

Ex 15.1

Q1

Now, $12x < 50$

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

(i)

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

(ii)

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

(iii)

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

Q2

Now, $-4x > 30$

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

(i)

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

(ii)

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

(iii)

$$-4x > 30$$

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

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

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

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

Q3

Now,

$$4x - 2 < 8$$

$$\Rightarrow 4x < 8 + 2$$

$$\Rightarrow 4x < 10$$

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

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

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

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

Q4

$$3x - 7 > x + 1$$

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

$$\Rightarrow 2x > 8$$

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

$$\Rightarrow x > 4$$

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

Q5

$$x + 5 > 4x - 10$$

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

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

$$\Rightarrow 3x < 15$$

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

$$\Rightarrow x < 5$$

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

Q6

$$\begin{aligned}
& 3x + 9 \geq -x + 19 \\
\Rightarrow & 3x + x \geq 19 - 9 \\
\Rightarrow & 4x \geq 10 \\
\Rightarrow & x \geq \frac{10}{4} = \frac{5}{2}
\end{aligned}$$

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

Q7

$$\begin{aligned}
& 2(3 - x) \geq \frac{x}{5} + 4 \\
\Rightarrow & 6 - 2x \geq \frac{x}{5} + 4 \\
\Rightarrow & -2x - \frac{x}{5} \geq 4 - 6 \\
\Rightarrow & \frac{-11x}{5} \geq -2 \\
\Rightarrow & \frac{11x}{5} \leq 2 \\
\Rightarrow & x \leq \frac{10}{11}
\end{aligned}$$

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

Q8

$$\begin{aligned}
& \frac{3x - 2}{5} \leq \frac{4x - 3}{2} \\
\Rightarrow & \frac{3x}{5} - \frac{2}{5} \leq \frac{4x}{2} - \frac{3}{2} \\
\Rightarrow & \frac{3x}{5} - \frac{4x}{2} \leq \frac{-3}{2} + \frac{2}{5} \\
\Rightarrow & \frac{6x - 20x}{10} \leq \frac{-15 + 4}{10} \\
\Rightarrow & -14x \leq -11 \\
\Rightarrow & 14x \geq 11 \\
\Rightarrow & x \geq \frac{11}{14}
\end{aligned}$$

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

Q9

$$\begin{aligned}
& -(x - 3) + 4 < 5 - 2x \\
\Rightarrow & -x + 3 + 4 < 5 - 2x \\
\Rightarrow & -x + 7 < 5 - 2x \\
\Rightarrow & -x + 2x < 5 - 7 \\
\Rightarrow & x < -2 \\
& (-\infty, -2) \text{ is the solution set}
\end{aligned}$$

Q10

$$\begin{aligned}
& \frac{x}{5} < \frac{3x - 2}{4} - \frac{5x - 3}{5} \\
\Rightarrow & \frac{x}{5} < \frac{3x - 2}{4} - \frac{(5x - 3)}{5} \\
\Rightarrow & \frac{x}{5} < \frac{5(3x - 2) - 4(5x - 3)}{20} \\
\Rightarrow & x < \frac{15x - 10 - 20x + 12}{4} \\
\Rightarrow & 4x < -5x + 2 \\
\Rightarrow & 4x + 5x < 2 \\
\Rightarrow & 9x < 2 \\
\Rightarrow & x < \frac{2}{9}
\end{aligned}$$

$\therefore$ The solution set is $\left(-\infty, \frac{2}{9}\right)$

Q11

$$\begin{aligned}
& \frac{2(x - 1)}{5} \leq \frac{3(2 + x)}{7} \\
\Rightarrow & 7(2(x - 1)) \leq 5(3(2 + x)) \\
\Rightarrow & 14(x - 1) \leq 15(2 + x) \\
\Rightarrow & 14x - 14 \leq 30 + 15x \\
\Rightarrow & 14x - 15x \leq 30 + 14 \\
\Rightarrow & -x \leq 44 \\
\Rightarrow & x \geq -44
\end{aligned}$$

$\therefore$ The solution set is $[-44, \infty)$

Q12

$$\begin{aligned}
& \frac{5x}{2} + \frac{3x}{4} \geq \frac{39}{4} \\
\Rightarrow & \frac{10x + 3x}{4} \geq \frac{39}{4} \\
\Rightarrow & 13x \geq 39 \\
\Rightarrow & x \geq \frac{39}{13} = 3 \\
\Rightarrow & x \geq 3
\end{aligned}$$

∴ The solution set is $[3, \infty)$

Q13

$$\begin{aligned}
& \frac{x-1}{3} + 4 < \frac{x-5}{5} - 2 \\
& \frac{x-1+12}{3} < \frac{x-5-10}{5} \\
& 5(x-1+12) < 3(x-5-10) \\
& 5(x+11) < 3(x-15) \\
& 5x+55 < 3x-45 \\
& 5x-3x < -45-55 \\
& 2x < -100 \\
& x < -50
\end{aligned}$$

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

Q14

$$\begin{aligned}
& \frac{2x+3}{4} - 3 < \frac{x-4}{3} - 2 \\
& \frac{2x+3-12}{4} < \frac{x-4-6}{3} \\
& 3(2x+3-12) < 4(x-4-6) \\
& 3(2x-9) < 4(x-10) \\
& 6x-27 < 4x-40 \\
& 6x-4x < -40+27 \\
& 2x < -13 \\
& x < -\frac{13}{2}
\end{aligned}$$

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

Q15

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

∴ The solution set is $(8, \infty)$

Q16

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

∴ The solution set is $[-26, \infty)$

Q17

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

∴ The solution set is $(-1, \infty)$

Q18

$$\begin{aligned}x - 2 &\leq \frac{5x + 8}{3} \\3(x - 2) &\leq 5x + 8 \\3x - 6 &\leq 5x + 8 \\3x - 5x &\leq 8 + 6 \\-2x &\leq 14 \\2x &\geq -14 \\x &\geq -7\end{aligned}$$

∴ The solution set is $[-7, \infty)$

Q19

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

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

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

This is not possible.

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

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

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

Q20

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

$$\text{Case 1: } 2x-3 > 0 \quad \text{and} \quad 3x-7 > 0$$

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

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

$$\text{Case 2: } 2x-3 < 0 \quad \text{and} \quad 3x-7 < 0$$

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

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

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

Q21

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

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

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

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

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

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

$$\text{Case 1: } x-5 > 0 \quad \text{and} \quad x-2 > 0$$

$$\Rightarrow x > 5 \quad \text{and} \quad x > 2$$

$$\Rightarrow x > 5$$

$$\text{Case 2: } x-5 < 0 \quad \text{and} \quad x-2 < 0$$

$$\Rightarrow x < 5 \quad \text{and} \quad x < 2$$

$$\Rightarrow x < 2$$

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

Q22

$$\begin{aligned}\frac{1}{x-1} &\leq 2 \\ \frac{1}{x-1} - 2 &\leq 0 \\ \frac{1-2(x-1)}{x-1} &\leq 0 \\ \frac{1-2x+2}{x-1} &\leq 0 \\ \frac{3-2x}{x-1} &\leq 0\end{aligned}$$

Case 1: $3-2x \geq 0$ *and* $x-1 < 0$

$$\begin{aligned}\Rightarrow x &\leq \frac{3}{2} && \text{and} && x < 1 \\ \Rightarrow x &< 1\end{aligned}$$

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

$$\begin{aligned}\Rightarrow x &\geq \frac{3}{2} && \text{and} && x > 1 \\ \Rightarrow x &\geq \frac{3}{2}\end{aligned}$$

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

Q23

$$\begin{aligned}\frac{4x+3}{2x-5} &< 6 \\ \frac{4x+3}{2x-5} - 6 &< 0 \\ \frac{4x+3-6(2x-5)}{2x-5} &< 0 \\ \frac{4x+3-12x+30}{2x-5} &< 0 \\ \frac{-8x+33}{2x-5} &< 0 \\ \frac{8x-33}{2x-5} &> 0\end{aligned}$$

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

$$\begin{aligned}\Rightarrow x &> \frac{33}{8} && \text{and} && x > \frac{5}{2} \\ \Rightarrow x &> \frac{33}{8}\end{aligned}$$

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

$$\begin{aligned}\Rightarrow x &< \frac{33}{8} && \text{and} && x < \frac{5}{2} \\ \Rightarrow x &< \frac{5}{2}\end{aligned}$$

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

Q24

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

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

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

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

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

$$\begin{aligned} \text{Case 1: } 4x - 12 > 0 \quad \text{and} \quad x + 6 < 0 \\ \Rightarrow x > 3 \quad \text{and} \quad x < -6 \end{aligned}$$

This is not possible.

$$\begin{aligned} \text{Case 2: } 4x - 12 < 0 \quad \text{and} \quad x + 6 > 0 \\ \Rightarrow x < 3 \quad \text{and} \quad x > -6 \end{aligned}$$

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

Q25

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

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

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

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

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

$$\begin{aligned} \text{Case 1: } 7x > 0 \quad \text{and} \quad 4 - x < 0 \\ \Rightarrow x > 0 \quad \text{and} \quad 4 < x \end{aligned}$$

$$\Rightarrow 4 < x$$

$$\begin{aligned} \text{Case 2: } 7x < 0 \quad \text{and} \quad 4 - x > 0 \\ \Rightarrow x < 0 \quad \text{and} \quad 4 > x \\ \Rightarrow x < 0 \end{aligned}$$

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

Q26

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

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

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

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

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

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

$$\begin{array}{ll} \text{Case 1: } x+7 > 0 & \text{and } x+3 < 0 \\ \Rightarrow x > -7 & \text{and } x < -3 \end{array}$$

$$\begin{array}{ll} \text{Case 2: } x+7 < 0 & \text{and } x+3 > 0 \\ \Rightarrow x < -7 & \text{and } x > -3 \end{array}$$

This is not possible.

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

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 $8x+3 < 0$

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

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

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

This is not possible

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

Q28

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

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

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

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

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

$$\begin{aligned} \text{Case 1: } x+5 > 0 \quad \text{and} \quad 2x-10 > 0 \\ \Rightarrow x > -5 \quad \text{and} \quad x > 5 \\ \Rightarrow \quad x > 5 \end{aligned}$$

$$\begin{aligned} \text{Case 2: } x+5 < 0 \quad \text{and} \quad 2x-10 < 0 \\ \Rightarrow x < -5 \quad \text{and} \quad x < 5 \\ \Rightarrow \quad x < -5 \end{aligned}$$

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

Ex 15.2

Q1

Consider the first inequation,

$$x + 3 > 0$$

$$x > -3 \quad \dots (i)$$

Consider the second inequation,

$$2x < 14$$

$$x < \frac{14}{2} = 7$$

$$x < 7 \quad \dots (ii)$$

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

Q2

Consider the first inequation,

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

$$\Rightarrow 2x + x > 5 + 7$$

$$\Rightarrow 3x > 12$$

$$\Rightarrow x > \frac{12}{3}$$

$$\Rightarrow x > 4 \quad \dots (i)$$

Consider the second inequation,

$$11 - 5x \leq 1$$

$$\Rightarrow -5x \leq 1 - 11$$

$$\Rightarrow -5x \leq -10$$

$$\Rightarrow 5x \geq 10$$

$$\Rightarrow x \geq 2 \quad \dots (ii)$$

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

Q3

Consider the first inequation,

$$\begin{aligned}x - 2 &> 0 \\x &> 2 \quad \dots (i)\end{aligned}$$

Consider the second inequation,

$$\begin{aligned}3x &< 18 \\x &< 6 \quad \dots (ii)\end{aligned}$$

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

Q4

Consider the first inequation,

$$\begin{aligned}2x + 6 &\geq 0 \\2x &\geq -6 \\x &\geq \frac{-6}{2} \\x &\geq -3 \quad \dots (i)\end{aligned}$$

Consider the second inequation,

$$\begin{aligned}4x - 7 &< 0 \\4x &< 7 \\x &< \frac{7}{4} \quad \dots (ii)\end{aligned}$$

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

Q5

Consider the first inequation,

$$\begin{aligned}3x - 6 &> 0 \\3x &> 6 \\x &> 2 \quad \dots (i)\end{aligned}$$

Consider the second inequation,

$$\begin{aligned}2x - 5 &> 0 \\2x &> 5 \\x &> \frac{5}{2} \quad \dots (ii)\end{aligned}$$

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

Q6

Consider the first inequation,

$$\begin{aligned}2x - 3 &< 7 \\2x &< 7 + 3 \\2x &< 10 \\x &< 5 \quad \dots (i)\end{aligned}$$

Consider the second inequation,

$$\begin{aligned}2x &> -4 \\x &> \frac{-4}{2} \\x &> -2 \quad \dots (ii)\end{aligned}$$

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

Q7

Consider the first inequation,

$$\begin{aligned}2x + 5 &\leq 0 \\2x &\leq -5 \\x &\leq \frac{-5}{2} \quad \dots (i)\end{aligned}$$

Consider the second inequation,

$$\begin{aligned}x - 3 &\leq 0 \\x &\leq 3 \quad \dots (ii)\end{aligned}$$

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

Q8

$$\begin{aligned}5x - 1 &< 24 \\5x &< 24 + 1 \\5x &< 25 \\x &< \frac{25}{5} \\x &< 5 \quad \dots (1)\end{aligned}$$

And

$$\begin{aligned}5x + 1 &> -24 \\5x &> -24 - 1 \\5x &> -25 \\x &> -5 \quad \dots (2)\end{aligned}$$

From equation (1) and (2),

$$-5 < x < 5$$

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



Q9

Consider the first inequation,

$$\begin{aligned}3x - 1 &\geq 5 \\3x &\geq 5 + 1 \\3x &\geq 6 \\x &\geq 2 \quad \dots (i)\end{aligned}$$

Consider the second inequation,

$$\begin{aligned}x + 2 &> -1 \\x &> -1 - 2 \\x &> -3 \quad \dots (ii)\end{aligned}$$

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

Q10

Consider the first inequation,

$$\begin{aligned}11 - 5x &> -4 \\-5x &> -4 - 11 \\-5x &> -15 \\5x &< 15 \\x &< 3 \quad \dots (i)\end{aligned}$$

Consider the second inequation,

$$\begin{aligned}4x + 13 &\leq -11 \\4x &\leq -11 - 13 \\4x &\leq -24 \\x &\leq -6 \quad \dots (ii)\end{aligned}$$

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

Q11

Consider the first inequation,

$$\begin{aligned}4x - 1 &\leq 0 \\4x &\geq -1 \\-5x &\leq -15 \\x &\leq \frac{1}{4} \quad \dots (i)\end{aligned}$$

Consider the second inequation,

$$\begin{aligned}3 - 4x &< 0 \\-4x &< -3 \\-x &< \frac{-3}{4} \\x &> \frac{3}{4} \quad \dots (ii)\end{aligned}$$

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

Q12

Consider the first inequation,

$$\begin{aligned}x + 5 &> 2(x + 1) \\x &> 2x + 2 - 5 \\x &> 2x - 3 \\x - 2 &> -3 \\-x &> -3 \\x &< 3 \quad \dots (i)\end{aligned}$$

Consider the second inequation,

$$\begin{aligned}2 - x &< 3(x + 2) \\2 - x &< 3x + 6 \\-x - 3x &< 6 - 2 \\-4x &< 4 \\x &> -1 \quad \dots (ii)\end{aligned}$$

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

Q13

Consider the first inequation,

$$\begin{aligned}2(x - 6) &< 3x - 7 \\\Rightarrow 2x - 12 &< 3x - 7 \\\Rightarrow -5 &< x \quad \dots (i)\end{aligned}$$

Consider the second inequation,

$$\begin{aligned}11 - 2x &< 6 - x \\-2x + x &< 6 - 11 \\-x &< -5 \\x &> 5 \quad \dots (ii)\end{aligned}$$

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

Q14

Consider the first inequation,

$$\begin{aligned}
 5x - 7 &< 3(x + 3) \\
 5x - 7 &< 3x + 9 \\
 5x - 3x &< 9 + 7 \\
 2x &< 16 \\
 x &< 8 \quad \dots (i)
 \end{aligned}$$

Consider the second inequation,

$$\begin{aligned}
 1 - \frac{3x}{2} &\geq x - 4 \\
 \frac{-3x}{2} - x &\geq -4 - 1 \\
 \frac{-3x - 2x}{2} &\geq -5 \\
 -5x &\geq -10 \\
 x &\leq 2 \quad \dots (ii)
 \end{aligned}$$

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

Q15

Consider the first inequation,

$$\begin{aligned}
 \frac{2x - 3}{4} - 2 &\geq \frac{4x}{3} - 6 \\
 \frac{2x - 3 - 8}{4} &\geq \frac{4x - 18}{3} \\
 3(2x - 11) &\geq 4(4x - 18) \\
 6x - 33 &\geq 16x - 72 \\
 6x - 16x &\geq -72 + 33 \\
 -10x &\geq -39 \\
 x &\leq \frac{39}{10} \quad \dots (i)
 \end{aligned}$$

Consider the second inequation,

$$\begin{aligned}
 2(2x + 3) &< 6(x - 2) + 10 \\
 4x + 6 &< 6x - 12 + 10 \\
 4x - 6x &< -12 - 6 + 10 \\
 -2x &< -8 \\
 x &> 8 \quad \dots (ii)
 \end{aligned}$$

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

Q16

Consider the first inequation,

$$\begin{aligned}\frac{7x-1}{2} &< -3 \\ 7x-1 &< -6 \\ 7x &< -6+1 \\ 7x &< -5 \\ x &< \frac{-5}{7} \quad \dots(i)\end{aligned}$$

Consider the second inequation,

$$\begin{aligned}\frac{3x+8}{5} + 11 &< 0 \\ \frac{3x+8+55}{5} &< 0 \\ \frac{3x+63}{5} &< \frac{0}{1} \\ 3x+63 &< 0 \\ 3x &< -63 \\ x &< -21 \quad \dots(ii)\end{aligned}$$

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

Q17

Consider the first inequation,

$$\begin{aligned}\frac{2x+1}{7x-1} &> 5 \\ \frac{2x+1}{7x-1} - 5 &> 0 \\ \frac{2x+1-5(7x-1)}{7x-1} &> 0 \\ 2x+1-35x+5 &> 0 \\ -33x+6 &> 0 \\ -33x &> -6 \\ x &< \frac{6}{33}, \quad x > \frac{1}{7} \quad \dots(i)\end{aligned}$$

Consider the second inequation,

$$\begin{aligned}\frac{x+7}{x-8} &> 2 \\ \frac{x+7}{x-8} - 2 &> 0 \\ \frac{x+7-2(x-8)}{x-8} &> 0 \\ \frac{x+7-2x+16}{x-8} &> 0 \\ x > 8, \quad x < 23 \quad \dots(ii)\end{aligned}$$

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

Q18

Consider the first inequation,

$$\begin{aligned}\frac{x}{2} &< 0 \\ x &< 0 \quad \dots (i)\end{aligned}$$

Consider the second inequation,

$$\begin{aligned}\frac{-x}{2} &< 3 \\ -x &< 6\end{aligned}$$

$$x > -6 \quad \dots (ii)$$

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

Q19

Consider the first inequation,

$$\begin{aligned}10 &\leq -5(x - 2) \\ 2 &\leq -(x - 2) \\ 2 &\leq -x + 2 \\ 2 - 2 &\leq -x \\ 0 &\leq -x \\ x &\leq 0 \quad \dots (i)\end{aligned}$$

Consider the second inequation,

$$\begin{aligned}-5(x - 2) &< 20 \\ -5x + 10 &< 20 \\ -5x &< 20 - 10 \\ -5x &< 10 \\ -x &< 2 \\ x &> -2 \quad \dots (ii)\end{aligned}$$

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

Q20

Consider the first inequation,

$$\begin{aligned}-5 &< 2x - 3 \\ 2x - 3 &> -5 \\ 2x &> -5 + 3 \\ 2x &> -2 \\ x &> -1 \quad \dots (i)\end{aligned}$$

Consider the second inequation,

$$\begin{aligned}2x - 3 &< 5 \\ 2x &< 5 + 3 \\ 2x &< 8 \\ x &< 4 \quad \dots (ii)\end{aligned}$$

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

Q21

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

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

Ex 15.3

Q1

Consider the first inequation,

$$x + \frac{1}{3} \geq 0$$

$$\therefore e. \quad x \geq \frac{-1}{3}.$$

$$\left| x + \frac{1}{3} - \frac{8}{3} > 0 \right|$$

$$x + \frac{1}{3} - \frac{8}{3} > 0$$

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

$$3x - 7 > 0$$

$$x > \frac{7}{3} \quad \dots (i)$$

Consider the second inequation,

$$x + \frac{1}{3} < 0 \quad \therefore e. \quad x < -\frac{1}{3}$$

$$\left| x + \frac{1}{3} - \frac{8}{3} > 0 \right|$$

$$-x - \frac{1}{3} - \frac{8}{3} > 0$$

$$-3x - 9 > 0$$

$$-3x > 9$$

$$3x < -9$$

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

$$x < -3 \quad \dots (ii)$$

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

Q2

We have,

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

$$\Rightarrow |4 - x| - 2 < 0 \quad \dots (i)$$

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

$$|4 - x| - 2 < 0$$

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

$$\Rightarrow 2 - x < 0$$

$$\Rightarrow -x < -2$$

$$\Rightarrow x > 2 \quad \dots (ii)$$

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

$$|4 - x| - 2 < 0$$

$$\Rightarrow -(4 - x) - 2 < 0$$

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

$$\Rightarrow x - 6 < 0$$

$$\Rightarrow x < 6 \quad \dots (iii)$$

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 $|3x - 4| \geq 0$

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

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

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

$$\Rightarrow \frac{6(3x - 4) - 5}{12} \leq 0$$

$$\Rightarrow 18x - 24 - 5 \leq 0$$

$$\Rightarrow 18x - 29 \leq 0$$

$$\Rightarrow 18x \leq 29$$

$$\Rightarrow x \leq \frac{29}{18} \quad \dots (ii)$$

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

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

Q4

We have,

$$\frac{|x-2|}{x-2} > 0 \quad \dots(i)$$

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

$$\begin{aligned} \Rightarrow \frac{x-2}{x-2} &\geq 0 \\ \Rightarrow x-2 &\geq 0 \\ \Rightarrow x &\geq 2 \quad \dots(ii) \end{aligned}$$

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

$$\begin{aligned} \Rightarrow -\frac{(x-2)}{x-2} &> 0 \\ \Rightarrow -(x-2) &> 0 \\ \Rightarrow -x+2 &< 0 \\ \Rightarrow -x &< -2 \\ \Rightarrow x &> 2 \quad \dots(iii) \end{aligned}$$

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

Q5

We have,

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

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

$$\begin{aligned} \Rightarrow \frac{1}{x-3} - \frac{1}{2} &< 0 \\ \Rightarrow \frac{2-(x-3)}{2(x-3)} &< 0 \\ \Rightarrow \frac{2-x+3}{2x-6} &< 0 \\ \Rightarrow \frac{-x+5}{2x-6} &< 0 \\ \Rightarrow -x+5 &< 0 \\ \Rightarrow -x &< -5 \\ \Rightarrow x &> 5 \quad \dots(ii) \end{aligned}$$

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

$$\begin{aligned} \Rightarrow \frac{1}{-x-3} - \frac{1}{2} &< 0 \\ \Rightarrow \frac{2-(-x-3)}{2(-x-3)} &< 0 \\ \Rightarrow 2+x+3 &< 0 \\ \Rightarrow x+5 &< 0 \\ \Rightarrow x &< -5 \quad \dots(iii) \end{aligned}$$

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

Q6

We have,

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

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

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

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

Case I: when $|x+2| \geq 0$
i.e, $x \geq -2$

$$\begin{aligned} \Rightarrow \quad & \frac{x+2-3x}{x} < 0 \\ \Rightarrow \quad & -2x+2 < 0 \\ \Rightarrow \quad & -2x < -2 \quad \text{and} \quad x > 0 \\ \Rightarrow \quad & x > 1 \quad \dots (ii) \end{aligned}$$

Case II: $|x+2| < 0$
i.e, $x < -2$

$$\begin{aligned} \Rightarrow \quad & -(x+2) - 3x < 0 \\ \Rightarrow \quad & -x-2-3x < 0 \\ \Rightarrow \quad & -4x-2 < 0 \\ \Rightarrow \quad & -4x < 2 \\ \Rightarrow \quad & x > \frac{-1}{2} \dots\dots\dots (iii) \\ \text{and} \quad & x < 0 \end{aligned}$$

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

Q7

We have,

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

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

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

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

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

$$2x \geq 1$$

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

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

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

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

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

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

$$2x < 1$$

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

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

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

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

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

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

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

Q8

We have,

$$|x - 1| + |x - 2| + |x - 3| - 6 \geq 0 \quad \dots (i)$$

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

$$x \geq 1$$

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

$$\Rightarrow -x + 4 - 6 \geq 0$$

$$\Rightarrow -x \geq 2$$

$$\Rightarrow x \leq -2$$

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

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

$$x \geq 2$$

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

$$x - 6 \geq 0$$

$$x \geq 6$$

$$\Rightarrow [6, \infty) \dots \dots \dots (iii)$$

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

$$x \geq 3$$

$$\Rightarrow x - 1 + x - 2 + x - 3 - 6 \geq 0$$

$$\Rightarrow 3x - 12 \geq 0$$

$$\Rightarrow 3x \geq 12$$

$$\Rightarrow x \geq 4$$

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

Q9

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

$$\text{Let } y = |x-2|$$

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

$$\Rightarrow 1 \leq y < 2$$

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

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

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

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

Q10

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

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

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

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

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

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

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

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

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

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

Q11

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

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

$$|x+1| = -(x+1) \text{ and } |x| = -x$$

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

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

$$\Rightarrow -2x>4$$

$$\Rightarrow x<-2$$

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

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

Q12

$$1 \leq |x-2| \leq 3$$

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

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

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

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 $\left(-\infty, -\frac{3}{2} \right]$

Ex 15.4

Q1

Let x be the smaller of the two consecutive odd positive integers. 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.

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

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.

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

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.

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

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

Q4

Suppose Rohit scores x marks in the third test then,

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

$$\Rightarrow 195 \leq 135 + x$$

$$\Rightarrow 195 - 135 \leq x$$

$$\Rightarrow 60 \leq x$$

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

Q5

We have,

$$F_1 = 86^\circ F$$

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

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

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

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

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

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

$$\Rightarrow C_1 = 5 \times 6 = 30^\circ C$$

$$\text{Now, } F_2 = 95^\circ F$$

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

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

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

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

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

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

$$\Rightarrow C_2 = 7 \times 5 = 35^\circ C$$

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

Q6

We have,

$$C_1 = 30^\circ\text{C}$$

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

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

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

$$\Rightarrow F_1 = 54 + 32$$

$$\Rightarrow F_1 = 86^\circ\text{F}$$

Now, $C_2 = 35^\circ\text{C}$

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

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

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

$$\Rightarrow F_2 = 63 + 32$$

$$\Rightarrow F_2 = 95^\circ\text{F}$$

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

Q7

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

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

$$\Rightarrow 90 \times 5 \leq 182 + 186 + x$$

$$\Rightarrow 450 \leq 368 + x$$

$$\Rightarrow 450 - 368 \leq x$$

$$\Rightarrow 82 \leq x$$

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

Q8

We have,

Profit = Revenue – Cost

Therefore, to earn some profit, we must have

Revenue > Cost

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

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

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

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

$$\Rightarrow x > 600$$

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 the longest side and third side of the triangle are $3x$ and $3x - 2$ respectively.

According to question,

perimeter of triangle ≥ 61

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

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

$$\Rightarrow 7x \geq 63$$

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

$$\Rightarrow x \geq 9$$

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

Q10

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

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

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

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

$$\Rightarrow 1125 + x < 45 \times 45$$

$$\Rightarrow 1125 + x < 2025$$

$$\Rightarrow x < 2025 - 1125$$

$$\Rightarrow x < 900$$

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

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

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

$$\Rightarrow \frac{3}{2} \times 1125 < 1125 + x$$

$$\Rightarrow 1.5 \times 1125 < 1125 + x$$

$$\Rightarrow 1687.5 < 1125 + x$$

$$\Rightarrow 1687.5 - 1125 < x$$

$$\Rightarrow 562.5 < x \dots\dots\dots (ii)$$

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

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

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 .

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

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

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

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

$$\Rightarrow 6.27 < x < 8.07$$

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

Ex 15.5

Q1

We have,

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

$$\Rightarrow x + y \leq 0$$

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

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

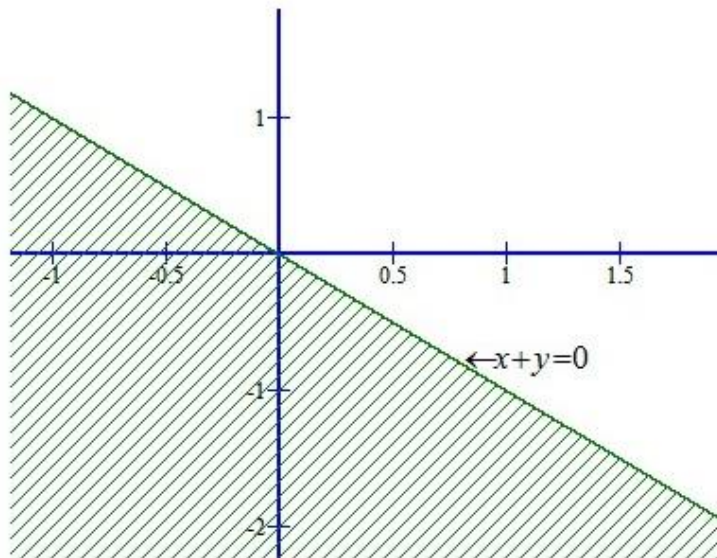
Putting $x = 0$, we get $y = 0$

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

We plot these points and join them by a thick line. This line divides 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 inequation 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 line divides the xy -plane in two parts.

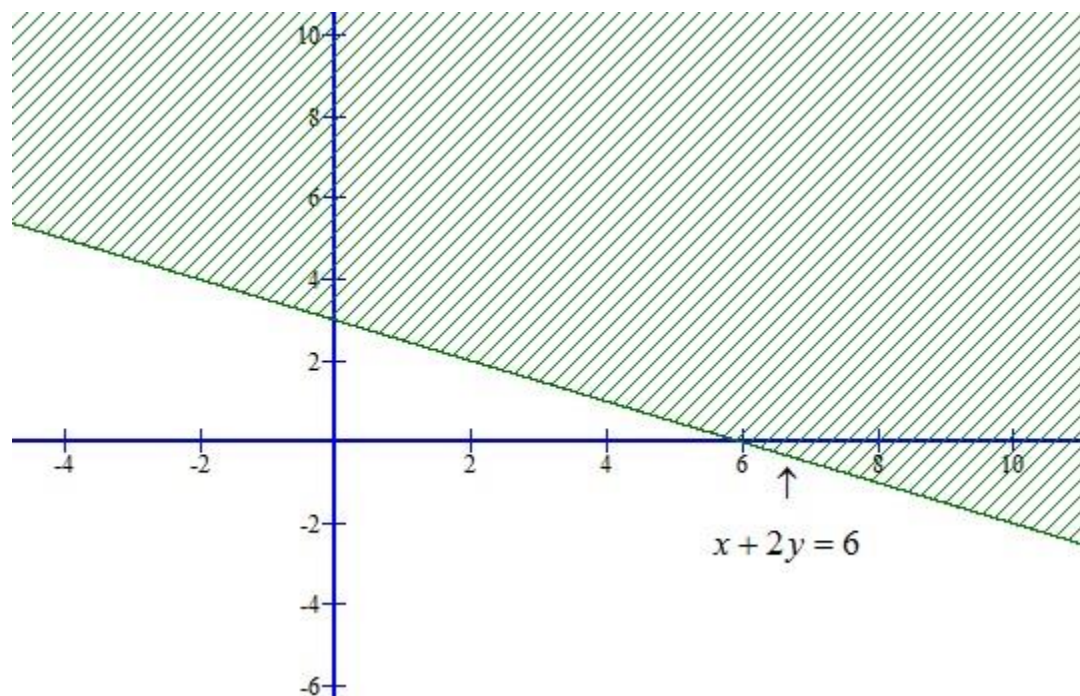
To determine the region represented by the given inequation consider the point $O(0,0)$.

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

It is not possible.

Clearly, $O(0,0)$ does not satisfy the inequation.

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



Q3

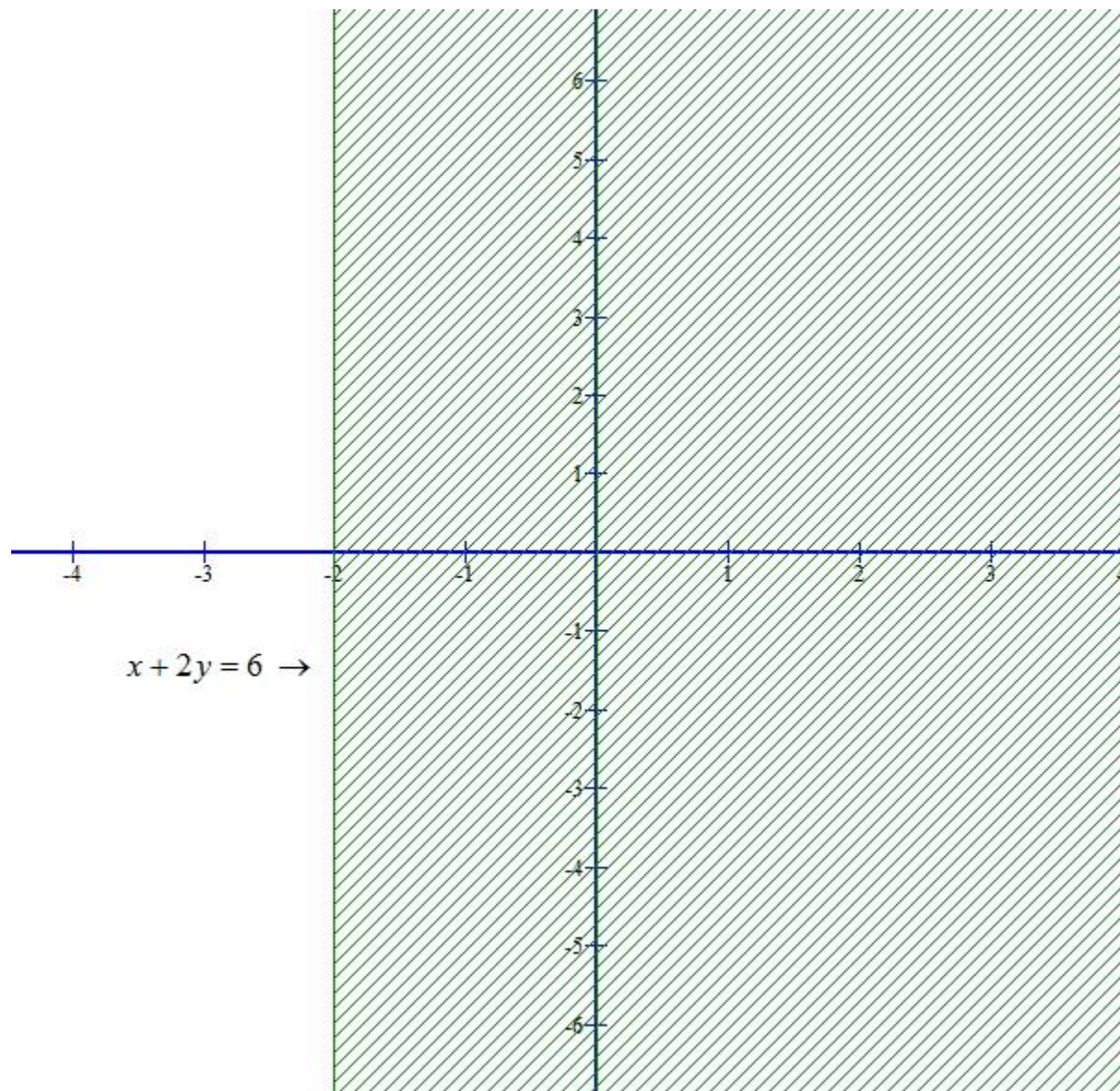
We have,

$$x + 2 \geq 0 \dots\dots\dots (i)$$

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 equation, we obtain,

$$x = 2y$$

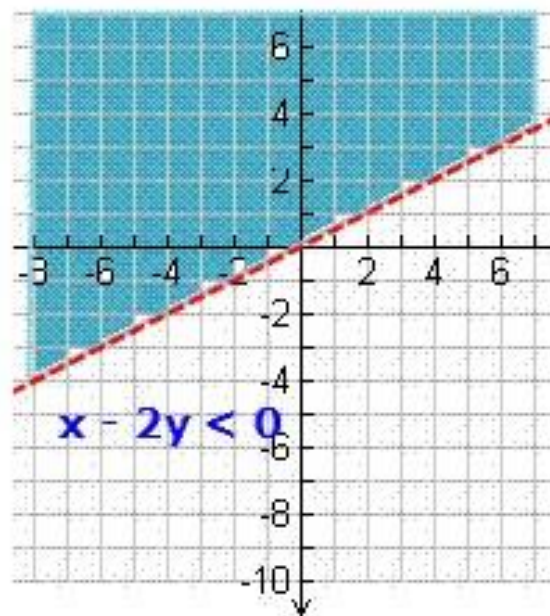
To determine the region represented by the given inequality consider the point $O(0,0)$

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

$$0 < 0$$

It is not possible. Clearly $O(0,0)$ does not satisfy the inequality.

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



Q5

We have,

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

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

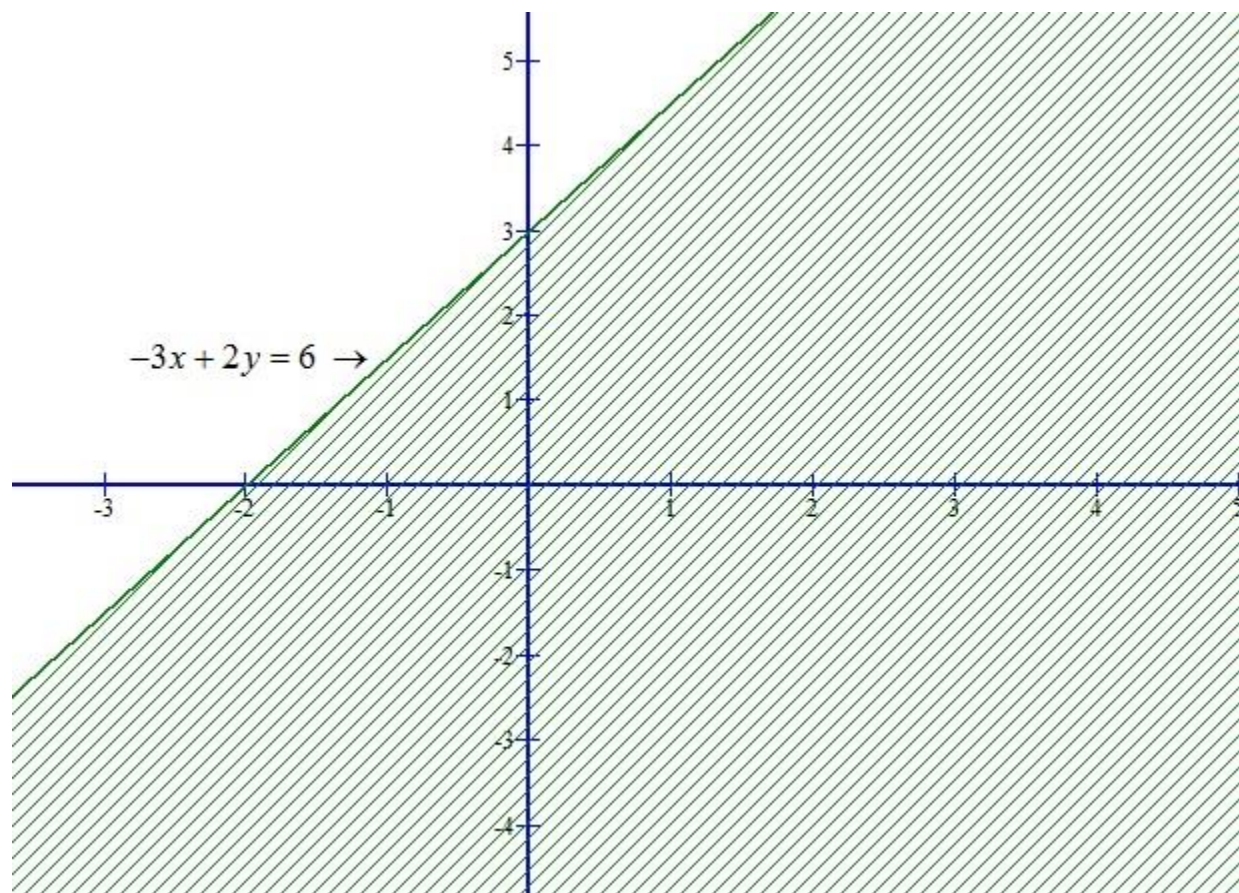
$$\text{Putting } x = 0, \text{ we get } y = \frac{6}{2} = 3$$

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

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 inequation, consider the point $O(0, 0)$.

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

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



Q6

We have,

$$x \leq 8 - 4y \dots\dots\dots (i)$$

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

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

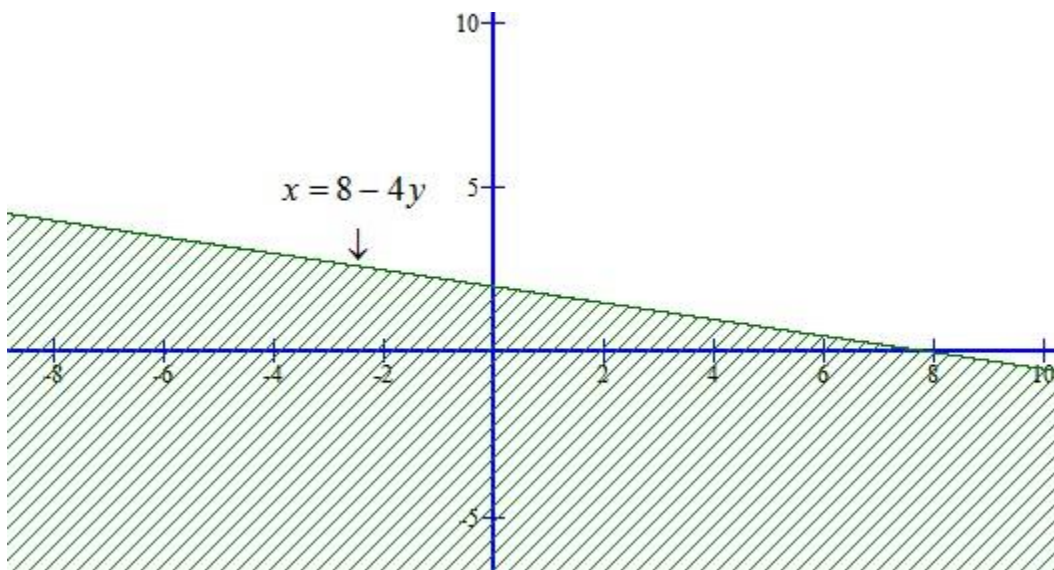
Putting $x = 0$, we get $y = \frac{8}{4} = 2$

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 $O(0,0)$.

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

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



Q7

We have,

$$0 \leq 2x - 5y + 10 \dots\dots\dots (i)$$

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

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

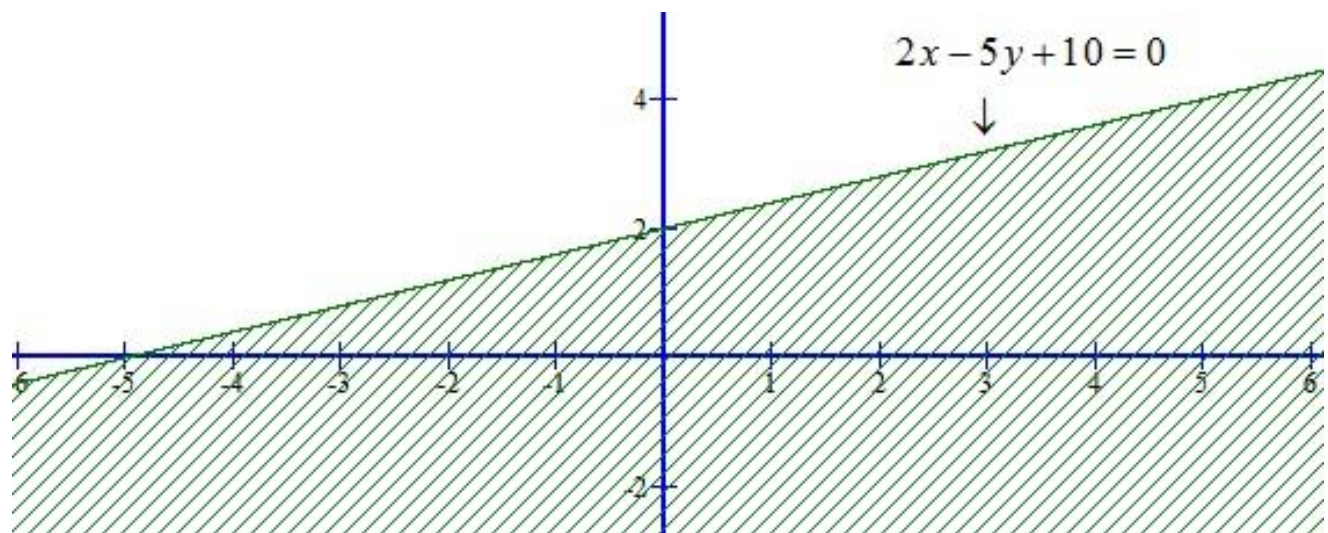
$$\text{Putting } y = 0, \text{ we get } x = \frac{-10}{2} = -5$$

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 inequation consider the point $O(0, 0)$.

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

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



Q8

We have,

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

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

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

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

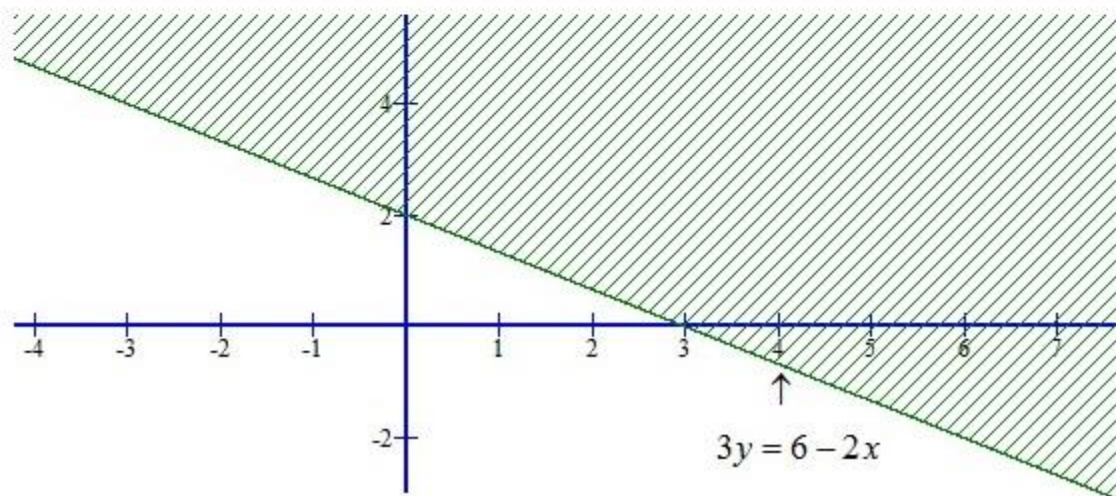
So, this line meets x-axis at $(3,0)$ and y-axis at $(0,2)$.

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 inequation 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,

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

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

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

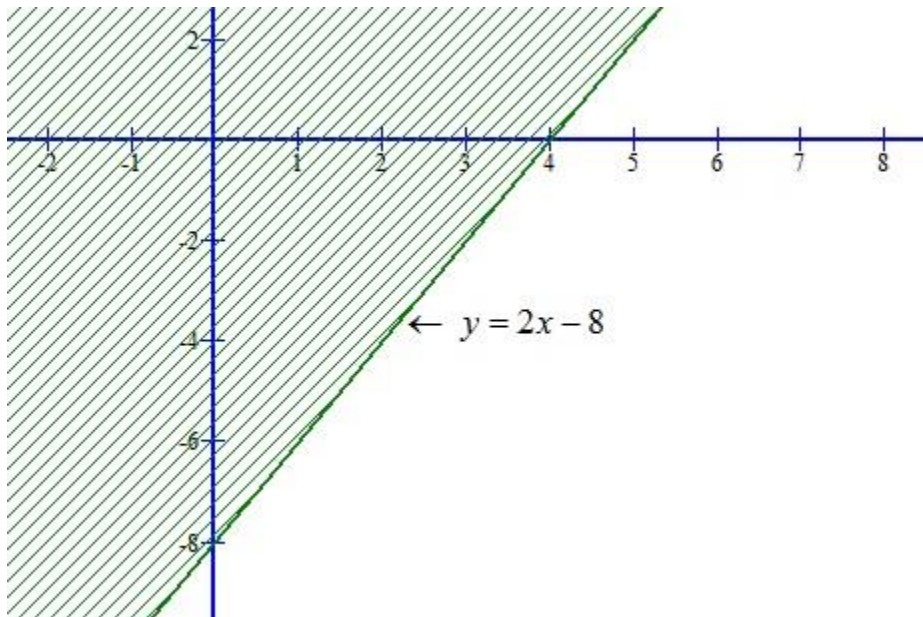
Putting $y = 0$, we get $x = \frac{8}{2} = 4$

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:



Q10

We have,

$$\begin{aligned} 3x - 2y &\leq x + y - 8 \\ \Rightarrow 3x - x &\leq y + 2y - 8 \\ \Rightarrow 2x &\leq 3y - 8 \dots\dots\dots (i) \end{aligned}$$

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

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

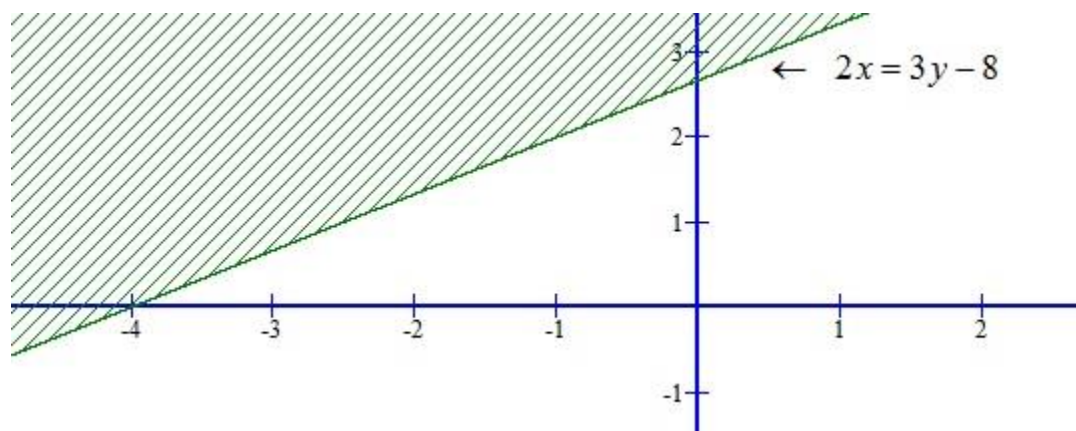
$$\text{Putting } x = 0, \text{ we get } y = \frac{8}{3}.$$

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

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 $0 \leq -8$ It is not possible.

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



Ex 15.6

Q1(i)

We have,

$$2x + 3y \leq 6, \quad 3x + 2y \leq 6, \quad x \geq 0, y \geq 0$$

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 $2x + 3y \leq 6$:

Putting $x = 0$ in equation $2x + 3y = 6$

$$\text{we get } y = \frac{6}{3} = 2.$$

Putting $y = 0$ in the equation $2x + 3y = 6$,

$$\text{we get } x = \frac{6}{2} = 3.$$

$\therefore$ 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 $2x + 3y \leq 6$.

Region represented by $3x + 2y \leq 6$:

Putting $x = 0$ in the equation

$$3x + 2y = 6, \text{ we get } y = \frac{6}{2} = 3.$$

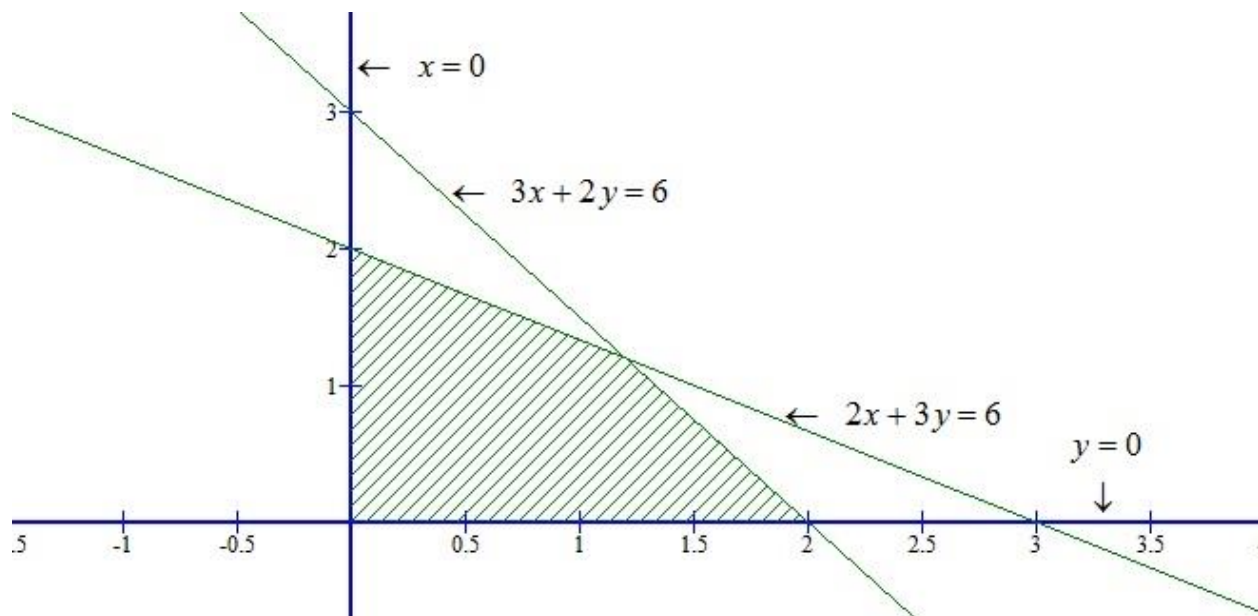
Putting $y = 0$ in the equation

$$3x + 2y = 6, \text{ we get } x = \frac{6}{3} = 2.$$

$\therefore$ 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 $3x + 2y \leq 6$.

Region represented by $x \geq 0$ and $y \geq 0$:

Clearly $x \geq 0$ and $y \geq 0$ represent the first quadrant.



Q1(ii)

We have,

$$2x + 3y \leq 6, \quad x + 4y \leq 4, \quad x \geq 0, y \geq 0$$

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

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

Region represented by $2x + 3y \leq 6$:

Putting $x = 0$ in $2x + 3y = 6$,

$$\text{we get } y = \frac{6}{3} = 2$$

Putting $y = 0$ in $2x + 3y = 6$,

$$\text{we get } x = \frac{6}{2} = 3.$$

$\therefore$ 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 $2x + 3y \leq 6 \Rightarrow 0 \leq 6$

Clearly, we find that $(0,0)$ satisfies inequation $2x + 3y \leq 6$

Region represented by $x + 4y \leq 4$

Putting $x = 0$ in $x + 4y = 4$

$$\text{we get, } y = \frac{4}{4} = 1$$

Putting $y = 0$ in $x + 4y = 4$,

$$\text{we get } x = 4$$

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

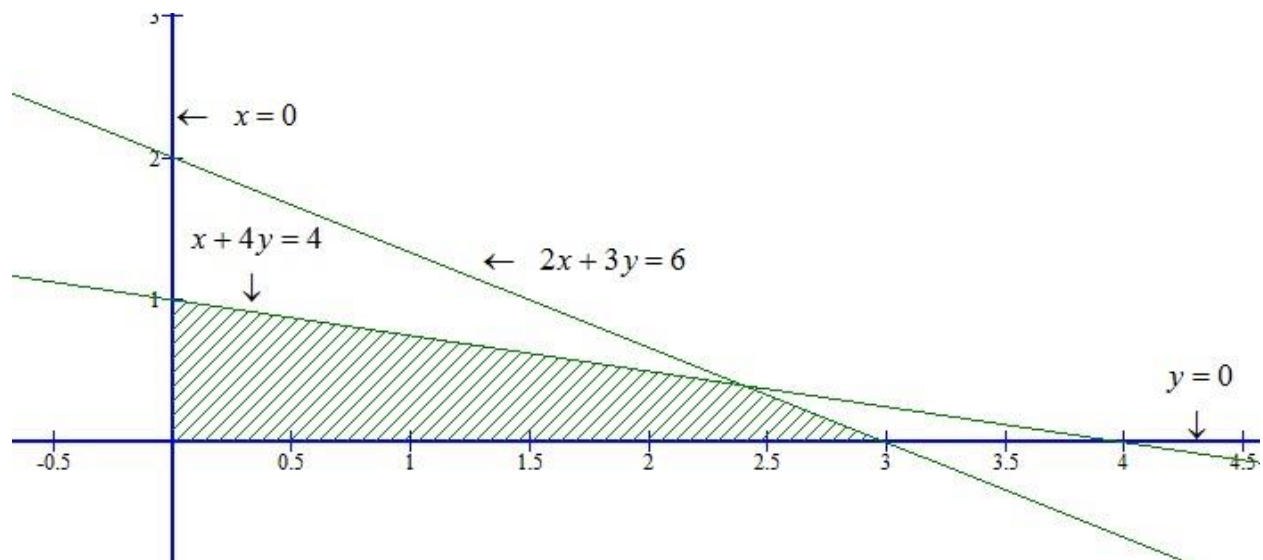
Now, putting $x = 0, y = 0$

in $x + 4y \leq 4$, we get $0 \leq 4$

Clearly, we find that $(0,0)$ satisfies inequation $x + 4y \leq 4$.

Region represented by $x \geq 0$ and $y \geq 0$:

Clearly $x \geq 0$ and $y \geq 0$ represent the first quadrant.



Q1(iii)

We have,

$$x - y \leq 1, \quad x + 2y \leq 8, \quad 2x + y \geq 2, \\ x \geq 0 \text{ and } y \geq 0$$

Converting the inequations into equations, we obtain

$$x - y = 1, \quad x + 2y = 8, \quad 2x + y = 2, \\ x = 0 \text{ and } y = 0.$$

Region represented by $x - y \leq 1$:

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 $x - y \leq 1$

in $x - y \leq 1$, we get, $0 \leq 1$

Clearly, we find that $(0, 0)$ satisfies inequation $x - y \leq 1$

Region represented by $x + 2y \leq 8$:

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 $x + 2y \leq 8$, we get $0 \leq 8$

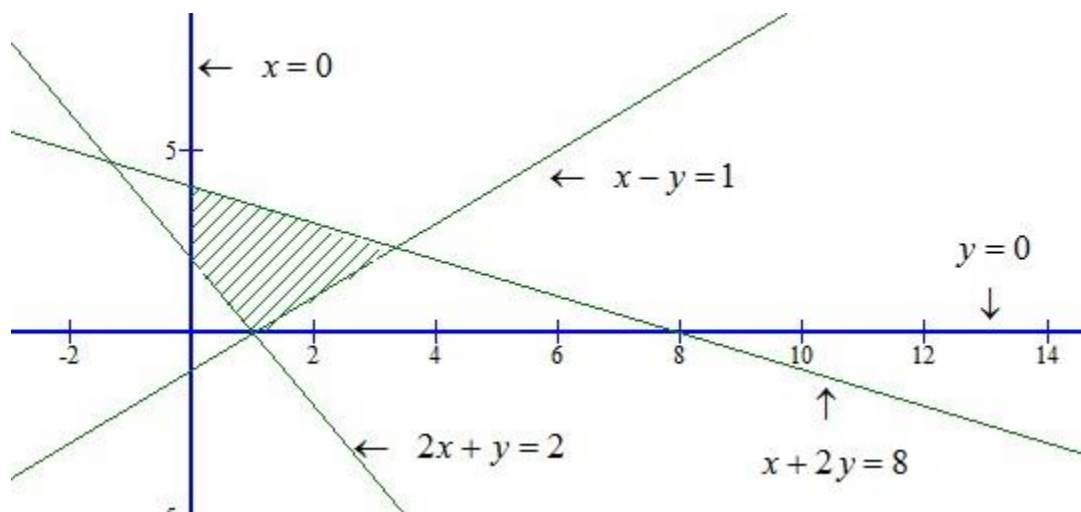
Clearly, we find that $(0, 0)$ satisfies inequation $x + 2y \leq 8$.

Region represented by $2x + y \geq 2$

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.



Q1(iv)

We have,

$$x + y \geq 1, \quad 7x + 9y \leq 63, \quad x \leq 6, \\ y \leq 5, \quad x \geq 0 \text{ and } y \geq 0$$

Converting the inequations into equations, we obtain

$$x + y = 1, \quad 7x + 9y = 63, \quad x = 6, \\ y = 5, \quad x = 0 \text{ and } y = 0.$$

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 points 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

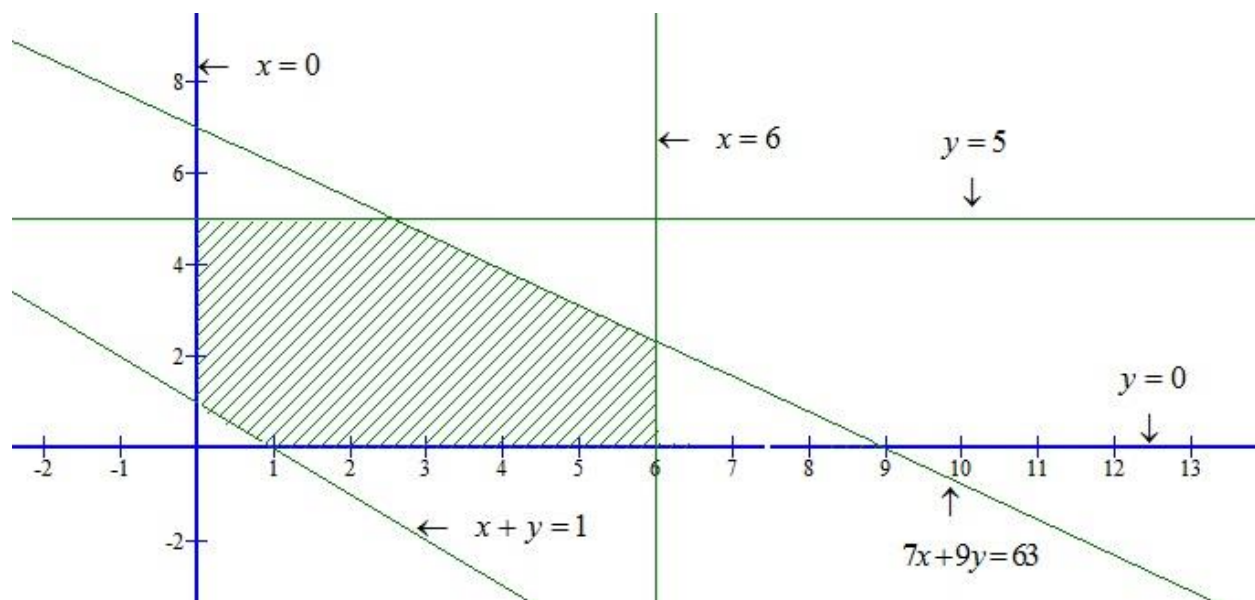
$\therefore (0,0)$ does not satisfy the inequality $x + y \geq 1$. So, the portion not containing the origin is represented by the inequality $x + y \geq 1$.

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 coordinate axes at $(0,7)$ and $(9,0)$. Join these points by a thick line.



Q1(v)

We have,

$$2x + 3y \leq 35, \quad y \geq 3, \quad x \geq 2, \quad x \geq 0 \text{ and } y \geq 0$$

Converting the inequations into equations, we get

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

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

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 $2x + 3y \leq 35$, we get $0 \leq 35$.

Clearly, $(0,0)$ satisfies the inequality $2x + 3y \leq 35$. So, the portion containing the origin represents the solution $2x + 3y \leq 35$.

Region represented by $y \geq 3$

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 $y \geq 3$.

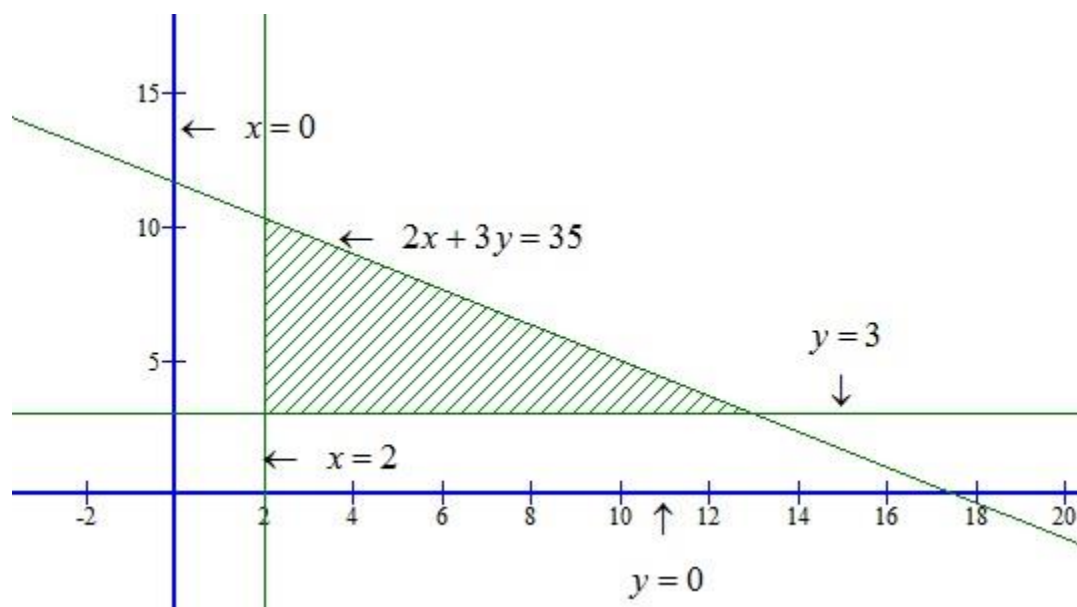
So, the portion not containing the origin is represented by the $y \geq 3$.

Region represented by $x \geq 2$

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 $x \geq 2$. 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.

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



Q2(i)

We have,

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

Converting the inequations into equations, we get

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

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 $y = 2$

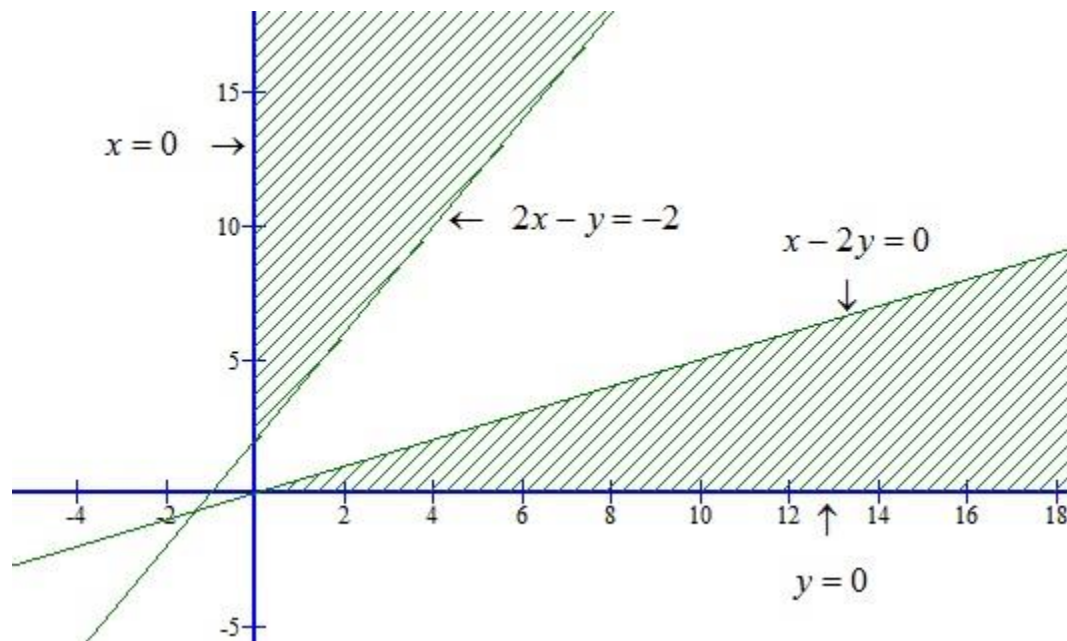
Putting $y = 0$ in $2x - y = -2$, we get $x = \frac{-2}{2} = -1$.

$\therefore$ 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 $2x - y \leq -2$. 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,

$$x + 2y \leq 3, \quad 3x + 4y \geq 12, \quad y \geq 1, \quad x \geq 0 \text{ and } y \geq 0$$

Converting the inequations into equations, we get

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

$$y = 1, \quad x = 0 \text{ and } y = 0.$$

Region represented by $x + 2y \leq 3$

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 $x + 2y \geq 3$, we get $0 \geq 3$.

Clearly, $(0, 0)$ satisfies the inequality $x + 2y \leq 3$. So, the portion containing the origin represents the solution set of the inequation $x + 2y \leq 3$.

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

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 $3x + 4y \geq 12$, we get $0 \geq 12$. This is not possible.

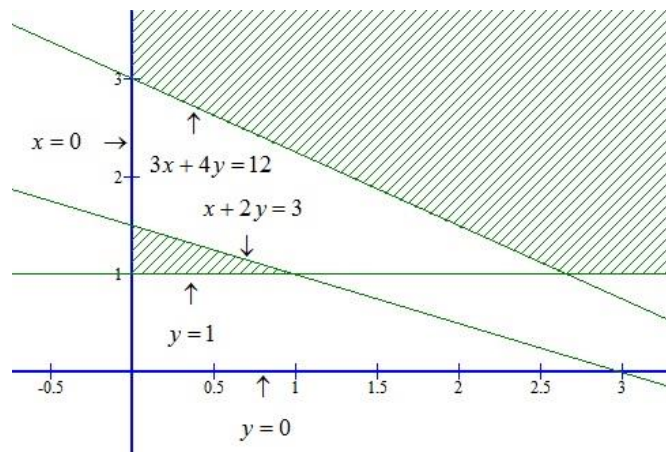
Since, $(0, 0)$ does not satisfy the inequation $3x + 4y \geq 12$. So, the portion not containing the origin is represented by the inequation $3x + 4y \geq 12$.

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

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

Region represented by $x \geq 0$ and $y \geq 0$

Clearly, $x \geq 0$ and $y \geq 0$ 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 $2x + 3y \leq 6$

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 $4x + 6y \leq 24$.

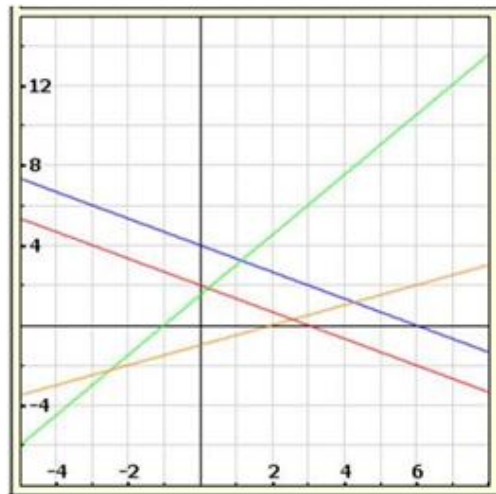
Consider the line $-3x + 2y = 3$.

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 $-3x + 2y \leq 3$.

Finally, 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 $x + 5y \geq 4$.

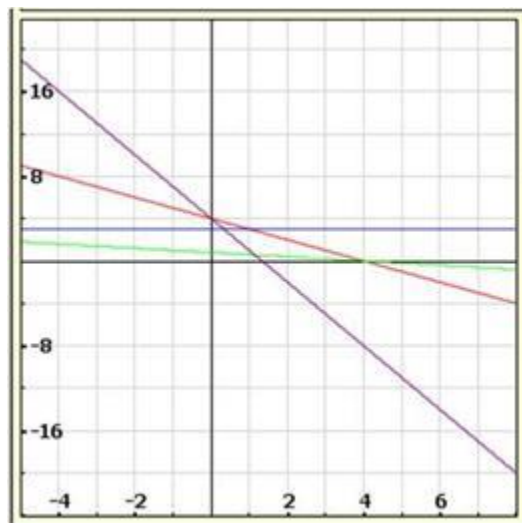
Finally, consider the line $6x + 2y = 8$. we observe that the shaded region and the origin are on the opposite sides of the $6x + 2y = 8$ and $(0,0)$ does not satisfy the inequation $6x + 2y = 8$.

so the fifth inequations is $6x + 2y \geq 8$,

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

$x + y \leq 4$, $y \leq 3$, $x \leq 3$, $x + 5y \geq 4$, $6x + 2y \geq 8$, $x \geq 0$, $y \geq 0$.



Q5

We have,

$$x + y \leq 9, \quad 3x + y \geq 12, \quad x \geq 0 \text{ and } y \geq 0$$

Converting the inequations into equations, we get

$$x + y = 9, \quad 3x + y = 12, \quad x = 0 \text{ and } y = 0.$$

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 coordinate 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 $x = \frac{12}{3} = 4$.

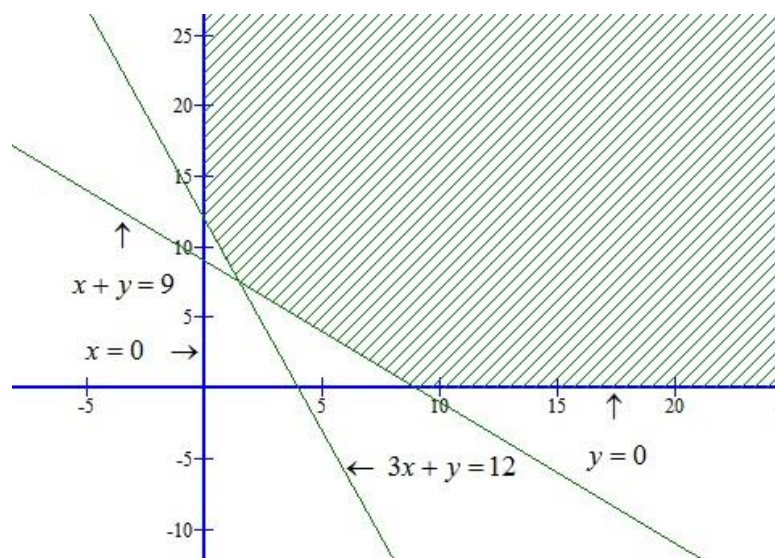
$\therefore$ The line $3x + y = 12$ meets the coordinate axes at $(0,12)$ and $(4,0)$. Joining these points by a thick line.

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,

$$2x + y \geq 8, \quad x + 2y \geq 8, \quad \text{and} \quad x + y \leq 6$$

Converting the inequations into equations, we obtain,

$$2x + y = 8, \quad x + 2y = 8, \quad \text{and} \quad x + y = 6$$

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 $x + y \leq 6$:

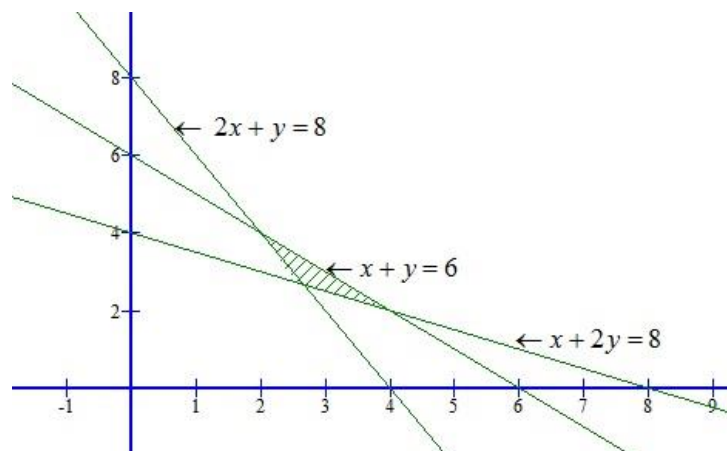
Putting $x = 0$ in $x + y = 6$, we get, $y = 6$.

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:



Q6(ii)

We have,

$$12x + 12y \leq 840, \quad 3x + 6y \leq 300, \quad 8x + 4y \leq 480, \quad x \geq 0 \text{ and } y \geq 0$$

Converting the inequations into equations, we obtain,

$$12x + 12y = 840, \quad 3x + 6y = 300, \quad 8x + 4y = 480, \quad x = 0 \text{ and } y = 0$$

Region represented by $12x + 12y \leq 840$:

Putting $x = 0$ in $12x + 12y = 840$, we get $y = \frac{840}{12} = 70$

Putting $y = 0$ in $12x + 12y \leq 840$, 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 $12x + 12y \leq 840$, we get $0 \leq 840$

Therefore, $(0, 0)$ satisfies the inequality $12x + 12y \leq 840$. so, the portion containing the origin represents the solution set of the inequation $12x + 12y \leq 840$

Region represented by $3x + 6y \leq 300$:

Putting $x = 0$ in $3x + 6y \leq 300$, 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 $3x + 6y \leq 300$, we get, $0 \leq 300$

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

Region represented by $8x + 4y \leq 480$:

Putting $x = 0$ in $8x + 4y = 480$, we get, $y = \frac{480}{4} = 120$

Putting $y = 0$ in $8x + 4y = 480$, we get, $x = \frac{480}{8} = 60$.

$\therefore$ The line $8x + 4y = 480$ meets the coordinate axes at $(0, 120)$ and $(60, 0)$. Join these points by a thick line.

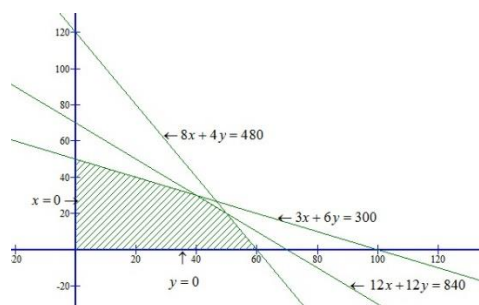
Now, putting $x = 0$ and $y = 0$ in $8x + 4y = 480$, we get $0 \leq 480$.

Therefore, $(0, 0)$ satisfies the inequality $8x + 4y \leq 480$.

So, the portion containing the origin represents the solution set of the inequation $8x + 4y \leq 480$.

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

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



Q6(iii)

We have,

$$x + 2y \leq 40, \quad 3x + y \geq 30, \quad 4x + 3y \geq 60, \quad x \geq 0 \text{ and } y \geq 0$$

Converting the inequations into equations, we obtain,

$$x + 2y = 40, \quad 3x + y = 30, \quad 4x + 3y = 60, \quad x = 0 \text{ and } y = 0$$

Region represented by $x + 2y \leq 40$:

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 $x + 2y \leq 40$, we get $0 \leq 40$

Therefore, $(0, 0)$ satisfies the inequality $x + 2y \leq 40$. so, the portion containing the origin represents the solution set of the inequation $x + 2y \leq 40$.

Region represented by $3x + y \geq 30$:

Putting $x = 0$ in $3x + y = 30$, 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 $3x + y \geq 30$, we get, $0 \geq 30$. This is not possible.

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

Region represented by $4x + 3y \geq 60$:

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.

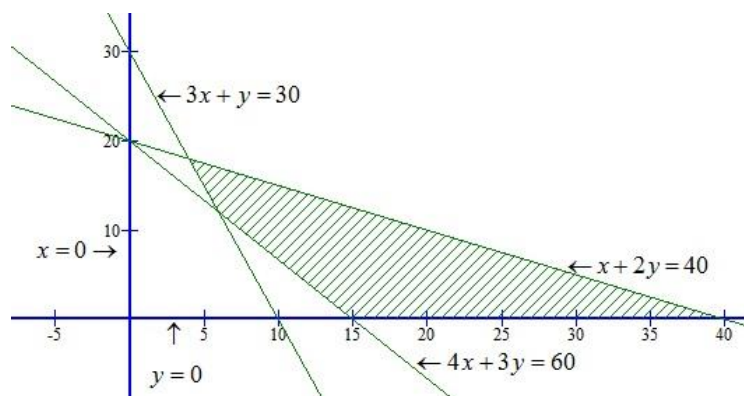
Now, putting $x = 0$, $y = 0$ in $4x + 3y \geq 60$, we get $0 \geq 60$.

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

Region represented by $x \geq 0$ and $y \geq 0$:

Clearly, $x \geq 0$ and $y \geq 0$ represent the first quadrant.

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



Q6(iv)

We have,

$$5x + y \geq 10, \quad 2x + 2y \geq 12, \quad x + 4y \geq 12, \quad x \geq 0 \text{ and } y \geq 0$$

Converting the inequations into equations, we obtain,

$$5x + y = 10, \quad 2x + 2y = 12, \quad x + 4y = 12, \quad x = 0 \text{ and } y = 0$$

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 $x + 4y \geq 12$

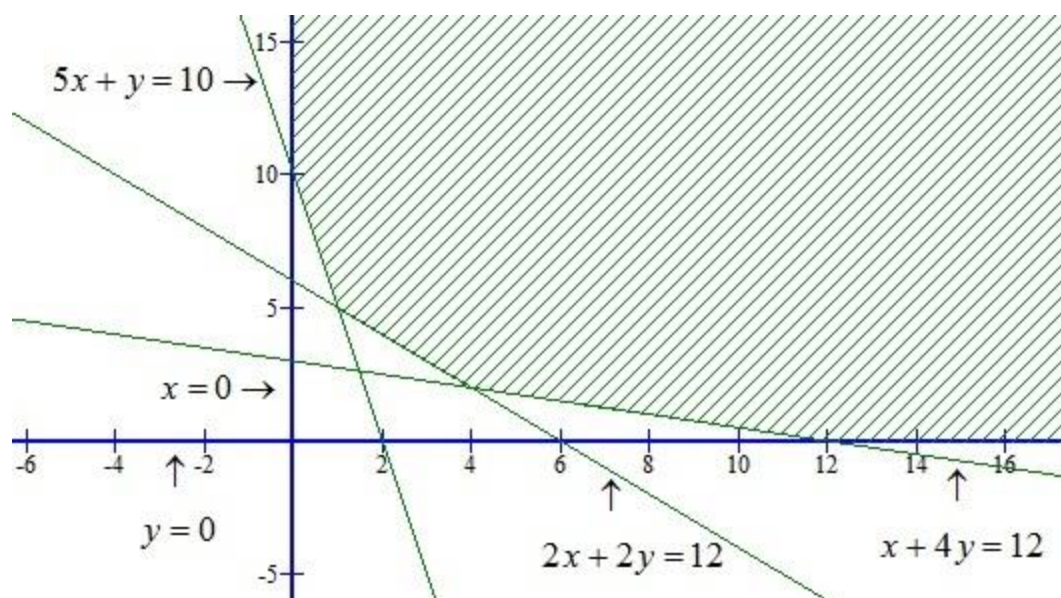
Putting $x = 0$ in $x + 4y = 12$, we get $y = \frac{12}{4} = 3$.

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 origin is represented by the inequation $x + 4y \geq 12$.



Q7

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

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

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

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

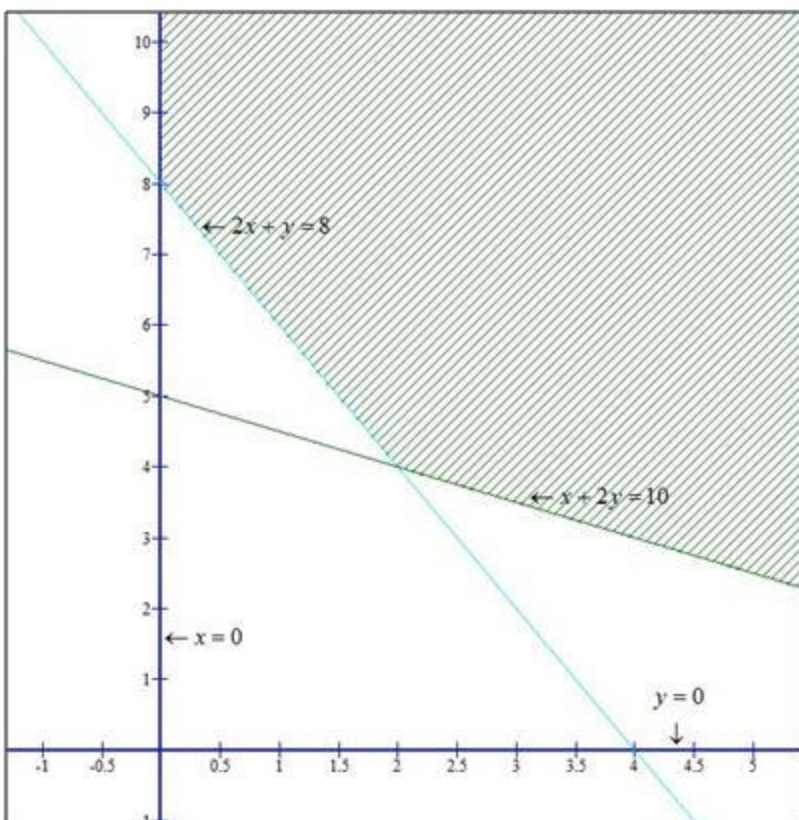
The line $3x + 4y = 12$ meets the co ordinate axes at $(0, 3)$ and $(4, 0)$. We find that $(0, 0)$ does not satisfy inequation $3x + 4y \geq 12$. So the portion not containing the origin is represented by the inequation $3x + 4y \geq 12$.

Region represented by $x \geq 0$:

Clearly, $x \geq 0$ represents the region lying on the right side of y-axis.

Region represented by $y \geq 1$:

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



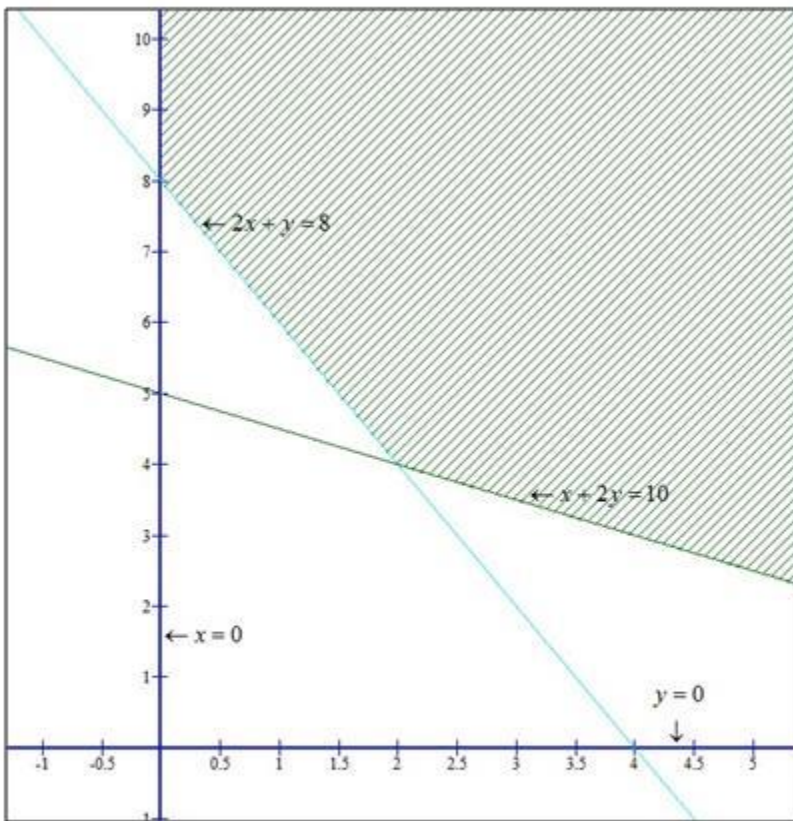
From graph we can see that the solution set satisfying the given inequalities is an unbounded region.

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 inequations is an unbounded region.