Linear Inequalities

Rules:

① Add / Subtract

↓

Sign of Inequality → No change

$5 > 3$
$-2 \quad -2$

$x + 2 > 5$

$x > 5 - 2$

$x > 3$

② Multiply / Divide

- ⊕ ve → Sign of Ineq. → No change
- ⊖ ve → Sign of Ineq. → Change

Process

- Single Inequality. $x > 5$
- Double Inequality $10 > x > 3$

Solve

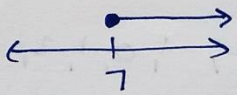
- Natural No. → Set
- Integers → Set
- Real No. → Interval

$2 < x \leq 3$

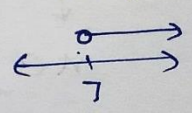
$x \in (2, 3]$

No. LINE

- Include $x \geq 7$



- Exclude $x > 7$



Exercise 5.1

① Solve $24x < 100$

(i) x is a natural No. → Set

(ii) x is an integer → Set

$24x < 100$

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

$\boxed{x < 4.22...}$ Ineq.

(i) Natural No. $\{1, 2, 3, 4, 5...\}$

Solution,

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

(ii) Integer $\{...-2, -1, 0, 1, 2, 3, 4, 5...\}$

$x \in \{...-2, -1, 0, 1, 2, 3, 4\}$

② Solve $\boxed{-12x > 30}$

Solve

-12 ∈ ve

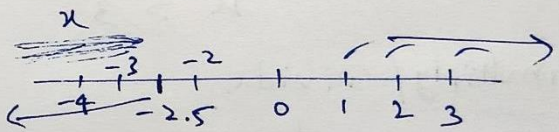
change

$x < \frac{30}{-12}$

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

$\Rightarrow \quad \boxed{x < -2.5}$ ✓

(i) x is a natural No. $\{1, 2, 3, ...\}$



No Solution,

(ii) x is an integer $\{...-2, -1, 0, 1, ...\}$

$x \in \{...-5, -4, -3\}$

③ Solve $5x - 3 < 7$

$\Rightarrow 5x < 10$

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

$x < 2$

(i) $x \in$ Integer — set

$x \in \{\ldots -2, -1, 0, 1\}$

(ii) $x \in$ Real — interval

$-\infty < x < 2$

$x \in (-\infty, 2)$

interval

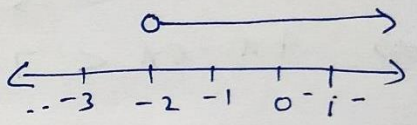
④ Solve $3x + 8 > 2$

$\Rightarrow 3x > 2 - 8$

$\Rightarrow 3x > -6$

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

$x > -2$



(i) $x \in$ integer

set

$x \in \{-1, 0, 1 \ldots\}$

✓

(ii) $x \in$ Real.

interval

$(-, -)$

$x > -2$

$-2 < x < \infty$

$x \in (-2, \infty)$

✓

Q.5 $4x + 3 < 6x + 7$ $x \in R$

$\Rightarrow 4x - 6x < 7 - 3$

$\Rightarrow -2x < 4$

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

(-)ve. Divide → Sign → change

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

$\Rightarrow -2 < x$

$\Rightarrow \boxed{-2 < x < \infty}$

$x \in (=, =)$

$[\quad)$ (✓

$(\quad]$ [✗

$[\quad]$

$\boxed{x \in (-2, \infty)}$ ✓

(6) $3x - 7 > 5x - 1$

$\Rightarrow -7 + 1 > 5x - 3x$

$\Rightarrow -6 > 2x$

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

2 → (+)ve (No change)

$\Rightarrow -3 > x$

$\Rightarrow x < -3$

$\Rightarrow \boxed{-\infty < x < -3}$

$x \in (-\infty, -3)$ ✓

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

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

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

$\Rightarrow x \leq -3$

$\Rightarrow -\infty < x \leq -3$

$x \in (-\infty, -3]$

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

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

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

$\Rightarrow 4 \geq x$

$\Rightarrow -\infty < x \leq 4$

$x \in (-\infty, 4]$

(9) $\frac{x}{1}+\frac{x}{2}+\frac{x}{3} < 11$

$\Rightarrow \frac{6x+3x+2x}{6} < 11$

$\Rightarrow 11x < 66$

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

$\Rightarrow x < 6$

$\Rightarrow -\infty < x < 6$

$x \in (-\infty, 6)$ ✓

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

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

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

$\Rightarrow \frac{-x}{6} > 1 \Rightarrow \frac{x}{-6} > 1$

$\Rightarrow x < -6$

$\Rightarrow -\infty < x < -6$

$x \in (-\infty, -6)$

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

$\Rightarrow 9(x-2) \leq 25(2-x)$

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

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

$\Rightarrow 34x \leq 68$

$\Rightarrow x \leq 2$

$\Rightarrow -\infty < x \leq 2$

$x \in (-\infty, 2]$

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

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

$\Rightarrow 4x-6x < 4-12$

$\Rightarrow -2x < -8$

$\Rightarrow +8 < 2x$

$\Rightarrow 4 < x$

$\Rightarrow \boxed{4 < x < \infty}$

$x \in (4, \infty)$

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

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

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

$\Rightarrow -4x \geq -8$

$\Rightarrow x \leq \frac{-8}{-4} \Rightarrow \boxed{x \leq 2}$

$x \in (-\infty, 2]$

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

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

$\Rightarrow 15x < 4(4x-1)$

$\Rightarrow 15x < 16x-4$

$\Rightarrow 15x-16x < -4$

$\Rightarrow -x < -4$

$\Rightarrow (-1).x < -4$

$\Rightarrow x > \frac{-4}{-1}$

$\Rightarrow x > 4$

$\Rightarrow 4 < x < \infty$

$x \in (4, \infty)$

$(-, -)$

[

16

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

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

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

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

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

$$\Rightarrow -17x \geq -34$$

$$\Rightarrow x \leq \frac{34}{17} 2$$

$$\Rightarrow x \leq 2$$

$$\Rightarrow -\infty < x \leq 2$$

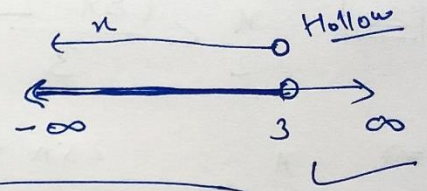
$$\boxed{x \in (-\infty, 2]}$$

17

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

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

$$\Rightarrow \boxed{x < 3}$$



$$\boxed{x \in (-\infty, 3)}$$

18

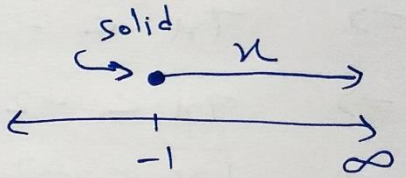
$$5x-3 \geq 3x-5$$

$$\Rightarrow 5x-3x \geq 3-5$$

$$\Rightarrow 2x \geq -2$$

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

$$\Rightarrow \boxed{x \geq -1}$$



$$\boxed{x \in [-1, \infty)}$$

19

$$3(1-x) < 2(x+4)$$

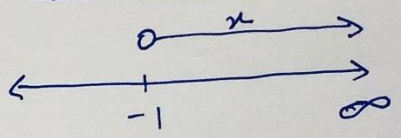
$$\Rightarrow 3-3x < 2x+8$$

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

$$\Rightarrow -5 < 5x$$

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

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



Sol^n: $x \in (-1, \infty)$

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

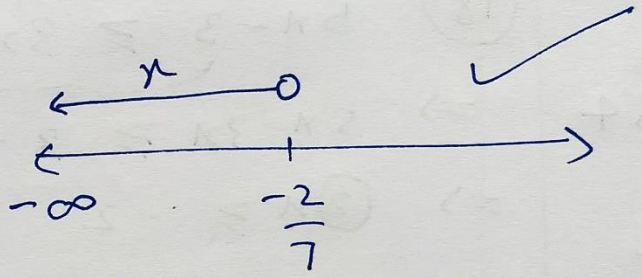
$\Rightarrow \frac{x}{2} < \frac{25x - 10 - 21x + 9}{15}$

$\Rightarrow 15x < 8x - 2$

$\Rightarrow 7x < -2$

$\Rightarrow 7x < -2$

$\Rightarrow \boxed{x < -\frac{2}{7}}$



$\boxed{x \in (-\infty, -\frac{2}{7})}$

Q.21

1st test → 70 ✓

2nd test → 75 ✓

3rd Test → x (let) ✓

Average → atleast 60 marks.

Average ≥ 60

$\Rightarrow \dfrac{70+75+x}{3} \geq 60$

$\Rightarrow 145 + x \geq 180$

$\Rightarrow x \geq 180 - 145$

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

$\therefore$ minimum marks in III test = 35

Marks of 3rd Test ≥ 35

Q.22 Marks is first four tests = 87, 92, 94, 95

Marks in Fifth Exam = x (let)

Grade 'A' ☆ → Average ≥ 90

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

$\Rightarrow \dfrac{368+x}{5} \geq 90$

$\Rightarrow 368 + (x) \geq 450$

$\Rightarrow x \geq 450 - 368$

$\Rightarrow (x) \geq 82$

min. Marks in (V) Exam = 82

(23)

Two Consecutive odd positive integers < 10

&

Sum > 11

Pair $\rightarrow$ (Small, Big) $(2x+1, 2x+3)$

Odd Odd

consecutive

$x \in I$

$2x+3 < 10$ — (1) $\rightarrow$

$2x < 7$

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

$x < 3.5$

Sum > 11

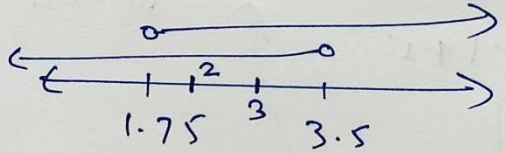
$\Rightarrow (2x+1) + (2x+3) > 11$

$\Rightarrow 4x+4 > 11$

$\Rightarrow 4x > 7$

$\Rightarrow x > \frac{7}{4}$

$\Rightarrow x > 1.75$



$x \in (1.75, 3.5)$

$x = 2, 3 \in I$

Pairs	$(2x+1, 2x+3)$
$x=2$	$(5, 7)$
$x=3$	$(7, 9)$

24 (Two Consecutive Even positive integers) > 5 → Smaller > 5

$2x > 5$

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

$\Rightarrow x > 2.5$ ✓

Sum < 23

Assumes: $x \in I$ ✓

Small Big

$(2x, 2x+2)$

Even Even

(Consecutive)

Sum < 23

$\Rightarrow (2x) + (2x+2) < 23$

$\Rightarrow 4x + 2 < 23$

$\Rightarrow 4x < 21$

$\Rightarrow x < \frac{21}{4}$ ✓

$\Rightarrow x < 5.25$ ✓

$x = 3, 4, 5$ ✓

Pairs $(2x, 2x+2)$

$x = 3$ $(6, 8)$ ✓

$x = 4$ $(8, 10)$ ✓

$x = 5$ $(10, 12)$ ✓

Q.25

the Longest side = $3x$

third side = $3x-2$

the shortest side = x (let)

Perimeter ≥ 61

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

$\Rightarrow 7x-2 \geq 61$

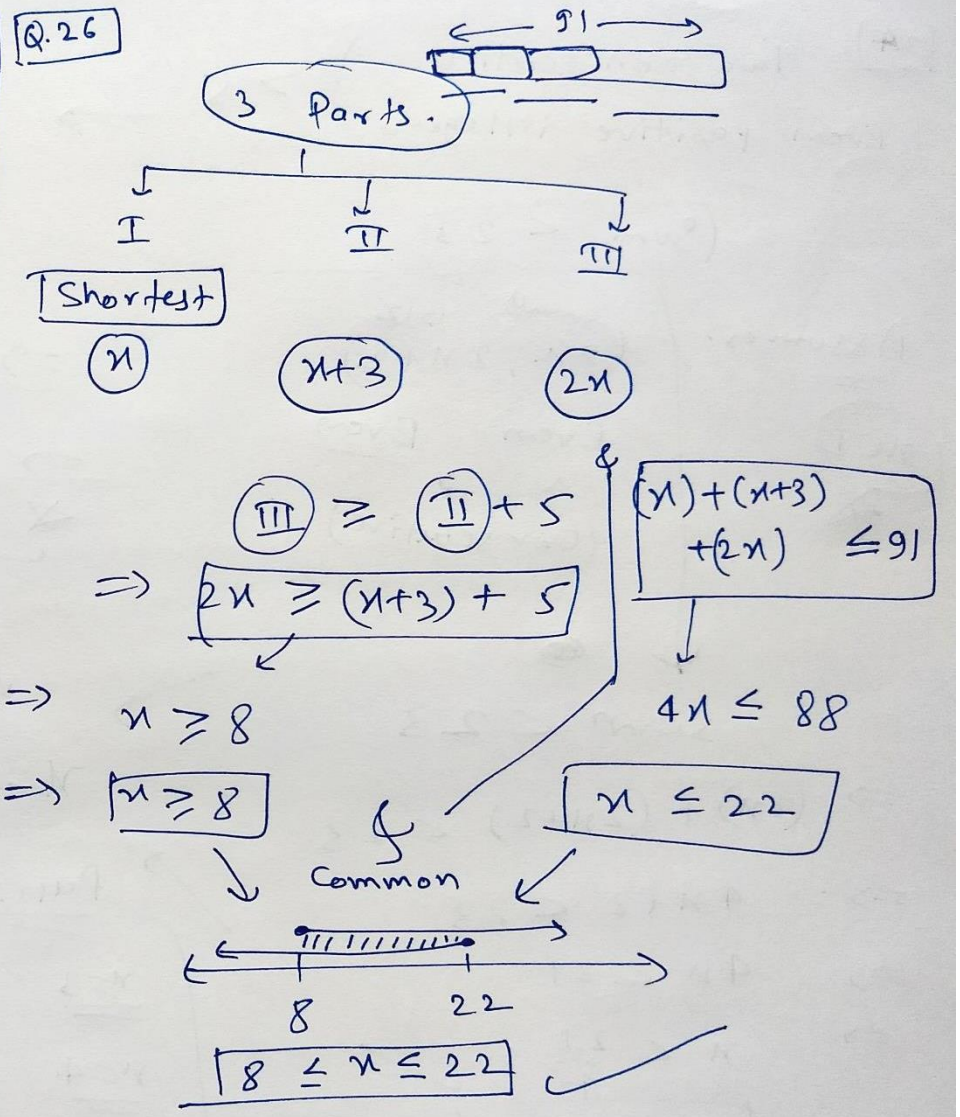
$\Rightarrow 7x \geq 63$

$\Rightarrow \boxed{x \geq 9}$

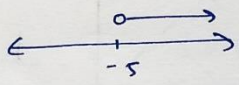
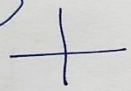
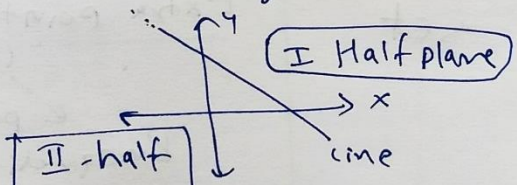
the Shortest side ≥ 9

min. length of the Shortest side = 9 cm

Q.26



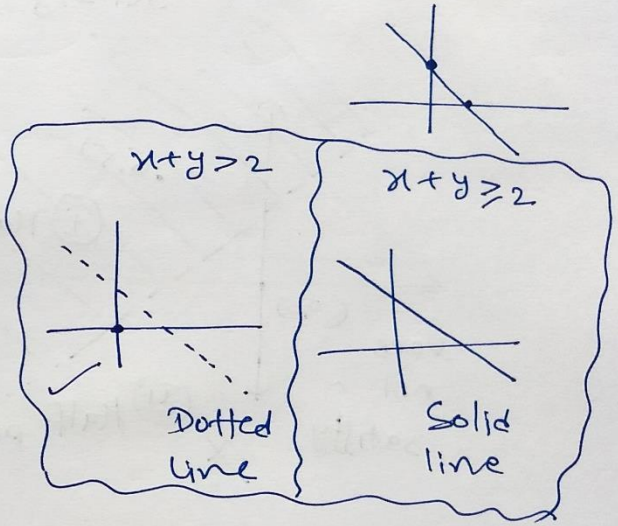
Ex. **5.2**

L.I. in 1-variable.	L.I. in 2 variables
One-D $x > -5$ 	$x+y > -5$ 2-D 
$x = 5$ → Point. Ray Ray $x=5$	$x+y = 5$ Straight line 
$x \geq 5$ Solution set ↓ Ray 1-D.	$x+y \geq 5$ Solution set. → Halfplane ↓ (x, y) Digram.

Steps to Solve L.I. in 2-Variables

$x+y > 2$

(I) Graph → Line $x+y=2$



(II) Take 3rd (other) point (0,0)

☆ Not on the given line

(II) Put this "other point" in the inequality.

(0,0) Generally

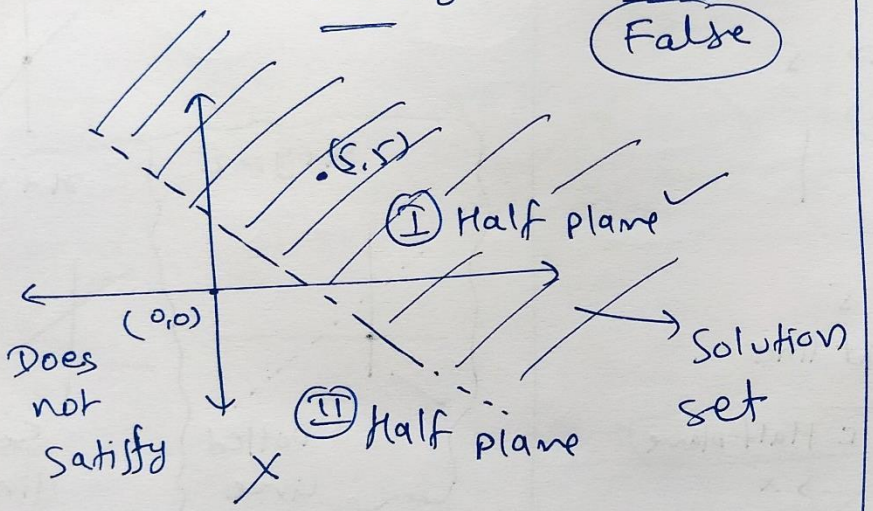
Satisfies — does not Satisfy

$x+y>2$

$0+0>2$

$0>2$

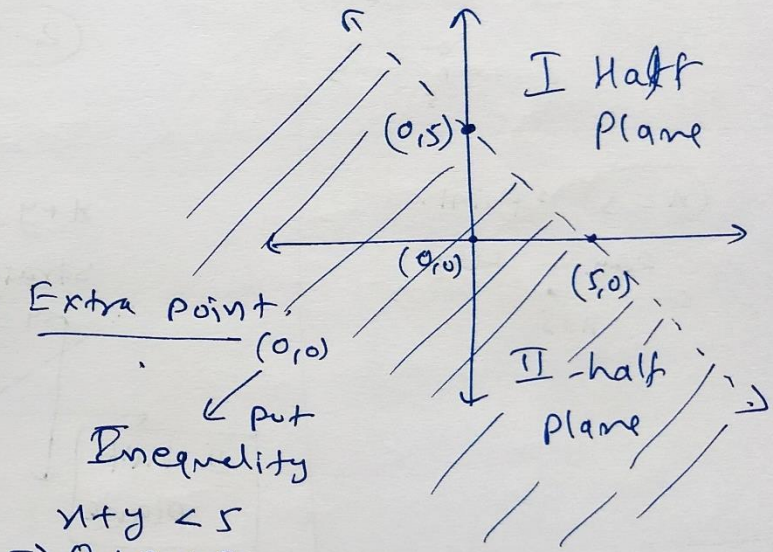
False



Q.1 $x+y<5$

Graph $\leftrightarrow x+y=5$

(0, 5) (5, 0)



Put Inequality

$x+y<5$

$\Rightarrow 0+0<5$

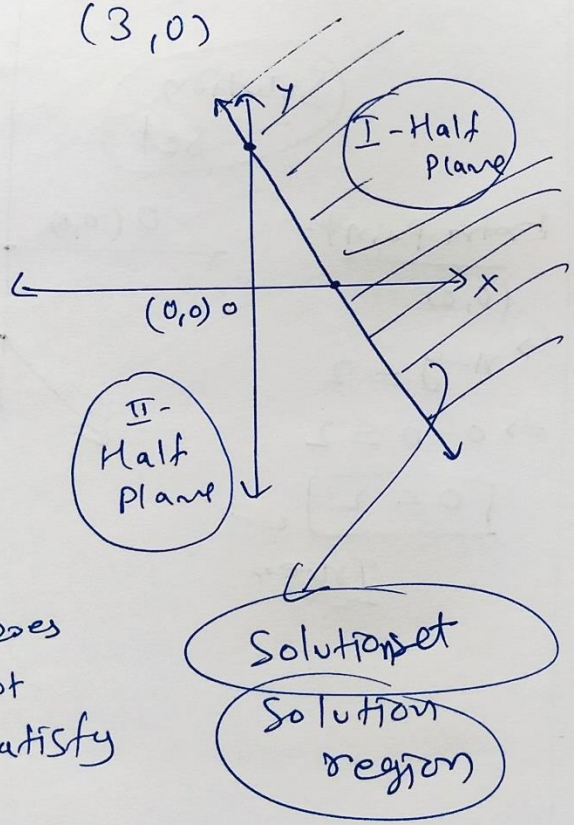
$\Rightarrow 0<5$ True

II-half plane which contains (0,0) is the solution set.

(2) $2x+y \geq 6$

Graph Line $2x+y=6$ Boundary

(0,6) (3,0)



Extra point

(0,0)

$2x+y \geq 6$

$\Rightarrow 0+0 \geq 6$

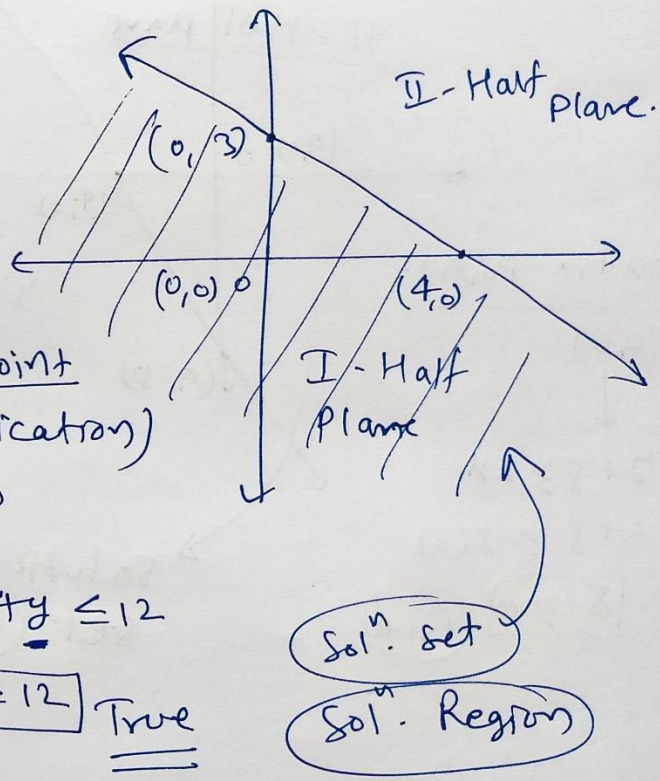
$0 \geq 6$ Does Not Satisfy

X

(3) $3x+4y \leq 12$

Graph (Border) $3x+4y=12$

(0,3) (4,0)



Extra point (verification)

(0,0)

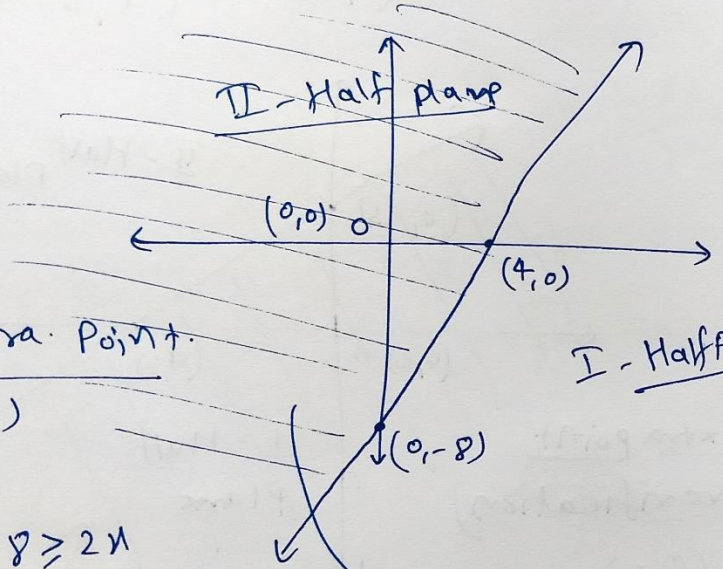
$3x+4y \leq 12$

$\Rightarrow 0 \leq 12$ True

④ $y + 8 \geq 2x$

Graph: Border: $y + 8 = 2x$

$(0, -8)$ $(4, 0)$



Extra Point.

$(0, 0)$

$y + 8 \geq 2x$

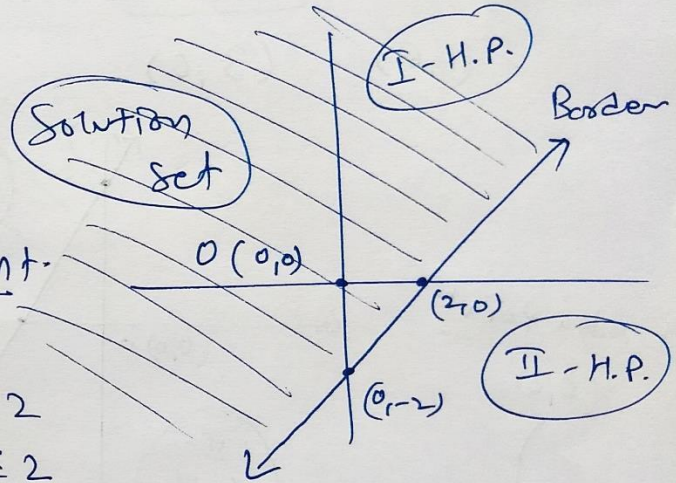
$\Rightarrow 0 + 8 \geq 2(0)$

$\Rightarrow 8 \geq 0$ True

⑤ $x - y \leq 2$

Graph: Border $x - y = 2$

$(0, -2)$ $(2, 0)$



Extra Point.

$(0, 0)$

$x - y \leq 2$

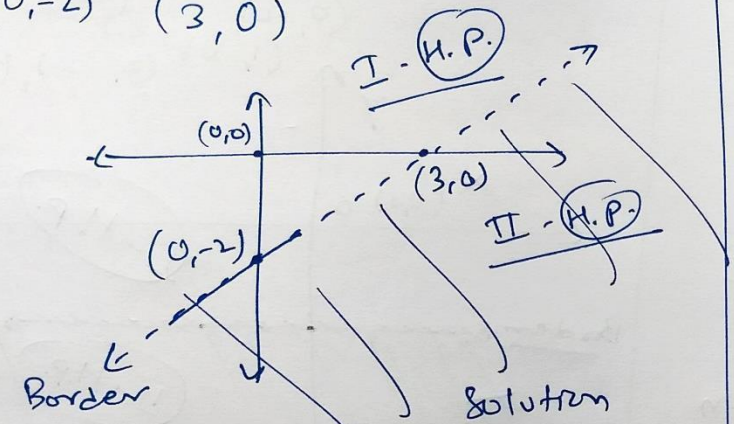
$\Rightarrow 0 - 0 \leq 2$

$0 \leq 2$ True.

⑥ $2x - 3y > 6$

Border $2x - 3y = 6$

$(0, -2)$ $(3, 0)$



Extra point $(0, 0)$

$2x - 3y > 6$

$\Rightarrow \quad 0 - 0 > 6$

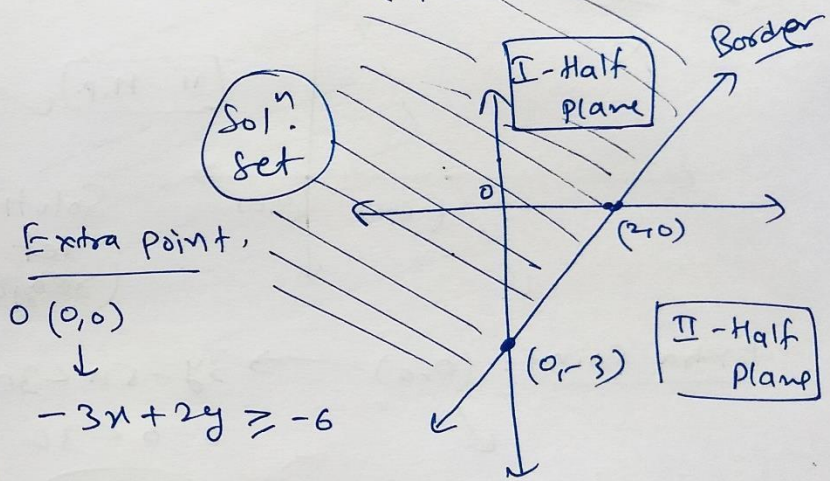
$0 > 6$ False

X

⑦ $-3x + 2y \geq -6$

Border $-3x + 2y = -6$ Line

$(0, -3)$ $(2, 0)$



Extra point,

$O\ (0, 0)$

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

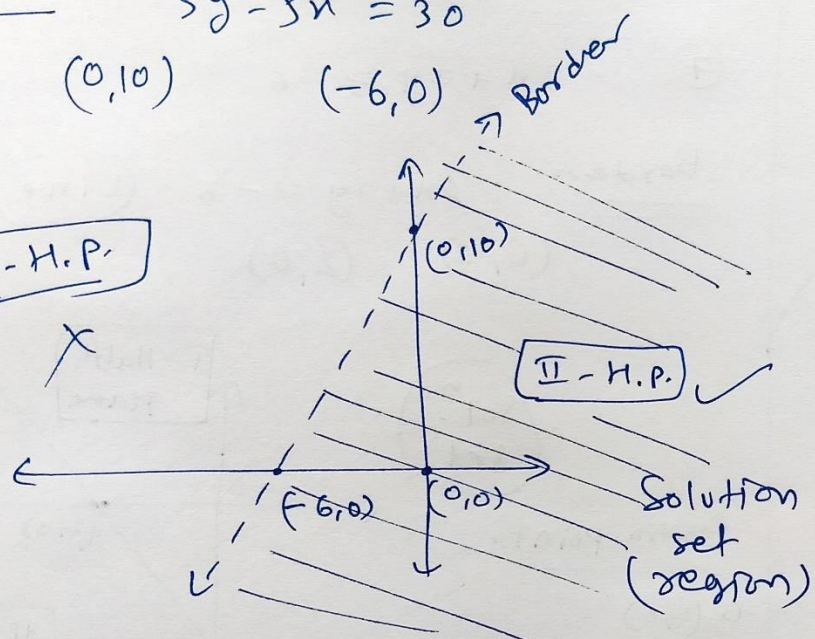
$\Rightarrow \quad 0 + 0 \geq -6$

$0 \geq -6$ True.

⑧ $3y - 5x < 30$

Border: $3y - 5x = 30$

$(0, 10)$ $(-6, 0)$



Extra point: $(0,0)$ → $3y - 5x < 30$

$0 - 0 < 30$

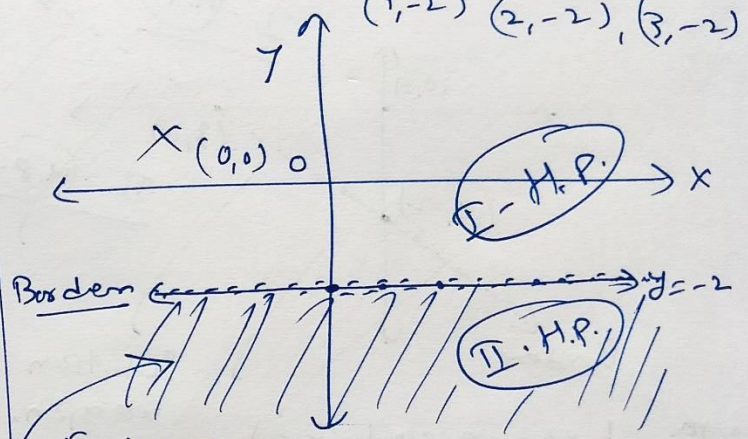
$\Rightarrow 0 < 30$

Satisfies

⑨ $y < -2$ Horizontal

Border: $y = -2$ → Line

$(0,-2)$ $(1,-2)$ $(2,-2)$, $(3,-2)$



Extra point - $(0,0)$ → $y < -2$

$\Rightarrow 0 < -2$

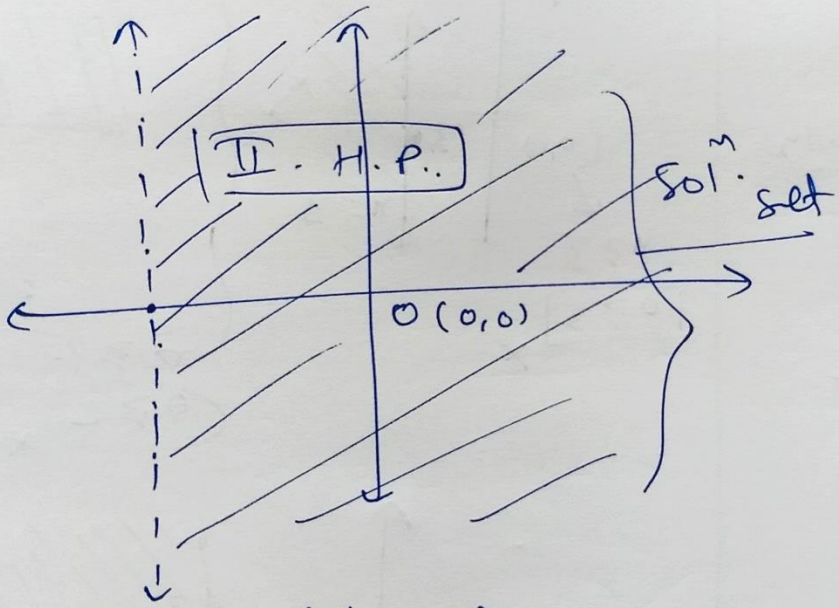
False.

Soln. set.

(10) $x > -3$

Border: $x = -3$ → { vertical line }

$(-3, 0)$ $(-3, 1)$ $(-3, 10)$



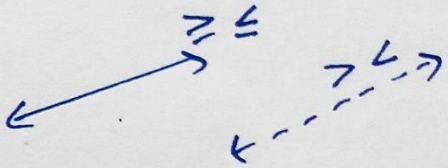
Check $(0, 0)$ ✓

$x > -3$

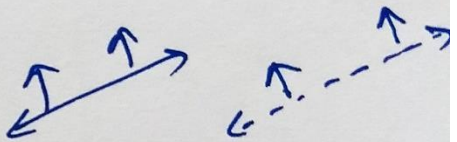
$0 > -3$ ✓

Perfect Approach for Ex. 5.3

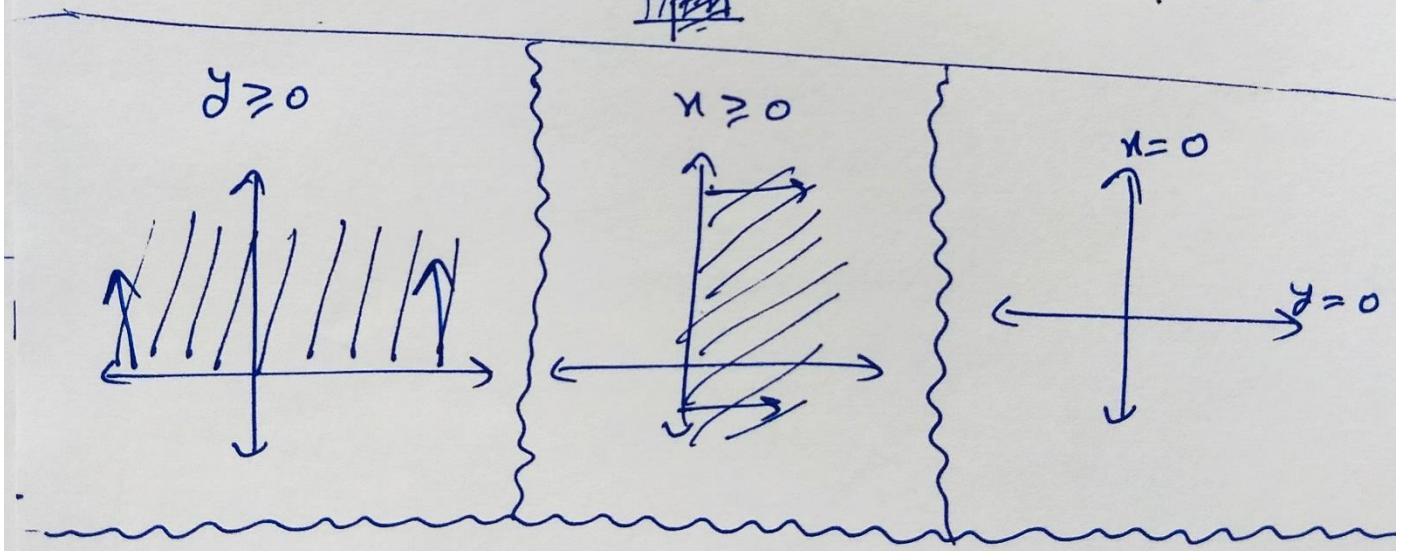
① (=) (Line) (Border)

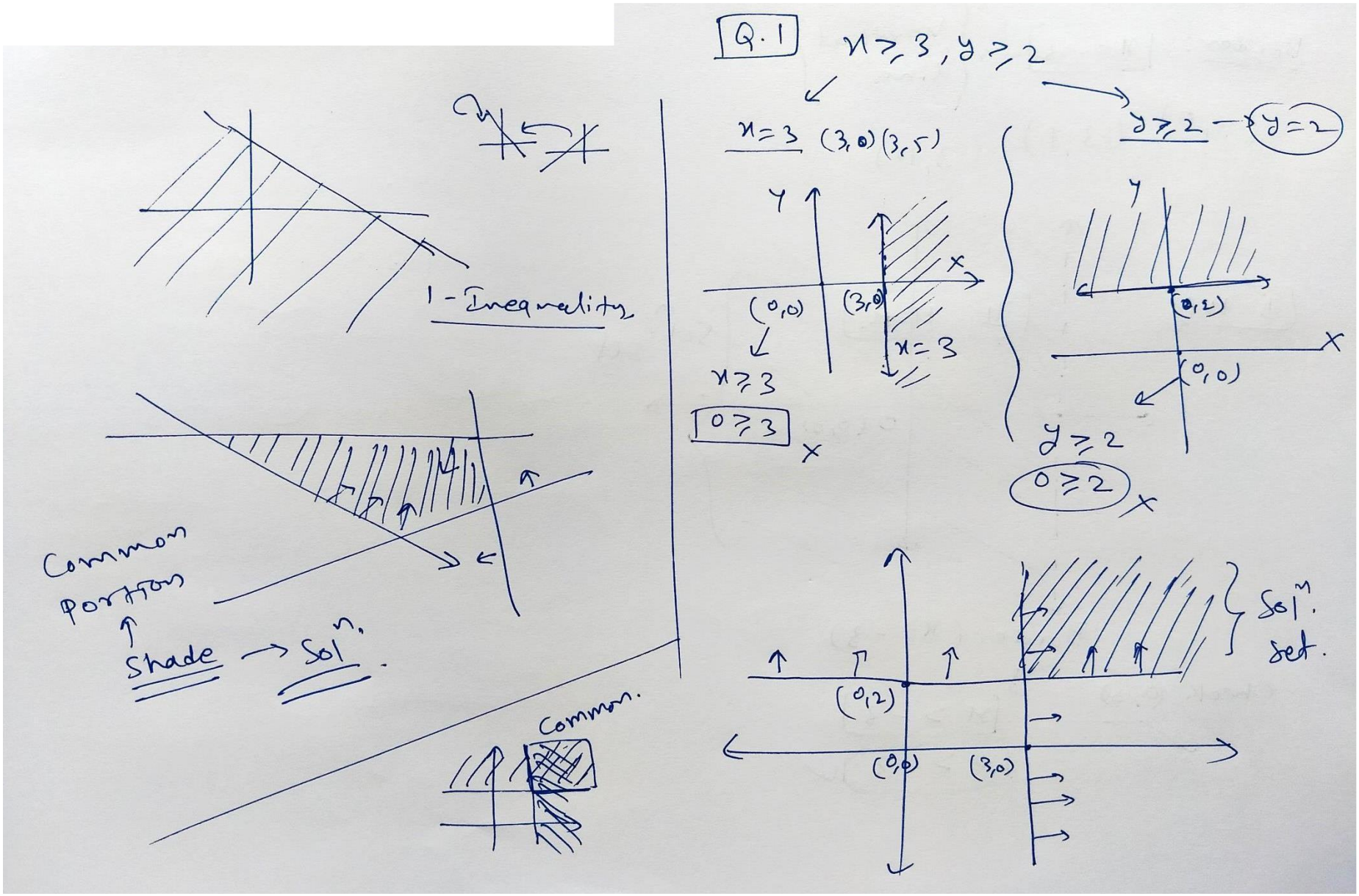


② (≥) (Half plane) (Region)



③ Common Sense (for Common Area)





Q.2 $3x + 2y \leq 12$, $x \geq 1$, $y \geq 2$

$x \geq 1$ → $x = 1$ ↕

$y \geq 2$ → $y = 2$ ↔

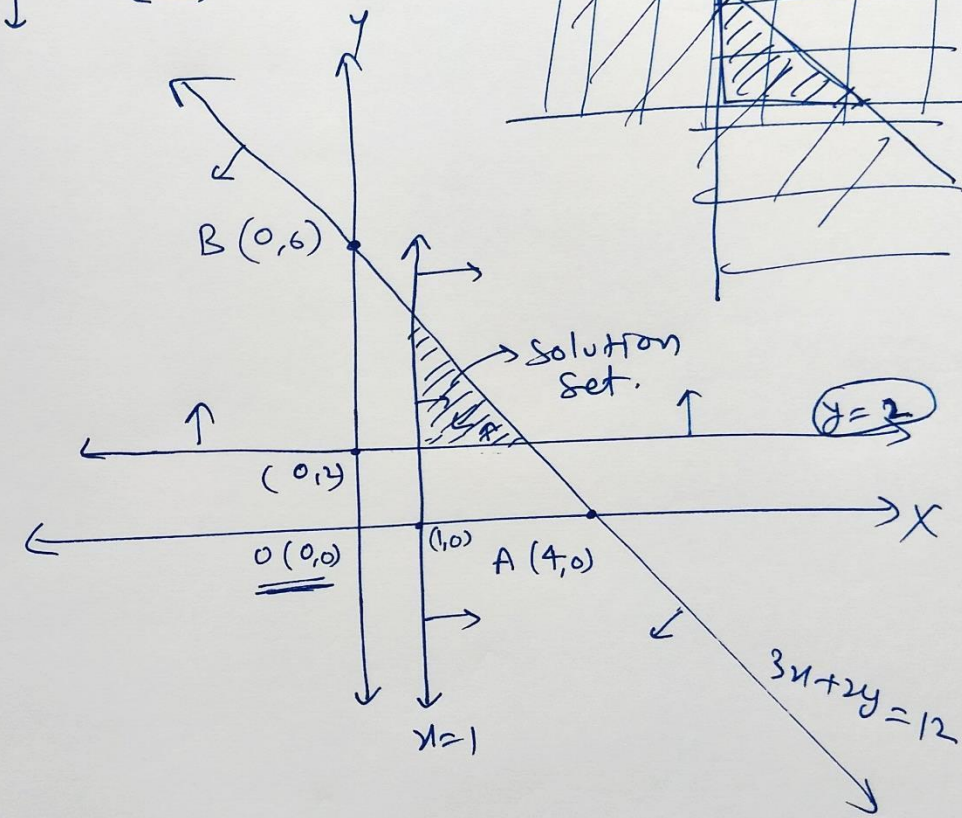
Border $3x + 2y = 12$

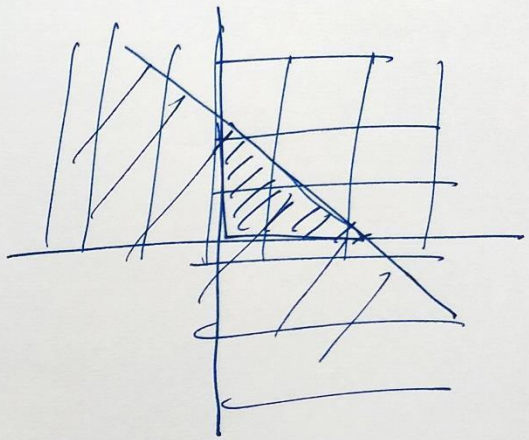
$(0, 6)$ $(4, 0)$

$(0,0) \longrightarrow 3x + 2y \leq 12$

$0 + 0 \leq 12$

$0 \leq 12$ ✓

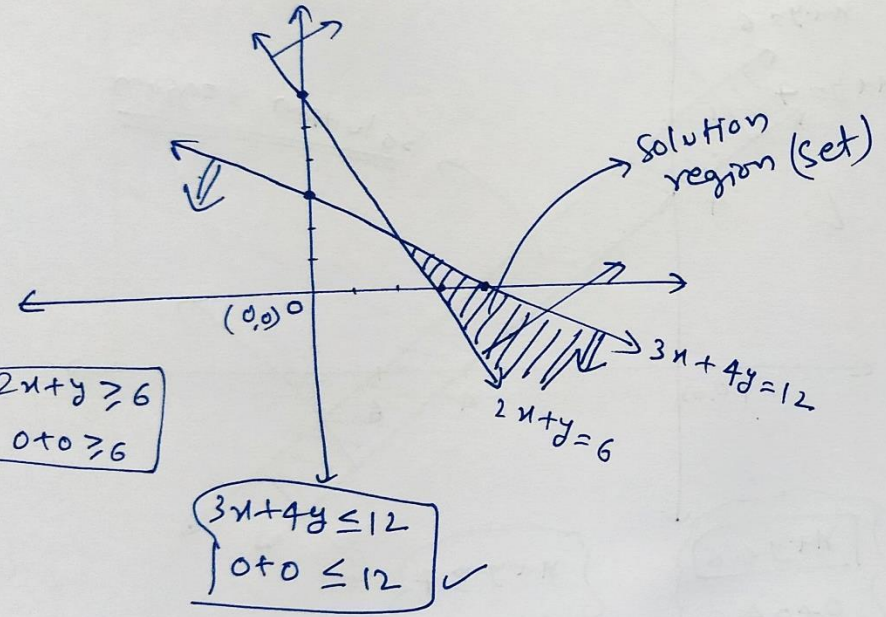




Q.3 $2x+y \geq 6$, $3x+4y \leq 12$

$2x+y=6$ → $(0,6)$ $(3,0)$

$3x+4y=12$ → $(0,3)$ $(4,0)$



$2x+y \geq 6$

$0+0 \geq 6$ ✗

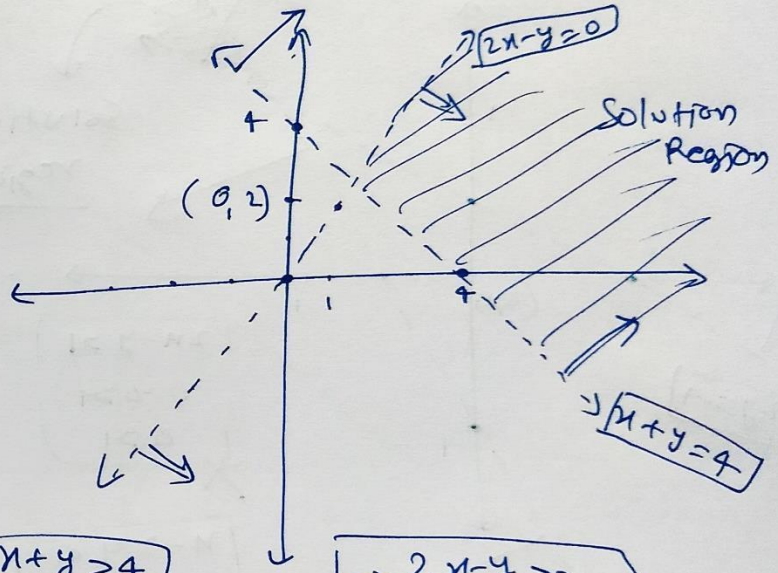
$3x+4y \leq 12$

$0+0 \leq 12$ ✓

Q.4 $x+y>4$, $2x-y>0$

$x+y=4$ → $(0,4)$ $(4,0)$

$2x-y=0$ → $(0,0)$ $(1,2)$



$x+y>4$

$0+0>4$

$0>4$ ✗

$2x-y>0$

$(0,2)$ ↑

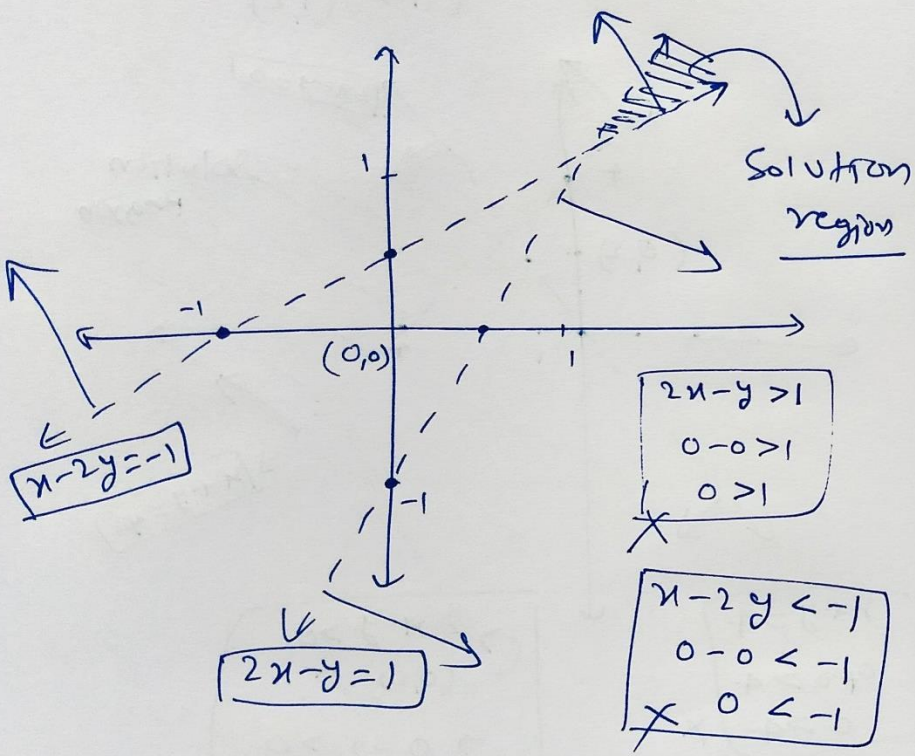
$\rightarrow 0-2>0$

$\Rightarrow -2>0$ ✗

⑤ $2x-y>1$, $x-2y<-1$

$2x-y=1$, $x-2y=-1$

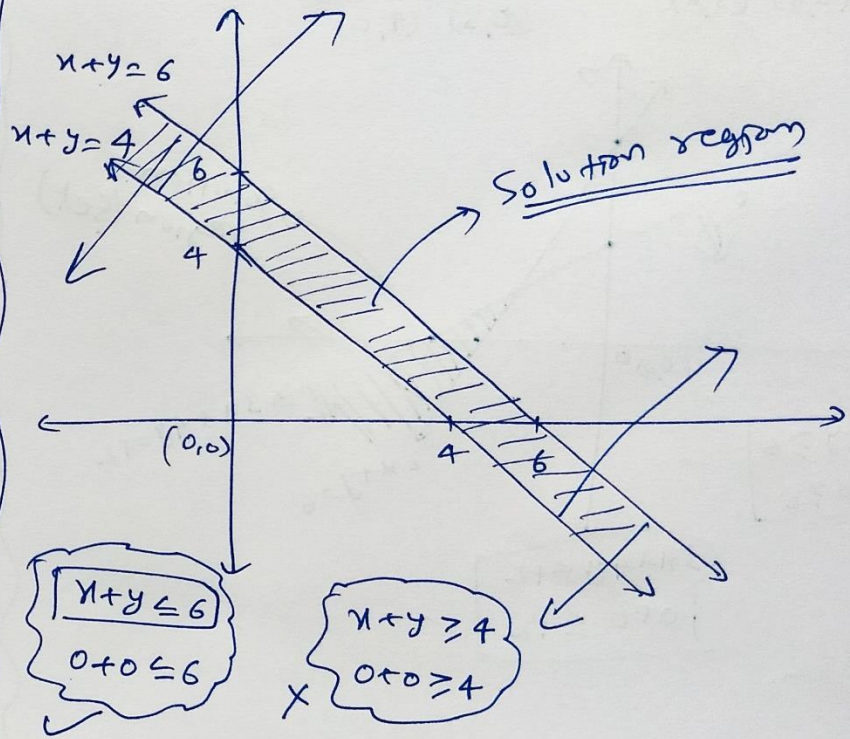
$(0,-1)$, $(\frac{1}{2},0)$ $(0,\frac{1}{2})$, $(-1,0)$



Q.6 $x+y\leq 6$, $x+y\geq 4$

$x+y=6$ $(0,6)(6,0)$

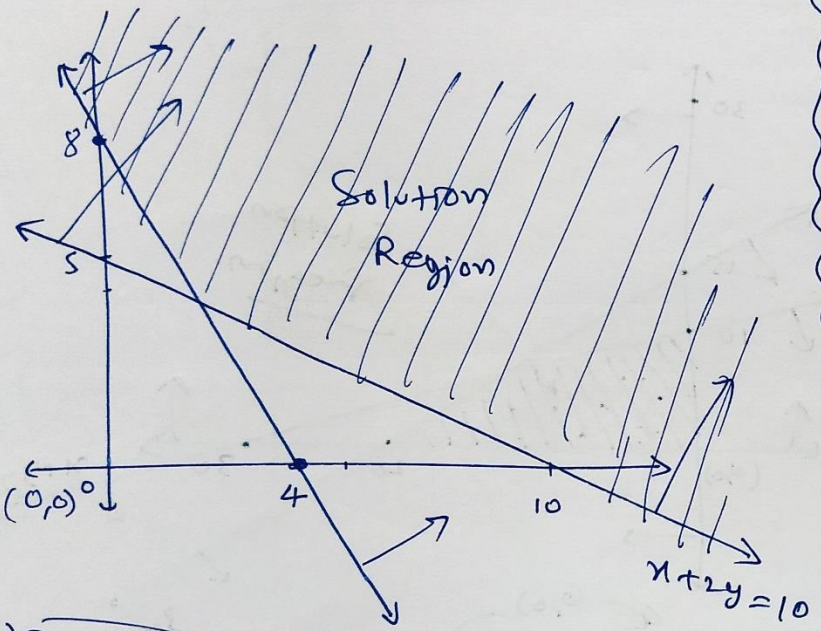
$x+y=4$ $(4,0)$, $(0,4)$



(7) $2x+y \geq 8$ $\quad x+2y \geq 10$

$2x+y=8$ $\quad x+2y=10$

(4,0) (0,8) $\quad$ (10,0) (0,5)



(0,0)

$2x+y \geq 8$

$0+0 \geq 8$ ✗

$x+2y \geq 10$

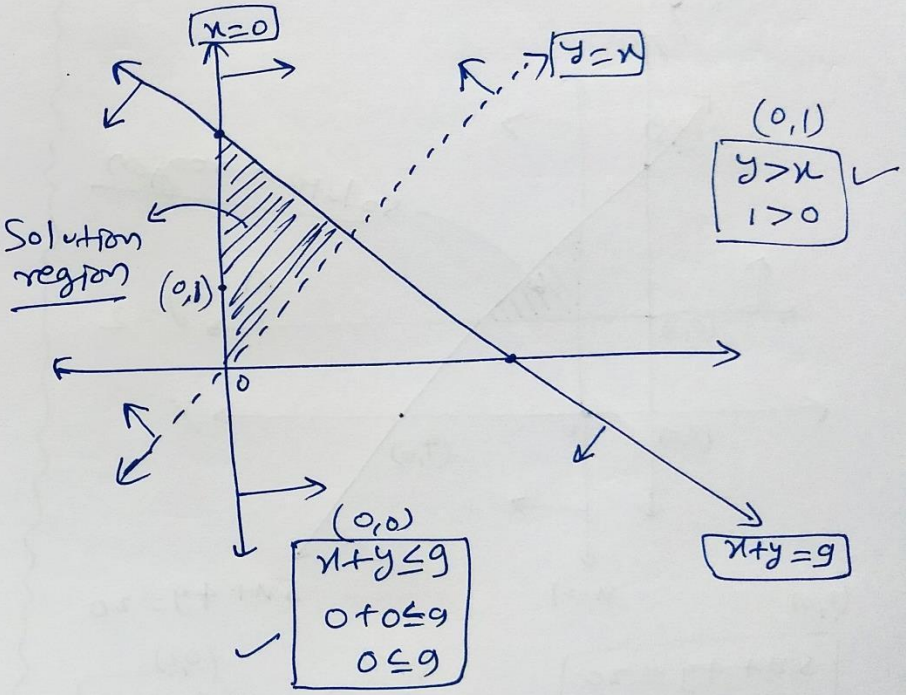
$0+0 \geq 10$ ✗

11th

Q.8 $\quad x+y \leq 9$, $\quad y > x$, $\quad x \geq 0$

$x+y=9$ $\quad y=x$ $\quad x=0$ (y-axis)

(0,9) (9,0)



(9) $5x + 4y \leq 20$, $x \geq 1$, $y \geq 2$

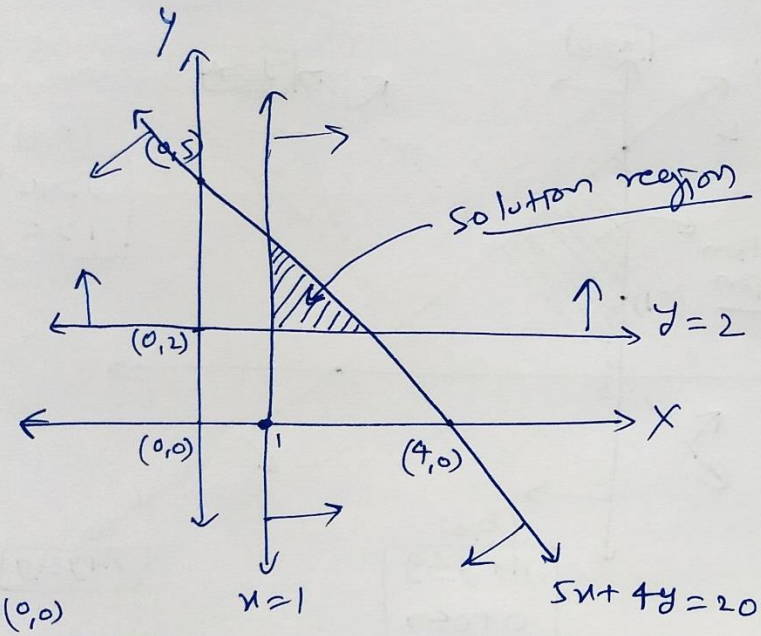
$5x + 4y = 20$

$(0,5)$, $(4,0)$

$x = 1$

$(1,0)$
$(1,1)$
$(1,2)$

$y = 2$



$(0,0)$

$5x + 4y \leq 20$

$0 + 0 \leq 20$

$0 \leq 20$

$(0,0)$

$x \geq 1$

$0 \geq 1$ ✗

$(0,0)$

$y \geq 2$

$0 \geq 2$ ✗

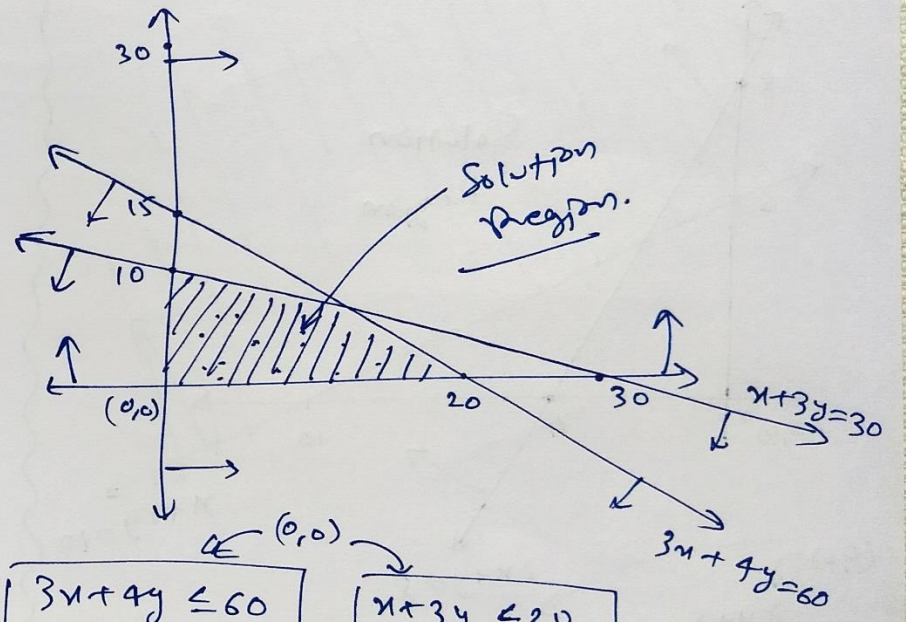
Q.10 $3x + 4y \leq 60$, $x + 3y \leq 30$, $x \geq 0$, $y \geq 0$

$3x + 4y = 60$

$(0,15)$ $(20,0)$

$x + 3y = 30$

$(0,10)$ $(30,0)$



$(0,0)$

$3x + 4y \leq 60$

$0 + 0 \leq 60$

$0 \leq 60$

$(0,0)$

$x + 3y \leq 30$

$0 + 0 \leq 30$

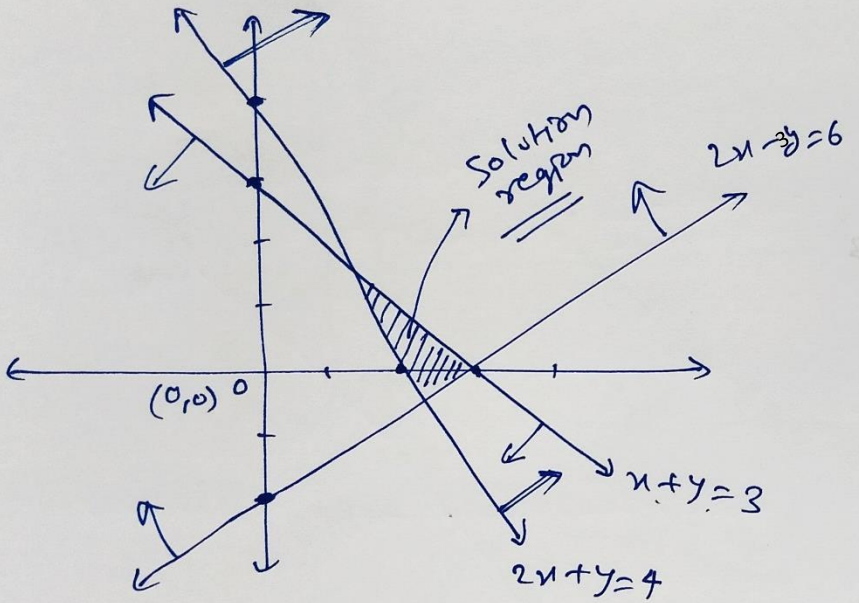
$0 \leq 30$

(11) $2x+y \geq 4$, $x+y \leq 3$, $2x-3y \leq 6$

$2x+y=4$: $(0,4)$ $(2,0)$

$x+y=3$: $(0,3)$ $(3,0)$

$2x-3y=6$: $(0,-2)$, $(3,0)$



$2x+y \geq 4$	$x+y \leq 3$	$2x-3y \leq 6$
$0+0 \geq 4$	$0+0 \leq 3$	$0-0 \leq 6$
$0 \geq 4$	$0 \leq 3$	$0 \leq 6$
✗	✓	✓

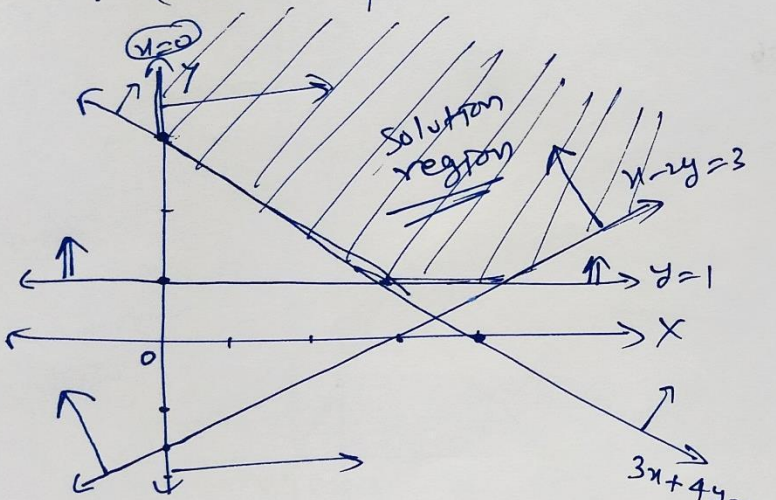
(12) $x-2y \leq 3$, $3x+4y \geq 12$, $x \geq 0$, $y \geq 1$

$x-y.2=3$: $(0,-1.5)$ $(3,0)$

$3x+4y=12$: $(0,3)$ $(4,0)$

Direct

$y=1$



$x-2y \leq 3$	$3x+4y \geq 12$	$y \geq 1$
$0-0 \leq 3$	$0+0 \geq 12$	$0 \geq 1$
$0 \leq 3$	$0 \geq 12$	✗
✓	✗	

(13) $4x + 3y \leq 60$, $y \geq 2x$, $x \geq 3$, $x, y \geq 0$

$4x + 3y = 60$

$(0, 20)$ $(15, 0)$

$y = 2x$

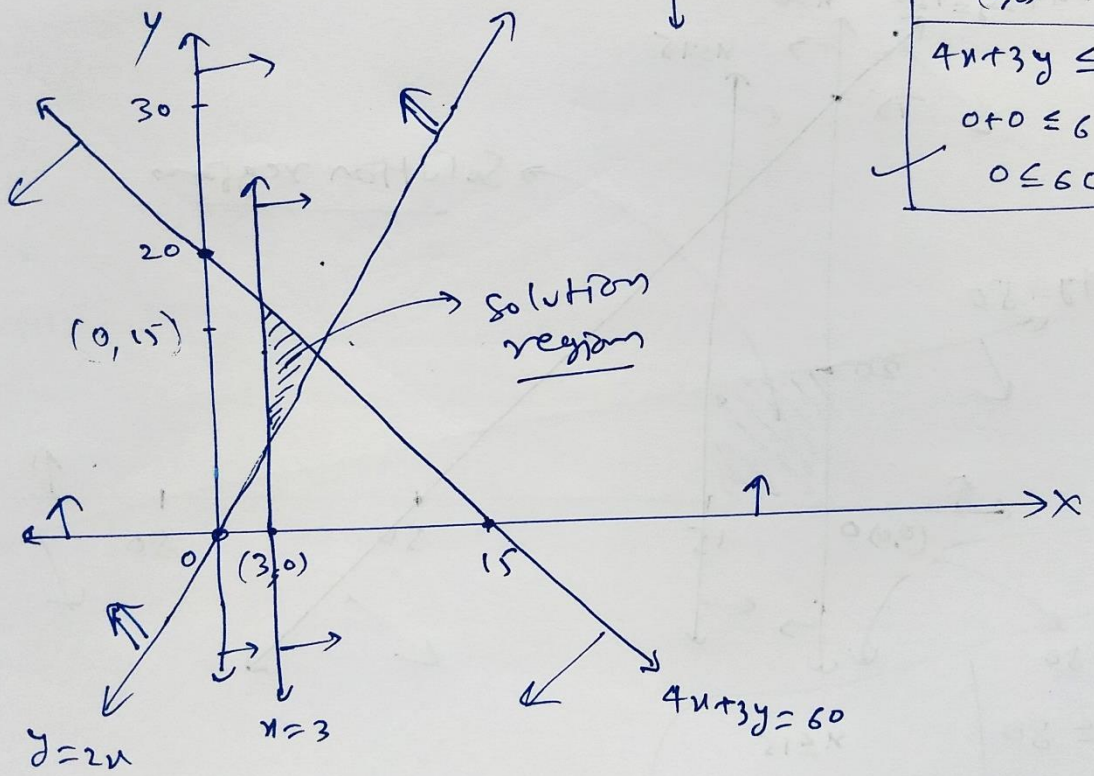
$(0, 0)$, $(5, 30)$

$x = 3$ $(3, 0)$

vertical line

$x \geq 0$ $y \geq 0$

Direct.



(0, 0)

$4x + 3y \leq 60$

$0 + 0 \leq 60$

$0 \leq 60$

~~(0, 0)~~ (0, 15)

$y \geq 2x$

$15 \geq 0$

(0, 0)

$x \geq 3$

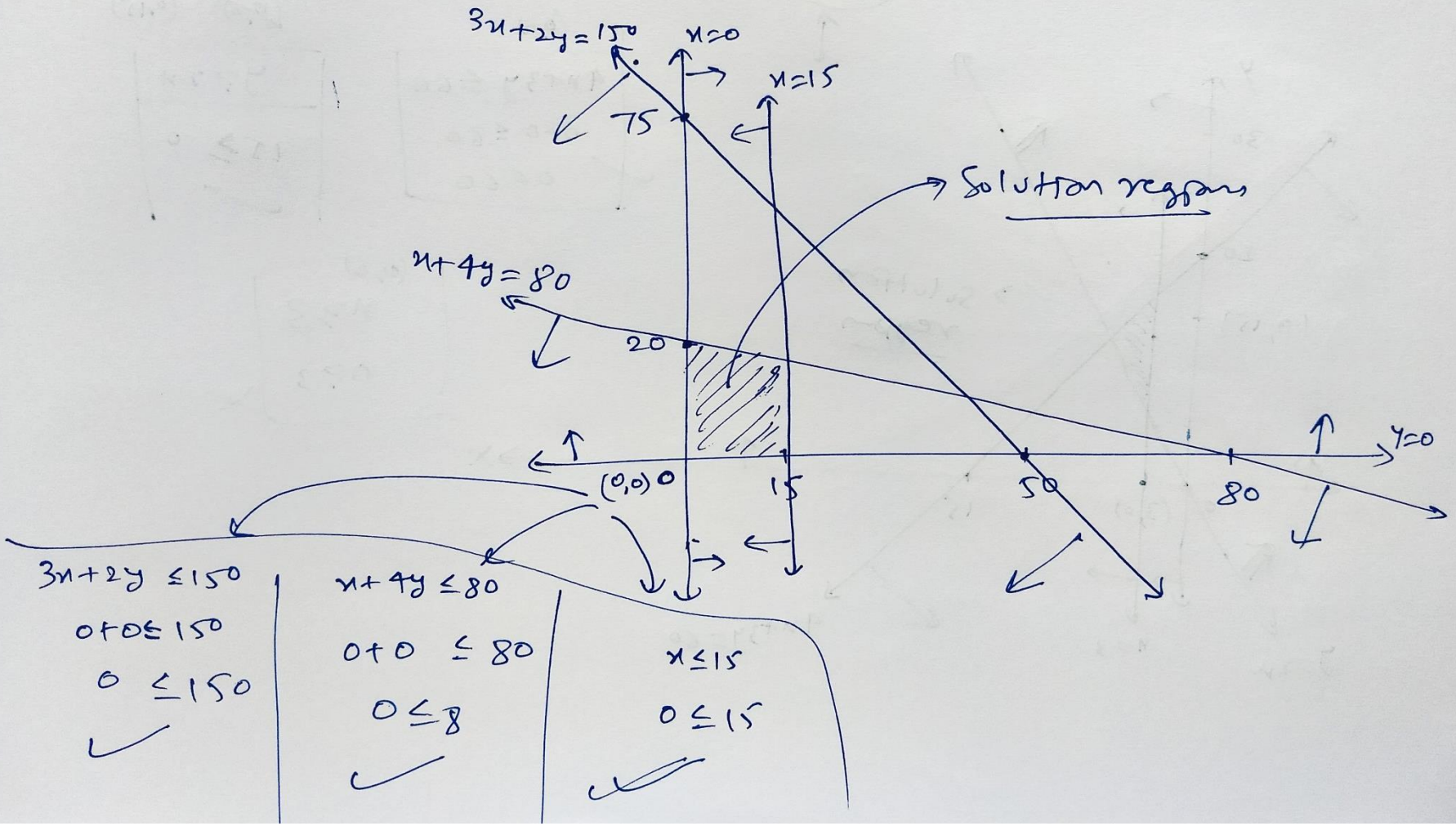
$0 \geq 3$

(14) $3x+2y \le 150$ $x+4y \le 80$ $x \le 15$ $y \ge 0$ $x \ge 0$

Direct.

Border $3x+2y = 150$ $x+4y = 80$ $x = 15$.

$(0,75)$ $(50,0)$ $(0,20)$, $(80,0)$ (vertical line)



$3x+2y \le 150$

$0+0 \le 150$

$0 \le 150$ ✓

$x+4y \le 80$

$0+0 \le 80$

$0 \le 8$ ✓

$x \le 15$

$0 \le 15$ ✓

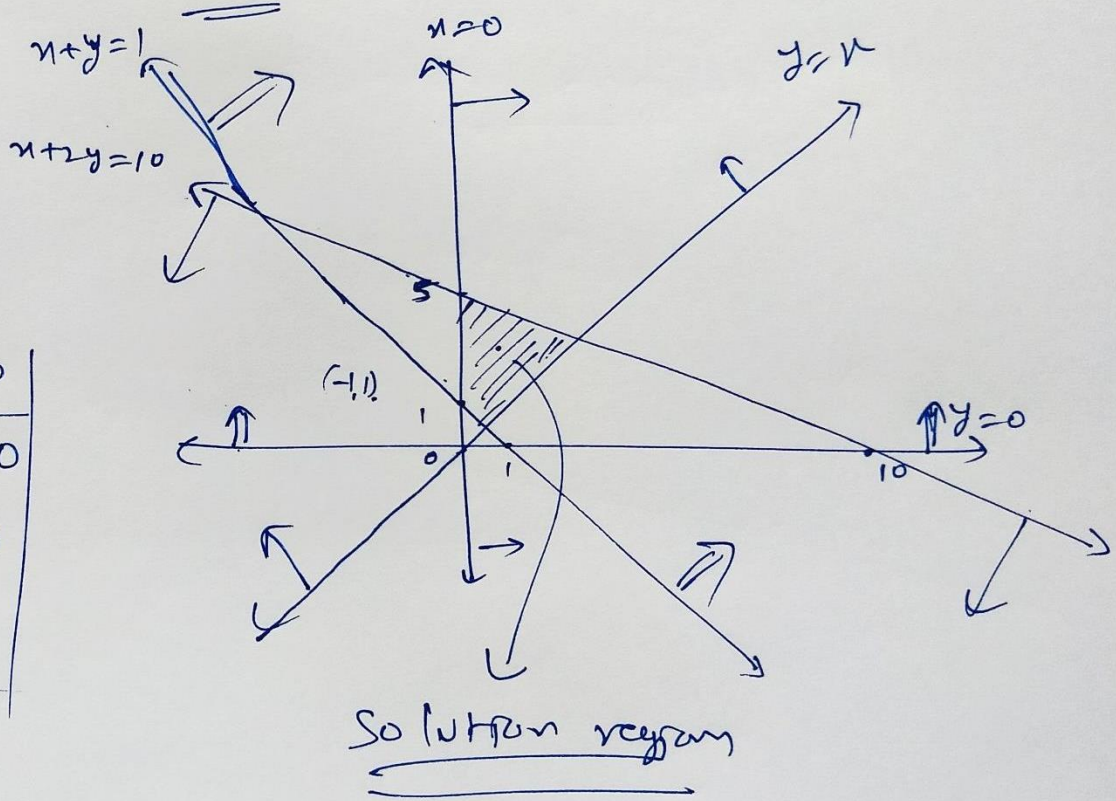
(15) $x+2y \le 10$ $x+y \ge 1$ $x-y \le 0$ $x \ge 0$ $y \ge 0$

Direct.

Border $x+2y=10$ $x+y=1$ $x-y=0$

$(10,0)$ $(0,5)$ $(1,0)$ $(0,1)$ $y=x$

Direct



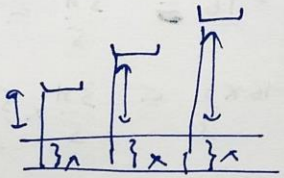
Solution region

$(0,0)$ ↓ $x+2y \le 10$	$(0,0)$ ↓ $x+y \ge 1$	$(-1,1)$ $x-y \le 0$
$0+0 \le 10$	$0+0 \ge 1$	$(-1)-(1) \le 0$
$0 \le 10$	$0 \ge 1$	$-2 \le 0$
✓	✗	✓

Miscellaneous Exercise 5.4 chapter 5 (11th)

Questions 1 to 6

Double Inequality



e.g. $1 \le -3x+4 < 5$

$-4 \quad -4 \quad -4$

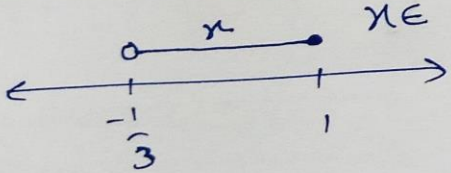
$\Rightarrow -3 \le -3x < 1$

Divide by -3 ← Sign of Inequality changes.

$\Rightarrow \frac{-3}{-3} \ge \frac{-3x}{-3} > \frac{1}{-3}$

$\Rightarrow \boxed{1 \ge x > -\frac{1}{3}}$

$x \in \left(-\frac{1}{3}, 1\right]$



Q.1 $2 \le 3x-4 \le 5$

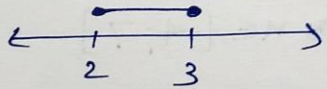
$\Rightarrow$ Add (+4)

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

$\Rightarrow 6 \le 3x \le 9$

Divide '3' → +ve → No change in sign

$\Rightarrow \boxed{2 \le x \le 3}$



$x \in [2,3]$

Q.2 $6 \le -3(2x-4) < 12$

-3 Divide ↓ Change

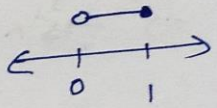
$\Rightarrow \frac{6}{-3} \ge \frac{-3(2x-4)}{-3} > \frac{12}{-3}$

$\Rightarrow -2 \ge 2x-4 > -4$

$\Rightarrow 4-2 \ge 2x > -4+4$

$\Rightarrow 2 \ge 2x > 0$

$\Rightarrow 1 \ge x > 0$



$x \in (0,1]$

Q.3 $-3 \le 4 - \frac{7x}{2} \le 18$

(-4) (-4) (-4)

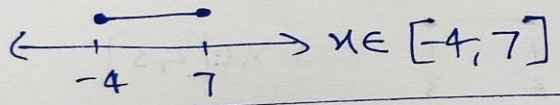
$\Rightarrow$

$-7 \le -\frac{7}{2}x \le 14$

Divide $\left(\frac{7}{2}\right)$:

$\Rightarrow \frac{+7}{\left(\frac{+7}{2}\right)} \ge x \ge \frac{-14}{\left(\frac{-7}{2}\right)}$

$\Rightarrow 7 \ge x \ge -4$



$x \in [-4, 7]$

Q.4 $-15 < \frac{3(x-2)}{5} \le 0$

multiply $5/3$

$\Rightarrow -\frac{15}{3} \times \frac{5}{3} < (x-2) \le 0$

$\Rightarrow -25 < x-2 \le 0$

$(+2)$ $(+2)$ $(+2)$

$\Rightarrow -23 < x \le 2 \Rightarrow x \in (-23, 2]$

Q.5 $-12 < 4 - \frac{3x}{-5} \le 2$

$\Rightarrow -12 < 4 + \frac{3x}{5} \le 2$

(-4) (-4) (-4)

$\Rightarrow -16 < \frac{3x}{5} \le -2$ (multiply $\frac{5}{3}$)

$\Rightarrow -16 \times \frac{5}{3} < \frac{3x}{5} \times \frac{5}{3} \le -2 \times \frac{5}{3}$

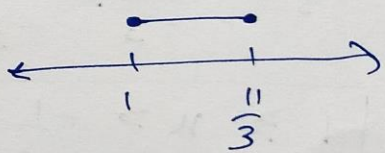
$\Rightarrow -\frac{80}{3} < x \le -\frac{10}{3} \Rightarrow x \in \left(-\frac{80}{3}, -\frac{10}{3}\right]$

Q.6 $7 \le \frac{(3x+11)}{2} \le 11$

$\Rightarrow 14 \le (3x+11) \le 22$

$\Rightarrow 3 \le 3x \le 11$

$\Rightarrow 1 \le x \le \frac{11}{3}$



$x \in \left[1, \frac{11}{3}\right]$

(7) $5x+1 > -24$ and $5x-1 < 24$

Solve $\cap$ Solve. → common

Number line (easy)

$5x+1 > -24$

$\Rightarrow 5x > -25$

$\Rightarrow x > \frac{-25}{5}$

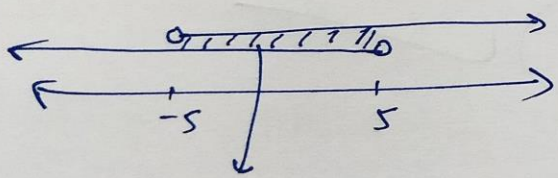
$\boxed{x > -5}$

$5x-1 < 24$

$\Rightarrow 5x < 25$

$\Rightarrow x < \frac{25}{5}$

$\Rightarrow \boxed{x < 5}$



Solution $x \in (-5, 5)$ ✓

(8) $2(x-1) < x+5$

$\Rightarrow 2x-2 < x+5$

$\Rightarrow 2x-x < 5+2$

$\Rightarrow \boxed{x < 7}$

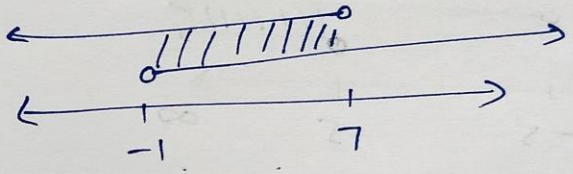
$3(x+2) > 2-x$

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

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

$\Rightarrow 4x > -4$

$\Rightarrow \boxed{x > -1}$



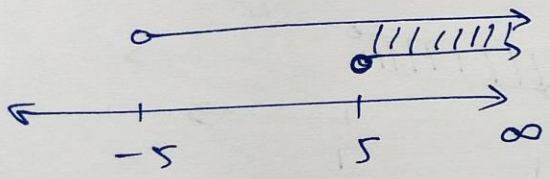
$x \in (-1, 7)$ ✓

(9) $3x-7 > 2(x-6)$

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

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

$\Rightarrow \boxed{x > -5}$



$x \in (5, \infty)$ ✓

$6-x > 11-2x$

$\Rightarrow 2x-x > 11-6$

$\Rightarrow \boxed{x > 5}$

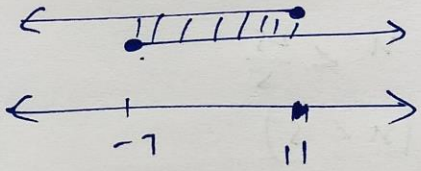
(10) $5(2x-7) - 3(2x+3) \leq 0$

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

$\Rightarrow 4x - 44 \leq 0$

$\Rightarrow 4x \leq 44$

$\Rightarrow \boxed{x \leq 11}$



$x \in [-7, 11]$ ✓

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

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

$\Rightarrow -4x \leq 28$

$\Rightarrow \frac{-4x}{-4} \geq \frac{28}{-4}$

$\Rightarrow \boxed{x \geq -7}$

(11)

$68 < \boxed{\text{Fahrenheit}} < 77$

$? < \text{celsius} < ?$

$\boxed{F = \frac{9}{5}C + 32}$

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

$-32 \quad -32 \quad -32$

$\Rightarrow \left(36 < \frac{9}{5}C < 45\right) \times \frac{5}{9}$

$\Rightarrow \boxed{20 < C < 25}$

Temperature in degree Celsius between 20°c & 25°c

(12)

Solution → Concentration (Fraction, %)

→ Volume → (L, cm^3, m^3, dm^3)

Complete

8% BA, 640 L + 2% BA, V = ? = x

↓

Mixture

4% < Conc. < 8%

V = (640 + x) L

$\% = \frac{\text{Interested}}{\text{total}} \times 100$

A B C

20 10 30 = 60

$\%C = \frac{30}{60} \times 100$

$= 50\%$

$4\% < \boxed{\text{Concentration of mixture}} < 6\%$

$\Rightarrow 4 < \dfrac{\text{vol. of (B.A.)}}{\text{total volume}} \times 100 < 6$

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

$\oplus$

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

Double inequality.

(I) $\quad {}^{2}\cancel{4}\times\left(\dfrac{640+x}{\cancel{100}}\right) < 640\times\dfrac{\overset{4}{\cancel{8}}}{\cancel{100}} + \dfrac{\cancel{2}x}{\cancel{100}}$

$\Rightarrow 1280 + 2x < 2560 + x$

$\Rightarrow 2x - x < 2560 - 1280$

$\Rightarrow \boxed{x < 1280}$

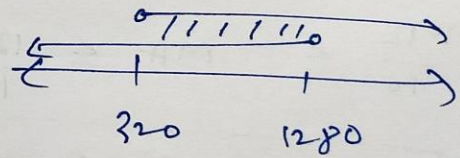
(II) $\quad 640\times\dfrac{\overset{4}{\cancel{8}}}{\cancel{100}} + \dfrac{\overset{1}{\cancel{2}}}{\cancel{100}}\times x < \overset{3}{\cancel{6}}\times\left(\dfrac{640+x}{\cancel{100}}\right)$

$\Rightarrow 2560 + x < 1920 + 3x$

$\Rightarrow 640 < 2x$

$\Rightarrow \boxed{320 < x}$

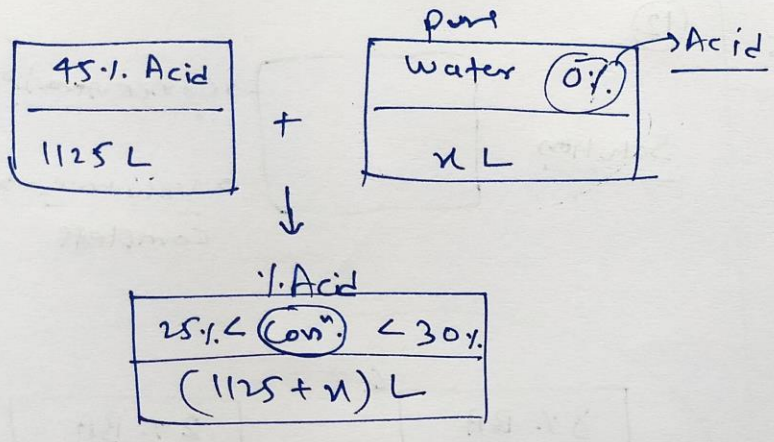
$320 < x, \quad x \leq 1280$



$x \in (320, 1280]$

2%. $\quad 320\text{L} \rightarrow 1280\text{L}$

(13)



$25\% < \frac{\text{Conc. of mixture}}{\%\text{ Acid}} < 30\%$

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

(I) (II)

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

$\Rightarrow 25 \times 1125 + 25x < 45 \times 1125$

$\Rightarrow 25x < 1125 \times 20$

$\Rightarrow x < \frac{1125 \times 20}{25}$

$\Rightarrow x < 45 \times 20$

$\Rightarrow x < 900$

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

$\Rightarrow 1125 \times 45 < 30 \times 1125 + 30x$

$\Rightarrow 1125 \times 15 < 30x$

$\Rightarrow \frac{1125 \times 15}{30} < x$

$\Rightarrow 562.5 < x$

$562.5 < x \qquad x < 900$

$x \in (562.5, 900)$

(14) $IQ = \frac{MA}{CA} \times 100$

MA → mental Age → ?

CA → Chronological Age → 12 years

$80 \leq IQ \leq 140$

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

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

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

$\Rightarrow 9.6 \leq MA \leq 16.8$