

CHAPTER:- 6

LINEAR INEQUALITIES

EXERCISE:- 6.1

Q.1.

$$24x < 100$$

$$\frac{24x}{24} < \frac{100}{24}$$

$$x < 4\frac{1}{6}$$

(i). when $x \in \mathbb{N}$,

$$\text{soln. set} = \{4, 3, 2, 1\}$$

(ii). when $x \in \mathbb{Z}$,

$$\text{soln. set} = \{4, 3, 2, 1, 0, -1, -2, -3, \dots\}$$

Q.2.

$$-12x > 30$$

$$\frac{-12x}{12} > \frac{30}{-2}$$

$$x < -5/2$$

(i). when $x \in \mathbb{N}$,

$$\text{soln set} = \{\} \text{ or } \phi$$

(ii). When $x \in \mathbb{Z}$,

$$\text{soln set} = \{-3, -4, -5, \dots\}$$

Q.3.

$$5x - 3 < 7$$

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

$$5x < 10$$

$$\frac{5x}{5} < \frac{10}{5}$$

$$x < 2$$

(i). when $x \in \mathbb{N}$,
soln. set = $\{1\}$

(ii). when $x \in \mathbb{Z}$,
soln. set = $\{1, 0, -1, -2, -3, \dots\}$

Q.4.

$$3x + 8 > 2$$

$$3x + 8 - 8 > 2 - 8$$

$$3x > -6$$

$$\frac{3x}{3} > \frac{-6}{3} \Rightarrow x > -2$$

(i). when $x \in \mathbb{N}$,
soln. set = $\{1, 2, 3, 4, \dots\}$

(ii). when $x \in \mathbb{Z}$,
soln. set = $\{-1, 0, 1, 2, 3, 4, \dots\}$

Q.5.

$$4x + 3 < 6x + 7$$

soln.

$$4x + 3 < 6x + 7$$

$$4x - 4x + 3 < 6x + 7 - 4x$$

$$3 < 2x + 7$$

$$-7 + 3 < 2x + 7 - 7$$

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

\therefore soln. set = $\{x: x \in \mathbb{R}, -2 < x\}$
or $= (-2, \infty)$

Q.6.

$$3x - 7 > 5x - 1$$

$$3x - 7 - 3x > 5x - 3x - 1$$

$$-7 > 2x - 1$$

$$-7 + 1 > 2x$$

$$\Rightarrow \begin{aligned} -6 &> 2x \\ -3 &> x \end{aligned}$$

Q.7. $3(x-1) \leq 2(x-3)$

soln. $3(x-1) \leq 2(x-3)$

$$3x - 3 \leq 2x - 6$$

$$3x - 2x - 3 \leq 2x - 6 - 2x$$

$$x - 3 \leq -6$$

$$x - 3 + 3 \leq -6 + 3$$

$$x \leq -3$$

$$\therefore \text{Solution set} = [-3, -\infty)$$

$$\text{or } \{x : x \in \mathbb{R}, x \leq -3\}$$

Q.8. $3(2-x) \geq 2(1-x)$

soln. $3(2-x) \geq 2(1-x)$

$$6 - 3x \geq 2 - 2x$$

$$6 - 3x + 3x \geq 2 - 2x + 3x$$

$$6 \geq 2 + x$$

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

$$4 \geq x$$

$$\therefore \text{Solution set} = [4, -\infty)$$

$$\text{or } \{x : x \in \mathbb{R}, x \leq 4\}$$

Q.9. $x + \frac{x}{2} + \frac{x}{3} < 11$

soln. $6x + 3x + 2x < 11$
 $6x$

$$\frac{11x}{6} < 11$$

$$\Rightarrow \frac{11x}{6} \times 6 < 11 \times 6$$

$$\frac{11x}{11} < 66/11$$

$$x < 6$$

\therefore Solution set = $(6, -\infty)$

or $\{x: x \in \mathbb{R}, x < 6\}$

Q.10.

sln

$$x/3 > x/2 + 1$$

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

$$x/3 \times 6 > (x+2)/2 \times 6$$

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

$$2x > 3x+6$$

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

$$-x > 6 \Rightarrow x < 6$$

\therefore Soln set = $(6, -\infty)$

or $\{x: x \in \mathbb{R}, x < 6\}$

Q.11.

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

$$\frac{3(x-2) \times 15}{5} \leq \frac{5(2-x) \times 15}{3}$$

$$3(x-2) \times 3 \leq 5(2-x) \times 5$$

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

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

$$34x-18+18 \leq 50+18$$

$$34x \leq 68$$

$$x \leq 68/34$$

$$x \leq 2$$

\therefore solution set = $[2, -\infty)$ or $\{x: x \in \mathbb{R}, x \leq 2\}$

$$Q.12. \quad \frac{1}{2} \left(\frac{3x}{5} + 4 \right) \geq \frac{1}{3} (x-6)$$

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

$$\frac{9x}{5} + 12 \geq 2x - 12$$

$$\frac{9x \times 5 + 12 \times 5}{5} \geq \frac{2x \times 5 - 12 \times 5}{5}$$

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

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

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

$$120 \geq x$$

$$\text{Solution set} = \{ [120, -\infty] \}$$

$$\text{or } \{ x: x \in \mathbb{R}, x \leq 120 \}$$

$$Q.13. \quad 2(2x+3)-10 < 6(x-2)$$

$$\text{soln} \quad 4x + 6 - 10 < 6x - 12$$

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

$$2x - 2 < 3x - 6$$

$$2x - 2x - 2 + 6 < 3x + 6 - 6 - 2x$$

$$4 < x$$

$$\text{Solution set} = (4, \infty)$$

$$Q.14. \quad 37 - (3x+5) \geq 9x - 8(x-3)$$

$$\text{soln.} \quad 37 - (3x+5) \geq 9x - 8(x-3)$$

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

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

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

$$8 \geq 4x$$

$$\frac{8}{4} \geq x$$

$$2 \geq x$$

$$\text{Solution set} = [2, -\infty)$$

$$\text{or } \{x: x \in \mathbb{R}, x \leq 2\}$$

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

$$\frac{x}{4} \times 60 < \frac{(5x-2) \times 60}{3} - \frac{(7x-3) \times 60}{5}$$

$$15x < 100x - 120 - 84x - 36$$

$$15x < 16x - 156$$

$$+156 + 15x - 15x < 16x - 15x - 156 + 156$$

$$156 < x$$

$$\text{Solution set} = (156, \infty)$$

$$\text{or } \{x: x \in \mathbb{R}, x > 156\}$$

$$Q.16. \quad \frac{(2x-1)}{3} \geq \frac{(2x-2)}{4} - \frac{(2-x)}{5}$$

$$\frac{(2x-1) \times 60}{3} \geq \frac{(2x-2) \times 60}{4} - \frac{(2-x) \times 60}{5}$$

$$40x - 20 \geq 45x - 300 - 24 + 12x$$

$$40x - 20 \geq 57x - 324$$

$$40x - 20 - 40x + 324 \geq 57x - 40x - 324 + 324$$

$$304 \geq 17x$$

$$\frac{304}{17} \geq x$$

$$17 \frac{15}{17} \geq x$$

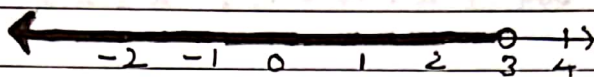
$$\text{Solution set} = [17 \frac{15}{17}, -\infty)$$

Q.17. $3x - 2 < 2x + 1$

soln. $3x - 2 < 2x + 1$

$$3x - 2 - 2x < 2x + 1 - 2x + 1$$

$$x < 3$$



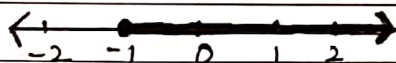
Q.18. $5x - 3 \geq 3x - 5$

soln. $5x - 3 - 3x + 3 \geq 3x - 3x + 3 - 5$

$$2x \geq -2$$

$$x \geq -2/2$$

$$x \geq -1$$



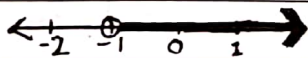
Q.19. $3(1-x) < 2(x+4)$

$$3 - 3x < 2x + 8$$

$$3 - 8 - 3x + 3x < 2x + 3x + 8 - 8$$

$$-5 < 5x$$

$$-1 < x$$



Q.20. $\frac{x}{2} < \frac{(5x-2)}{3} - \frac{(7x-3)}{5}$

soln. $\frac{x}{2} < \frac{(5x-2)}{3} - \frac{(7x-3)}{5}$

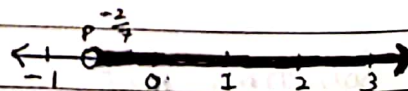
$$\frac{x}{2} \times 30 < \frac{(5x-2)}{3} \times 30 - \frac{(7x-3)}{5} \times 30$$

$$15x < 50x - 20 - 42x + 18$$

$$15x < 8x - 2$$

$$7x < -2$$

$$x < -2/7$$



Q.21. least marks to be obtained to get 60 mark avg
 $= x$ (say)

then,

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

$$145 + x \geq 180$$

$$x \geq 180 - 145$$

$$x \geq 35$$

\Rightarrow for at least 60 marks ^{or more} avg., he should
 get ~~at least~~ marks ≥ 35

\Rightarrow Marks in 3rd subject ≥ 35 .

Q.22. ~~least~~ marks to be obtained ^{in 5th subject} to get 90 marks avg.
 or more $= x$ (say)

then,

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

$$368 + x \geq 450$$

$$x \geq 450 - 368$$

$$x \geq 82$$

\Rightarrow for A grade,

Marks in 5th subject ≥ 82

Q.23. let the odd no.s be x & $x+1$ respectively,
 then, $x < 10$ (given).

$$x + (x+2) > 11$$

$$2x > 9 \Rightarrow x > 9/2 \Rightarrow x > 4\frac{1}{2}$$

\therefore solution set = $\{\{5, 7\}, \{7, 9\}\}$

Q.24 let the numbers be x & $x+2$ resp.,

$$x > 5, \text{ (given)}$$

$$\text{a/q, } x + (x+2) < 23$$

$$2x < 21$$

$$x < 10\frac{1}{2}$$

\therefore Solution set = $\{\{6, 8\}, \{8, 10\}, \{10, 12\}\}$

Q.25 let the shortest side be x ,

then,

$$\text{longest side} = 3x$$

$$\text{third side} = 3x - 2$$

$$\text{a/q, } x + 3x + 3x - 2 \text{ cm} \geq 61 \text{ cm}$$

$$7x \geq 63 \text{ cm}$$

$$x \geq 9 \text{ cm}$$

\therefore soln. set of shortest side = $\{9, 10, 11, 12, \dots\}$

Minimum length of shortest side = 9 cm.

Q.26 length of shortest board be x ,

then, 2nd piece = $(x+3)$ & 3rd piece = $2x$

a/q,

$$x + (x+3) + 2x \leq 91$$

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

$$4x \leq 88$$

$$x \geq 8 \quad \dots (ii)$$

$$x \leq 22 \quad \dots (i)$$

from (i) & (ii),

$$8 \leq x \leq 22$$

\therefore soln set of the shortest board =

$$\{8, 9, 10, \dots, 22\}$$