Ex 15.1

Q1

Now, $12x < 50$

$$\Rightarrow x < \frac{50}{12} = \frac{25}{6}$$

(i)

Since $x \in R$, $x \in \left(-\infty, \frac{25}{6}\right)$

(ii)

Since $x \in Z, x \in \{\ldots,-3,-2,-1,0,1,2,3,4\}$

(iii)

Since $x \in N, x \in \{1,2,3,4\}$

Q2

Now, $-4x > 30$

$$\Rightarrow x < \frac{-30}{4} = \frac{-15}{2}$$

(i)

If $x \in R$, then $x < \frac{-15}{2} \Rightarrow x \in \left(-\infty, -\frac{15}{2}\right)$

(ii)

If $x \in Z$, then $x < -\frac{15}{2} \Rightarrow x \in \{\ldots,-10,-9-8\}$

(iii)

$-4x > 30$

$$\Rightarrow -x > \frac{30}{4}$$

$$\Rightarrow x < -\frac{30}{4}$$

As $x \in N$, so x can not be less than 1.

$\therefore$ The solution set of the inequality $-4x > 30$ is null set ϕ.

SUPERCOP

Q3

Now,

$4x - 2 < 8$

$\Rightarrow 4x < 8 + 2$

$\Rightarrow 4x < 10$

$\Rightarrow x < \frac{10}{4} = \frac{5}{2}$

(i) If $x \in R$, then $x < \frac{5}{2} \Rightarrow x \in \left(-\infty, \frac{5}{2}\right)$

(ii) If $x \in Z$ then $x < \frac{5}{2} \Rightarrow x \in \{\ldots, -2, -1, 0, 1, 2\}$

(iii) If $x \in N$ then $x < \frac{5}{2} \Rightarrow x \in \{1, 2\}$

Q4

$3x - 7 > x + 1$

$\Rightarrow \quad 3x - x > 1 + 7$

$\Rightarrow \quad 2x > 8$

$\Rightarrow \quad x > \frac{8}{2} = 4$

$\Rightarrow \quad x > 4$

$\therefore (4, \infty)$ is the solution set.

Q5

$x + 5 > 4x - 10$

$\Rightarrow \quad x - 4x > -10 - 5$

$\Rightarrow \quad -3x > -15$

$\Rightarrow \quad 3x < 15$

$\Rightarrow \quad x < \frac{15}{3} = 5$

$\Rightarrow \quad x < 5$

$\therefore \quad (-\infty, 5)$ is the solution set

SUPERCOP

Q6

$$3x + 9 \geq -x + 19$$

$\Rightarrow \quad 3x + x \geq 19 - 9$

$\Rightarrow \quad 4x \geq 10$

$\Rightarrow \quad x \geq \frac{10}{4} = \frac{5}{2}$

$\therefore \left[\frac{5}{2}, \infty\right)$ is the solution set

Q7

$$2(3 - x) \geq \frac{x}{5} + 4$$

$\Rightarrow \quad 6 - 2x \geq \frac{x}{5} + 4$

$\Rightarrow \quad -2x - \frac{x}{5} \geq 4 - 6$

$\Rightarrow \quad \frac{-11x}{5} \geq -2$

$\Rightarrow \quad \frac{11x}{5} \leq 2$

$\Rightarrow \quad x \leq \frac{10}{11}$

$\left(-\infty, \frac{10}{11}\right]$ is the solution set

Q8

$$\frac{3x - 2}{5} \leq \frac{4x - 3}{2}$$

$\Rightarrow \quad \frac{3x}{5} - \frac{2}{5} \leq \frac{4x}{2} - \frac{3}{2}$

$\Rightarrow \quad \frac{3x}{5} - \frac{4x}{2} \leq \frac{-3}{2} + \frac{2}{5}$

$\Rightarrow \quad \frac{6x - 20x}{10} \leq \frac{-15 + 4}{10}$

$\Rightarrow \quad -14x \leq -11$

$\Rightarrow \quad 14x \geq 11$

$\Rightarrow \quad x \geq \frac{11}{14}$

$\left[\frac{11}{14}, \infty\right)$ is the solution set

SUPERCOP

Q9

$$-(x-3)+4<5-2x$$
$$\Rightarrow \quad -x+3+4<5-2x$$
$$\Rightarrow \quad -x+7<5-2x$$
$$\Rightarrow \quad -x+2x<5-7$$
$$\Rightarrow \quad x<-2$$
$(-\infty,-2)$ is the solution set

Q10

$$\frac{x}{5}<\frac{3x-2}{4}-\frac{5x-3}{5}$$
$$\Rightarrow \quad \frac{x}{5}<\frac{3x-2}{4}-\frac{(5x-3)}{5}$$
$$\Rightarrow \quad \frac{x}{5}<\frac{5(3x-2)-4(5x-3)}{20}$$
$$\Rightarrow \quad x<\frac{15x-10-20x+12}{4}$$
$$\Rightarrow \quad 4x<-5x+2$$
$$\Rightarrow \quad 4x+5x<2$$
$$\Rightarrow \quad 9x<2$$
$$\Rightarrow \quad x<\frac{2}{9}$$
$\therefore$ The solution set is $\left(-\infty,\frac{2}{9}\right)$

Q11

$$\frac{2(x-1)}{5}\leq\frac{3(2+x)}{7}$$
$$\Rightarrow \quad 7(2(x-1))\leq 5(3(2+x))$$
$$\Rightarrow \quad 14(x-1)\leq 15(2+x)$$
$$\Rightarrow \quad 14x-14\leq 30+15x$$
$$\Rightarrow \quad 14x-15x\leq 30+14$$
$$\Rightarrow \quad -x\leq 44$$
$$\Rightarrow \quad x\geq -44$$
$\therefore$ The solution set is $[-44,\infty)$

SUPERCOP

Q12

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

$$\Rightarrow \quad \frac{10x + 3x}{4} \geq \frac{39}{4}$$

$$\Rightarrow \quad 13x \geq 39$$

$$\Rightarrow \quad x \geq \frac{39}{13} = 3$$

$$\Rightarrow \quad x \geq 3$$

$\therefore$ The solution set is $[3, \infty)$

Q13

$$\frac{x-1}{3} + 4 < \frac{x-5}{5} - 2$$

$$\frac{x-1+12}{3} < \frac{x-5-10}{5}$$

$$5(x-1+12) < 3(x-5-10)$$

$$5(x+11) < 3(x-15)$$

$$5x + 55 < 3x - 45$$

$$5x - 3x < -45 - 55$$

$$2x < -100$$

$$x < -50$$

$\therefore$ The solution set is $(-\infty, -50)$

Q14

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

$$\frac{2x+3-12}{4} < \frac{x-4-6}{3}$$

$$3(2x+3-12) < 4(x-4-6)$$

$$3(2x-9) < 4(x-10)$$

$$6x - 27 < 4x - 40$$

$$6x - 4x < -40 + 27$$

$$2x < -13$$

$$x < -\frac{13}{2}$$

$\therefore$ The solution set is $\left(-\infty, -\frac{13}{2}\right)$

SUPERCOP

Q15

$$\frac{5-2x}{3} < \frac{x}{6} - 5$$
$$\frac{5-2x}{3} < \frac{x-30}{6}$$
$$6(5-2x) < 3(x-30)$$
$$30 - 12x < 3x - 90$$
$$-12x - 3x < -90 - 30$$
$$-15x < -120$$
$$15x > 120$$
$$x > \frac{120}{15} = 8$$

$\therefore$ The solution set is $(8, \infty)$

Q16

$$\frac{4+2x}{3} \geq \frac{x}{2} - 3$$
$$\frac{4+2x}{3} \geq \frac{x-6}{2}$$
$$2(4+2x) \geq 3(x-6)$$
$$8 + 4x \geq 3x - 18$$
$$4x - 3x \geq -18 - 8$$
$$x \geq -26$$

$\therefore$ The solution set is $[-26, \infty)$

Q17

$$\frac{2x+3}{5} - 2 < \frac{3(x-2)}{5}$$
$$\frac{2x+3-10}{5} < \frac{3x-6}{5}$$
$$2x - 7 < 3x - 6$$
$$2x - 3x < -6 + 7$$
$$-x < 1$$
$$x > -1$$

$\therefore$ The solution set is $(-1, \infty)$

SUPERCOP

Q18

$$x - 2 \le \frac{5x+8}{3}$$
$$3(x-2) \le 5x+8$$
$$3x - 6 \le 5x + 8$$
$$3x - 5x \le 8 + 6$$
$$-2x \le 14$$
$$2x \ge -14$$
$$x \ge -7$$

$\therefore$ The solution set is $[-7, \infty)$

Q19

$$\frac{6x-5}{4x+1} < 0$$

Case 1: $6x - 5 > 0$ *and* $4x + 1 < 0$

$\Rightarrow x > \frac{5}{6}$ *and* $x < \frac{-1}{4}$

This is not possible.

Case 2: $6x - 5 < 0$ *and* $4x + 1 > 0$

$\Rightarrow x < \frac{5}{6}$ *and* $x > \frac{-1}{4}$

$\therefore$ Solution set is $\left(-\frac{1}{4}, \frac{5}{6}\right)$

SUPERCOP

Q20

$$\frac{2x-3}{3x-7} > 0$$

Case 1: $2x - 3 > 0$ *and* $3x - 7 > 0$

$\Rightarrow x > \frac{3}{2}$ *and* $x > \frac{7}{3}$

$\Rightarrow x > \frac{7}{3}$

Case 2: $2x - 3 < 0$ *and* $3x - 7 < 0$

$\Rightarrow x < \frac{3}{2}$ *and* $x < \frac{7}{3}$

$\Rightarrow x < \frac{3}{2}$

$\therefore \left(-\infty, \frac{3}{2}\right) \cup \left(\frac{7}{3}, \infty\right)$ is the solution set

Q21

$$\frac{3}{x-2} < 1$$

$$\frac{3}{x-2} - 1 < 0$$

$$\frac{3-(x-2)}{x-2} < 0$$

$$\frac{3-x+2}{x-2} < 0$$

$$\frac{5-x}{x-2} < 0$$

$$\frac{x-5}{x-2} > 0$$

Case 1: $x - 5 > 0$ *and* $x - 2 > 0$

$\Rightarrow x > 5$ *and* $x > 2$

$\Rightarrow x > 5$

Case 2: $x - 5 < 0$ *and* $x - 2 < 0$

$\Rightarrow x < 5$ *and* $x < 2$

$\Rightarrow x < 2$

$\therefore$ solution set is $(-\infty, 2) \cup (5, \infty)$

SUPERCOP

Q22

$$\frac{1}{x-1} \le 2$$
$$\frac{1}{x-1} - 2 \le 0$$
$$\frac{1-2(x-1)}{x-1} \le 0$$
$$\frac{1-2x+2}{x-1} \le 0$$
$$\frac{3-2x}{x-1} \le 0$$

Case 1: $3-2x \ge 0 \quad and \quad x-1<0$

$\Rightarrow x \le \frac{3}{2} \quad and \quad x<1$

$\Rightarrow x<1$

Case 2: $3-2x \le 0 \quad and \quad x-1>0$

$\Rightarrow x \ge \frac{3}{2} \quad and \quad x>1$

$\Rightarrow x \ge \frac{3}{2}$

Hence the solution set is $(-\infty, 1) \cup \left[\frac{3}{2}, \infty\right)$

Q23

$$\frac{4x+3}{2x-5} < 6$$

$$\frac{4x+3}{2x-5} - 6 < 0$$

$$\frac{4x+3-6(2x-5)}{2x-5} < 0$$

$$\frac{4x+3-12x+30}{2x-5} < 0$$

$$\frac{-8x+33}{2x-5} < 0$$

$$\frac{8x-33}{2x-5} > 0$$

Case 1: $8x-33>0 \quad and \quad 2x-5>0$

$\Rightarrow x > \frac{33}{8} \quad and \quad x > \frac{5}{2}$

$\Rightarrow x > \frac{33}{8}$

Case 2: $8x-33<0 \quad and \quad 2x-5<0$

$\Rightarrow x < \frac{33}{8} \quad and \quad x < \frac{5}{2}$

$\Rightarrow x < \frac{5}{2}$

Hence the solution set is $\left(-\infty, \frac{5}{2}\right) \cup \left(\frac{33}{8}, \infty\right)$

SUPERCOP

Q24

$$\frac{5x-6}{x+6}<1$$

$$\frac{5x-6}{x+6}-1<0$$

$$\frac{5x-6-(x+6)}{x+6}<0$$

$$\frac{5x-6-x-6}{x+6}<0$$

$$\frac{4x-12}{x+6}<0$$

Case 1: $4x-12>0$ *and* $x+6<0$
$\Rightarrow x>3$ *and* $x<-6$

This is not possible.

Case 2: $4x-12<0$ *and* $x+6>0$
$\Rightarrow x<3$ *and* $x>-6$

Hence the solution set is $(-6,3)$

Q25

$$\frac{5x+8}{4-x}<2$$

$$\frac{5x+8}{4-x}-2<0$$

$$\frac{5x+8-2(4-x)}{4-x}<0$$

$$\frac{5x+8-8+2x}{4-x}<0$$

$$\frac{7x}{4-x}<0$$

Case 1: $7x>0$ *and* $4-x<0$
$\Rightarrow x>0$ *and* $4<x$

$\Rightarrow 4<x$

Case 2: $7x<0$ *and* $4-x>0$
$\Rightarrow x<0$ *and* $4>x$
$\Rightarrow x<0$

Hence solution set is $(-\infty,0)\cup(4,\infty)$

SUPERCOP

Q26

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

$$\frac{x-1}{x+3} - 2 > 0$$

$$\frac{x-1-2(x+3)}{x+3} > 0$$

$$\frac{x-1-2x-6}{x+3} > 0$$

$$\frac{-x-7}{x+3} > 0$$

$$\frac{x+7}{x+3} < 0$$

Case 1: $x + 7 > 0$ *and* $x + 3 < 0$
$\Rightarrow x > -7$ *and* $x < -3$

Case 2: $x + 7 < 0$ *and* $x + 3 > 0$
$\Rightarrow x < -7$ *and* $x > -3$

This is not possible.

$\therefore$ The solution set is $(-7, -3)$

SUPERCOP

Q27

$$\frac{7x-5}{8x+3} > 4$$

$$\frac{7x-5}{8x+3} - 4 > 0$$

$$\frac{7x-5-4(8x+3)}{8x+3} > 0$$

$$\frac{7x-5-32x-12}{8x+3} > 0$$

$$\frac{-25x-17}{8x+3} > 0$$

$$\frac{25x+17}{8x+3} < 0$$

Case 1: $25x+17 > 0$ *and* $8x+3 < 0$

$\Rightarrow x > \frac{-17}{25}$ *and* $x < \frac{-3}{8}$

Case 2: $25x+17 < 0$ *and* $8x+3 > 0$

$\Rightarrow x < \frac{-17}{25}$ *and* $x > \frac{-3}{8}$

This is not possible

$\therefore$ Hence the solution set is $\left(\frac{-17}{25}, \frac{-3}{8}\right)$

SUPERCOP

Q28

$$\frac{x}{x-5} > \frac{1}{2}$$

$$\frac{x}{x-5} - \frac{1}{2} > 0$$

$$\frac{2x-(x-5)}{2(x-5)} > 0$$

$$\frac{2x-x+5}{2x-10} > 0$$

$$\frac{x+5}{2x-10} > 0$$

Case 1: $x+5>0$ *and* $2x-10>0$
$\Rightarrow x>-5$ *and* $x>5$
$\Rightarrow$ $x>5$

Case 2: $x+5<0$ *and* $2x-10<0$
$\Rightarrow x<-5$ *and* $x<5$
$\Rightarrow$ $x<-5$

Hence the solution set is $(-\infty,-5)\cup(5,\infty)$

SUPERCOP

Ex 15.2

Q1

Consider the first inequation,

$$x + 3 > 0$$
$$x > -3 \qquad \ldots(i)$$

Consider the second inequation,

$$2x < 14$$
$$x < \frac{14}{2} = 7$$
$$x < 7 \qquad \ldots(ii)$$

From (i) and (ii), $(-3, 7)$ is the solution set of the simultaneous equations.

Q2

Consider the first inequation,

$$2x - 7 > 5 - x$$
$$\Rightarrow \quad 2x + x > 5 + 7$$
$$\Rightarrow \quad 3x > 12$$
$$\Rightarrow \quad x > \frac{12}{3}$$
$$\Rightarrow \quad x > 4 \; \ldots\ldots\ldots\ldots\ldots(i)$$

Consider the second inequation,

$$11 - 5x \le 1$$
$$\Rightarrow \quad -5x \le 1 - 11$$
$$\Rightarrow \quad -5x \le -10$$
$$\Rightarrow \quad 5x \ge 10$$
$$\Rightarrow \quad x \ge 2 \; \ldots\ldots\ldots\ldots(ii)$$

From (i) and (ii), $(4, \infty)$ is the solution set of the simultaneous equations.

SUPERCOP

Q3

Consider the first inequation,

$$x - 2 > 0$$
$$x > 2 \qquad \ldots(\text{i})$$

Consider the second inequation,

$$3x < 18$$
$$x < 6 \quad \ldots(\text{ii})$$

From (i) and (ii), $(2, 6)$ is the solution set of the simultaneous equations.

Q4

Consider the first inequation,

$$2x + 6 \geq 0$$
$$2x \geq -6$$
$$x \geq \frac{-6}{2}$$
$$x \geq -3 \qquad \ldots(\text{i})$$

Consider the second inequation,

$$4x - 7 < 0$$
$$4x < 7$$
$$x < \frac{7}{4} \qquad \ldots(\text{ii})$$

From (i) and (ii), $\left[-3, \frac{7}{4}\right]$ is the solution set of the simultaneous equations.

Q5

Consider the first inequation,

$$3x - 6 > 0$$
$$3x > 6$$
$$x > 2 \qquad \ldots(\text{i})$$

Consider the second inequation,

$$2x - 5 > 0$$
$$2x > 5$$
$$x > \frac{5}{2} \qquad \ldots(\text{ii})$$

From (i) and (ii), $\left[\frac{5}{2}, \infty\right]$ is the solution set of the simultaneous equations.

SUPERCOP

Q6

Consider the first inequation,

$2x - 3 < 7$
$2x < 7 + 3$
$2x < 10$
$x < 5 \qquad \ldots(i)$

Consider the second inequation,

$2x > -4$
$x > \frac{-4}{2}$
$x > -2 \qquad \ldots(ii)$

From (i) and (ii), $[-2, 5]$ is the solution set of the simultaneous equations.

Q7

Consider the first inequation,

$2x + 5 \le 0$
$2x \le -5$
$x \le \frac{-5}{2} \qquad \ldots(i)$

Consider the second inequation,

$x - 3 \le 0$
$x \le 3 \quad \ldots(ii)$

From (i) and (ii), $\left(-\infty, \frac{-5}{2}\right]$ is the solution set of the simultaneous equations.

Q8

$5x - 1 < 24$
$5x < 24 + 1$
$5x < 25$
$x < \frac{25}{5}$
$x < 5 \quad \ldots..(1)$

And

$5x + 1 > -24$
$5x > -24 - 1$
$5x > -25$
$x > -5 \ldots..(2)$

From equation (1) and (2),

$< x < 5$

$\Rightarrow \quad (-5, 5)$

SUPERCOP

Q9

Consider the first inequation,

$$3x - 1 \geq 5$$
$$3x \geq 5 + 1$$
$$3x \geq 6$$
$$x \geq 2 \qquad \ldots(\text{i})$$

Consider the second inequation,

$$x + 2 > -1$$
$$x > -1 - 2$$
$$x > -3 \qquad \ldots(\text{ii})$$

From (i) and (ii), $[2, \infty]$ is the solution set of the simultaneous equations.

Q10

Consider the first inequation,

$$11 - 5x > -4$$
$$-5x > -4 - 11$$
$$-5x > -15$$
$$5x < 15$$
$$x < 3 \qquad \ldots(\text{i})$$

Consider the second inequation,

$$4x + 13 \leq -11$$
$$4x \leq -11 - 13$$
$$4x \leq -24$$
$$x \leq -6 \qquad \ldots(\text{ii})$$

From (i) and (ii), $[-\infty, -6]$ is the solution set of the simultaneous equations.

Q11

Consider the first inequation,

$$4x - 1 \leq 0$$
$$4x > -1$$
$$-5x \leq -15$$
$$x \leq \frac{1}{4} \qquad \ldots(\text{i})$$

Consider the second inequation,

$$3 - 4x < 0$$
$$-4x < -3$$
$$-x < \frac{-3}{4}$$
$$x > \frac{3}{4} \qquad \ldots(\text{ii})$$

From (i) and (ii), there is no solution set of the simultaneous equations.

SUPERCOP

Q12

Consider the first inequation,

$$x + 5 > 2(x + 1)$$
$$x > 2x + 2 - 5$$
$$x > 2x - 3$$
$$x - 2 > -3$$
$$-x > -3$$
$$x < 3 \qquad \ldots(\text{i})$$

Consider the second inequation,

$$2 - x < 3(x + 2)$$
$$2 - x < 3x + 6$$
$$-x - 3x < 6 - 2$$
$$-4x < 4$$
$$x > -1 \qquad \ldots(\text{ii})$$

From (i) and (ii), $(-1, 3)$ is the solution set of the simultaneous equations.

Q13

Consider the first inequation,

$$2(x - 6) < 3x - 7$$
$$\Rightarrow 2x - 12 < 3x - 7$$
$$\Rightarrow -5 < x \qquad \ldots(\text{i})$$

Consider the second inequation,

$$11 - 2x < 6 - x$$
$$-2x + x < 6 - 11$$
$$-x < -5$$
$$x > 5 \qquad \ldots(\text{ii})$$

From (i) and (ii), $(5, \infty)$ is the solution set of the simultaneous equations.

SUPERCOP

Q14

Consider the first inequation,

$$5x - 7 < 3(x+3)$$
$$5x - 7 < 3x + 9$$
$$5x - 3x < 9 + 7$$
$$2x < 16$$
$$x < 8 \qquad \ldots(\text{i})$$

Consider the second inequation,

$$1 - \frac{3x}{2} \geq x - 4$$
$$\frac{-3x}{2} - x \geq -4 - 1$$
$$\frac{-3x - 2x}{2} \geq -5$$
$$-5x > -10$$
$$x \leq 2 \qquad \ldots(\text{ii})$$

From (i) and (ii), $(-\infty, 2)$ is the solution set of the simultaneous equations.

Q15

Consider the first inequation,

$$\frac{2x-3}{4} - 2 \geq \frac{4x}{3} - 6$$
$$\frac{2x-3-8}{4} \geq \frac{4x-18}{3}$$
$$3(2x-11) \geq 4(4x-18)$$
$$6x - 33 \geq 16x - 72$$
$$6x - 16x \geq -72 + 33$$
$$-10x \geq -39$$
$$x \leq \frac{39}{10} \qquad \ldots(\text{i})$$

Consider the second inequation,

$$2(2x+3) < 6(x-2) + 10$$
$$4x + 6 < 6x - 12 + 10$$
$$4x - 6x < -12 - 6 + 10$$
$$-2x < -8$$
$$x > 8 \qquad \ldots(\text{ii})$$

From (i) and (ii), there is no solution set of the simultaneous equations.

SUPERCOP

Q16

Consider the first inequation,

$$\frac{7x-1}{2} < -3$$
$$7x - 1 < -6$$
$$7x < -6 + 1$$
$$7x < -5$$
$$x < \frac{-5}{7} \qquad \ldots(i)$$

Consider the second inequation,

$$\frac{3x+8}{5} + 11 < 0$$

$$\frac{3x+8+55}{5} < 0$$

$$\frac{3x+63}{5} < \frac{0}{1}$$

$$3x + 63 < 0$$

$$3x < -63$$
$$x < -21 \qquad \ldots(ii)$$

From (i) and (ii), $(-\infty, -21)$ is the solution set of the simultaneous equations.

Q17

Consider the first inequation,

$$\frac{2x+1}{7x-1} > 5$$
$$\frac{2x+1}{7x-1} - 5 > 0$$
$$\frac{2x+1-5(7x-1)}{7x-1} > 0$$
$$2x + 1 - 35x + 5 > 0$$
$$-33x + 6 > 0$$
$$-33x > -6$$
$$x < \frac{6}{33}, \quad x > \frac{1}{7} \qquad \ldots(i)$$

Consider the second inequation,

$$\frac{x+7}{x-8} > 2$$

$$\frac{x+7}{x-8} - 2 > 0$$

$$\frac{x+7-2(x-8)}{x-8} > 0$$

$$\frac{x+7-2x+16}{x-8} > 0$$

$$x > 8, \quad x < 23 \qquad \ldots(ii)$$

From (i) and (ii), there is no solution set of the simultaneous equations.

SUPERCOP

Q18

Consider the first inequation,

$$\frac{x}{2} < 0$$
$$x < 0 \quad \ldots(\text{i})$$

Consider the second inequation,

$$\frac{-x}{2} < 3$$
$$-x < 6$$

$$x > -6 \ldots(\text{ii})$$

From (i) and (ii), $(-6, 0)$ is the solution set of the simultaneous equations.

Q19

Consider the first inequation,

$$10 \le -5(x-2)$$
$$2 \le -(x-2)$$
$$2 \le -x+2$$
$$2-2 \le -x$$
$$0 \le -x$$
$$x \le 0 \qquad \ldots(\text{i})$$

Consider the second inequation,

$$-5(x-2) < 20$$
$$-5x+10 < 20$$
$$-5x < 20-10$$
$$-5x < 10$$
$$-x < 2$$
$$x > -2 \qquad \ldots(\text{ii})$$

From (i) and (ii), $(-2, 0)$ is the solution set of the simultaneous equations.

SUPERCOP

Q20

Consider the first inequation,

$$-5 < 2x - 3$$
$$2x - 3 > -5$$
$$2x > -5 + 3$$
$$2x > -2$$
$$x > -1 \qquad \ldots(i)$$

Consider the second inequation,

$$2x - 3 < 5$$
$$2x < 5 + 3$$
$$2x < 8$$
$$x < 4 \qquad \ldots(ii)$$

From (i) and (ii), $(-1, 4)$ is the solution set of the simultaneous equations.

Q21

$$\frac{4}{x+1} \leq 3 \leq \frac{6}{x+1}$$
$$\Rightarrow 4 \leq 3(x+1) \leq 6$$
$$\Rightarrow \frac{4}{3} \leq (x+1) \leq \frac{6}{3}$$
$$\Rightarrow \frac{4}{3} - 1 \leq x \leq 2 - 1$$
$$\Rightarrow \frac{1}{3} \leq x \leq 1$$

Solution set for given inequation is $\left[\frac{1}{3}, 1\right]$.

SUPERCOP

Ex 15.3

Q1

Consider the first inequation,

$$x+\frac{1}{3}\geq 0$$
$$\therefore e \quad x\geq \frac{-1}{3}.$$
$$\left|x+\frac{1}{3}\right|-\frac{8}{3}>0$$
$$x+\frac{1}{3}-\frac{8}{3}>0$$
$$\frac{3x-7}{3}>0$$
$$3x-7>0$$
$$x>\frac{7}{3} \qquad \ldots(i)$$

Consider the second inequation,

$$x+\frac{1}{3}<0 \quad \therefore \ e. \quad x<-\frac{1}{3}$$
$$\left|x+\frac{1}{3}-\frac{8}{3}>0\right|$$
$$-x-\frac{1}{3}-\frac{8}{3}>0$$
$$-3x-9>0$$
$$-3x>9$$
$$3x<-9$$
$$x<\frac{-9}{3}$$
$$x<-3 \qquad \ldots(ii)$$

From (i) and (ii), $(-\infty,-3)\cup\left(\frac{7}{3},\infty\right)$ is the solution set of the simultaneous equations.

SUPERCOP

Q2

We have,

$|4-x|+1-3<0$

$\Rightarrow |4-x|-2<0 \qquad \ldots(i)$

Case I: When $|4-x| \geq 0$

$$|4-x|-2<0$$
$$\Rightarrow \quad 4-x-2<0$$
$$\Rightarrow \quad 2-x<0$$
$$\Rightarrow \quad -x<-2$$
$$\Rightarrow \quad x>2 \qquad \ldots(ii)$$

Case II: When $|4-x|<0$

$$|4-x|-2<0$$
$$\Rightarrow \quad -(4-x)-2<0$$
$$\Rightarrow \quad -4+x-2<0$$
$$\Rightarrow \quad x-6<0$$
$$\Rightarrow \quad x<6 \qquad \ldots(iii)$$

Combining (ii) and (iii) we get $(2,6)$ as the solution set.

Q3

We have,

$$\frac{|3x-4|}{2}-\frac{5}{12} \leq 0$$

Case I: When $|3x-4| \geq 0$

$$\frac{|3x-4|}{2}-\frac{5}{12} \leq 0$$
$$\Rightarrow \quad \frac{|3x-4|}{2}-\frac{5}{12} \leq 0$$
$$\Rightarrow \quad \frac{3x-4}{2}-\frac{5}{12} \leq 0$$
$$\Rightarrow \quad \frac{6(3x-4)-5}{12} \leq 0$$
$$\Rightarrow \quad 18x-24-5 \leq 0$$
$$\Rightarrow \quad 18x-29 \leq 0$$
$$\Rightarrow \quad 18x \leq 29$$
$$\Rightarrow \quad x \leq \frac{29}{18} \qquad \ldots(ii)$$

Case II: When $|3x-4|<0$

$$\frac{|3x-4|}{2}-\frac{5}{12} \leq 0$$

SUPERCOP

Q4

We have,

$$\frac{|x-2|}{x-2} > 0 \qquad \ldots(i)$$

Case I: When $|x-2| \geq 0$

$x \geq 2$

$$\Rightarrow \quad \frac{x-2}{x-2} \geq 0$$
$$\Rightarrow \quad x-2 \geq 0$$
$$\Rightarrow \quad x \geq 2 \qquad \ldots(ii)$$

Case II: when $|x-2| < 0$

$x < 2$

$$\Rightarrow \quad -\frac{(x-2)}{x-2} > 0$$
$$\Rightarrow \quad -(x-2) > 0$$
$$\Rightarrow \quad -x+2 < 0$$
$$\Rightarrow \quad -x < -2$$
$$\Rightarrow \quad x > 2 \qquad \ldots(iii)$$

Combining (ii) and (iii) we get $(2, \infty)$ as the solution set.

Q5

We have,

$$\frac{1}{|x|-3} - \frac{1}{2} < 0 \qquad \ldots(i)$$

Case I: when $|x| \geq 0 \Rightarrow x \geq 0$

$$\Rightarrow \quad \frac{1}{x-3} - \frac{1}{2} < 0$$

$$\Rightarrow \quad \frac{2-(x-3)}{2(x-3)} < 0$$

$$\Rightarrow \quad \frac{2-x+3}{2x-6} < 0$$

$$\Rightarrow \quad \frac{-x+5}{2x-6} < 0$$

$$\Rightarrow \quad -x+5 < 0$$
$$\Rightarrow \quad -x < -5$$
$$\Rightarrow \quad x > 5 \qquad \ldots(ii)$$

Case II: when $|x| < 0, \quad x < 0$

$$\Rightarrow \quad \frac{1}{-x-3} - \frac{1}{2} < 0$$
$$\Rightarrow \quad \frac{2-(-x-3)}{2(-x-3)} < 0$$
$$\Rightarrow \quad 2+x+3 < 0$$
$$\Rightarrow \quad x+5 < 0$$
$$\Rightarrow \quad x < -5 \qquad \ldots(iii)$$

Combining (ii) and (iii) we get $(-\infty, -5) \cup (-3, 3) \cup (5, \infty)$ as the solution set.

SUPERCOP

Q6

We have,

$$\frac{|x+2|-x}{x} < 0$$

$$\frac{|x+2|-x}{x} - 2 < 0$$

$$\frac{|x+2|-x-2x}{x} < 0$$

$$\frac{|x+2|-3x}{x} < 0 \qquad \ldots(i)$$

Case I: when $|x+2| \geq 0$

i.e, $x \geq -2$

$$\Rightarrow \quad \frac{x+2-3x}{x} < 0$$

$$\Rightarrow \quad -2x+2 < 0$$

$$\Rightarrow \quad -2x < -2 \qquad \text{and} \qquad x > 0$$

$$\Rightarrow \quad x > 1 \quad \ldots(ii)$$

Case II: $|x+2| < 0$

i.e, $x < -2$

$$\Rightarrow \quad -(x+2) - 3x < 0$$

$$\Rightarrow \quad -x-2-3x < 0$$

$$\Rightarrow \quad -4x-2 < 0$$

$$\Rightarrow \quad -4x < 2$$

$$\Rightarrow \quad x > \frac{-1}{2} \ \ldots\ldots\ldots\ldots(iii)$$

and $x < 0$

Combining (ii) and (iii) we get $(-\infty, 0) \cup (1, \infty)$ as the solution set.

SUPERCOP

Q7

We have,

$$\frac{|2x-1|}{x-1} - 2 > 0$$

$$\frac{|2x-1| - 2(x-1)}{x-1} > 0$$

$$\frac{|2x-1| - 2x + 2}{x-1} > 0 \qquad \ldots(i)$$

Case I: when $|2x-1| \geq 0$

$$i.e,\ 2x - 1 \geq 0$$
$$2x \geq 1$$
$$x \geq \frac{1}{2}$$

$\Rightarrow \quad |2x-1| - 2x + 2 > 0$ and $x - 1 > 0$

$\Rightarrow \quad 2x - 1 - 2x + 2 > 0$ and $x > 1$

$\Rightarrow \quad x > 1 \qquad \ldots(ii)$

Case II: when $|2x-1| < 0$

$$i.e,\ 2x - 1 < 0$$
$$2x < 1$$
$$x < \frac{1}{2}$$

$\Rightarrow \quad -(2x-1) - 2x + 2 > 0$ and $x < 1$

$\Rightarrow \quad -4 + 3 > 0$

$\Rightarrow \quad -x > -\frac{3}{4}$

$\Rightarrow \quad x < \frac{3}{4}$ and $x < 1$

$\Rightarrow \quad x \in \left(\frac{3}{4}, 1\right) \qquad \ldots(iii)$

Combining (ii) and (iii) we get $\left(\frac{3}{4}, 1\right) \cup (1, \infty)$ as the solution set.

SUPERCOP

Q8

We have,

$|x-1|+|x-2|+|x-3|-6 \ge 0 \qquad \ldots(i)$

Case I: $|x-1| \ge 0$

$x \ge 1$

$\Rightarrow \quad x-1-(x-2)-(x-3)-6 \ge 0$

$\Rightarrow \quad -x+4-6 \ge 0$

$\Rightarrow \quad -x \ge 2$

$\Rightarrow \quad x \le -2$

$\Rightarrow \quad (-\infty,-2] \qquad \ldots(ii)$

Case II: $|x-2| \ge 0$

$x \ge 2$

$\Rightarrow \quad x-1+x-2-(x-3)-6 \ge 0$

$x-6 \ge 0$

$x \ge 6$

$\Rightarrow \quad [6,\infty) \ \ldots\ldots\ldots\ldots(iii)$

case III: When $|x-3| \ge 0$

$x \ge 3$

$\Rightarrow \quad x-1+x-2+x-3-6 \ge 0$

$\Rightarrow \quad 3x-12 \ge 0$

$\Rightarrow \quad 3x \ge 12$

$\Rightarrow \quad x \ge 4$

$\Rightarrow \quad \therefore\ x \in [4,\infty)$

SUPERCOP

Q9

$$\frac{|x-2|-1}{|x-2|-2} \le 0$$

Let $y = |x-2|$

$$\Rightarrow \frac{y-1}{y-2} \le 0$$

$$\Rightarrow 1 \le y < 2$$

$$\Rightarrow 1 \le |x-2| < 2$$

$$\Rightarrow x \in [-2+2, -1+2] \cup [1+2, 2+2]$$

$$\Rightarrow x \in [0,1] \cup [3,4]$$

The solution set is $[0,1] \cup [3,4]$.

Q10

$$\frac{1}{|x|-3} \le \frac{1}{2}$$

$$\Rightarrow \frac{1}{|x|-3} - \frac{1}{2} \le 0$$

$$\Rightarrow \frac{2-|x|+3}{2(|x|-3)} \le 0$$

$$\Rightarrow \frac{5-|x|}{2(|x|-3)} \le 0$$

$$\Rightarrow \frac{|x|-5}{2(|x|-3)} \ge 0$$

$$\Rightarrow \frac{|x|-5}{|x|-3} \ge 0$$

$$\Rightarrow |x| \ge 5 \text{ or } |x| < 3$$

$$\Rightarrow x \in (-\infty, -5] \cup [5, \infty) \text{ or } x \in (-3, -3)$$

$$\Rightarrow x \in (-\infty, -5] \cup (-3, -3) \cup [5, \infty)$$

The solution set is $(-\infty, -5] \cup (-3, -3) \cup [5, \infty)$.

SUPERCOP

Q11

$|x+1|+|x|>3$

CASE1: When $-\infty<x<-1$

$|x+1|=-(x+1)$ and $|x|=-x$

$\therefore |x+1|+|x|>3$

$\Rightarrow -(x+1)-x>3$

$\Rightarrow -2x>4$

$\Rightarrow x<-2$

But, $-\infty<x<-1$.

$\therefore$ The solution set of the given inequation is $(-\infty,-2)$.

Q12

$1\le|x-2|\le3$

$\Rightarrow x\in[-3+2,-1+2]\cup[1+2,3+2]$

$\Rightarrow x\in[-1,1]\cup[3,5]$

$\therefore$ The solution set for given inequality is $[-1,1]\cup[3,5]$.

SUPERCOP

Q13

$|3-4x| \geq 9$

$\Rightarrow 4\left|\frac{3}{4}-x\right| \geq 9$

$\Rightarrow \left|\frac{3}{4}-x\right| \geq \frac{9}{4}$

CASE1: When $-\infty < x \leq -\frac{3}{4}$

$\left|\frac{3}{4}-x\right| = \left(\frac{3}{4}-x\right)$

$\therefore \left|\frac{3}{4}-x\right| \geq \frac{9}{4}$

$\Rightarrow \left(\frac{3}{4}-x\right) \geq \frac{9}{4}$

$\Rightarrow -\frac{6}{4} \geq x$

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

But, $-\infty < x < -1.$

$\therefore$ The solution set of the given inequation is $\left(-\infty, -\frac{3}{2}\right]$.

SUPERCOP

Ex 15.4

Q1

Let x be the smaller of the two consecutive odd positive intgers. Then the other odd integer is $x+2$.
It is given that both the integers are smaller than 10 and their sum is more than 11.

$$\begin{aligned}
\therefore\quad & x+2<10 \text{ and, } x+(x+2)>11 \\
\Rightarrow\quad & x<10-2 \text{ and } 2x+2>11 \\
\Rightarrow\quad & x<8 \text{ and } 2x>9 \\
\Rightarrow\quad & x<8 \text{ and } x>\frac{9}{2} \\
\Rightarrow\quad & \frac{9}{2}<x<8 \\
\Rightarrow\quad & x=5,7 \qquad [\because x \text{ is an odd integer}]
\end{aligned}$$

Hence, the required pairs of odd integers are $(5,7)$ and $(7,9)$.

Q2

Let x be the smaller of the two consecutive odd natural numbers. Then the other odd integer is $x+2$.

It is given that both the natural number are greater than 10 and their sum is less than 40.

$$\begin{aligned}
\therefore\quad & x>10 \text{ and, } x+x+2<40 \\
\Rightarrow\quad & x>10 \text{ and } 2x<38 \\
\Rightarrow\quad & x>10 \text{ and } x<19 \\
\Rightarrow\quad & 10<x<19 \\
\Rightarrow\quad & x=11,13,15,17 \qquad [\because x \text{ is an odd number}]
\end{aligned}$$

Hence, the required pairs of odd natural numbers are $(11,13),(13,15),(15,17)$ and $(17,19)$.

Q3

Let x be the smaller of the two consecutive even positive integers.
Then the other even integer is $x+2$.
It is given that both the even integers are greater than 5 and their sum is less than 23.

$$\begin{aligned}
\therefore\quad & x>5 \text{ and, } x+x+2<23 \\
\Rightarrow\quad & x>5 \text{ and } 2x<21 \\
\Rightarrow\quad & x>5 \text{ and } x<\frac{21}{2} \\
\Rightarrow\quad & 5<x<\frac{21}{2}=10.5 \\
\Rightarrow\quad & x=6,8,10 \qquad [\because x \text{ is an even integer}]
\end{aligned}$$

Hence, the required pairs of even positive integer are $(6,8),(8,10)$ and $(10,12)$.

SUPERCOP

Q4

Suppose Rohit scores x marks in the third test then,

$$65 \le \frac{65+70+x}{3}$$

$\Rightarrow \quad 195 \le 135 + x$

$\Rightarrow \quad 195 - 135 \le x$

$\Rightarrow \quad 60 \le x$

Hence, the minimum marks Rohit should score in the third test is 60.

Q5

We have,

$F_1 = 86°F$

$\therefore \quad F_1 = \frac{9}{5}C_1 + 32 \qquad \left[\because F = \frac{9}{5}C + 32\right]$

$\Rightarrow \quad 86 = \frac{9}{5}C_1 + 32$

$\Rightarrow \quad 86 - 32 = \frac{9}{5}C_1$

$\Rightarrow \quad 54 = \frac{9}{5}C_1$

$\Rightarrow \quad 9C_1 = 5 \times 54$

$\Rightarrow \quad C_1 = \frac{5 \times 54}{9}$

$\Rightarrow \quad C_1 = 5 \times 6 = 30°C$

Now, $F_2 = 95°F$

$\therefore \quad F_2 = \frac{9}{5}C_2 + 32$

$\Rightarrow \quad 95 = \frac{9}{5}C_2 + 32$

$\Rightarrow \quad 95 - 32 = \frac{9}{5}C_2$

$\Rightarrow \quad 63 = \frac{9}{5}C_2$

$\Rightarrow \quad 9C_2 = 63 \times 5$

$\Rightarrow \quad C_2 = \frac{63 \times 5}{9}$

$\Rightarrow \quad C_2 = 7 \times 5 = 35°C$

$\therefore$ The range of temperature of the solution is from $30°C$ to $35°C$.

SUPERCOP

Q6

We have,

$$C_1 = 30^\circ C$$

$$\therefore \quad F_1 = \frac{9}{5}C_1 + 32 \qquad \left[\because F = \frac{9}{5}C + 32\right]$$

$$\Rightarrow \quad F_1 = \frac{9}{5}\times 30 + 32$$

$$\Rightarrow \quad F_1 = 9\times 6 + 32$$

$$\Rightarrow \quad F_1 = 54 + 32$$

$$\Rightarrow \quad F_1 = 86^\circ F$$

Now, $C_2 = 35^\circ C$

$$\therefore \quad F_2 = \frac{9}{5}C_2 + 32$$

$$\Rightarrow \quad F_2 = \frac{9}{5}\times 35 + 32$$

$$\Rightarrow \quad F_2 = 9\times 7 + 32$$

$$\Rightarrow \quad F_2 = 63 + 32$$

$$\Rightarrow \quad F_2 = 95^\circ F$$

$\therefore$ Hence, the temperature of the solution lies between $86^\circ F$ to $95^\circ F$.

Q7

Suppose Shikha scores x marks in the fifth paper. Then,

$$90 \le \frac{87+95+92+94+x}{5}$$

$$\Rightarrow \quad 90\times 5 \le 182 + 186 + x$$

$$\Rightarrow \quad 450 \le 368 + x$$

$$\Rightarrow \quad 450 - 368 \le x$$

$$\Rightarrow \quad 82 \le x$$

Hence, the minimum marks is required in the last paper is 82.

SUPERCOP

Q8

We have,
Profit = Revenue – Cost
Therefore, to earn some profit, we must have
Revenue > Cost

$\Rightarrow \quad 2x > 300 + \frac{3}{2}x$

$\Rightarrow \quad 2x - \frac{3}{2}x > 300$

$\Rightarrow \quad \frac{4x - 3x}{2} > 300$

$\Rightarrow \quad x > 300 \times 2$

$\Rightarrow \quad x > 600$

Hence, the manufacturer must sell more than 600 cassettes to realize some profit.

Q9

Let the length of the shortest side be x.
Then, the length of te longest side and third side of the triangle are $3x$ and $3x - 2$ respectively.

According to question,
perimeter of triangle ≥ 61

$\Rightarrow \quad x + 3x - 2 + 3x \geq 61$

$\Rightarrow \quad 7x \geq 61 + 2$

$\Rightarrow \quad 7x \geq 63$

$\Rightarrow \quad x \geq \frac{63}{7}$

$\Rightarrow \quad x \geq 9$

$\therefore$ The minimum length of the shortest side is 9cm.

SUPERCOP

Q10

Let the quantity of water to be added to solution $= x$ liters.

$\therefore \quad 25\%(1125 + x) < 45\%$ of 1125

$\Rightarrow \quad \frac{25}{100}(1125 + x) < \frac{45}{100} \times 1125$

$\Rightarrow \quad 1125 + x < \frac{45}{25} \times 1125$

$\Rightarrow \quad 1125 + x < 45 \times 45$
$\Rightarrow \quad 1125 + x < 2025$
$\Rightarrow \quad x < 2025 - 1125$
$\Rightarrow \quad x < 900$

and 45% of $1125 < 30\%(1125 + x)$

$\Rightarrow \quad \frac{45}{100} \times 1125 < \frac{30}{100}(1125 + x)$

$\Rightarrow \quad \frac{45}{30} \times 1125 < 1125 + x$

$\Rightarrow \quad \frac{3}{2} \times 1125 < 1125 + x$
$\Rightarrow \quad 1.5 \times 1125 < 1125 + x$
$\Rightarrow \quad 1687.5 < 1125 + x$
$\Rightarrow \quad 1687.5 - 1125 < x$
$\Rightarrow \quad 562.5 < x \quad \ldots\ldots\ldots\ldots\ldots\ldots (ii)$

Using (i) and (ii), we get $562.5 < x < 900$

Hence, quantity of water lies between 562.5 litres and 900 litres.

SUPERCOP

Q11

Let x liters of 2% solution will have to be added to 640 liters of the 8% solution of acid.

Total quantity of mixture = $(640+x)$

Total acid in the $(640+x)$ liters of mixture

$$\frac{2}{100}x+\frac{8}{100}640$$

It is given that acid content in the resulting mixture must be more than 4% but less than 6%.

$$\frac{4}{100}[640+x]<\left(\frac{2}{100}x+\frac{8}{100}640\right)<\frac{6}{100}[640+x]$$

$$\Rightarrow 4[640+x]<(2x+8640)<6[640+x]$$

$$\Rightarrow 2560+4x<2x+8640 \text{ and } 2x+8640<3840+6x$$

$$\Rightarrow 2560-8640<2x-4x \text{ and } 2x-6x<3840-8640$$

$$\Rightarrow x<1280 \text{ and } x>320$$

More than 320 litres but less than 1280 liters of 2% is to be added.

Q12

Let the pH value of third reading be x.

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

$$\Rightarrow \quad 21.6<7.48+7.85+x<23.4$$

$$\Rightarrow \quad 21.6<15.33+x<23.4$$

$$\Rightarrow \quad 21.6-15.33<x<23.4-15.33$$

$$\Rightarrow \quad 6.27<x<8.07$$

$\therefore$ The range of pH value for the third reading is lies between 6.27 and 8.07.

SUPERCOP

Ex 15.5

Q1

We have,

$$x + 2y - y \le 0$$

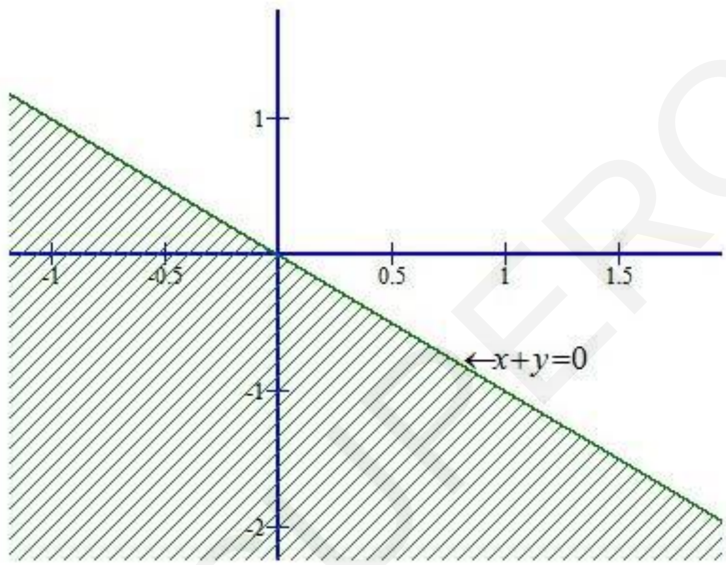
$$\Rightarrow \quad x + y \le 0$$

Converting the given inequation into equation we obtain, $x + y = 0$.

Putting $y = 0$, we get $x = 0$
Putting $x = 0$, we get $y = 0$
Putting $x = 3$, we get $y = -3$.

We plot these points and join them by a thick line. This lines divider the xy – plane in two parts.
To determine the region represented by the given inequality consider the inequality.

So, the region containing the origin is represented by the given ineqation as show below:



This region represents the solution set of the given inequations.

Q2

We have,

$$x + 2y \geq 6$$

Converting the inequation into equation, we obtain, $x + 2y = 6$.

Putting $y = 0$, we get $x = 6$

Putting $x = 0$, we get $2y = 6 \Rightarrow y = 3$

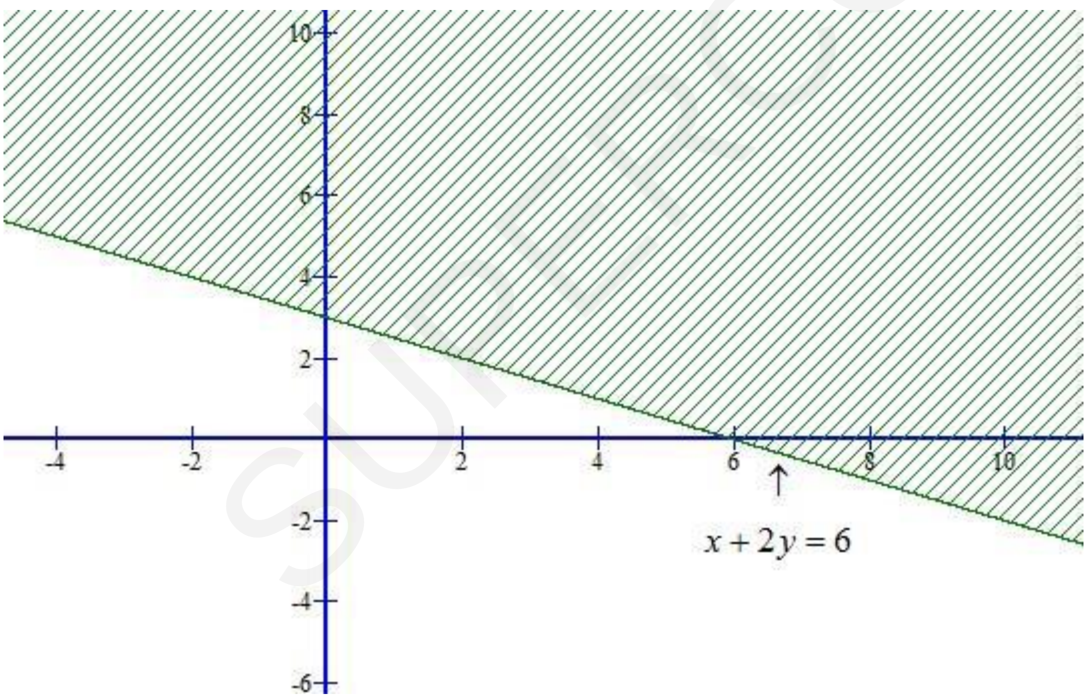
We plot these points and join them by a thick line. This lines divider the xy – plane in two parts. To determine the region represented by the given inequality consider the point $O(0, 0)$.

Putting $x = 0$ and $y = 0$ in (i) we get, $0 \geq 6$

It is not possible.

Clearly, $O(0,0)$ does not satisfies the inequality.

So, the region represented by the given inequation is the shaded region shown below:



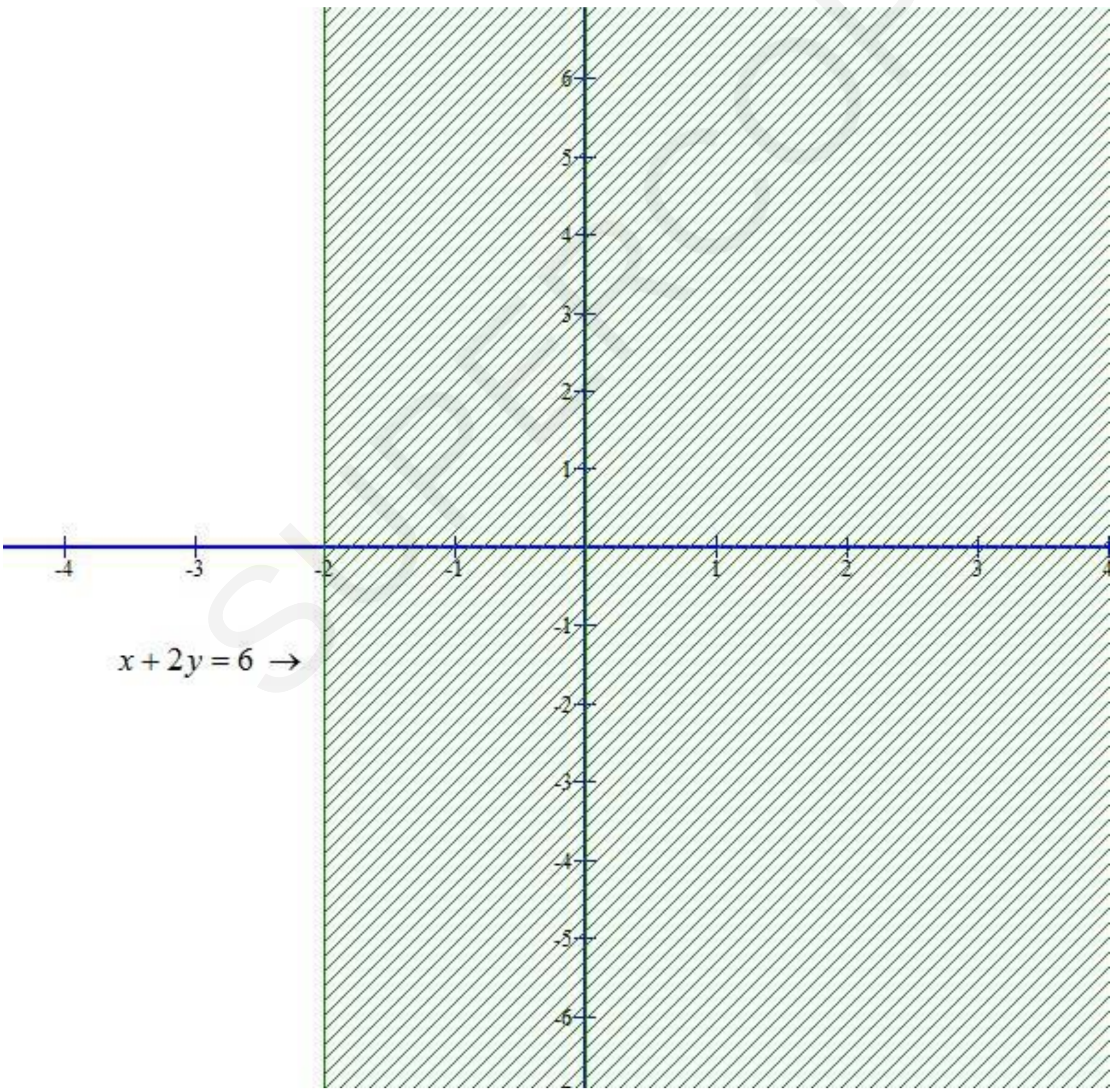
Q3

We have,

$$x + 2 \geq 0 \ldots\ldots\ldots\ldots\ldots\ldots \text{(i)}$$

Converting the inequation into equation, we obtain, $x = -2$. Clearly, it is a line parallel to y-axis. This line divides the xy – plane in two parts. One part on the LHS of $x = -2$ and the other on its RHS.

Putting $x = 0$ in the inequation(i), we get $2 \geq 0$
we find that the point $(0,0)$ satisfies the inequality. So, the region represented by the given inequation is the shaded region shown below:



Q4

We have

$$x - 2y < 0$$

Converting the inequation into eqaution, we obtain,

$$x < 2y$$

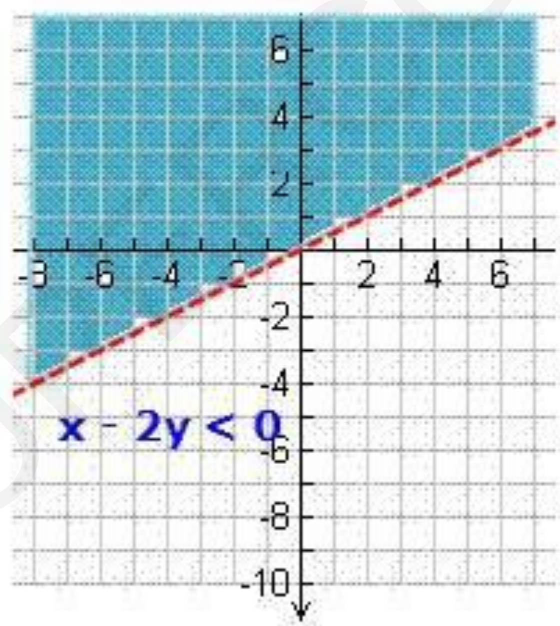
To determine the region represented by the given inequality consider the point $o(0,0)$

Putting $x = 0$ and $y = 0$ in equation we have

$$0 < 0$$

It is not possibvle.Clearly $o(0,0)$ does not satisfy the inequality.

So, the region represented by the given inequation is the shadd region shown below:



Q5

We have,

$$-3x + 2y \leq 6 \ldots\ldots\ldots\ldots\ldots\ldots (i)$$

Converting the given inequation into equation, we obtain, $-3x + 2y = 6$.

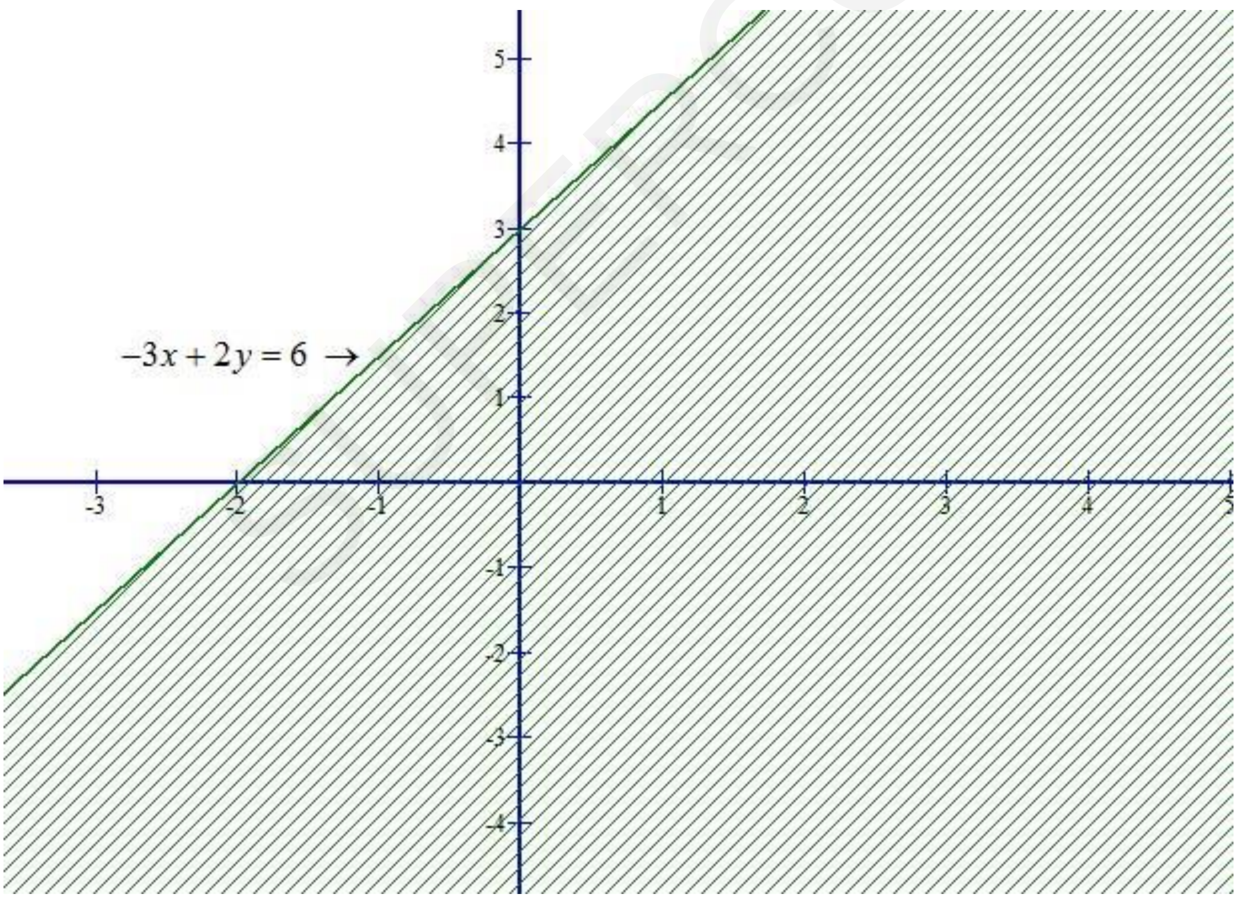
Putting $x = 0$, we get $y = \frac{6}{2} = 3$

Putting $y = 0$, we get $x = \frac{-6}{3} = -2$

we plot these points and join them by a thick line. This line meets x-axis at $(-2, 0)$ and y-axis at $(0,3)$. This line divides the xy-plan into two parts. To determine the region represented by the given inequality, consider the point $0(0,0)$.

Putting $x = 0$ and $y = 0$ in the inequation(i), we get, $0 \leq 6$

Clearly, $(0,0)$ satisfies the inequality. So the region containing the origin is represented by the given inequation as shown below.



Q6

We have,

$x \le 8 - 4y$ .... (i)

Converting the given inequation into equation, we obtain, $x = 8 - 4y$.

Putting $y = 0$, we get $x = 8$

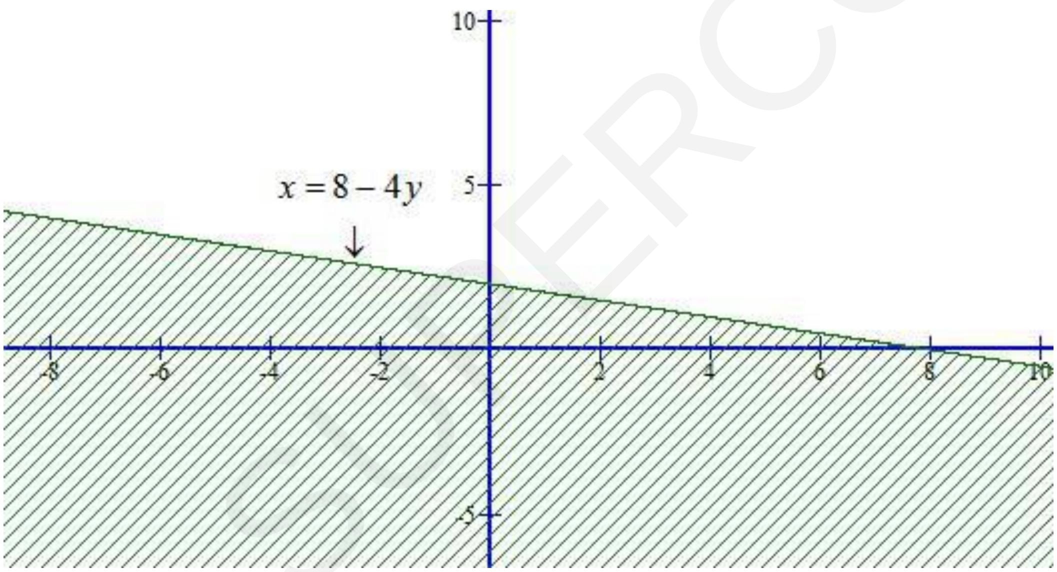
Putting $x = 0$, we get $y = \frac{8}{4} = 2$

So, this line meets x-axis at $(8,0)$ and y-axis at $(0,2)$.

we plot these points and join them by a thick line. This line divides the xy-plane in two parts. To determine the region represented the given inequality consider the point $0(0,0)$.

Putting $x = 0$ and $y = 0$ in the inequation (i), we get $0 \le 8$

Clearly, $(0,0)$ satisfies the inequality. so, the region containing the origin is represented by the given inequation as shown below:



Q7

We have,

$$0 \le 2x - 5y + 10 \ldots\ldots\ldots\ldots\ldots\ldots (i)$$

Converting the given inequation into equation, we obtain, $2x - 5y + 10 = 0$.

Putting $x = 0$, we get $y = \frac{-10}{-5} = 2$

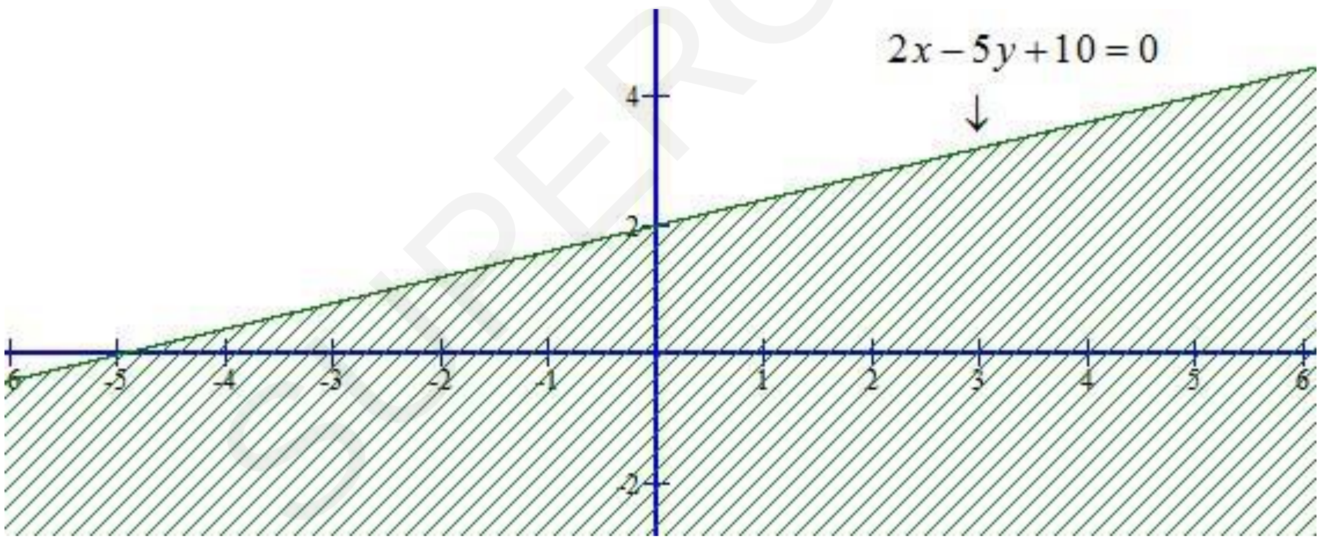
Putting $y = 0$, we get $x = \frac{-10}{2} = -5$

So, this line meets x-axis at $(-5,0)$ and y-axis at $(0,2)$.

we plot these points and join them by a thick line. This line divides the xy-plane in two parts. To determine the region represented by the given inequality consider the point $0(0,0)$.

Putting $x = 0$ and $y = 0$ in the inequation (i), we get $0 \le 10$

Clearly, $(0,0)$ satisfies the inequality. so, the region containing the origin is represented by the given inequation as shown below:



Q8

We have,

$$3y \geq 6 - 2x \ldots\ldots\ldots\ldots\ldots\ldots (i)$$

Converting the given inequation into equation, we obtain, $3y = 6 - 2x$.

Putting $x = 0$, we get $y = \frac{6}{3} = 2$

Putting $y = 0$, we get $x = \frac{6}{2} = 3$

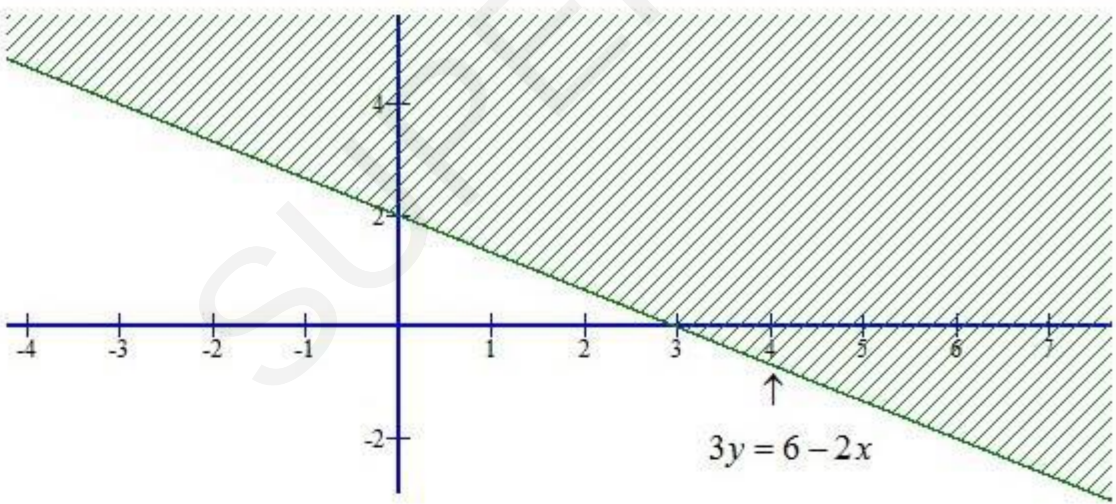
So, this line meets x-axis at $(3,0)$ and y-axis at $(0,2)$.

we plot these points and join them by a thick line. This line divides the xy-plane in two parts. To determine the region represented by the given inequality consider the point $O(0,0)$.

Putting $x = 0$ and $y = 0$ in the inequation (i), we get $0 \geq 6$ it is not possible.

$\therefore$ we find that the point $(0,0)$ does not satisfy the equation $3y \geq 6 - 2x$.

So, the region represented by the given equation is shaded region shown below:



Q9

We have,

$$y \geq 2x - 8 \ldots\ldots\ldots\ldots\ldots\ldots (i)$$

Converting the given inequation into equation, we obtain, $y = 2x - 8$.

Putting $x = 0$, we get $y = -8$

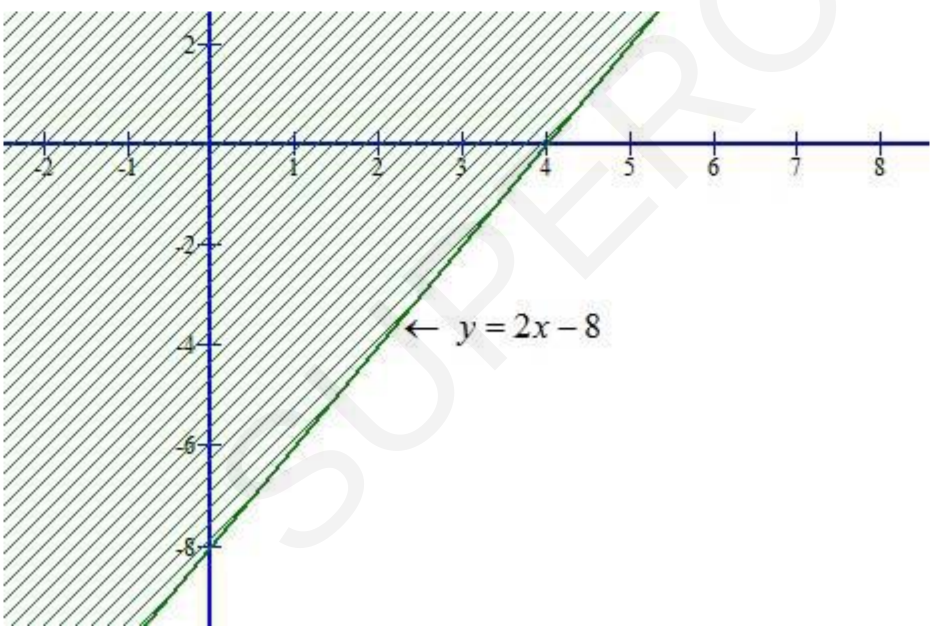
Putting $y = 0$, we get $x = \frac{8}{2} = 4$

So, this line meets x-axis at $(4,0)$ and y-axis at $(0,-8)$.

we plot these points and join them by a line. This line divides the xy-plane in two parts. To determine the region represented by the given inequality consider the point $O(0,0)$.

Putting $x = 0$ and $y = 0$ in the inequation (i), we get $0 \geq -8$

Clearly, $(0,0)$ satisfies the inequality the region containing the origin is represented by the given inequation as show below:



SUPERCOP

Q10

We have,

$$3x - 2y \le x + y - 8$$

$$\Rightarrow \quad 3x - x \le y + 2y - 8$$

$$\Rightarrow \quad 2x \le 3y - 8 \;\ldots\ldots\ldots\ldots\; (i)$$

Converting the given inequation into equation, we obtain, $2x = 3y - 8$.

Putting $y = 0$, we get $x = \frac{-8}{2} = -4$

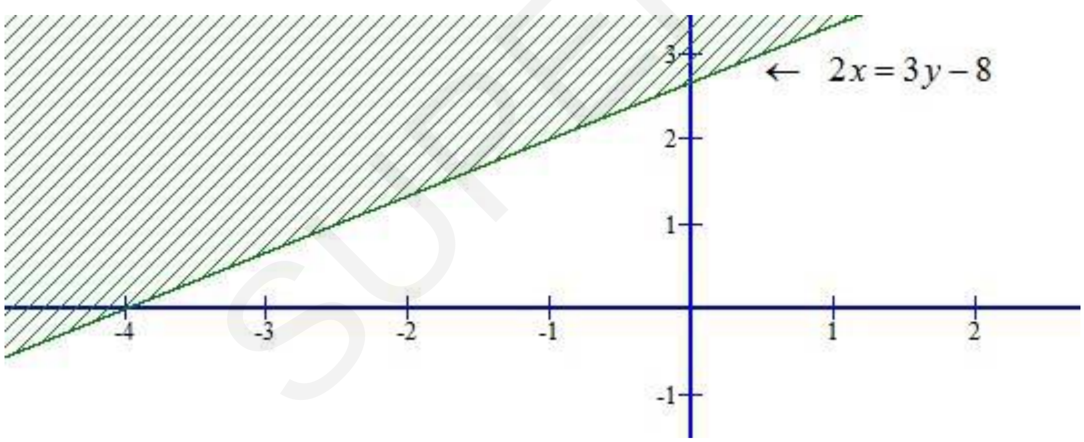
Putting $x = 0$, we get $y = \frac{8}{3}$.

So, this line meets x-axis at $(-4,0)$ and y-axis at $\left(0, \frac{8}{3}\right)$.

we plot these points and join them by a line. This line divides the xy-plane in two parts. To determine the region represented by the given inequality consider the point $0(0,0)$.

Putting $x = 0$ and $y = 0$ in the inequation (i), we get $0 \le -8$ It is not possible.

$\therefore$ we find that the point $(0,0)$ does not satisfy the inequation $2x \le 3y - 8$. so, the region represented by the given equation is the shaded region.



Ex 15.6

Q1(i)

We have,

$$2x+3y\le 6,\quad 3x+2y\le 6,\quad x\ge 0, y\ge 0$$

Converting the given inequation into equations, the inequations reduce to $2x+3y=6$,

$$3x+2y=6,\quad x=0 \text{ and } y=0.$$

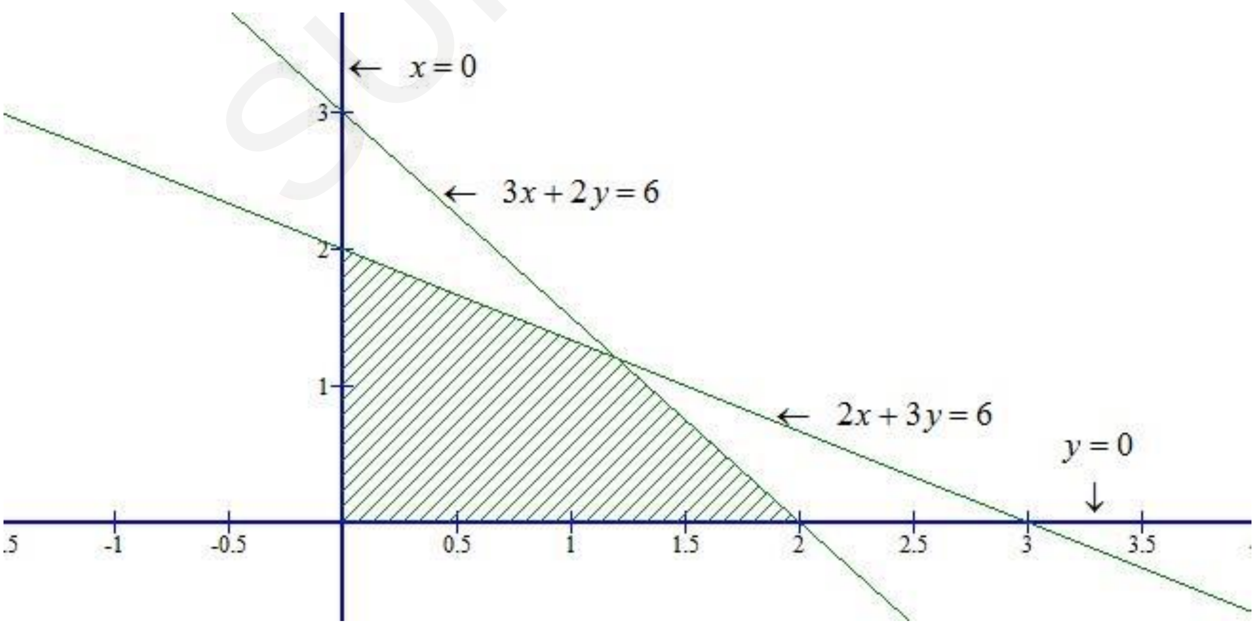
Region represented by $2x+3y\le 6$:
Putting $x=0$ inequation $2x+3y=6$
we get $y=\frac{6}{3}=2$.
Putting $y=0$ in the equation $2x+3y=6$,
we get $x=\frac{6}{3}=3$.

$\therefore$ This line $2x+3y=6$ meets the coordinate axes at $(0,2)$ and $(3,0)$. Draw a thick line joining these points. we find that $(0,0)$ satisfies inequation $2x+3y\le 6$.

Region represented by $3x+2y\le 6$:
Putting $x=0$ in the equation
$3x+2y=6$, we get $y=\frac{6}{2}=3$.
Putting $y=0$ in the equation
$3x+2y=6$, we get $x=\frac{6}{2}=2$.

$\therefore$ This line $3x+2y=6$ meets the coordinate axes at $(0,3)$ and $(2,0)$. Draw a thick line joining these points. we find that $(0,0)$ satisfies inequation $3x+2y\le 6$.

Region represented by $x\ge 0$ and $y\ge 0$:
Clearly $x\ge 0$ and $y\ge 0$ represent the first quadrant.



Q1(ii)

We have,

$2x+3y \le 6, \quad x+4y \le 4, \quad x \ge 0, y \ge 0$

Converting the inequations into equations, the inequations reduce to $2x+3y=6$,

$x+4y=4, \quad x=0$ and $y=0$.

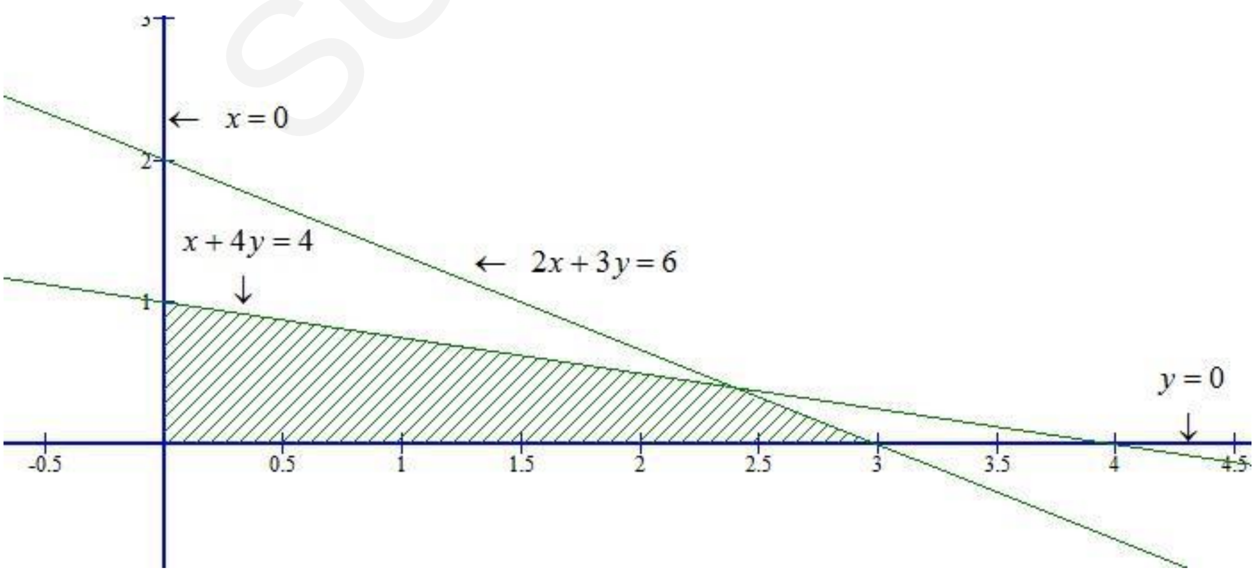
Region represented by $2x+3y \le 6$:
Putting $x=0$ in $2x+3y=6$,
we get $y=\frac{6}{3}=2$
Putting $y=0$ in $2x+3y=6$,
we get $x=\frac{6}{2}=3$.

$\therefore$ The line $2x+3y=6$ meets the coordinate axes at $(0,2)$ and $(3,0)$. Draw a thick line joining these points.
Now, putting $x=0$ and $y=0$ in $2x+3y \le 6 \quad \Rightarrow 0 \le 6$

Clearly, we find that $(0,0)$ satisfies inequation $2x+3y \le 6$
Region represented by $x+4y \le 4$
Putting $x=0$ in $x+4y=4$
we get, $y=\frac{4}{4}=1$
Putting $y=0$ in $x+4y=4$,
we get $x=4$

$\therefore$ The line $x+4y=4$ meets the coordinate axes at $(0,1)$ and $(4,0)$. Draw a thick line joining these points.
Now, putting $x=0, \; y=0$
in $x+4y \le 4$, we get $0 \le 4$

Clearly, we find that $(0,0)$ satisfies inequation $x+4y \le 4$.
Region represented by $x \ge 0$ and $y \ge 0$:
Clearly $x \ge 0$ and $y \ge 0$ represent the first quadrant.



SUPERCOP

Q1(iii)

We have,

$x - y \le 1, \quad x + 2y \le 8, \quad 2x + y \ge 2,$

$x \ge 0$ and $y \ge 0$

Converting the inequations into equations, we obtain

$x - y = 1, \quad x + 2y = 8 \quad 2x + y = 2,$

$x = 0$ and $y = 0.$

Region represented by $x - y \le 1$:
Putting $x = 0$ in $x - y = 1$,
we get $y = -1$
Putting $y = 0$ in $x - y = 1$,
we get $x = 1$

$\therefore$ The line $x - y = 1$ meets the coordinate axes at $(0, -1)$ and $(1, 0)$. Draw a thick line joining these points.
Now, putting $x = 0$ and $y = 0$ in $x - y \le 1$
in $x - y \le 1$, we get, $0 \le 1$

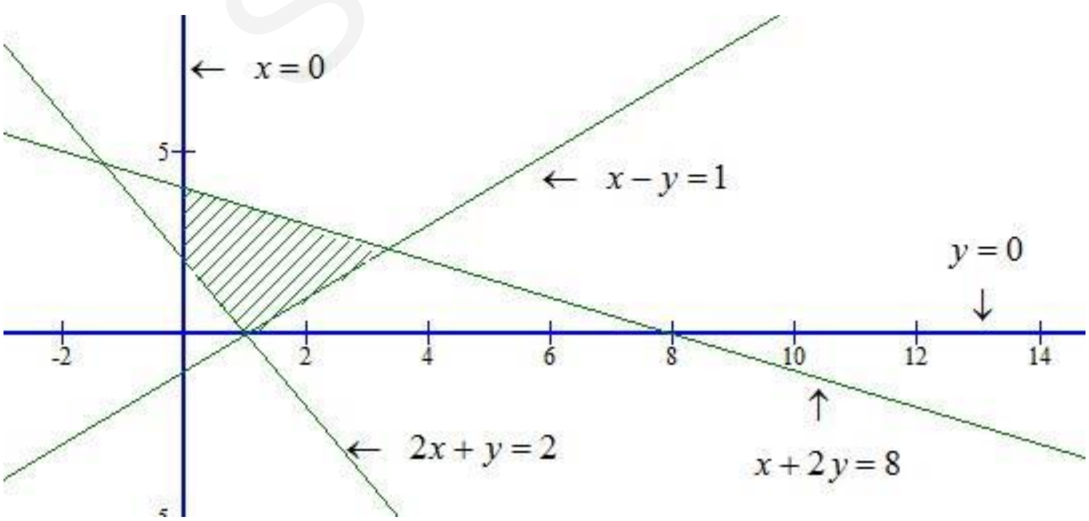
Clearly, we find that $(0,0)$ satisfies inequation $x - y \le 1$
Region represented by $x + 2y \le 8$:
Putting $x = 0$ in $x + 2y = 8$,
we get, $y = \frac{8}{2} = 4$
Putting $y = 0$ in $x + 2y = 8$,
we get $x = 8$,

$\therefore$ The line $x + 2y = 8$ meets the coordinate axes at $(8,0)$ and $(0,4)$. Draw a thick line joining these points.
Now, putting $x = 0$, $y = 0$
in $x + 2y \le 8$, we get $0 \le 8$

Clearly, we find that $(0,0)$ satisfies inequation $x + 2y \le 8$.

Region represented by $2x + y \ge 2$
Putting $x = 0$ in $2x + y = 2$, we get $y = 2$
Putting $y = 0$ in $2x + y = 2$, we get $x = \frac{2}{2} = 1$.

The line $2x + y = 2$ meets the coordinate axes at $(0,2)$ and $(1,0)$. Draw a thick line joining these points.



SUPERCOP

Q1(iv)

We have,

$x + y \geq 1, \quad 7x + 9y \leq 63, \quad x \leq 6,$

$y \leq 5 \quad x \geq 0$ and $y \geq 0$

Converting the inequations into equations, we obtain

$x + y = 1, \quad 7x + 9y = 63 \quad x = 6,$

$y = 5, \quad x = 0$ and $y = 0.$

Region represented by $x + y \geq 1$:

Putting $x = 0$ in $x + y = 1$, we get $y = 1$

Putting $y = 0$ in $x + y = 1$, we get $x = 1$

$\therefore$ The line $x + y = 1$ meets the coordinate axes at $(0,1)$ and $(1,0)$. join these point by a thick line.

Now, putting $x = 0$ and $y = 0$ in $x + y \geq 1$, we get $0 \geq 1$

This is not possible

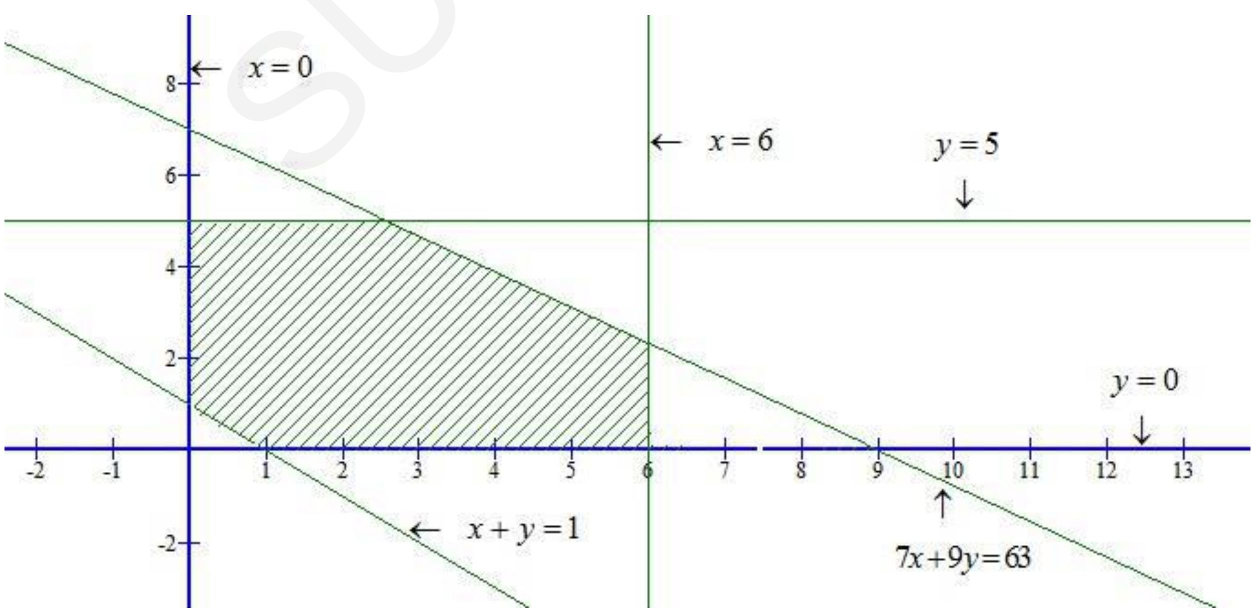
$\therefore$ $(0,0)$ is not satisfies the inequality $x + y \geq 1$. So, the portion not containing the origin is represented by the inequation $x + y \geq 1$.

Region represented by $7x + 9y \leq 63$:

Putting $x = 0$ in $7x + 9y = 63$, we get, $y = \frac{63}{9} = 7.$

Putting $y = 0$ in $7x + 9y = 63$, we get $x = \frac{63}{7} = 9.$

$\therefore$ The line $7x + 9y = 63$ meets the coordinete axes of $(0,7)$ and $(9,0)$. Join these points by a thick line.



SUPERCOP

Q1(v)

We have,

$2x + 3y \le 35, \quad y \ge 3, \quad x \ge 2, \quad x \ge 0$ and $y \ge 0$

Converting the inequations into equations, we get

$2x + 3y = 35, \quad y = 3, \quad x = 2, \quad x = 0$ and $y = 0$.

Region represented by $2x + 3y \le 35$:

Putting $x = 0$ in $2x + 3y = 35$, we get $y = \frac{35}{3}$

Putting $y = 0$ in $2x + 3y = 35$, we get $x = \frac{35}{2}$

$\therefore$ The line $2x + 3y = 35$ meets the coordinate axes at $\left(0, \frac{35}{3}\right)$ and $\left(\frac{35}{2}, 0\right)$. joining these point by a thick line.

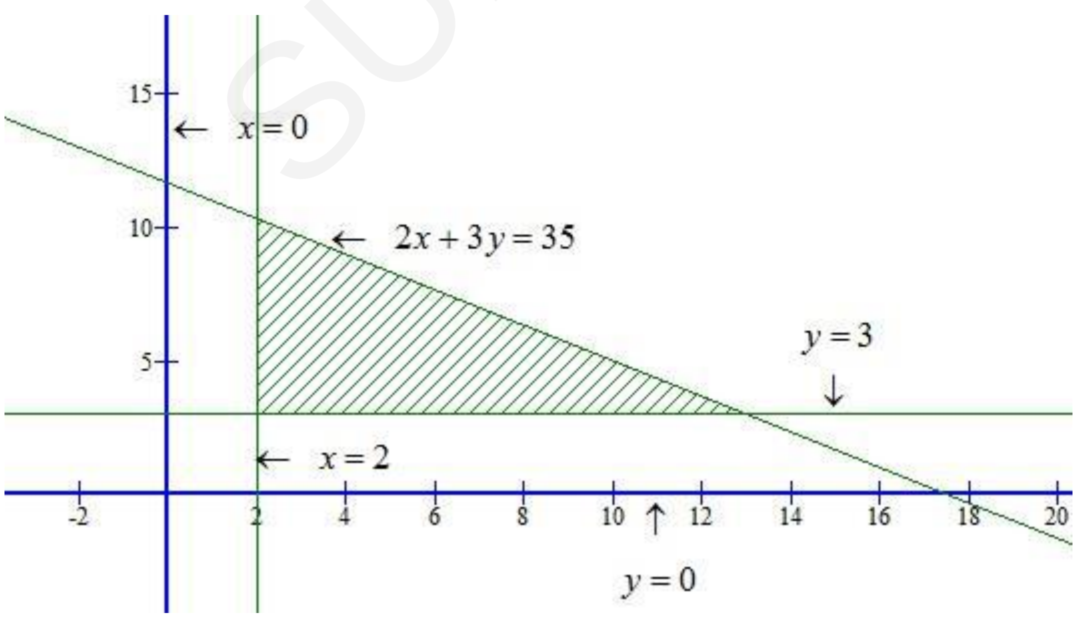
Now, putting $x = 0$ and $y = 0$ in $2x + 3y \le 35$, we get $0 \le 35$.
Clearly, $(0,0)$ satisfies the inequality $2x + 3y \le 35$. So, the portion containing the origin represents the solution $2x + 3y \le 35$.

Region represented by $y \ge 3$:
Clearly, $y = 3$ is a line parallel to x-axis at a distance 3 units from the origin. Since $(0,0)$ does not satisfies the inequation $y \ge 3$.
So, the portion not containing the origin is represented by the $y \ge 3$.

Region represented by $x \ge 2$:
Clearly, $x = 2$ is a line parallel to y-axis at a distance of 2 units from the origin. Since $(0,0)$ does not satisfies the inequation $x \ge 2$. so, the portion not containing the origin is represented by the given inequation.

Region represented by $x \ge 0$ and $y \ge 0$: clearly, $x \ge 0$ and $y \ge 0$ represent the first quadrant.

The common region of the above five regions represents the solution set of the given inequations as shown below.



SUPERCOP

Q2(i)

We have,

$x - 2y \geq 0, \quad 2x - y \leq -2, \quad x \geq 0$ and $y \geq 0$

Converting the inequations into equations, we get

$x - 2y = 0, \quad 2x - y = -2, \quad x = 0$ and $y = 0.$

Region represented by $x - 2y \geq 0$:
Putting $x = 0$ in $x - 2y = 0$, we get $y = 0$
Putting $y = 2$ in $x - 2y = 0$, we get $x = 4$

$\therefore$ The line $x - 2y = 0$ meets the coordinate axes at $(0,0)$. joining these point $(0,0)$ and $(4,2)$ by a thick line.

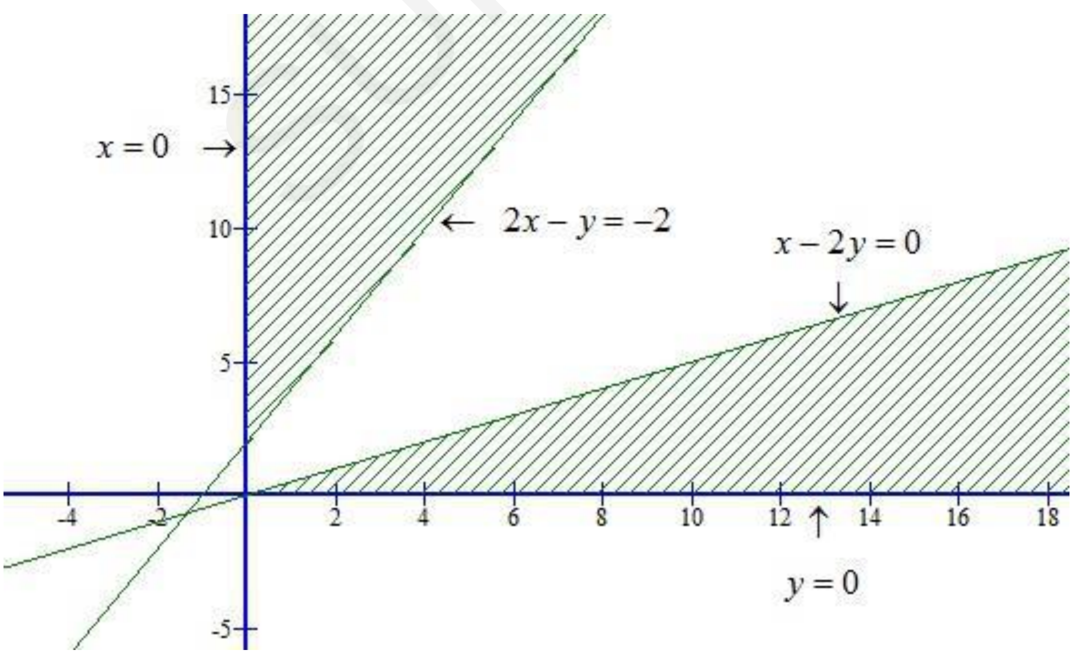
Now, putting $x = 0$ and $y = 0$ in $x - 2y \geq 0$, we get $0 \geq 0$.
Clearly, we find that $(0,0)$ satisfies the inequation $x - 2y \geq 0$. So, the portion containing the origin is represented by the given inequation.

Region represented by $2x - y \leq -2$:
Putting $x = 0$ in $2x - y = -2$, we get $y = 2$
Putting $y = 0$ in $2x - y = -2$, we get $x = \frac{-2}{2} = -1.$

$\therefore$ The line $2x - y = -2$ meets the coordinate axes of $(0,2)$ and $(-1,0)$. Joining these points by a thick line.

Now, putting $x = 0$ and $y = 0$ in $2x - y \leq -2$, we get $0 \leq -2$ This is not possible.
Since, $(0,0)$ does not satisfy the portion inequation $2 - y \leq -2$. So, the portion not containing the origin is represented by the inequation $2x - y \leq -2$.

Region represented by $x \geq 0$ and $y \geq 0$: Clearly, $x \geq 0$ and $y \geq 0$ represented the first quadrant.



Q2(ii)

We have,

$x + 2y \le 3, \quad 3x + 4y \ge 12, \quad y \ge 1, \quad x \ge 0$ and $y \ge 0$

Converting the inequations into equations, we get

$x + 2y = 3, \quad 3x + 4y = 12,$

$y = 1, \; x = 0$ and $y = 0.$

Region represented by $x + 2y \le 3$:

Putting $x = 0$ in $x + 2y = 3$, we get $y = \frac{3}{2}$

Putting $y = 0$ in $x + 2y = 3$, we get $x = 3$.

$\therefore$ The line $x + 2y = 3$ meets the coordinate axes at $\left(0, \frac{3}{2}\right)$ and $(3,0)$. join these point by a thick line.

Now, putting $x = 0$ and $y = 0$ in $x + 2y \ge 3$, we get $0 \ge 3$.
Clearly, $(0,0)$ satisfies the inequality $x + 2y \le 3$. So, the portion containing the origin represents the solution set of the inequation $x + 2y \le 3$.

Region represented by $3x + 4y \ge 12$:

Putting $x = 0$ in $3x + 4y = 12$, we get $y = \frac{12}{4} = 3$

Putting $y = 0$ in $3x + 4y = 12$, we get $x = \frac{12}{3} = 4$.

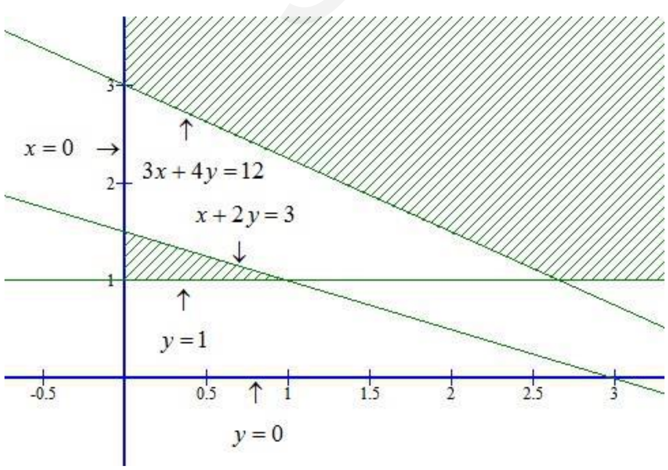
$\therefore$ The line $3x + 4y = 12$ meets the coordinate axes of $(0,3)$ and $(4,0)$. Join these points by a thick line.

Now, putting $x = 0$ and $y = 0$ in $3x + 4y \ge 12$, we get $0 \le 12$ This is not possible.
Since, $(0,0)$ does not satisfies the inequation $3x + 4y \ge 12$. So, the portion not containing the origin is represented by the inequation $3x + 4y \ge 12$.

Region represented by $y \ge 1$: Clearly, $y = 1$ is a line parallel to x-axis at a distance of 1 units from the origin. Since $(0,0)$ does not stisfies the inequation $y \ge 1$.

So, the portion not containing the origin is represented by the inequation.

Region represented by $x \ge 0$ and $y \ge 0$:
Clearly, $x \ge 0$ and $y \ge 0$ represent the first quadrant.



Q3

Consider the line $2x+3y=6$. we observe that the shaded region and the origin are on the opposite sides of the line $2x+3y=6$ and $(0,0)$ does not satisfy the inequation $2x+3y\geq 6$. So, we must have one inequations as $2x+3y\geq 6$

Consider the line $4x+6y=24$. we observe that the shaded region and the origin are on the same side of the line $4x+6y=24$ and $(0,0)$ satisfies the linear inequation $4x+6y\leq 24$.

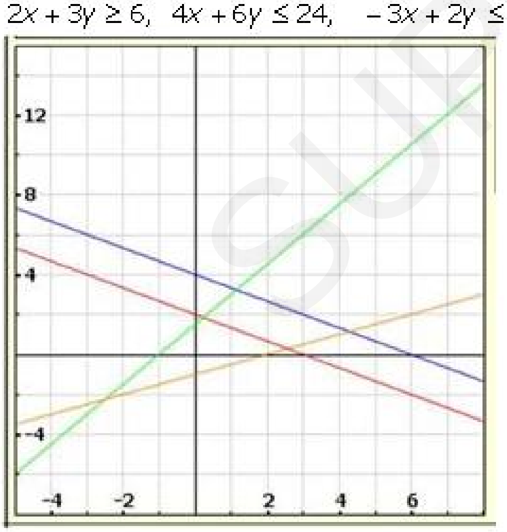
So, the second inequations is $4x+6y\leq 24$.

Consider the line $-3x+2y=3$.
We observe that the shaded region and the origin are on the same side of the line $-3x+2y=3$ and $(0,0)$ satisfies the linear inequation $-3x+2y\leq 3$. so, the third inequations is $-3x+2y\leq 3$.

Finaly,consider the line $x-2y=2$. we observe that the shaded region and the origin are on the same side of the line $x-2y=2$ and $(0,0)$ satisfies the linear inequation $x-2y\leq 2$. so, the forth inequations is $x-2y\leq 2$.

We also notice that the shaded region is above x-axis and is on the right side of y-axis. so, we must have $x\geq 0$ and $y\geq 0$.

Thus, the linear inequations corresponding to the given solution set are
$2x+3y\geq 6,\ \ 4x+6y\leq 24,\ \ -3x+2y\leq 3,\ \ x-2y\leq 2,\ \ x\geq 0,\ y\geq 0$.



Q4

Consider the line $x + y = 4$. we observe that the shaded region and the origin are on the same side of the line $x + y = 4$ and $(0,0)$ satisfies the linear inequation $x + y \leq 4$. So, we must have one inequations as $x + y \leq 4$

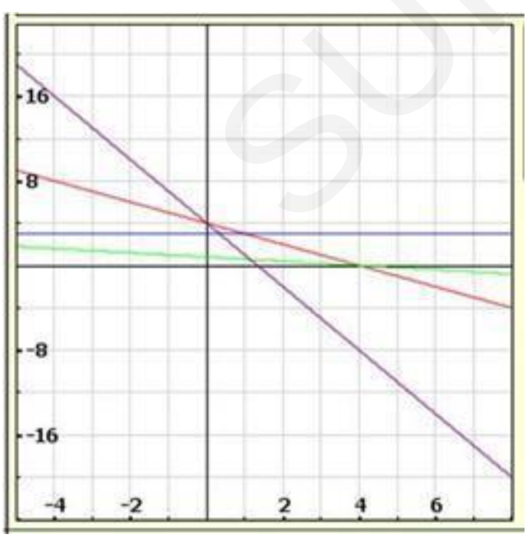
Consider the line $y = 3$. we observe that the shaded region and the origin are on the same side of the line $y = 3$ and $(0,0)$ satisfies the linear inequation $y \leq 3$. so, the second inequations is $y \leq 3$.

Consider the line $x = 3$.
We observe that the shaded region and the origin are on the same side of the line $x = 3$ and $(0,0)$ satisfies the linear inequation $x \leq 3$. so, the third inequations is $x \leq 3$.

Consider the line $x + 5y = 4$. we observe that the shaded region and the origin are on the opposite sides of the line $x + 5y = 4$ and $(0,0)$ does not satisfy the inequation $x + 5y \geq 4$. so, the fourth inequations is $x + 5y \geq 4$.

Finaly, consider the line $6x + 2y = 8$. we observe that the shaded region and the origin are on the opposite sides of the $6x + 2y = 8$ and $(0, 0)$ does not satisfy the inequation $6x + 2y = 8$. so the fifth inequations is $6x + 2y = 8$,
we also, notice that the shaded region is above x-axis and is on the right side of y-axis. so, we must have $x \geq 0$ and $y \geq 0$

Thus, the ilnear inequations corresponding to the given solution set are
$x + y \leq 4, \quad y \leq 3, \quad x \leq 3, \quad x + 5y \geq 4, \; 6x + 2y \geq 8, \; x \geq 0, \; y \geq 0.$



SUPERCOP

Q5

We have,
$x + y \leq 9,\ \ 3x + y \geq 12,\ x \geq 0$ and $y \geq 0$

Converting the inequations into equations, we get
$x + y = 9,\ \ 3x + y = 12,\ x = 0$ and $y = 0.$

Region represented by $x + y \geq 9$:
Putting $x = 0$ in $x + y = 9,$ we get $y = 9.$
Putting $y = 0$ in $x + y = 9,$ we get $x = 9.$

$\therefore$ The line $x + y = 9$ meets the coordinat axes at $(0,9)$ and $(9,0)$. Join these points by a thick line.

Now, putting $x = 0$ and $y = 0$ in $x + y \geq 9,$ we get $0 \geq 9$ This is not possible.
$\therefore$ We find that $(0,0)$ is not satisfies the inequation $x + y \geq 9.$
So, the portion not containing the origin is represented by the given inequation.

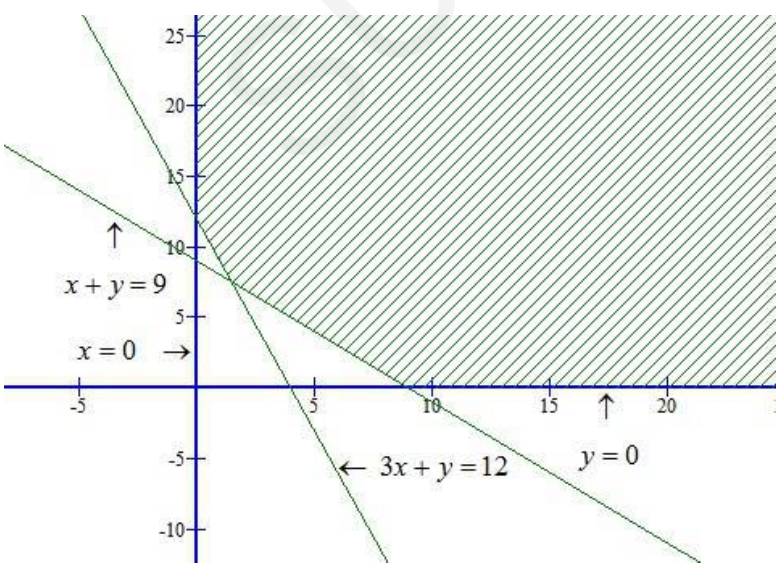
Region represented by $3x + y \geq 12$:
Putting $x = 0$ in $3x + y = 12,$ we get $y = 12$
Putting $y = 0$ in $3x + y = 12,$ we get $x = \frac{12}{3} = 4.$

$\therefore$ The line $3x + y = 12$ meets the coordinate axes at $(0,12)$ and $(4,0)$. Joining these points by a thick line.
Now, putting $x = 0$ and $y = 0$ in $3x + y \geq 12,$ we get, $0 \geq 12$

This is not possible.

$\therefore$ we find that $(0,0)$ is not satisfies the inequation $3x + y \geq 12.$ so the portion not containing the origin is represented by the given inequation.

Region represented by $x \geq 0$ and $y \geq 0$: clearly, $x \geq 0$ and $y \geq 0$ represent the first quadrant.



Q6(i)

We have,
$2x + y \geq 8$, $x + 2y \geq 8$, and $x + y \leq 6$

Converting the inequations into equations, we obtain,
$2x + y = 8$, $x + 2y = 8$, and $x + y = 6$

Region represented by $2x + y \geq 8$:
Putting $x = 0$ in $2x + y = 8$, we get $y = 8$.
Putting $y = 0$ in $2x + y = 8$, we get $x = \frac{8}{2} = 4$

$\therefore$ The line $2x + y = 8$ meets the coordinate axes at $(0,8)$ and $(4,0)$. Join these points by a thick line.

Now, putting $x = 0$ and $y = 0$ in $2x + y \geq 8$, we get $0 \geq 8$ This is not possible.
$\therefore$ We find that $(0,0)$ is not satisfies the inequation $2x + y \geq 8$.
So, the portion not containing the origin is represented by the given inequation.

Region represented by $x + 2y \geq 8$:
Putting $x = 0$ in $x + 2y = 8$, we get $y = \frac{8}{2} = 4$
Putting $y = 0$ in $x + 2y = 8$, we get $x = 8$.

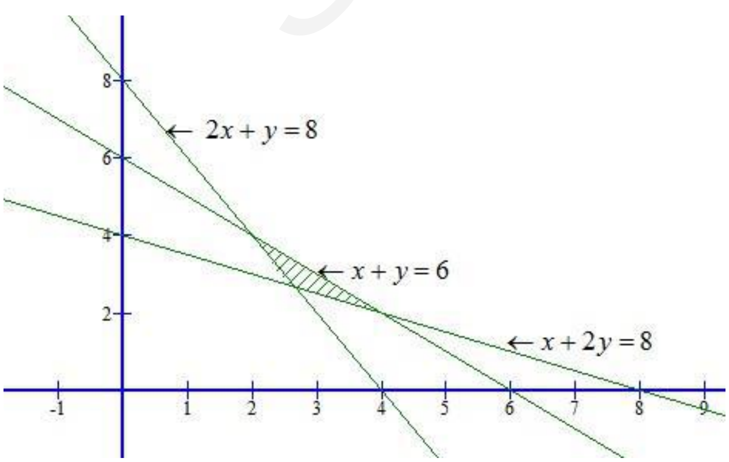
$\therefore$ The line $x + 2y = 8$ meets the coordinate axes at $(0,4)$ and $(8,0)$. Joining these points by a thick line.
Now, putting $x = 0$ and $y = 0$ in $x + 2y \geq 8$, we get, $0 \geq 8$, This is not possible.

$\therefore$ we find that $(0,0)$ is not satisfies the inequation $x + 2y \geq 8$. so the portion not containing the origin is represented by the given inequation.

Region represented by $x + y \leq 6$:
Putting $x = 0$ in $x + y = 6$, we get, $y = 6$.
Putting $y = 0$ in $x + y = 6$, we get, $x = 6$.

$\therefore$ The line $x + y = 6$ meets the coordinate axes at $(0,6)$ and $(6,0)$. Joining these points by a thick line.
Now, putting $x = 0$ and $y = 0$ in $x + y \leq 6$, we get $0 \leq 6$

Therefore, $(0,0)$ satisfies $x + y \leq 6$. so the portion containing the origin is represented by the given inequation. The common region of the above three regions represents the solution set of the given inequations as shown below:



SUPERCOP

Q6(ii)

We have,
$12x+12y \le 840$, $3x+6y \le 300$, $8x+4y \le 480$, $x \ge 0$ and $y \ge 0$

Converting the inequations into equations, we obtain,
$12x+12y = 840$, $3x+6y = 300$, $8x+4y = 480$, $x = 0$ and $y = 0$

Region represented by $12x+12y \le 840$:
Putting $x = 0$ in $12x+12y = 840$, we get $y = \frac{840}{12} = 70$
Putting $y = 0$ in $12x+12y \le 840$, we get $x = \frac{840}{12} = 70$

$\therefore$ The line $12x+12y = 840$, meets the coordinate axes at $(0,70)$ and $(70,0)$. Join these points by a thick line.

Now, putting $x = 0$ and $y = 0$ in $12x+12y \le 840$, we get $0 \le 840$

Therefore, $(0,0)$ satisfies the inequality $12x+12y \le 840$. so, the portion containing the origin represents the solution set of the inequation $12x+12y \le 840$
Region represented by $3x+6y \le 300$:
Putting $x = 0$ in $3x+6y \le 300$, we get $y = \frac{300}{6} = 50$
Putting $y = 0$ in $x = \frac{300}{3} = 100$.
$\therefore$ The line $3x+6y = 300$ meets the coordinate axes at $(0,50)$ and $(100,0)$. Joining these points by a thick line.

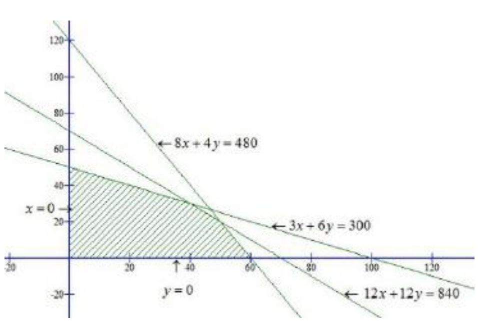
Now, putting $x = 0$ and $y = 0$ in $3x+6y \le 300$, we get, $0 \le 300$

Therefore $(0,0)$ satisfies the inequality $3x+6y \le 300$. so, the portion containing the origin represents the solution set of the inequation $3x+6y \le 300$.

Region represented by $8x+4y \le 480$:
Putting $x = 0$ in $8x+4y = 480$, we get, $y = \frac{480}{4} = 120$
Putting $y = 0$ in $8x+4y = 480$, we get, $y = \frac{480}{8} = 60$.
$\therefore$ The line $8x+4y = 480$ meets the coordinate axes at $(0,120)$ and $(60,0)$. Join these points by a thick line.
Now, putting $x = 0$ and $y = 0$ in $8x+4y = 480$, we get $0 \le 480$.
Therefore, $(0,0)$ satisfies the inequality $8x+4y \le 480$.

So, the portion containing the origin represents the solution set of the inequation $8x+4y \le 480$.
Region represented by $x \ge 0$ and $y \ge 0$: clearly, $x \ge 0$ and $y \ge 0$ represent the first quadrant.

The common region of the above five regions represents the solution set of the given inequations as shown below:



SUPERCOP

Q6(iii)

We have,
$x+2y \le 40,\ \ 3x+y \ge 30,\ \ 4x+3y \ge 60,\ \ x \ge 0$ and $y \ge 0$

Converting the inequations into equations, we obtain,
$x+2y = 40,\ \ 3x+y = 30,\ \ 4x+3y = 60,\ \ x = 0$ and $y = 0$

Region represented by $x+2y \le 40$:
Putting $x = 0$ in $x+2y = 40$, we get $y = \frac{40}{2} = 20$
Putting $y = 0$ in $x+2y = 40$, we get $x = 40$

$\therefore$ The line $x+2y = 40$, meets the coordinate axes at $(0,20)$ and $(40,0)$. Join these points by a thick line.

Now, putting $x = 0$ and $y = 0$ in $x+2y \le 40$, we get $0 \le 40$

Therefore, $(0,0)$ satisfies the inequality $x+2y \le 40$. so, the portion containing the origin represents the solution set of the inequation $x+2y \le 40$.
Region represented by $3x+y \ge 30$:
Putting $x = 0$ in $3x+y \le 30$, we get $y = 30$
Putting $y = 0$ in $3x+y = 30$, we get, $x = \frac{30}{3} = 10$
$\therefore$ The line $3x+y = 30$ meets the coordinate axes at $(0,30)$ and $(10,0)$. Joining these points by a thick line.

Now, putting $x = 0$ and $y = 0$ in $3x+y \ge 30$, we get, $0 \ge 30$. This is not possible.

Therefore $(0,0)$ does not satisfies the inequality $3x+y \ge 30$. so, the portion not containing the origin is represented by the inequation $3x+y \ge 30$.

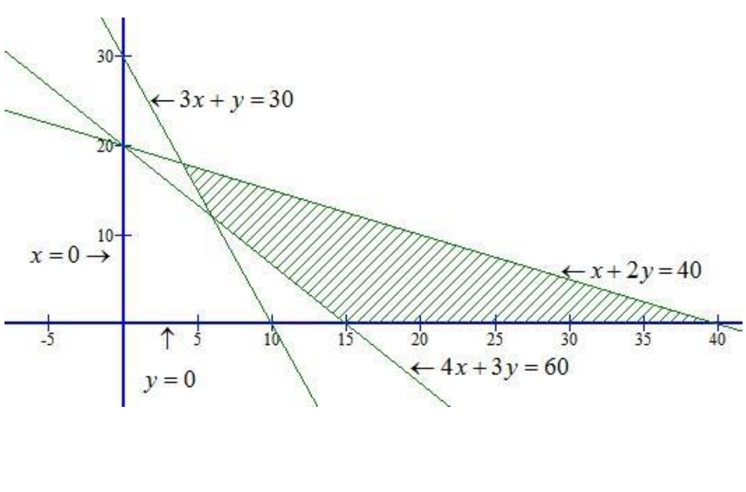
Region represented by $4x+3y \ge 60$:
Putting $x = 0$ in $4x+3y = 60$, we get, $y = \frac{60}{3} = 20$
Putting $y = 0$ in $4x+3y = 60$, we get, $x = \frac{60}{4} = 15$.
$\therefore$ The line $4x+3y = 60$ meets the coordinate axes at $(0,20)$ and $(15,0)$. Join these points by a thick line.

Now, putting $x = 0$, $y = 0$ in $4x+3y \ge 60$, we get $0 \ge 60$.

This is not possible. Therefore, $(0,0)$ does not satisfies the inequality $4x+3y \ge 60$. so, the portion not containing the origin is represented by the inequation $4x+3y \ge 60$.

Region represented by $x \ge 0$ and $y \ge 0$:
Clearly, $x \ge 0$ and $y \ge 0$ represent the first quadrant.

The common region of the above five regions represents the solution set of the given inequations as shown below:



SUPERCOP

Q6(iv)

We have,
$5x+y\geq 10,\ \ 2x+2y\geq 12,\ \ x+4y\geq 12,\ \ x\geq 0$ and $y\geq 0$

Converting the inequations into equations, we obtain,
$5x+y=10,\ \ 2x+2y=1,\ \ x+4y=12,\ \ x=0$ and $y=0$

Region represented by $5x+y\geq 10$:
Putting $x=0$ in $5x+y=10$, we get $y=10$
Putting $y=0$ in $5x+y=10$, we get $x=\frac{10}{5}=2$

$\therefore$ The line $5x+y=10$, meets the coordinate axes at $(0,10)$ and $(2,0)$. Join these points by a thick line.

Now, putting $x=0$ and $y=0$ in $5x+y\geq 10$, we get $0\geq 10$, This is not possible.

$\therefore$ $(0,0)$ does not satisfies the inequality $5x+y\geq 10$. so, the portion not containing the origin is represented by the inequation $5x+y\geq 10$.

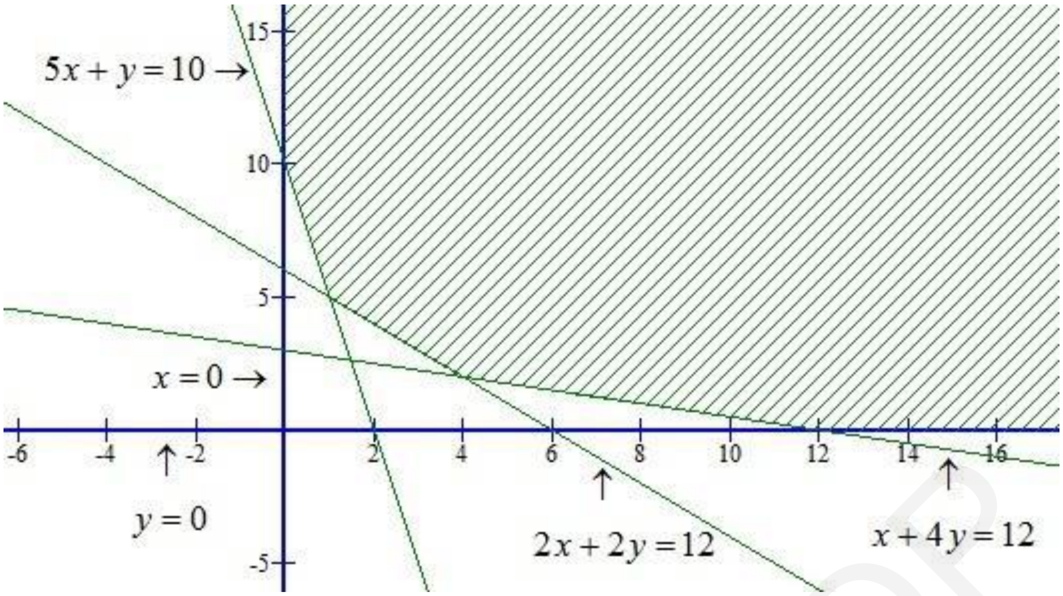
Region represented by $2x+2y\geq 12$:
Putting $x=0$ in $2x+2y=12$, we get $y=\frac{12}{2}=6$
Putting $y=0$ in $2x+2y=12$, we get $x=\frac{12}{2}=6$.
$\therefore$ The line $2x+2y=12$ meets the coordinate axes at $(0,6)$ and $(6,0)$. Join these point by a thick line.
Now, putting $x=0$ and $y=0$ in $2x+2y=12$, we get $0\geq 12$, which is not possible.
Therefore, $(0,0)$ does not satisfies the inequality $2x+2y=12$. so, the portion not containing the origin is represented by the inequation $2x+2y=12$.

Region represented by $x+4y\geq 12$:
Putting $x=0$ in $x+4y=12$, we get $y=\frac{12}{4}=3$.
Putting $y=0$ in $x+4y=12$, we get $x=12$.

$\therefore$ The line $x+4y=12$ meets the coordinate axes at $(0,3)$ and $(12,0)$. Join these points by a thick line.
Now, putting $x=0$ and $y=0$ in $x+4y=12$, we get $0\geq 12$, which is not possible.

Therefore, $(0,0)$ does not satisfies the inequality $x+4y\geq 12$. so, the portion not containing the origion is represented by the inequation $x+4y\geq 12$.

SUPERCOP



Q7

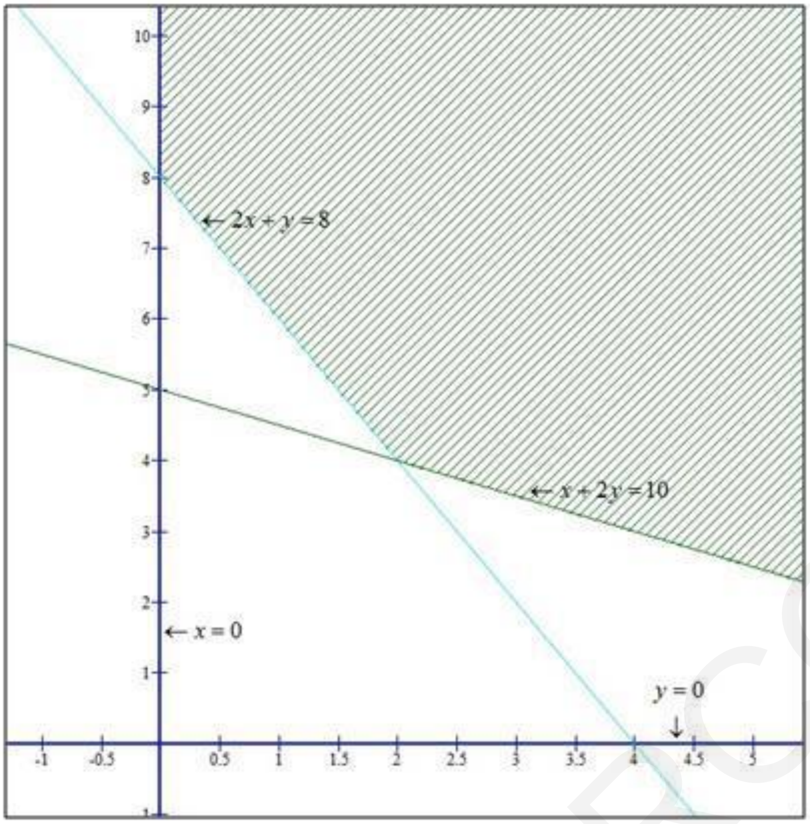
Converting the inequations into equations, we get
$x + 2y = 3, 3x + 4y = 12, x = 0, y = 1$.

Region represented by $x + 2y \le 3$:
The line $x + 2y = 3$ meets the co ordinate axes at (0, 3/2) and (3, 0). We find that (0, 0) satisfies inequation $x + 2y \le 3$ .So the portion containing origin represents the solution set of the inequation $x + 2y \le 3$.

Region represented by $3x + 4y \ge 12$:
The line $3x + 4y = 12$ meets the co ordinate axes at (0, 3) and (4, 0). We find that (0, 0) does not satisfy inequation $3x + 4y \ge 12$ .So the portion not containing the origin is represented by the inequation $3x + 4y \ge 12$.

Region represented by $x \ge 0$:
Clearly, $x \ge 0$ represents the region lying on the right side of y-axis.

Region represented by $y \ge 1$:
The line $y = 1$ is parallel to x-axis. (0, 0) does not satisfy inequation $y \ge 1$ .So the region lying above the line $y = 1$ is represented by $y \ge 1$.



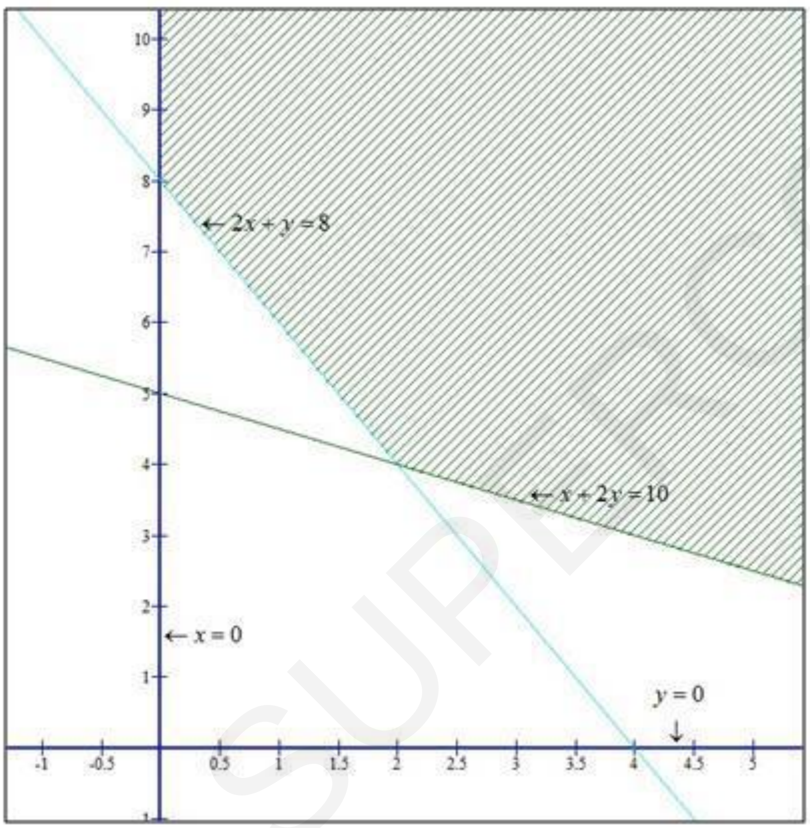
From graph we can see that the solution set satisfying the given inequalities is an unbounded region.

SUPERCOP

Q8

Converting the inequations into equations, we get
$2x + y = 8, x + 2y = 10, x = 0, y = 0$.

Region represented by $2x + y \geq 8$:
The line $2x + y = 8$ meets the co ordinate axes at
(0, 8) and (4, 0). We find that (0, 0) does not satisfy
inequation $2x + y \geq 8$. So the portion not containing the



From graph we can see that the solution set satisfying
the given inequalities is an unbounded region.