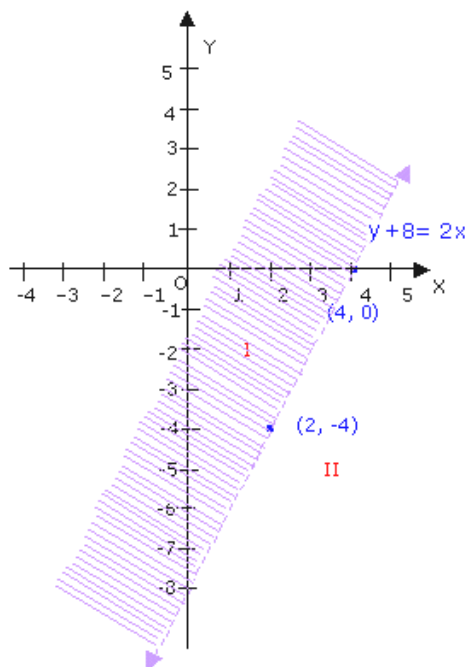
Therefore, the shaded half plane II is the solution region of the inequation including points on the line

$y + 8 = 2x$ .

Scale

1 cm = 1 unit along x-axis

1 cm = 1 unit along y-axis



### Question-35

Represent the following inequation graphically in two dimensional plane and hence solve them:  $2x \leq 6 - 3y$

#### Solution:

We draw the graph of the equation  $2x = 6 - 3y$

x	0	3
y	2	0

Put  $x = 0$

Then  $2(0) \leq 6 - 3y$

or  $y \leq 2$

Put  $x = 0, y = 0$

Then  $2(0) \leq 6 - 3(0)$

or  $0 \leq 6$ , which is true.

Hence, half plane I is not the solution of the given inequation.

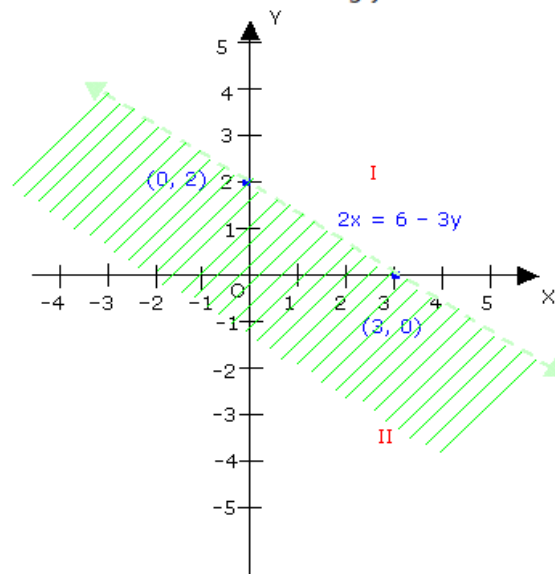
Therefore, the shaded half plane II is the solution region of the inequation

including points on the line  $2x = 6 - 3y$

Scale

1 cm = 1 unit along x-axis

1 cm = 1 unit along y-axis



### Question-36

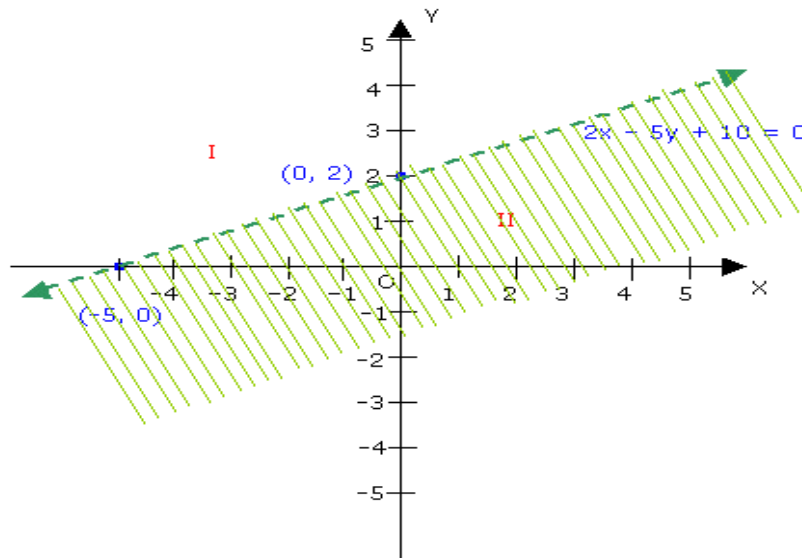
Represent the following inequation graphically in two dimensional plane and hence solve them:  $0 \leq 2x - 5y + 10$

**Solution:**

Scale

1 cm = 1 unit along x-axis

1 cm = 1 unit along y-axis



We draw the graph of the equation  $2x - 5y + 10 = 0$

x	0	-5
y	2	0

Put  $x = 0$

$$\text{Then } 0 \leq 2(0) - 5y + 10$$

$$\text{or } -10 \leq -5y$$

Put  $x = 0, y = 0$

$$\text{Then } 0 \leq 2(0) - 5(0) + 10$$

or  $0 \leq 10$ , which is false.

Hence, half plane I is not the solution of the given inequation.

Therefore, the shaded half plane II is the solution region of the inequation including points on the line

$$2x - 5y + 10 = 0.$$

### Question-37

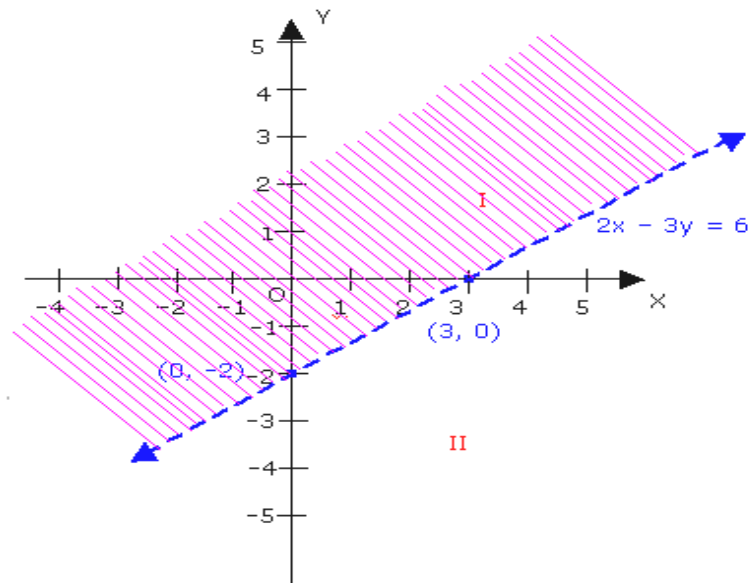
Represent the following inequation graphically in two dimensional plane and hence solve them:  $2x - 3y < 6$

#### Solution:

Scale

1 cm = 1 unit along x-axis

1 cm = 1 unit along y-axis



We draw the graph of the equation  $2x - 3y = 6$

x	0	3
y	-2	0

Put  $x = 0$

Then  $2(0) - 3y < 6$

or  $y < -2$

Put  $x = 0, y = 0$

Then  $2(0) - 3(0) < 6$

or  $0 < 6$ , which is true.

Hence, half plane II is not the solution of the given inequation.

Therefore, the shaded half plane I is the solution region of the inequation excluding points on the line

$2x - 3y = 6$

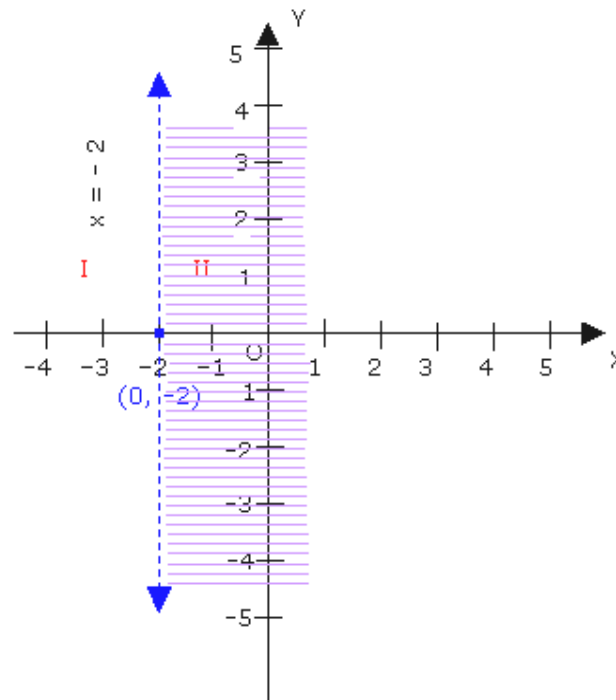
### Question-38

Represent the following inequation graphically in two dimensional plane and hence solve them:  $x > -2$

#### Solution:

1 cm = 1 unit along x-axis

1 cm = 1 unit along y-axis



The graph of the equation  $x = -2$  is vertical line parallel to  $y$  – axis.

Put  $x = 0$

Then  $0 > -2$ , which is true.

Hence, the solution region is the shaded region on the right hand side of the line  $x = -2$  containing the origin.

Hence every point on the shaded region is the solution of the given inequation.

## Linear Inequalities

- $\frac{4}{x+1} \leq 3 \leq \frac{6}{x+1}, (x > 0)$
- $\frac{|x-2|-1}{|x-2|-2} \leq 0$
- $\frac{1}{|x|-3} \leq \frac{1}{2}$
- $|x-1| \leq 5, |x| \geq 2$
- $-5 \leq \frac{2-3x}{4} \leq 9$
- $4x + 3 \geq 2x + 17, 3x - 5 < -2.$
- A company manufactures cassettes. Its cost and revenue functions are  $C(x) = 26,000 + 30x$  and  $R(x) = 43x$ , respectively, where  $x$  is the number of cassettes produced and sold in a week. How many cassettes must be sold by the company to realise some profit?
- The water acidity in a pool is considered normal when the average pH reading of three daily measurements is between 8.2 and 8.5. If the first two pH readings are 8.48 and 8.35, find the range of pH value for the third reading that will result in the acidity level being normal.
- A solution of 9% acid is to be diluted by adding 3% acid solution to it. The resulting mixture is to be more than 5% but less than 7% acid. If there is 460 litres of the 9% solution, how many litres of 3% solution will have to be added?
- A solution is to be kept between  $40^{\circ}\text{C}$  and  $45^{\circ}\text{C}$ . What is the range of temperature in degree fahrenheit, if the conversion formula is  $F = \frac{9}{5}C + 32$ ?
- The longest side of a triangle is twice the shortest side and the third side is 2 cm longer than the shortest side. If the perimeter of the triangle is more than 166 cm then find the minimum length of the shortest side.
- In drilling world's deepest hole it was found that the temperature  $T$  in degree celcius,  $x$  km below the earth's surface was given by  $T = 30 + 25(x - 3)$ ,  $3 \leq x \leq 15$ . At what depth will the temperature be between  $155^{\circ}\text{C}$  and  $205^{\circ}\text{C}$ ?

13. Solve the following system of inequalities  $\frac{2x+1}{7x-1} > 5, \frac{x+7}{x-8} > 2$

14. Find the linear inequalities for which the shaded region in the given figure is the solution set.

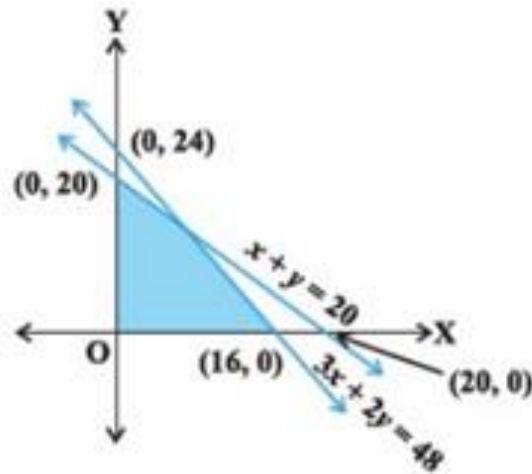


Fig 6.5

15. Find the linear inequalities for which the shaded region in the given figure is the solution set.

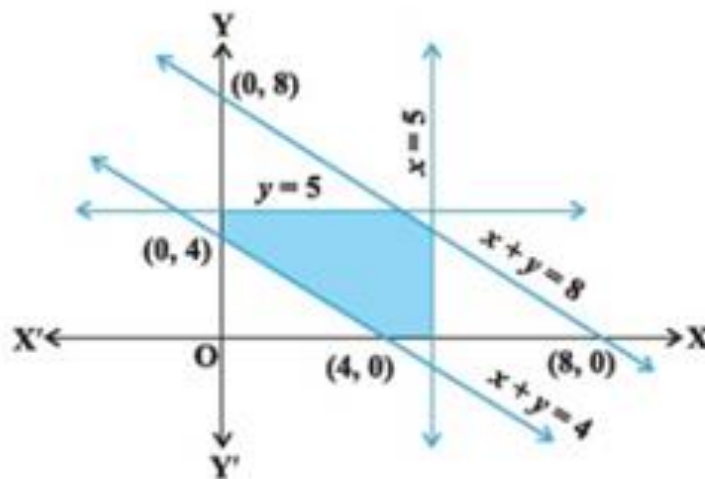


Fig 6.6

16. Show that the following system of linear inequalities has no solution  $x+2y \leq 3, 3x+4y \geq 12, x \geq 0, y \geq 1$

17. Solve the following system of linear inequalities:

$$3x + 2y \geq 24, 3x + y \leq 15, x \geq 4$$

18. Show that the solution set of the following system of linear inequalities is an unbounded region

$$2x + y \geq 8, x + 2y \geq 10, x \geq 0, y \geq 0$$

Choose the correct answer from the given four options in each of the Exercises 19 to 26 (M.C.Q.).

19. If  $x < 5$ , then

(A)  $-x < -5$

(B)  $-x \leq -5$

(C)  $-x > -5$

(D)  $-x \geq -5$

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

(A)  $\frac{x}{b} < \frac{y}{b}$

(B)  $\frac{x}{b} \leq \frac{y}{b}$

(C)  $\frac{x}{b} > \frac{y}{b}$

(D)  $\frac{x}{b} \geq \frac{y}{b}$

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

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

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

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

(D)  $x \in [-10, 10]$

22. If  $x$  is a real number and  $|x| < 3$ , then

(A)  $x \geq 3$

(B)  $-3 < x < 3$

(C)  $x \leq -3$

(D)  $-3 \leq x \leq 3$

23.  $x$  and  $b$  are real numbers. If  $b > 0$  and  $|x| > b$ , then

(A)  $x \in (-b, \infty)$

(B)  $x \in [-\infty, b)$

(C)  $x \in (-b, b)$

(D)  $x \in (-\infty, -b) \cup (b, \infty)$

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

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

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

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

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



25. If  $|x + 2| \leq 9$ , then

(A)  $x \in (-7, 11)$

(B)  $x \in [-11, 7]$

(C)  $x \in (-\infty, -7) \cup (11, \infty)$

(D)  $x \in (-\infty, -7) \cup [11, \infty)$

26. The inequality representing the following graph is:

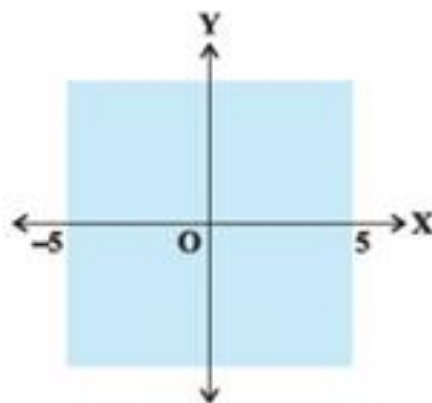


Fig 6.7

(A)  $|x| < 5$

(B)  $|x| \leq 5$

(C)  $|x| > 5$

(D)  $|x| \geq 5$

Solution of a linear inequality in variable  $x$  is represented on number line in Exercises 27 to 30. Choose the correct answer from the given four options in each of the exercises (M.C.Q.).

27. (A)  $x \in (-\infty, 5)$  (B)  $x \in (-\infty, 5]$

(C)  $x \in [5, \infty)$  (D)  $x \in (5, \infty)$



Fig 6.8

28. (A)  $x \in (\frac{9}{2}, \infty)$

(B)  $x \in [\frac{9}{2}, \infty)$

(C)  $x \in [-\infty, \frac{9}{2})$

(D)  $x \in (-\infty, \frac{9}{2}]$

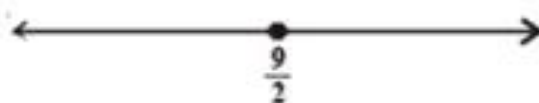


Fig 6.9

29. (A)  $x \in (-\infty, \frac{7}{2})$  (B)  $x \in (-\infty, \frac{7}{2}]$

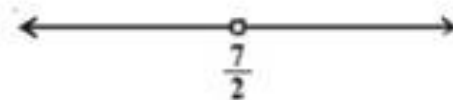


Fig 6.10

(C)  $x \in [\frac{7}{2}, -\infty)$  (D)  $x \in (\frac{7}{2}, \infty)$

30. (A)  $x \in (-\infty, -2)$   
(B)  $x \in (-\infty, -2]$   
(C)  $x \in (-2, \infty)$   
(D)  $x \in [-2, \infty)$



Fig 6.11

## True or False Type Questions

31. State which of the following statements is True or False

- (i) If  $x < y$  and  $b < 0$ , then  $\frac{x}{b} < \frac{y}{b}$ .  
(ii) If  $xy > 0$ , then  $x > 0$  and  $y < 0$   
(iii) If  $xy > 0$ , then  $x < 0$  and  $y < 0$   
(iv) If  $xy < 0$ , then  $x < 0$  and  $y < 0$   
(v) If  $x < -5$  and  $x < -2$ , then  $x \in (-\infty, -5)$   
(vi) If  $x < -5$  and  $x > 2$ , then  $x \in (-5, 2)$   
(vii) If  $x > -2$  and  $x < 9$ , then  $x \in (-2, 9)$   
(viii) If  $|x| > 5$ , then  $x \in (-\infty, -5) \cup [5, \infty)$   
(ix) If  $|x| \leq 4$ , then  $x \in [-4, 4]$   
(x) Graph of  $x < 3$  is

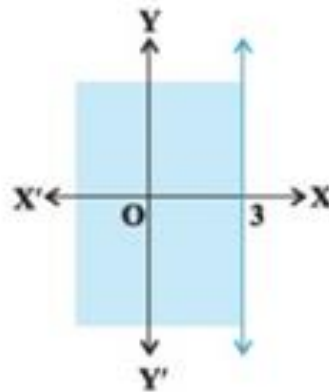
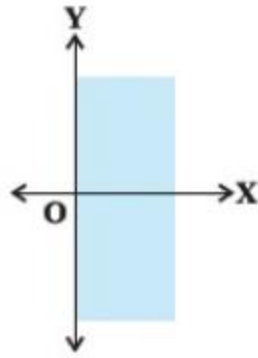


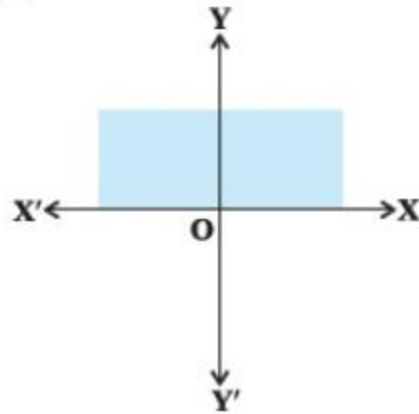
Fig 6.12

- (xi) Graph of  $x \geq 0$  is



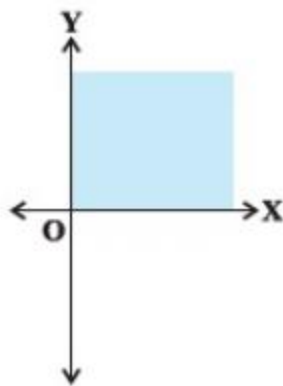
**Fig 6.13**

(xii) Graph of  $y \leq 0$  is



**Fig 6.14**

(xiii) Solution set of  $x \geq 0$  and  $y \leq 0$  is



**Fig 6.15**

(xiv) Solution set of  $x \geq 0$  and  $y \leq 1$  is

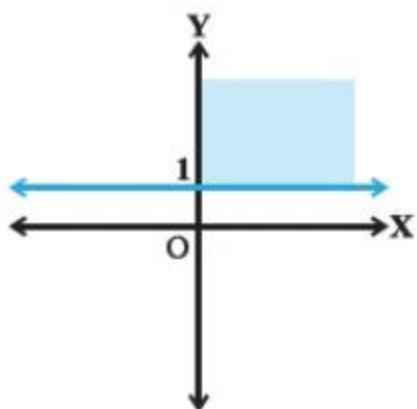


Fig 6.16

(xv) Solution set of  $x + y \geq 0$  is

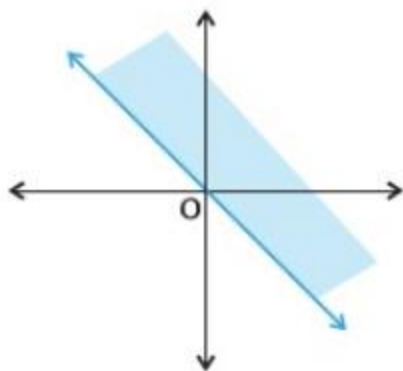


Fig 6.17

## Fill in the Blanks Type Questions

32. Fill in the blanks of the following:

(i) If  $-4x \geq 12$ , then  $x \dots -3$ .

(ii) If  $\frac{-3}{4}x \leq -3$ , then  $x \dots 4$ .

(iii) If  $\frac{2}{x+2} > 0$ , then  $x \dots -2$ .

- (iii) If  $\frac{2}{x+2} > 0$ , then  $x \dots -2$ .
- (iv) If  $x > -5$ , then  $4x \dots -20$ .
- (v) If  $x > y$  and  $z < 0$ , then  $-xz \dots -yz$ .
- (vi) If  $p > 0$  and  $q < 0$ , then  $p - q \dots p$ .
- (vii) If  $|x+2| > 5$ , then  $x \dots -7$  or  $x \dots 3$ .
- (viii) If  $-2x + 1 \geq 9$ , then  $x \dots -4$ .

**CBSE Class 11 Mathematics**

**Important Questions**

**Chapter 6**

**Linear Inequalities**

**1 Marks Questions**

1. Solve  $\frac{3x-4}{2} \geq \frac{x+1}{4} - 1$

Ans.  $\frac{3x-4}{2} \geq \frac{x+1}{4} - \frac{1}{1}$

$$\frac{3x-4}{2} \geq \frac{x+1-4}{4}$$

$$\frac{3x-4}{2} \geq \frac{x-3}{4}$$

$$2(3x-4) \geq (x-3)$$

$$6x-8 \geq x-3$$

$$x \geq 1$$

2. Solve  $3x+8 > 2$  when  $x$  is a real no.

Ans.  $3x+8 > 2$

$$3x > 2-8$$

$$3x > -6$$

$$x > -2$$

$$(-2, \infty)$$

3. Solve the inequality  $\frac{x}{4} < \frac{(5x-2)}{3} - \frac{(7x-3)}{5}$

Ans.  $\frac{x}{4} < \frac{5x-2}{3} - \frac{7x-3}{5}$

$$\frac{x}{4} < \frac{5(5x-2) - 3(7x-3)}{15}$$

$$\frac{x}{4} < \frac{4x-1}{15}$$

$$15x < 16x - 4$$

$$-x < -4$$

$$x > 4$$

$$(4, \infty)$$

4. If  $4x > -16$  then  $x \square -4$ .

Ans.  $x > -4$ .

5. Solve the inequality  $\frac{1}{2} \left( \frac{3x}{5} + 4 \right) \geq \frac{1}{3} (x - 6)$

Ans.  $\frac{1}{2} \left( \frac{3x}{5} + 4 \right) \geq \frac{1}{3} (x - 6)$

$$\frac{3x}{10} + 2 \geq \frac{x}{3} - 2$$

$$\frac{3x}{10} - \frac{x}{3} \geq -4$$

$$\frac{9x - 10x}{30} \geq -4$$

$$\frac{-x}{30} \geq -4$$

$$-x \geq -120$$

$$x \leq 120$$

$$(-\infty, 120]$$

6. Solution set of the in inequations  $2x-1 \leq 3$  and  $3x+1 \geq -5$  is.

Ans.  $2x-1 \leq 3$ ,  $3x+1 \geq -5$

$$\Rightarrow 2x \leq 4, 3x \geq -6$$

$$\Rightarrow x \leq 2, x \geq -2$$

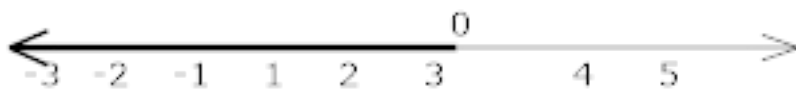
$$\Rightarrow -2 \leq x \leq 2$$

7. Solve  $7x+3 < 5x+9$ . Show the graph of the solution on number line.

Ans.  $7x+3 < 5x+9$

$$2x < 6$$

$$x < 3$$



8. Solve the inequality.  $\frac{2x-1}{3} \geq \frac{3x-2}{4} - \frac{2-x}{5}$

Ans.  $\frac{2x-1}{3} \geq \frac{5(3x-2) - 4(2-x)}{20}$

$$20(2x-1) \geq 3(19x-18)$$

$$40x-20 \geq 57x-54$$



$$-17x \geq -34$$

$$x \leq 2$$

$$(-\infty, 2]$$

9. Solve  $5x - 3 \leq 3x + 1$  when  $x$  is an integer.

Ans.  $5x - 3 \leq 3x + 1$

$$5x - 3x \leq 4$$

$$2x \leq 4$$

$$x \leq 2$$

$$\{\dots, -3, -2, -1, 0, 1, 2\}$$

10. Solve  $30x < 200$  when  $x$  is a natural no.

Ans.  $30x < 200$

$$x < \frac{200}{30}$$

$$x < \frac{20}{3}$$

Solution set of the inequality  $\{1, 2, 3, 4, 5, 6\}$

11. Solve the inequality  $\frac{x}{2} \geq \frac{5x-2}{3} - \frac{7x-3}{5}$

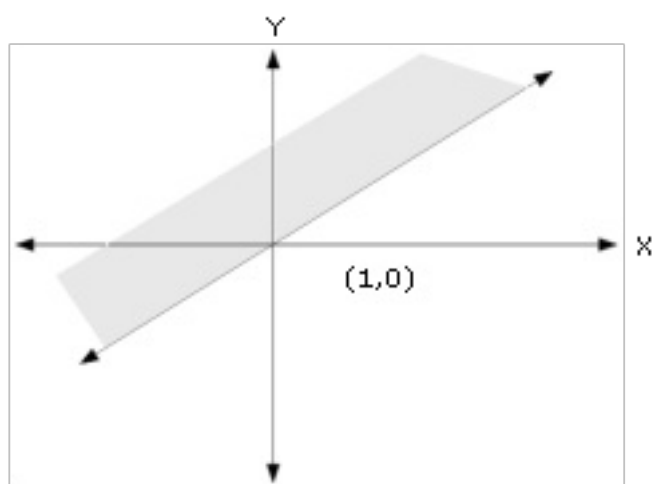
Ans.  $\frac{x}{2} \geq \frac{5(5x-2) - 3(7x-3)}{15}$

$$\frac{x}{2} \geq \frac{25x-10-21x+9}{15}$$

$$\frac{x}{2} \geq \frac{4x-1}{15}$$

$$15x \geq 8x - 2$$

$$7x \geq -2 \Rightarrow x \geq -\frac{2}{7}$$



12. Solve  $5x - 3 < 3x + 1$  when  $x$  is an integer.

Ans.  $5x - 3 < 3x + 1$

$$2x < 4$$

$$x < 2$$

When  $x$  is an integer the solutions of the given inequality are.....-4,-3,-2,-1, 0, 1

**CBSE Class 12 Mathematics**

**Important Questions**

**Chapter 6**

**Linear Inequalities**

**4 Marks Questions**

**1. Solve  $3x - 6 \geq 0$  graphically**

**Ans.**  $3x - 6 \geq 0$ .....(i)

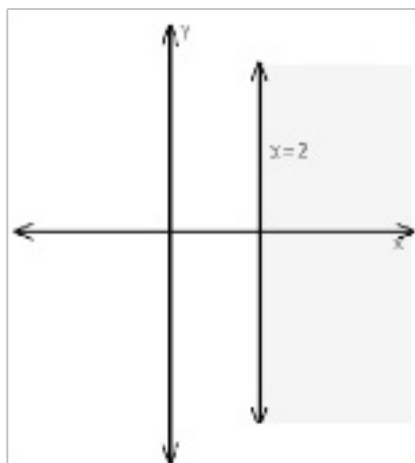
$$3x - 6 = 0$$

$$x = 2$$

Put (0,0) in eq. (i)

$$0 - 6 \geq 0$$

$$0 > 6 \text{ false.}$$



**2. Ravi obtained 70 and 75 mark in first unit test. Find the minimum marks he should get in the third test to have an average of at least 60 marks.**

**Ans.** Let Ravi secure  $x$  marks in third test

$$\text{ATQ } \frac{70 + 75 + x}{3} \geq 60$$

$$x \geq 135$$

**3. Find all pairs of consecutive odd natural no. both of which are larger than 10 such that their sum is less than 40.**

**Ans.** Let  $x$  and  $x+2$  be consecutive odd natural no.

$$\text{ATQ } x > 10 \dots\dots (i)$$

$$(x) + (x+2) < 40$$

$$x < 19 \dots\dots (ii)$$

From (i) and (ii)

$$(11,13) \quad (13,15), \quad (15,17) \quad (17,19)$$

**4. A company manufactures cassettes and its cost equation for a week is  $C=300+1.5x$  and its revenue equation is  $R=2x$ , where  $x$  is the no. of cassettes sold in a week. How many cassettes must be sold by the company to get some profit?**

**Ans.** Profit = revenue-cost

$$R > C \quad [\text{for to get some profit}]$$

$$2x > 300 + 1.5x$$

$$\frac{1}{2}x > 300$$

$$x > 600$$

**5. The longest side of a  $\Delta$  is 3 times the shortest side and the third side is 2 cm shorter than the longest side. If the perimeter of the  $\Delta$  is at least 61 cm find the minimum length of the shortest side.**

**Ans.** Let shortest side be  $x$  cm then the longest side is  $3x$  cm and the third side  $(3x-2)$  cm.

$$\text{ATQ } (x) + (3x) + (3x - 2) \geq 61$$

$$x \geq 9$$

Length of shortest side is 9 cm.

**6. In drilling world's deepest hole it was found that the temperature  $T$  in degree Celsius,  $x$  km below the surface of earth was given by  $T = 30 + 25(x - 3)$ ,  $3 < x < 15$  At what depth will the tempt. Be between  $200^\circ\text{C}$  and  $300^\circ\text{C}$**

**Ans.** Let  $x$  km is the depth where the tempt lies between  $200^\circ\text{C}$  and  $300^\circ\text{C}$

$$200^\circ\text{C} < T < 300^\circ\text{C}$$

$$200 < 30 + 25(x - 3) < 300$$

$$\frac{49}{5} < x < \frac{69}{5} \Rightarrow 9.8 < x < 13.8$$

**7. A man wants to cut three lengths from a single piece of board of length 91 cm. The second length is to be 3 cm longer than the shortest and the third length is to be twice as long as the shortest. What are the possible lengths of the shortest board if the third piece is to be at least 5 cm longer than the second.**

**Ans.** Let the shortest length be  $x$  cm, then second length is  $(x + 3)$  cm and the third length is  $2x$  cm.

$$\text{ATQ } 4x + 3 \leq 91$$

$$x \leq \frac{88}{4}$$

$$x \leq 22$$

Again ATQ

$$2x \geq 5 + (x + 3)$$

$$x \geq 8$$

$$x \in [8, 22]$$

**8. The water acidity in a pool is considered normal when the average pH reading of three daily measurements is between 7.2 and 7.8. If the first two pH readings are 7.48 and 7.85, find the range of pH value for the third reading that will result in the acidity level being normal.**

**Ans.** Let third reading be  $x$  then

$$7.2 < \frac{7.48 + 7.85 + x}{3} < 7.8$$

$$21.6 < 15.33 + x < 23.4$$

$$6.27 < x < 7.07$$

**9. A plumber can be paid under two schemes as given below.**

**I: Rs 600 and Rs 50 per hr.**

**II: Rs 170 per hr.**

**If the job takes  $n$  hr. for what values of  $n$  does the scheme I give the plumber the better wages.**

**Ans.** For better wages earning should be more than

$$600 + 50n > 170n$$

$$n < 5$$

Thus for better wages scheme working hr. should be less than 5 hr.

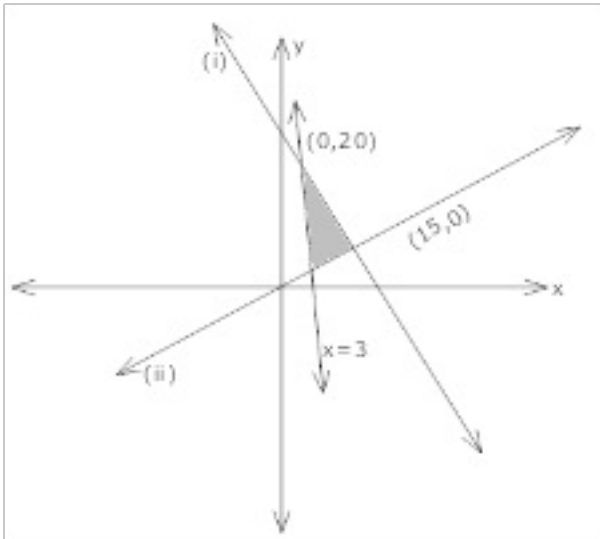
$$4x + 3y = 60$$

$x$	0	15
$y$	20	0

$$y = 2x$$

$x$	0	20
$y$	0	40

$$x = 3$$



10. Solve the inequalities  $3x + 4y \leq 12$  graphically

Ans.  $3x + 4y \geq 12$ .....(i)

$$3x + 4y = 12$$

$x$	0	4
$y$	3	0

Put  $(0,0)$  in eq. ....(i)

$$0 + 0 \geq 12 \text{ false}$$

11. Solve graphically  $x - y \leq 0$

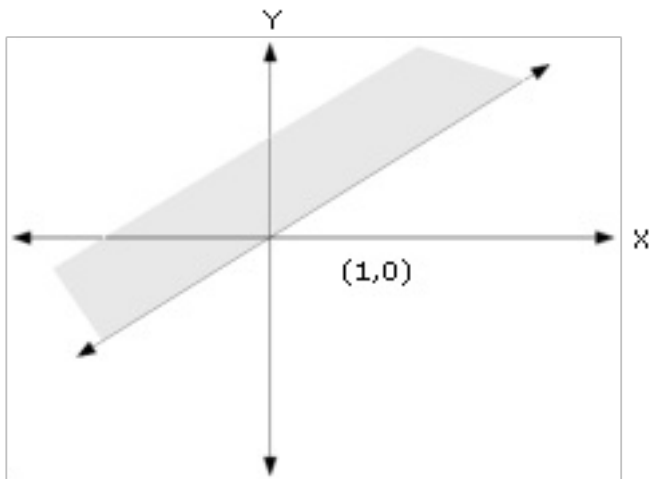
Ans.  $x - y \leq 0$ .....(i)

$$x = y$$

Put (1,0) in eq. (i)

$$1 - 0 \leq 0$$

$$1 \leq 0 \text{ false}$$

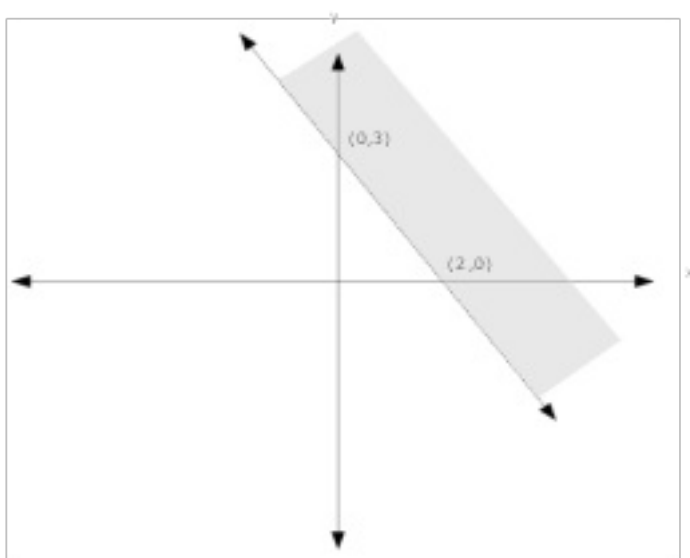


**12. Solve  $3x + 2y > 6$  graphically**

**Ans.  $3x + 2y > 6$ .....(i)**

$$3x + 2y = 6$$

$x$	0	2
$y$	3	0





Put  $(0, 0)$  in eq. ....  $(i)$

$$0 + 0 > 6$$

$0 > 6$  which is false

CBSE Class 12 Mathematics

Important Questions

Chapter 6

Linear Inequalities

6 Marks Questions

1. IQ of a person is given by the formula  $IQ = \frac{MA}{CA} \times 100$

Where MA is mental age and CA is chronological age. If  $80 \leq IQ \leq 140$  for a group of 12yr old children, find the range of their mental age.

Ans.  $80 \leq IQ \leq 140$  (Given)

$$80 \leq \frac{MA}{CA} \times 100 \leq 140$$

$$80 \leq \frac{MA}{12} \times 100 \leq 140$$

$$80 \times \frac{12}{100} \leq MA \times \frac{100}{12} \times \frac{12}{100} \leq 140 \times \frac{12}{100}$$

$$\frac{96}{10} \leq MA \leq \frac{168}{10}$$

$$9.6 \leq MA \leq 16.8$$

2. Solve graphically  $4x + 3y \leq 60$   $y \geq 2x$   $x \geq 3$   $x, y \geq 0$

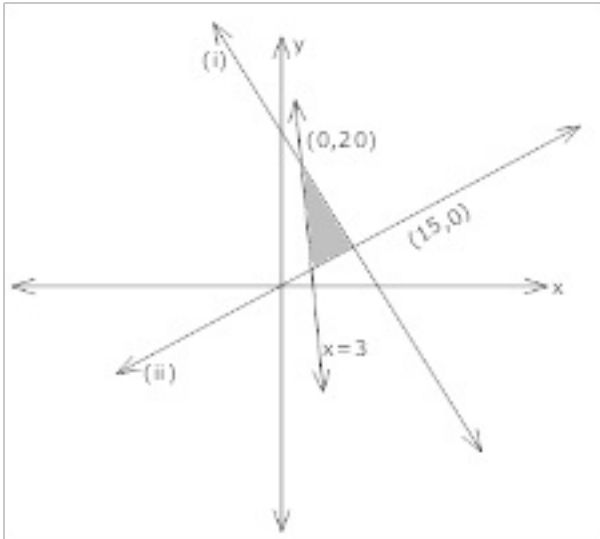
Ans.  $4x + 3y = 60$

$x$	0	15
$y$	20	0

$$y = 2x$$

$x$	<b>0</b>	<b>20</b>
$y$	0	40

$$x = 3$$



**3. A manufacturer has 600 litre of a 12% sol. Of acid. How many litres of a 30% acid sol. Must be added to it so that acid content in the resulting mixture will be more than 15% but less than 18%.**

**Ans.** Let  $x$  litres of 30% acid sol. Is required to be added.

$$30\%x + 12\% \text{ of } 600 > 15\% \text{ of } (x + 600) \text{ and}$$

$$30\%x + 12\% \text{ of } 600 < 18\% \text{ of } (x + 600)$$

$$\frac{30x}{100} + \frac{12}{100}(600) > \frac{15}{100}(x + 600)$$

$$\frac{30x}{100} + \frac{12}{100}(600) < \frac{18}{100}(x + 600)$$

$$x > 120 \text{ and } x < 300$$

i.e.  $120 < x < 300$ .

4. Solve graphically  $x - 2y \leq 3$   $3x + 4y \geq 12$   $x \geq 0$   $y \geq 1$

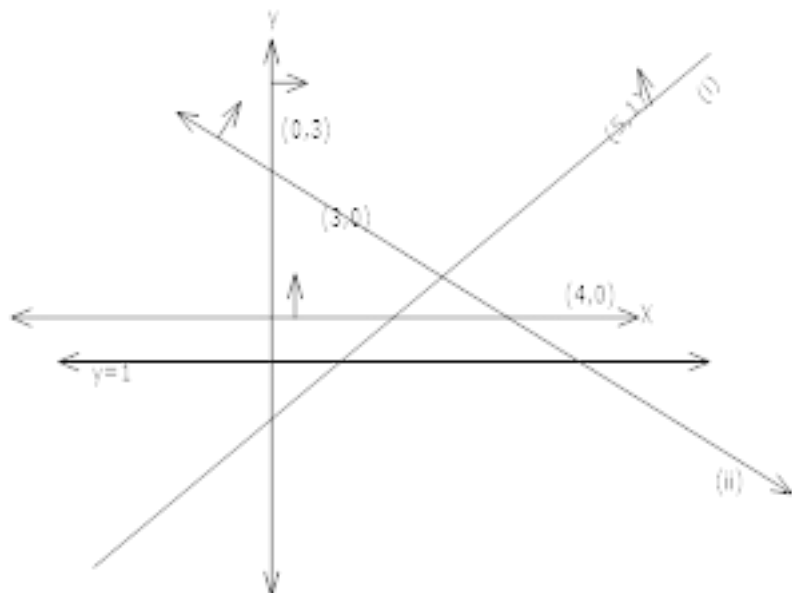
Ans.  $x - 2y = 3$

$x$	3	5
$y$	0	1

$$3x + 4y = 12$$

$x$	0	4
$y$	3	0

$$y = 1$$



5. A sol. Of 8% boric acid is to be diluted by adding a 2% boric acid sol. to it. The resulting mixture is to be more than 4% but less than 6% boric acid. If we have 640 litres of the 8% sol. how many litre of the 2% sol. will have to be added.

Ans. Let  $x$  be added

ATQ 2% of  $x + 8\%$  of 640  $> 4\%$  of  $(640 + x)$

$$\frac{2x}{100} + \frac{8 \times 640}{100} > \frac{4}{100} (640 + x)$$

$$x < 1280 \dots (i)$$

And 12% of  $x + 8\%$  of 640 < 6% of  $(640 + x)$

$$\frac{2x}{100} + \frac{8 \times 640}{100} < \frac{6}{100}(640 + x)$$

$$x > 320 \dots (ii)$$

From (i) and (ii)

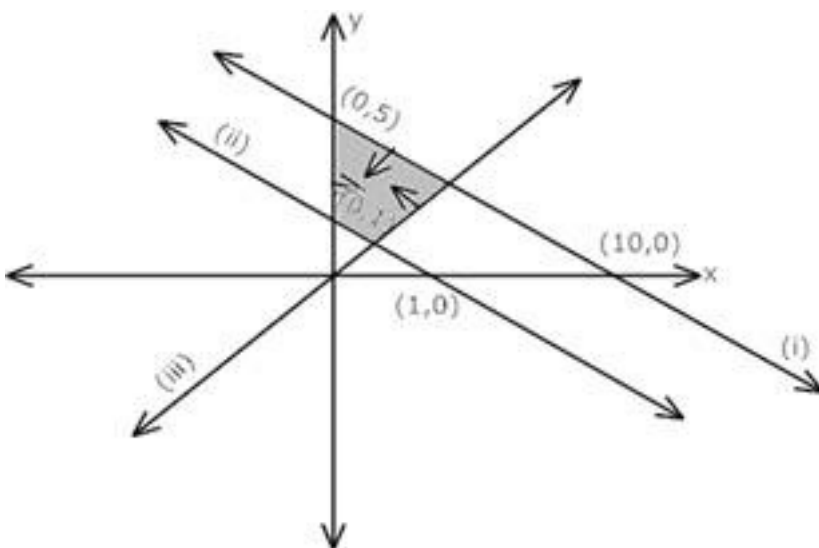
$$320 < x < 1280$$

**6. Solve graphically**  $x + 2y \leq 10$   $x + y \geq 1$   $x - y \leq 0$

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

**Ans.**  $x + 2y = 10$

$x$	<b>0</b>	<b>10</b>
$y$	5	0



$$x + y = 1$$

$x$	<b>0</b>	<b>1</b>
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$y$	1	0
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$$x - y = 0$$

$x$	0	2
$y$	0	2

**7. How many litres of water will have to be added to 1125 litres of the 45% sol. Of acid so that the resulting mixture will contain more than 25% but less than 30% acid content.**

**Ans.** Let  $x$  litre of water be added to 1125 litre of 45 acid sol.

$$45\% \text{ of } 1125 > 25\% \text{ of } (x + 1125)$$

$$30\% \text{ of } 1125 < 30\% \text{ of } (x + 1125)$$

$$900 > x > 562.5$$

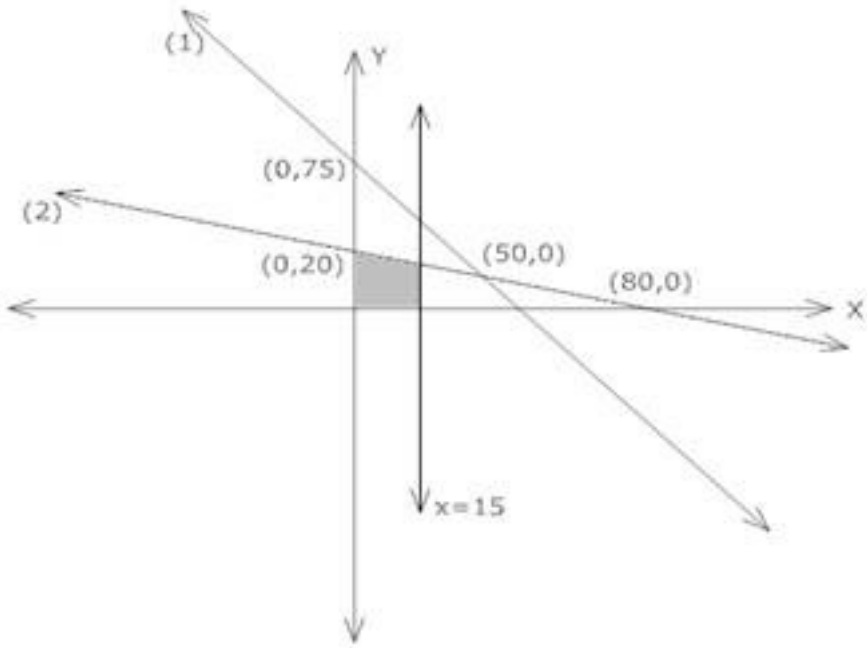
**8. Solve graphically**  $3x + 2y \leq 150$   $x + 4y \leq 80$   $x \leq 15$   $y \geq 0$   $x \geq 0$

**Ans.**  $3x + 2y = 150$

$$x + 4y = 80$$

$$x = 15$$

$x$	0	50
$y$	75	0



$x$	<b>0</b>	<b>80</b>
$y$	20	0