

24/July/2023

## Chapter - 6

## Linear Inequalities

### Exercise - 6.1

Q1- Solve  $24x < 100$  when

(i)  $x$  is a natural no.

(ii)  $x$  is an integer

$24x < 100$  divide both side by 24

$$\frac{24x}{24} < \frac{100}{24} \quad \begin{matrix} 25 \\ 6 \end{matrix}$$

$$\boxed{x < \frac{25}{6}}$$

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

$$x = \{1, 2, 3, 4\}$$

$$\frac{24x}{24} < \frac{100}{24}$$
$$x < 4\frac{1}{6}$$

$$x = \{-\infty \dots 1, 0, 1, 2, 3, 4\}$$

2. Solve  $-12x > 30$ , when

(i)  $x$  is a natural no.

(ii)  $x$  is an integer

$$-12x > 30$$

divide both side by 12

$$\frac{-12x}{12} > \frac{30}{12} \quad \begin{matrix} 5 \\ 2 \end{matrix}$$

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

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

There is no Natural no less than  $-\frac{5}{2}$

$$-3, -4, -5 \dots -\infty$$

For

$$\{-3, -4, -5 \dots\}$$



Ques - Solve  $5x - 3 < 7$ , when

(i)  $x$  is an integer

$$5x - 3 < 7$$

$$5x < 7 + 3$$

$5x < 10$  divide by 5

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

$$x < 2$$

{ 1, 0, -1, -2, -3, ... }

(ii)  $x$  is real no.  
( 2,  $-\infty$  )

Ques 4 - Solve  $3x + 8 > 2$ , when

(i)  $x$  is an integer

(ii)  $x$  is a real no.

$$3x + 8 > 2$$

Subtract 8 on both side

( -2,  $\infty$  )

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

$$3x > -6$$

divide by 3

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

$$\boxed{x > -2}$$

{ -1, 0, 1, 2, ...  $\infty$  }



5.  $4x + 8 < 5x + 7$

$$\begin{aligned}
 4x + 8 &< 5x + 7 \\
 4x - 5x &< 7 - 8 \\
 -x &< -1 \\
 x &> -1 \\
 -2, -1, 0, 1, 2, \dots & \\
 (-1, \infty) & \text{ is the solution}
 \end{aligned}$$

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

$$\begin{aligned}
 3(x-1) &\leq 2(x-3) \\
 3x - 3 &\leq 2x - 6 \\
 3x - 2x &\leq -6 + 3 \\
 x &\leq -3 \\
 (-\infty, -3] &
 \end{aligned}$$

6.  $3x - 7 > 5x - 1$

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

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

$$\begin{aligned}
 3(2-x) &\geq 2(1-x) \\
 6 - 3x &\geq 2 - 2x \\
 -3x + 2x &\geq 2 - 6 \\
 -x &\geq -4 \\
 x &\leq 4 \\
 (-\infty, 4] &
 \end{aligned}$$

Q9-  $x + \frac{x}{2} + \frac{x}{3} < 11$

$$\begin{aligned}
 \frac{6x + 3x + 2x}{6} &< 11 \\
 11x &< 66 \\
 x &< 6 \\
 (-\infty, 6) &
 \end{aligned}$$

10.  $\frac{x}{3} > \frac{x}{2} + 1$

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



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

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

$\frac{3x-6}{5} \leq \frac{10-5x}{3}$

$3(3x-6) \leq 5(10-5x)$

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

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

$34x \leq 68$

$x \leq \frac{68}{34}$

$x \leq 2$

$x \leq 2$

$(-\infty, 2]$

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

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

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

$3 \left( \frac{3x+20}{5} \right) \geq 2x-12$

$\frac{9x+60}{5} \geq 2x-12$

$\frac{9x}{5} + \frac{60}{5} \geq 2x-12$

$\frac{9x}{5} - \frac{2x}{1} \geq -12-12$

$\frac{9x-10x}{5} \geq -24$

$-x \geq -120 \Rightarrow x \leq 120$

$(-\infty, 120]$

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

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

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

$4x - 4 < 6x - 12$

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

$-2x < -8$

$-x < -4$

$x > 4$

$(4, \infty)$

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

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

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

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

$-4x \geq -8$

$-x \geq -2$

$x \leq 2$

$(-\infty, 2]$



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

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

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

$$\frac{x}{4} < \frac{25x - 10 - 21x + 9}{15}$$

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

$$15x < 16x - 4$$

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

$$-x < -4$$

$$x > 4$$

$$(4, \infty)$$

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

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

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

$$\frac{2x-1}{3} \geq \frac{15x - 10 - 8 + 4x}{20}$$

$$\frac{2x-1}{3} \geq \frac{19x-18}{20}$$

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

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

$$-17x \geq -34$$

$$-x \geq -2$$

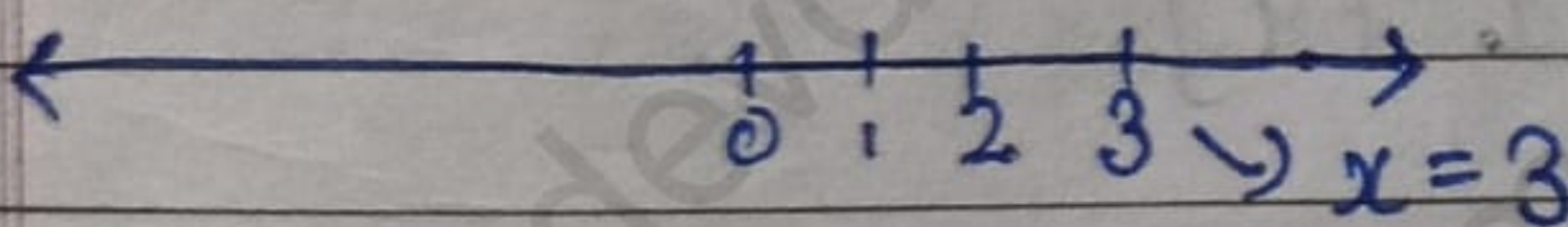
$$x \leq 2$$

$$(-\infty, 2]$$

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

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

$$x < 3 \quad x \in (-\infty, 3)$$

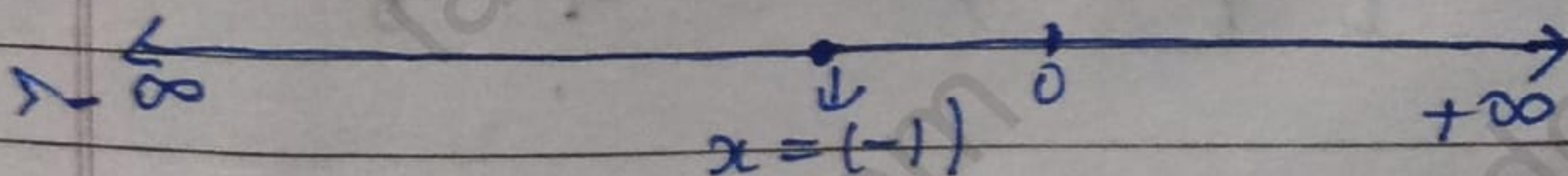


$$18. 5x - 3 \geq 3x - 5$$

$$2x \geq -2$$

$$x \geq -1$$

$$x \in [-1, \infty)$$





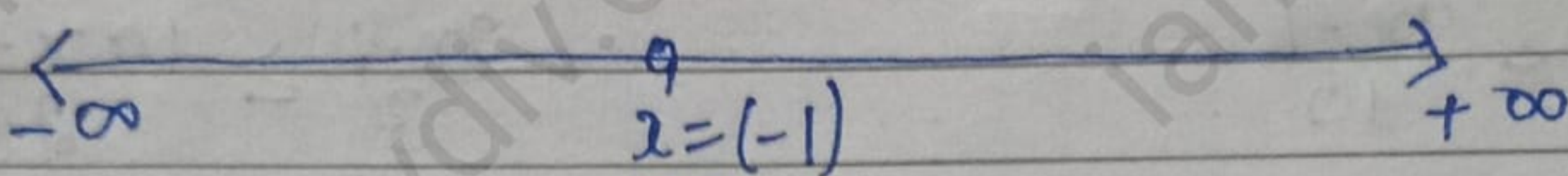
$$19. \quad 3(1-x) < 2(x+4)$$

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

$$-5 < 5x$$

$$-1 < x$$

$$x \in (-1, \infty)$$



$$20. \quad \frac{x}{2} \geq \frac{(5x-2)}{3} - \frac{(7x-3)}{5}$$

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

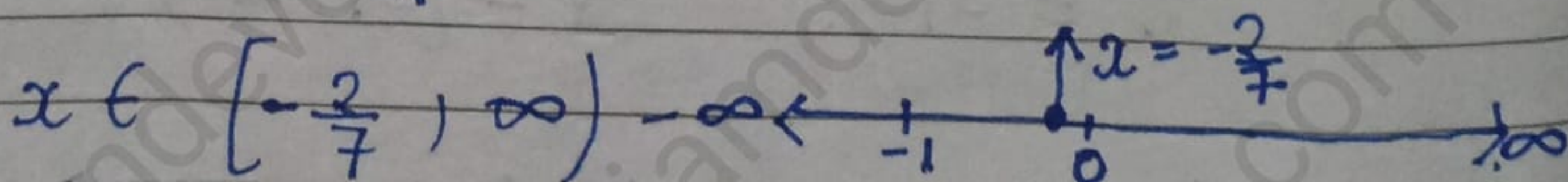
$$15x \geq 2[25x - 10 - 21x + 9]$$

$$15x \geq 2[4x - 1]$$

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

$$7x \geq -2$$

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





21. Rewritten - - - - - 60 marks.

Let marks in third test =  $x$

A.T.Q.  $\frac{70+75+x}{3} \geq 60$

$$145+x \geq 180$$

$$x \geq 180-145$$

$$\boxed{x \geq 35}$$

23 Find - - - - - more than 11

Let two consecutive positive integers are  $x, x+2$

~~$x+1$~~

A.T.Q.  $x + x + 2 > 11$

$$2x > 11-2$$

$$2x > 9$$

$$x > \frac{9}{2} \left(4\frac{1}{2}\right)$$

5, 7, 9

Pair of odd integers less than 10 are

(5, 7) (7, 9) Ans



21. A man . . . . . second?

Let the length of the shortest board be  $x$   
 " " " second board  $(x+3)$   
 " " " third piece  $2x$

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

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

$$4x \leq 88 \Rightarrow x \leq 22$$

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

$$2x \geq x + 8$$

$$x \geq 8$$

$$8 \leq x \leq 22 \text{ (Ans)}$$

22. To receive . . . . . course.

Let the marks in fifth examinations be  $x$

To get a grade A

$$\text{Average} \geq 90$$

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

$$368 + x \geq 450$$

$$x \geq 450 - 368$$

$$x \geq 82$$

To get a grade A, Sunita must get 82 or more marks in fifth exam



25/July/2023

### Miscellaneous Exercise

10.  $5(2x-7) - 3(2x+3) \leq 0, 2x+19 \leq 6x+47$

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

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

$$4x - 44 \leq 0$$

$$x \leq 11$$

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

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

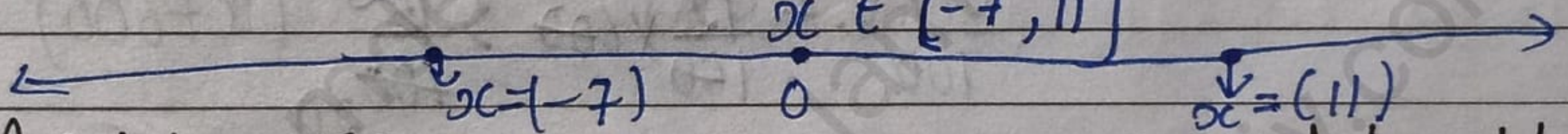
$$4x \leq 28$$

$$x \leq 7$$

$$x \geq -7$$

$$x \leftarrow \text{H} \quad -7 \leq x \leq 11$$

$$x \in [-7, 11]$$



12. A solution of 8% to be added?

Let 2% solution is  $x$  lit.

A.T.Q.

$$(640+x) \times \frac{4}{100} < 640 \times \frac{8}{100} + x \times \frac{2}{100} < (640+x) \times \frac{6}{100}$$

$$(640+x) \times \frac{4}{100} < \frac{5120+2x}{100} < (640+x) \times \frac{6}{100}$$

$$2560 + 4x < 5120 + 2x < 3840 + 6x$$

$$2560 + 4x < 5120 + 2x$$

$$4x - 2x < 5120 - 2560$$

$$2x < 2560 - 1280$$



$$x < 1280 \quad \text{--- (1)}$$

$$5120 + 2x < 3840 + 6x$$

$$5120 - 3840 < 6x - 2x$$

$$320 + 280 < 4x$$

$$320 < x$$

$$320 < x \quad \text{--- (2)}$$

from (1) & (2)

$$320 < x < 1280$$

Ex. 20:- A manufacturer - - - - - 18%?

Let 30% acid solution be  $x$   
 30% of  $x$  + 12% of  $600 > 15\%$  of  $(x + 600)$  --- (1)  
 30% of  $x$  + 12% of  $600 < 18\%$  of  $(x + 600)$  --- (2)

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

$$\frac{3x}{10} + 72 > \frac{3x}{20} + \frac{1800}{20}$$

$$\frac{3x}{10} + 72 > \frac{3x}{20} + 90$$

$$72 - 90 > \frac{3x}{20} - \frac{3x}{10}$$

$$18 > \frac{3x - 6x}{20}$$

$$-18 > \frac{-3x}{20}$$

$$-360 > -3x \Rightarrow -360 < x$$

+ 3



$$120 < x$$

$$x > 120$$

$$120 < x < 300$$

From eq. (2)

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

$$\frac{3x}{10} + 72 < \frac{18x}{100} + 108$$

$$\frac{3x}{10} - \frac{18x}{100} < 108 - 72$$

$$\frac{30x - 18x}{100} < 36$$

$$\frac{12}{100} < 36$$

$$x < \frac{3600}{12}$$

$$x < 300$$

$$120 < x < 300$$



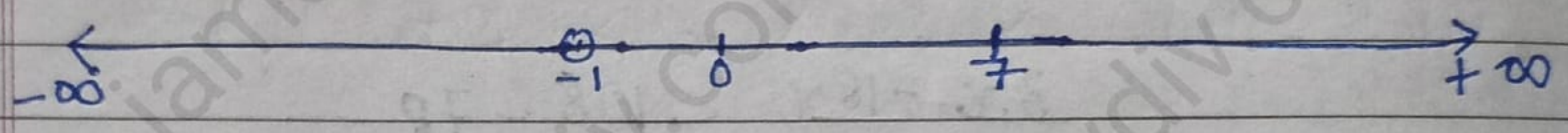
8.  $2(x-1) < x+5$  ,  $3(x+2) > 2-x$

$$2(x-1) < x+5$$
$$2x-2 < x+5$$
$$\boxed{x < 7}$$

$$3(x+2) > 2-x$$
$$3x+6 > 2-x$$
$$4x > -4$$
$$\boxed{x > -1}$$

$$\boxed{-1 < x < 7}$$

$$\boxed{x \in (-1, 7)}$$

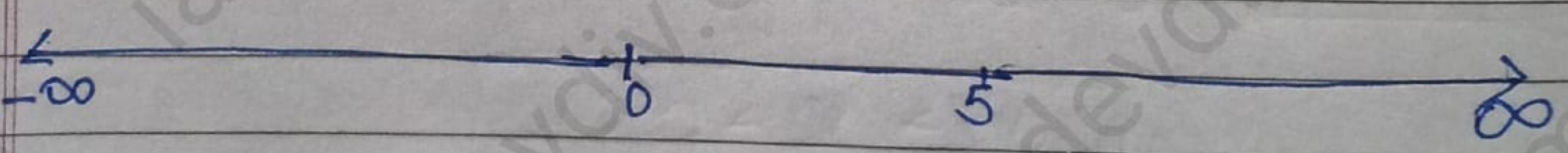


9.  $3x-7 > 2(x-6)$  ,  $6-x > 11-2x$

$$3x-7 > 2(x-6)$$
$$3x-7 > 2x-12$$
$$\boxed{x > -5}$$

$$6-x > 11-2x$$
$$\boxed{x > 5}$$

$$\boxed{x \in (5, \infty)}$$





11. A solution - - - - -

Range in Fahrenheit

$$68^{\circ} < F < 77^{\circ}$$

$$68 - 32 < \frac{9C}{5} < 77 - 32$$

$$4 < \frac{9C}{5} < 45$$

$$20 < C < 25$$

Creates that  $20^{\circ}\text{C}$  and less than  $25^{\circ}\text{C}$  Range in degree  $^{\circ}\text{C}$

14. IQ - - - - - age

$$80 \leq \text{IQ} \leq 140$$

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

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

$$\frac{8 \times 12}{10} \leq \text{MA} \leq \frac{14 \times 12}{10}$$

$$9.6 \leq \text{MA} \leq 16.8$$



13. How - - - - - (answer)

Volume of 45% Sol. = 1125 Lit.

,, water (0% acid) = x Lit.

25% of (1125 + x) < Resulting mixture < 30% of (1125 + x)

$$\frac{25}{100} \times (1125 + x) < \frac{45}{100} \times 1125 + \frac{0}{100} \times x < \frac{30}{100} \times (1125 + x)$$

$$25(1125 + x) < 45 \times 1125 < 30(1125 + x)$$

$$5(1125 + x) < 9 \times 1125 < 6(1125 + x)$$

$$5 \times 1125 + 5x < 9 \times 1125$$

$$5x < 9 \times 1125 - 5 \times 1125$$

$$5x < 1125 \times 4$$

$$x < 900$$

$$x < 900$$

$$9 \times 1125 < 6 \times 1125 + 6x$$

$$9 \times 1125 - 6 \times 1125 < 6x$$

$$1125(9 - 6) < 6x$$

$$1125 \times 3 < 6x$$

$$\frac{1125}{2} < x \rightarrow$$

$$562.5 < x$$

$$562.5 < x < 900$$

Volume of water

More than 562.5L but less than 900L



## Exercise 6.1

24. Find - - - - - 23

Let the two consecutive even positive integers be  $x$  and  $x+2$

$$x > 5$$

$$x+2 > 5, \quad x > 3$$

Also,  $x+x+2 < 23$

$$2x < 21$$

$$x < \frac{21}{2}$$

$$x < 10.5$$

Pair of even consecutive integers are  
 $(6, 8)$   $(8, 10)$   $(10, 12)$

25. The - - - - - side

Let the shortest side =  $x$

longest =  $3x$

Third side =  $3x-2$

Perimeter  $\geq 61$

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

$$7x \geq 63$$

$$x \geq 9$$

Minimum length of the shortest side is 9 cm.