



# Class 11 Maths || Chapter 6 : Linear Inequalities || Class Notes

Toppers Village

## Class 11 Maths chapter 6 Linear Inequalities

Rules:

① Add / Subtract

↓  
Sign of Inequality → (No change)

$$\begin{array}{r} 5 > 3 \\ -2 & -2 \end{array}$$

$$x + 2 > 5$$

$$x > 5 - 2$$

$$x > 3$$

② Multiply / Divide

⊕ve

Sign of Ineq.

No change

⊖ve

Sign of Ineq.

Change

Process

Single Inequality.

$$x > 5$$

Solve

Natural No.

↓  
Set

Integers

↓  
Set

Real No.

Interval

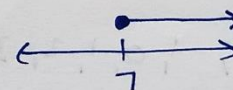
$$2 < x \leq 3$$

$$x \in (2, 3]$$

No. LINE

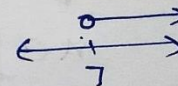
Include

$$x \geq 7$$



Exclude

$$x > 7$$



### Exercise 6.1

① Solve  $24x < 100$

(i)  $x$  is a natural No.  $\rightarrow$  Set

(ii)  $x$  is an integer  $\rightarrow$  Set

$$24x < 100$$

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

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

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

Solution,

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

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

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

② Solve

$$\boxed{-12x > 30}$$

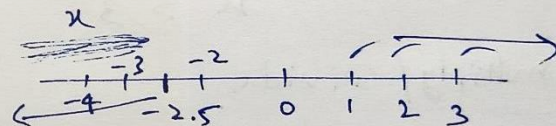
Solve

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

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

$$\Rightarrow \boxed{x < -2.5} \checkmark$$

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



No Solution,

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

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

-12  $\ominus$ ve  
change



③ Solve  $5x - 3 < 7$

$\Rightarrow 5x < 10$

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

$x < 2$

(i)  $x \in \text{Integer}$   
Set

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

(ii)  $x \in \text{Real}$   
Interval

$-\infty < x < 2$

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

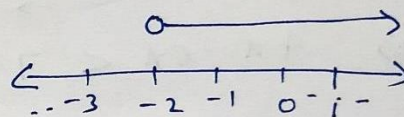
④ Solve  $3x + 8 > 2$

$\Rightarrow 3x > 2 - 8$

$\Rightarrow 3x > -6$

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

$x > -2$



(i)  $x \in \text{integer}$

Set

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

(ii)  $x \in \text{Real.}$

Interval

$x > -2$

$-2 < x < \infty$

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

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Class-11-Maths

Exercise 6.1

Linear Inequalities

**Q.5**

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

$$x \in \mathbb{R}$$

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

$$\Rightarrow -2x < 4$$

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

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

$$\Rightarrow -2 < x$$

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

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

⊖ve. Divide

Sign → change

$$x \in (=, =)$$

$$[ \quad )$$

$$( \quad ]$$

$$[ \quad ]$$

(✓)

[x

**⑥**

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

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

$$\Rightarrow -6 > 2x$$

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

$$\Rightarrow -3 > x$$

$$\Rightarrow x < -3$$

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

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

2 → ⊕ve  
(No change)



$$\textcircled{7} \quad 3(x-1) \leq 2(x-3)$$

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

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

$$\Rightarrow x \leq -3$$

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

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

$$\textcircled{\text{Q.8.}} \quad 3(2-x) \geq 2(1-x)$$

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

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

$$\Rightarrow 4 \geq x$$

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

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

$$\textcircled{9} \quad \frac{x}{1} + \frac{x}{2} + \frac{x}{3} < 11$$

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

$$\Rightarrow 11x < 66$$

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

$$\Rightarrow \boxed{x < 6}$$

$$\Rightarrow \boxed{-\infty < x < 6}$$

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

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

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

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

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

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

$$\Rightarrow x < -6$$

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

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

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

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

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

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

$$\Rightarrow 34x \leq 68$$

$$\Rightarrow x \leq 2$$

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

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

$$\boxed{13} \quad 2(2x+3)-10 < 6(x-2)$$

$$\Rightarrow 4x + \underline{6-10} < \cancel{12} 6x - 12$$

$$\Rightarrow \underline{4x - 6x} < 4 - 12$$

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

$$\Rightarrow +8 < 2x$$

$$\Rightarrow 4 < x$$

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

$$x \in (4, \infty)$$

$$\boxed{14} \quad 37 - (3x+5) \geq 9x - 8(x-3)$$

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

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

$$\Rightarrow -4x \geq -8 \quad x \in (-\infty, 2]$$

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

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Ex. 6.1 Linear Inequalities

$$\boxed{15} \quad \frac{x}{4} < \frac{(5x-2)}{3} - \frac{(7x-3)}{5} \quad x \in \mathbb{R}$$

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

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

$$\Rightarrow 15x < \underline{16x} - 4$$

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

$$\Rightarrow -x < -4$$

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

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

$$\Rightarrow x > 4$$

$$\Rightarrow 4 < x < \infty$$

$$x \in (4, \infty) \quad \checkmark$$



16

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

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

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

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

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

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

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

$$\Rightarrow x \leq 2$$

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

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

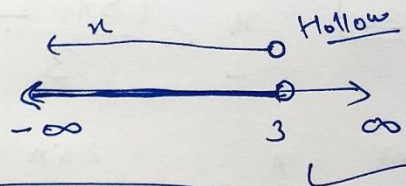
17

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

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

$$\Rightarrow x < 3$$

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



18

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

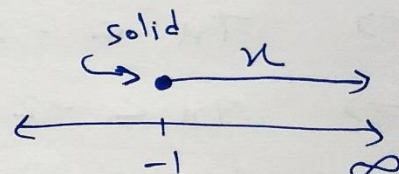
$$\Rightarrow 5x-3x \geq 3-5$$

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

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

$$\Rightarrow x \geq -1$$

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



19

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

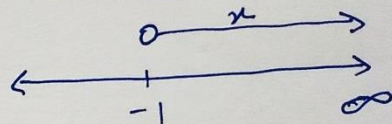
$$\Rightarrow 3-3x < 2x+8$$

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

$$\Rightarrow -5 < 5x$$

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

$$\Rightarrow -1 < x$$



Sol<sup>n</sup>:  $x \in (-1, \infty)$

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

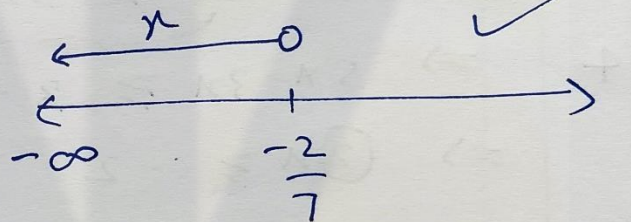
$$\Rightarrow \frac{x}{2} < \frac{25x - 10 - 21x + 9}{15}$$

$$\Rightarrow 15x < 8x - 2$$

$$\Rightarrow 7x < -2$$

$$\Rightarrow 7x < -2$$

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



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



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### Class-11-Maths    Exercise 6.1

**Q.21**    1<sup>st</sup> test  $\rightarrow 70$  ✓

2<sup>nd</sup> test  $\rightarrow 75$  ✓

3<sup>rd</sup> Test  $\rightarrow x$  (let) ✓

Average  $\rightarrow$  at least 60 marks.

$$\text{Average} \geq 60$$

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

$$\Rightarrow 145+x \geq 180 \quad \uparrow$$

$$\Rightarrow x \geq 180-145$$

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

$$\boxed{\text{Marks of 3<sup>rd</sup> Test} \geq 35}$$

$\therefore$  minimum  
marks in  
III test = 35

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

Marks in Fifth Exam =  $x$  (let)

Grade 'A'  $\rightarrow$  Average  $\geq 90$   
★

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

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

$$\Rightarrow 368+x \geq 450 \quad \uparrow$$

$$\Rightarrow x \geq 450-368$$

$$\Rightarrow \boxed{x \geq 82}$$

min. Marks in (V) Exam = 82

↑

(23)

Two consecutive  
odd positive integers  $< 10$   
& Sum  $> 11$

Pair  $\rightarrow$   $\left( \overset{\text{Small}}{2n+1}, \overset{\text{Big}}{2n+3} \right)$   
consecutive  
 $n \in \mathbb{I}$

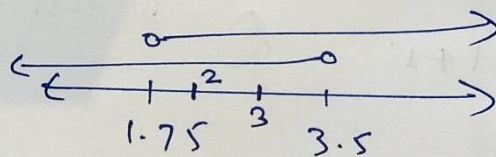


$$\begin{aligned}
 2n+3 &< 10 \quad \text{--- (i)} \\
 \text{Sum} &> 11 \\
 \Rightarrow (2n+1) &+ (2n+3) > 11 \\
 \Rightarrow 4n+4 &> 11 \\
 \Rightarrow 4n &> 7 \\
 \Rightarrow n &> \frac{7}{4} \\
 \Rightarrow n &> 1.75
 \end{aligned}$$

$$2n < 7$$

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

$$n < 3.5$$



$$n \in (1.75, 3.5)$$

$$n = 2, 3 \in \mathbb{I}$$

Pairs  $(2n+1, 2n+3)$

$$\underline{n=2} \quad (5, 7)$$

$$\underline{n=3} \quad (7, 9)$$



24 Two Consecutive  
(Even positive integers)  $> 5 \rightarrow$  Smaller  $> 5$

$$\boxed{\text{Sum} < 23}$$

Assumes.

$x \in \mathbb{I}$   
★

small B.T.R  
( $2x, 2x+2$ )  
Even Even  
(consecutive)

$$\text{Sum} < 23$$

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

$$\Rightarrow 4x + 2 < 23$$

$$\Rightarrow 4x < 21$$

$$\Rightarrow x < \frac{21}{4}$$

$$\Rightarrow \boxed{x < 5.25} \quad \star$$

$$2x > 5$$

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

$$\Rightarrow \star \boxed{x > 2.5}$$

$$\underline{x = 3, 4, 5} \quad \checkmark$$

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

$$\underline{x=3} \quad (6, 8) \quad \checkmark$$

$$\underline{x=4} \quad (8, 10) \quad \checkmark$$

$$\underline{x=5} \quad (10, 12) \quad \checkmark$$

**Q.25**

the longest side =  $3x$

third side =  $3x - 2$

the shortest side =  $x$  (let)

$$\text{Perimeter} \geq 61$$

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

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

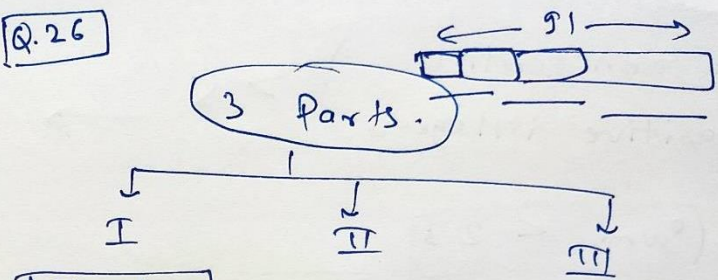
$$\Rightarrow 7x \geq 63$$

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

the shortest side  $\geq 9$

min. length of  
the shortest side = 9 cm

**Q.26**



Shortest

$$(x)$$

$$(x+3)$$

$$(2x)$$

$$(III) \geq (II) + 5$$

$$\Rightarrow \boxed{2x \geq (x+3) + 5}$$

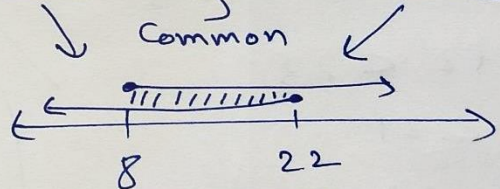
$$\Rightarrow x \geq 8$$

$$\Rightarrow \boxed{x \geq 8}$$

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

$$4x \leq 88$$

$$\boxed{x \leq 22}$$



$$\boxed{8 \leq x \leq 22}$$



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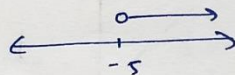
Class-11-Maths

## Linear Inequalities

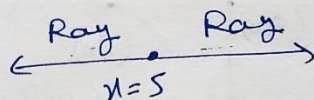
Ex. 6.2

L.I. in 1-variable.

(One-D)  $x > -5$



$x = 5$  → Point.



$x \geq 5$

Solution set

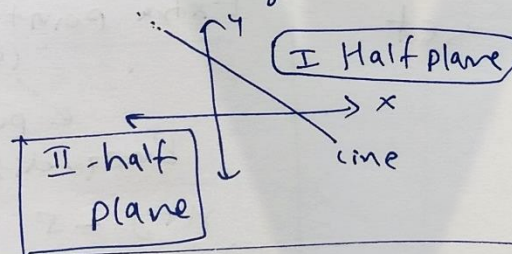
↓  
(Ray) 1-D.

L.I. in 2 variables

$x + y > -5$

(2-D)

$x + y = 5$   
Straight line



$x + y \geq 5$

Solution set. → Halfplane

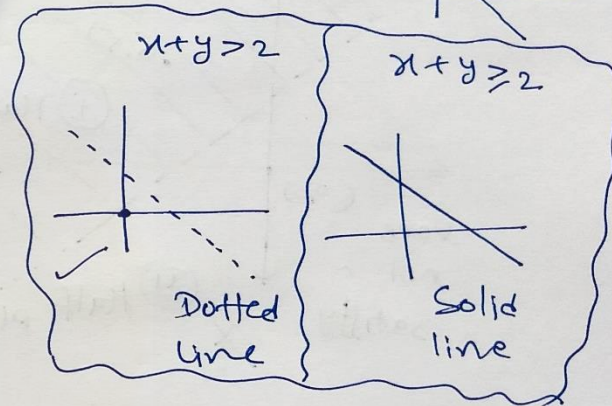
(x, y)

Diagram.

Steps to Solve L.I. in 2-Variables

$x + y > 2$

(I) Graph → Line  $x + y = 2$



(II) Take 3<sup>rd</sup> point  
(other) (0, 0)

★ Not on the given line



③ put this "other point"

in the inequality.

Satisfies      does not Satisfy

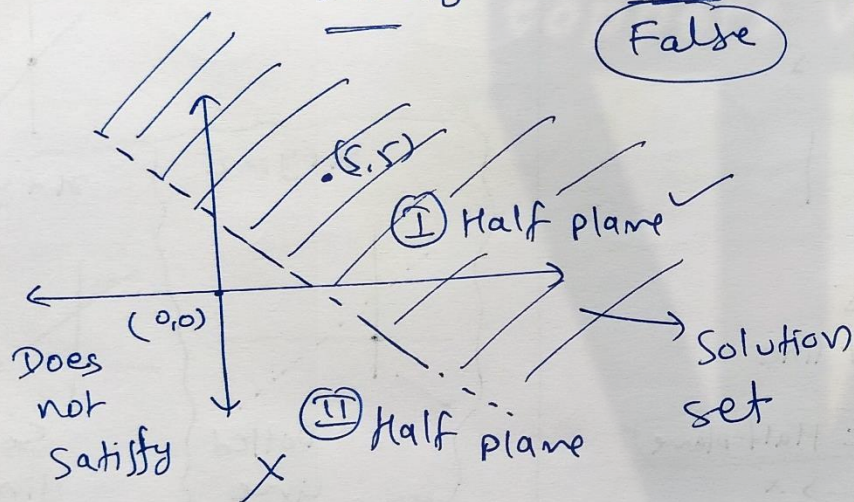
$(0,0)$  generally

$$x+y > 2$$

$$0+0 > 2$$

$$0 > 2$$

False



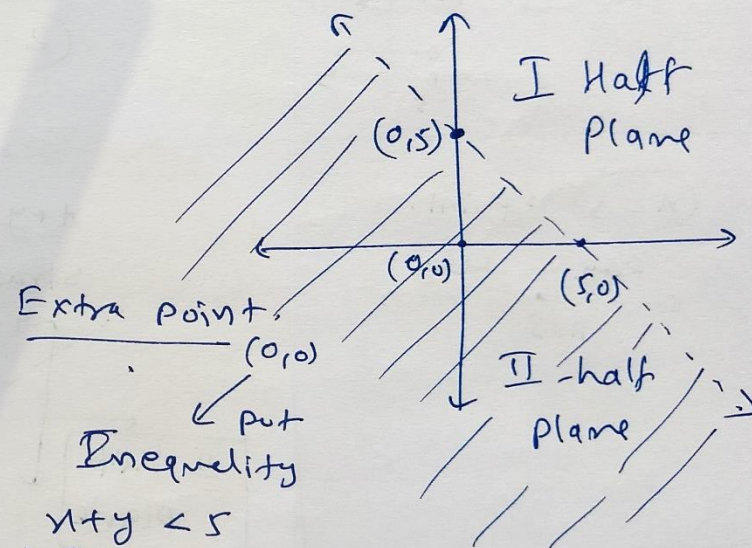
## Exercise 6.2

Q.1

$$x+y < 5$$

Graph  $\leftrightarrow x+y = 5$

$(0,5)$     $(5,0)$



$$x+y < 5$$

$$\Rightarrow 0+0 < 5$$

$$\Rightarrow 0 < 5$$

True

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



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## Class -11-Maths Exercise 6.2

②  $2x + y \geq 6$

Graph Line  $2x + y = 6$  Boundary  
(0,6) (3,0)

Extra Point  
(0,0)

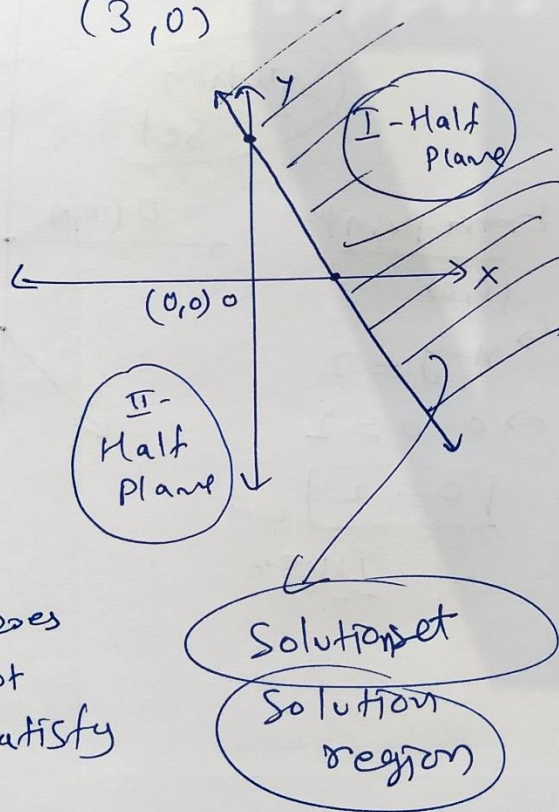
$2x + y \geq 6$

$\Rightarrow 0 + 0 \geq 6$

$0 \geq 6$

X

Does  
Not  
Satisfy



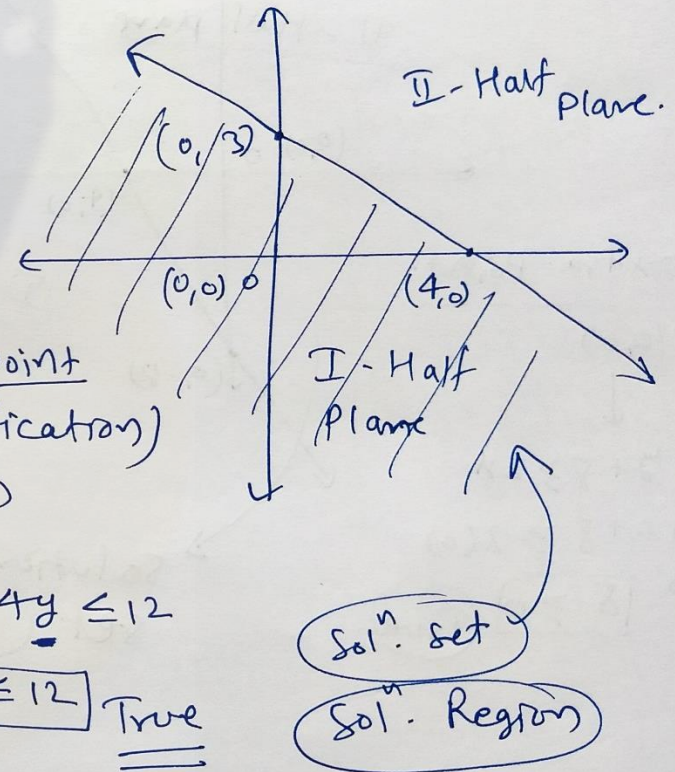
③  $3x + 4y \leq 12$

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

Extra point  
(verification)  
(0,0)

$3x + 4y \leq 12$

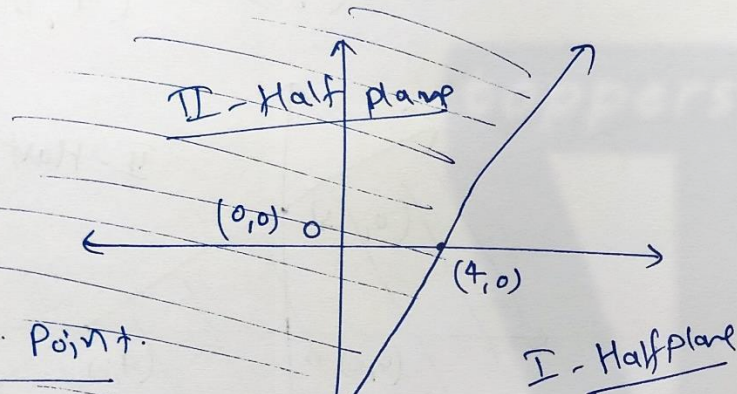
$\Rightarrow 0 \leq 12$  True



④  $x + 8 \geq 2x$

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

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



Extra Point:

$(0, 0)$



$$x + 8 \geq 2x$$

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

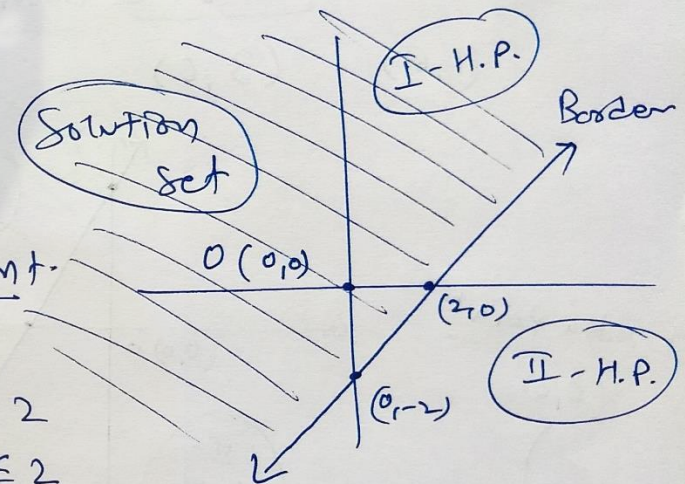
$$\Rightarrow 8 \geq 0 \quad \text{True}$$

Solution set (Region)

⑤  $x - y \leq 2$

Graph: Border  $x - y = 2$

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



Extra Point:

$(0, 0)$

$$\hookrightarrow x - y \leq 2$$

$$\Rightarrow 0 - 0 \leq 2$$

$$0 \leq 2$$

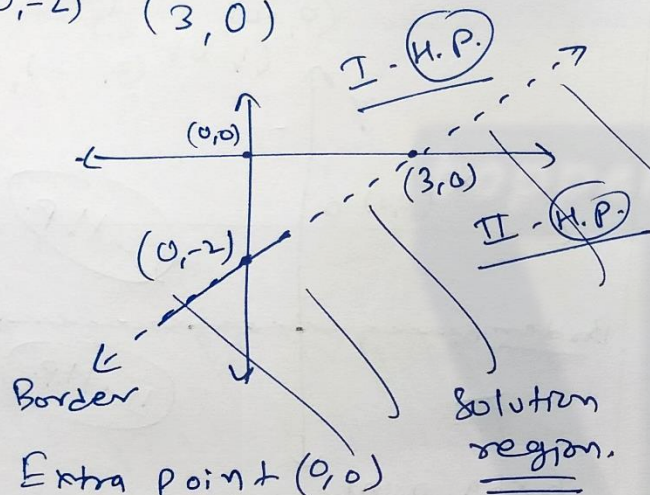
True



⑥  $2x - 3y > 6$

Border  $2x - 3y = 6$

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



~~Extra~~ Extra point  $(0, 0)$

$2x - 3y > 6$

$\Rightarrow 0 - 0 > 6$

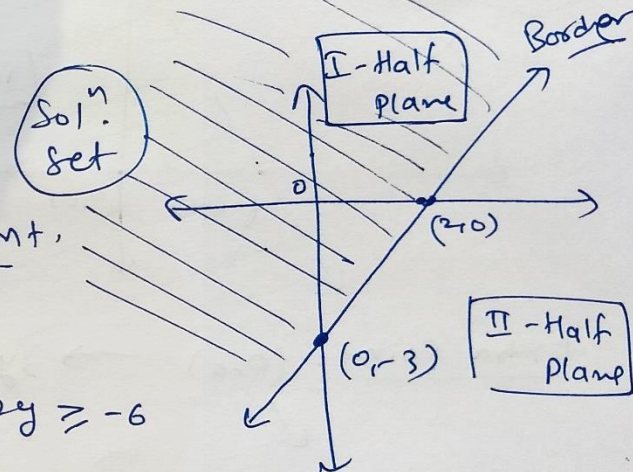
$\boxed{0 > 6}$  False  
X

## Toppers Village

### Exercise 6.2

⑦  $-3x + 2y \geq -6$

Border  $-3x + 2y = -6$  Line  
 $(0, -3) \quad (2, 0)$



Extra point,

$0 (0, 0)$

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

$\Rightarrow 0 + 0 \geq -6$

$\boxed{0 \geq -6}$  True, ✓

⑧  $3y - 5x < 30$

Border:  $3y - 5x = 30$

$(0, 10)$

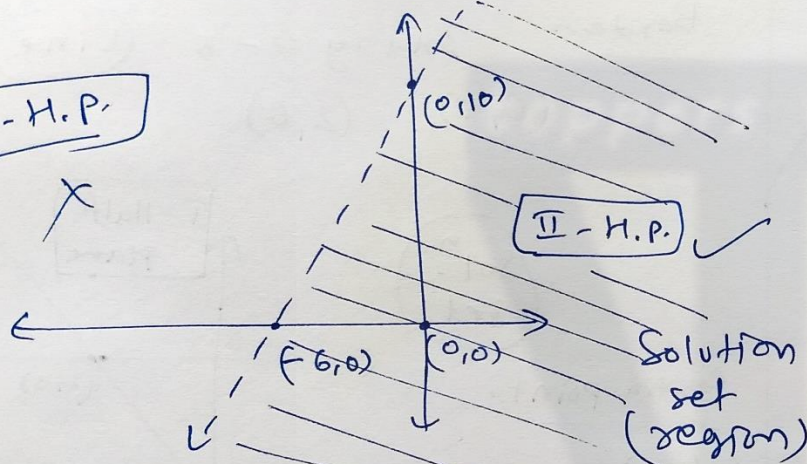
$(-6, 0)$

→ Border

I - H.P.

X

II - H.P.



Extra Point:  $(0, 0) \rightarrow 3y - 5x < 30$

$0 - 0 < 30$

$\Rightarrow 0 < 30$  ✓

Satisfies

⑨  $y < -2$

Border:  $y = -2$  → Line

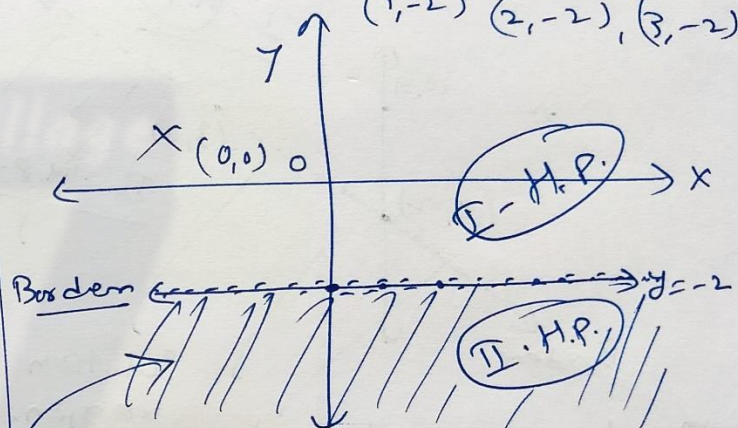
Horizontal

$(0, -2)$

$(1, -2)$

$(2, -2)$

$(3, -2)$



Extra point:  $(0, 0) \rightarrow y < -2$

$\Rightarrow 0 < -2$

False.

Sol<sup>n</sup>. Set,

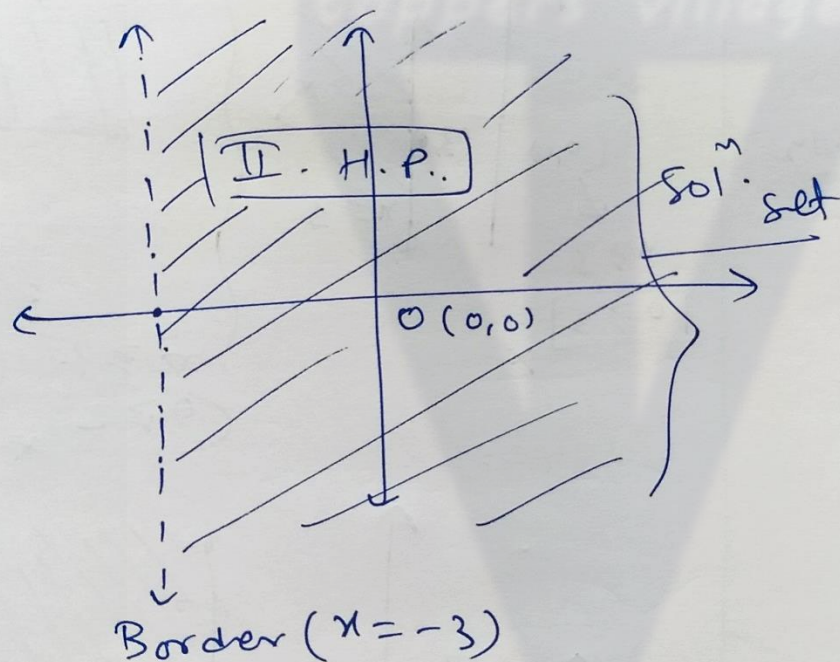


⑩  $x > -3$

Border:  $x = -3 \rightarrow \left\{ \begin{array}{l} \text{vertical} \\ \text{line} \end{array} \right\}$

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

I - H.P.



check  $(0,0)$   
✓

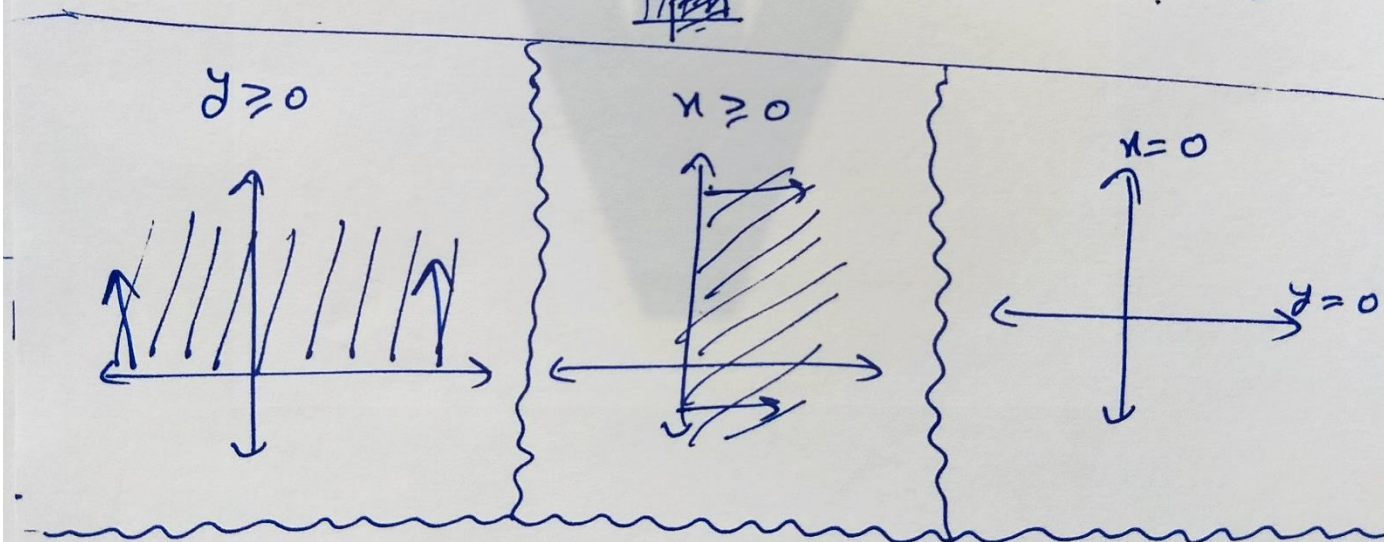
$x > -3$   
 $0 > -3$  ✓

## Perfect Approach for Ex. 6.3

① (=) (Line) (Border)  $\longleftrightarrow \begin{matrix} \xrightarrow{\geq} \\ \xleftarrow{\leq} \end{matrix}$

② ( $\geq$ ) (Half plane) (Region)  $\begin{matrix} \nearrow \\ \nwarrow \end{matrix}$   $\begin{matrix} \nearrow \\ \nwarrow \end{matrix}$

③ Common Sense (for Common Area)

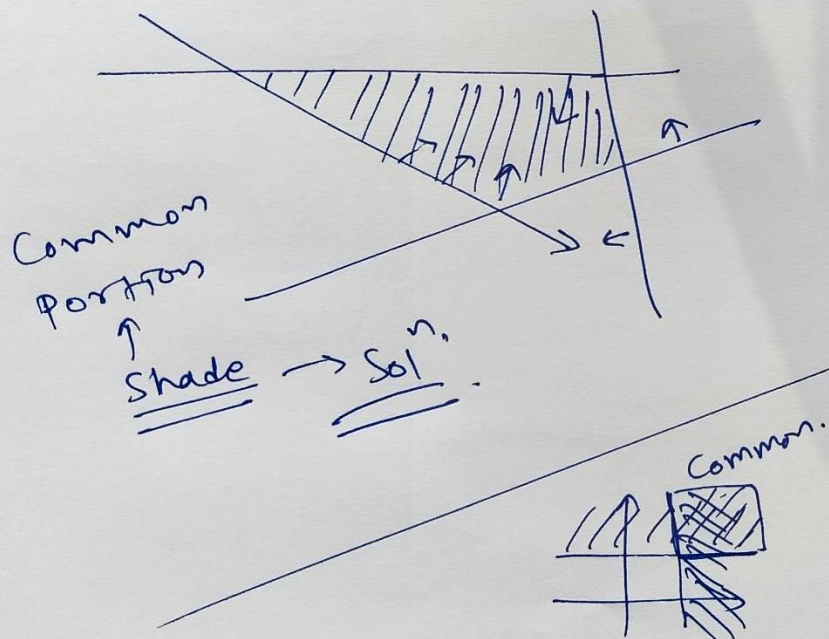
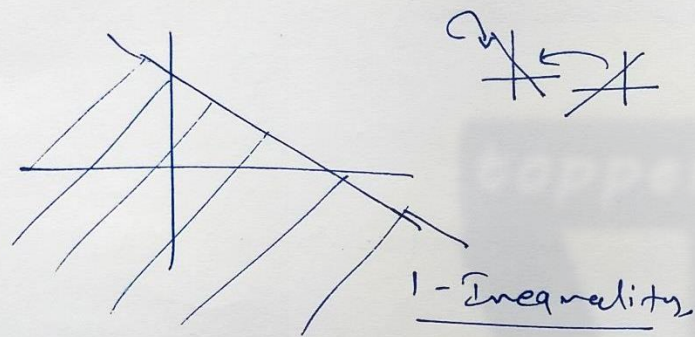




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class-11-maths

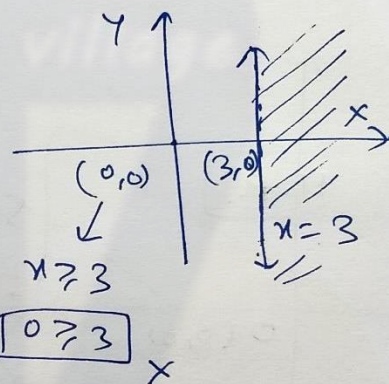
Exercise 6.3



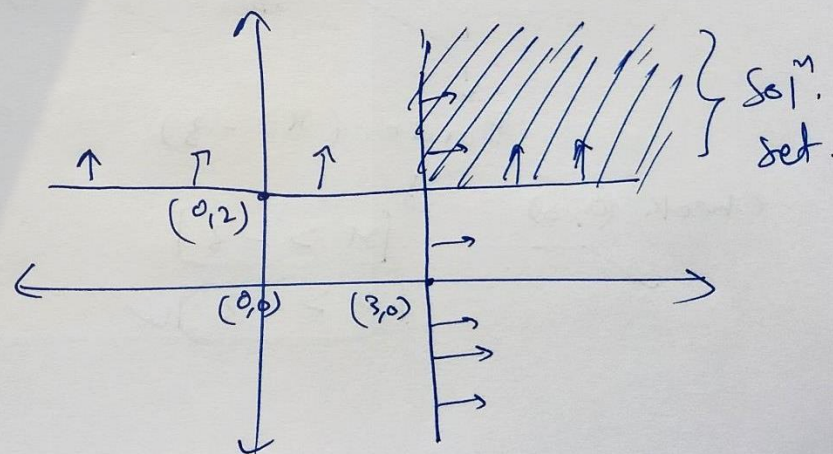
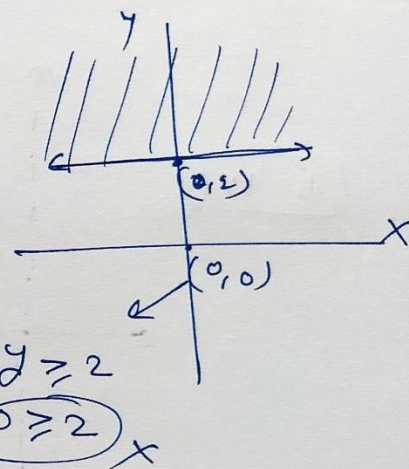
Q.1

$$x \geq 3, y \geq 2$$

$$x = 3 \quad (3, 0) (3, 5)$$



$$y \geq 2 \rightarrow y = 2$$



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

Border  $3x + 2y = 12$

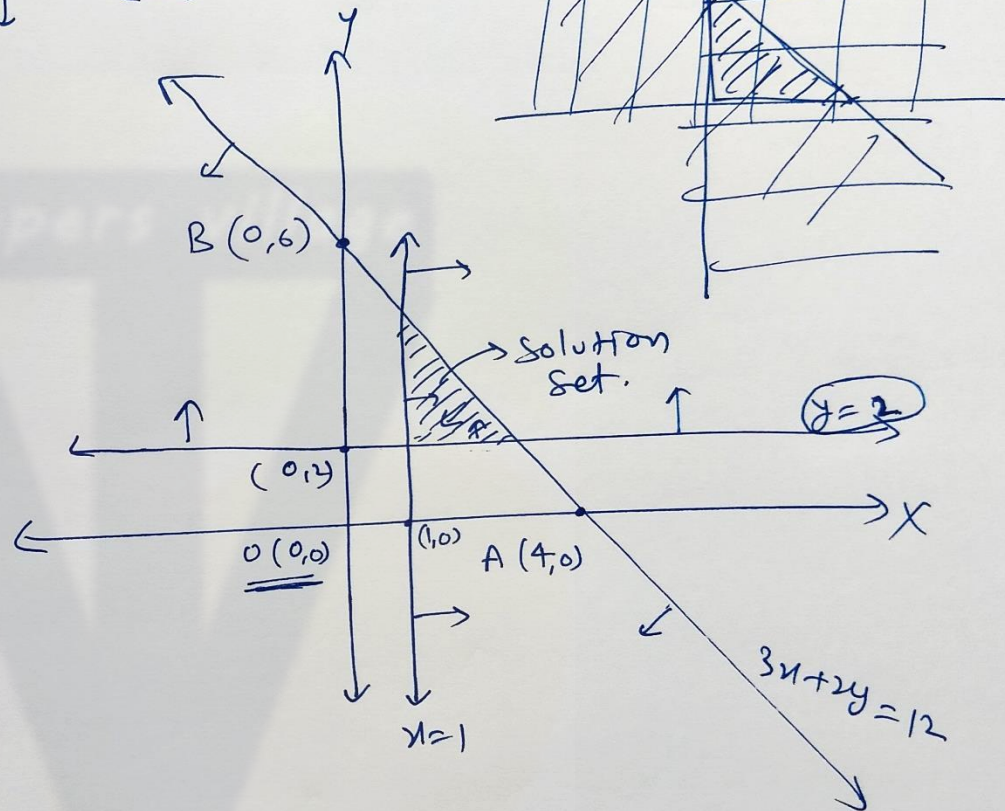
$(0, 6)$   $(4, 0)$

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

$0 + 0 \leq 12$

$0 \leq 12 \checkmark$

$x = 1$   
 $y = 2$





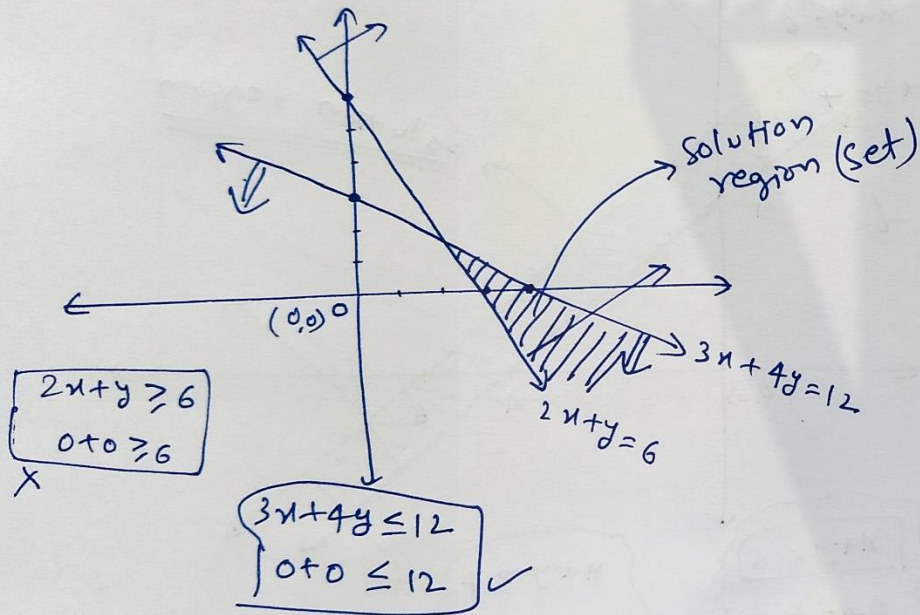
Toppers Village

Class 11 Maths Exercise 6.3 Linear Inequalities

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

$2x + y = 6$   
(0, 6) (3, 0)

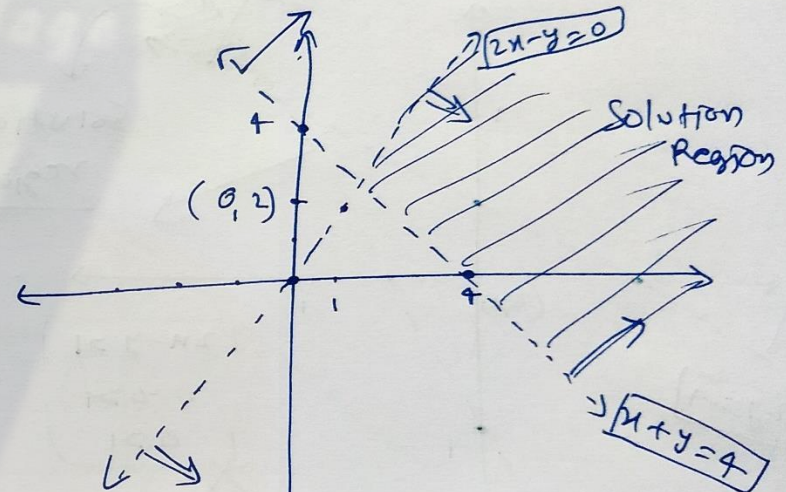
$3x + 4y = 12$   
(0, 3) (4, 0)



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

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

$2x - y = 0$   
(0, 0) (1, 2)



$x + y > 4$   
 $0 + 0 > 4$  X  
 $0 > 4$  X

$2x - y > 0$   
(0, 2) ↑  
 $\Rightarrow 0 - 2 > 0$   
 $\Rightarrow -2 > 0$  X

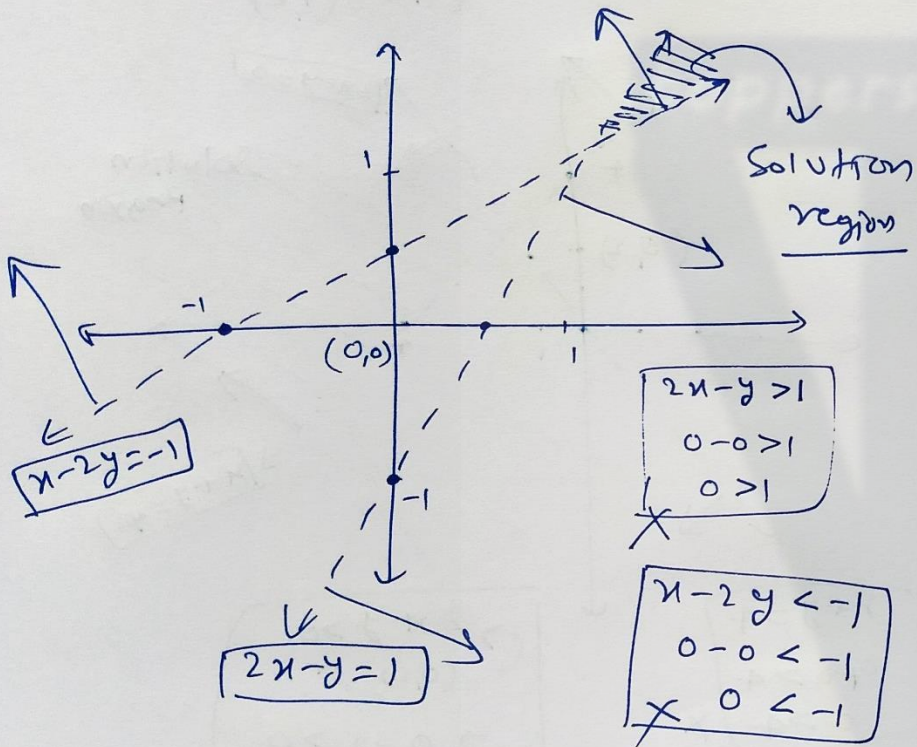
⑤  $2x - y > 1$ ,  $x - 2y < -1$

$2x - y = 1$

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

$x - 2y = -1$

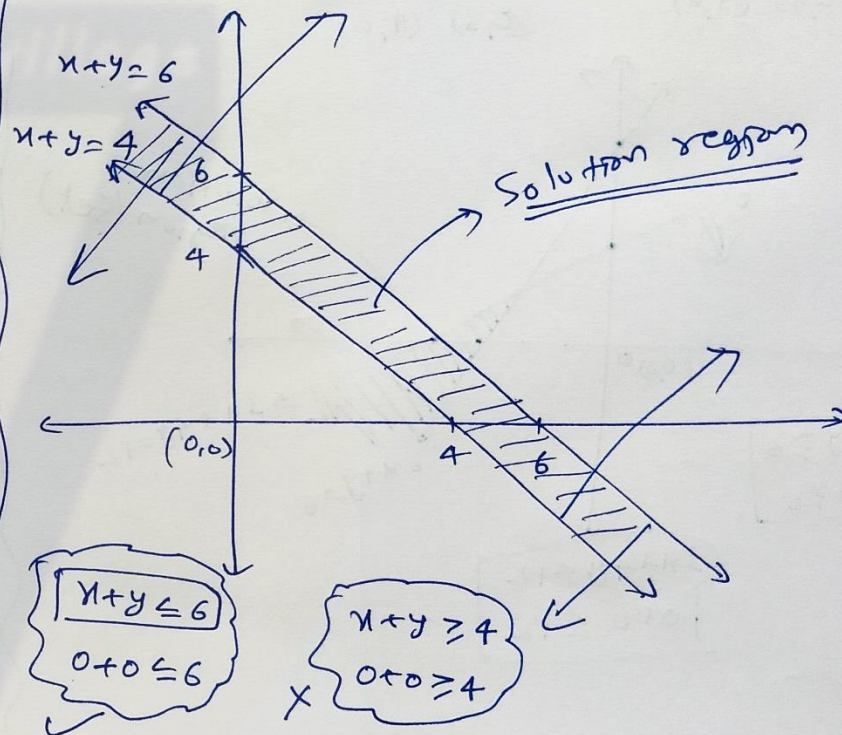
$(0, \frac{1}{2}), (-1, 0)$



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

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

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





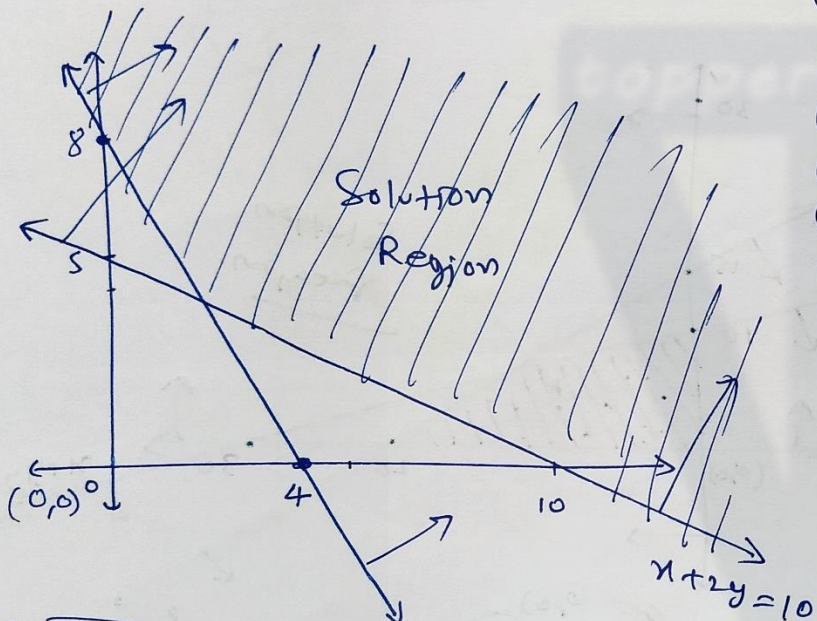
⑦  $2x + y \geq 8$      $x + 2y \geq 10$

$2x + y = 8$

$x + 2y = 10$

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

$(10, 0)$   $(0, 5)$



$(0, 0) \rightarrow 2x + y \geq 8$   
 $0 + 0 \geq 8$   
 $\times$

$\times$   $x + 2y \geq 10$   
 $0 + 0 \geq 10$

Toppers Village

Exercise 6.3 Linear Inequalities

11<sup>th</sup>

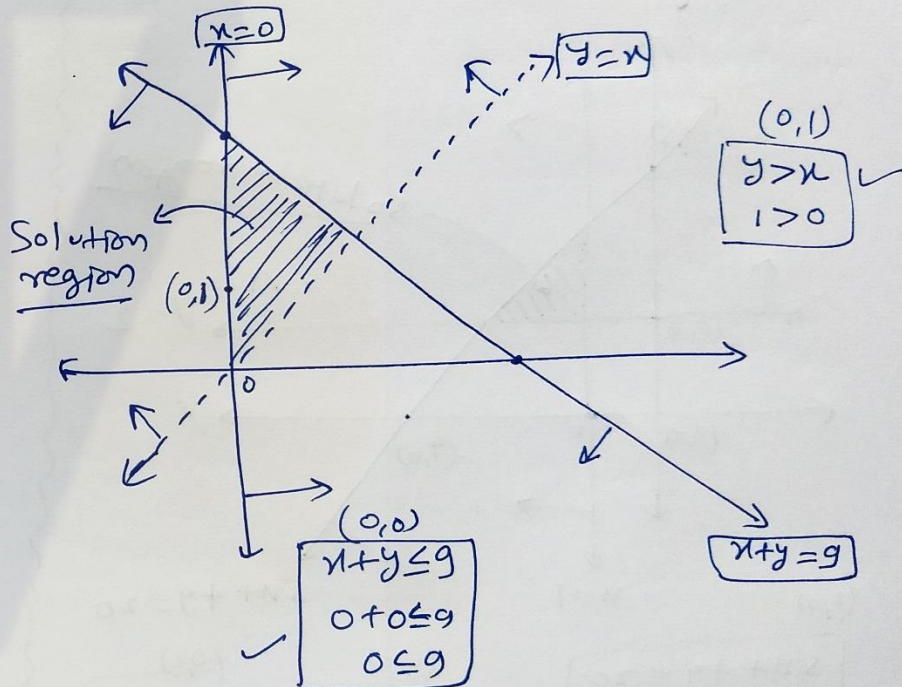
Q.8

$x + y \leq 9$ ,  $y > x$ ,  $x \geq 0$

$x + y = 9$   
 $(0, 9)$   $(9, 0)$

$y = x$

$x = 0$  (y-axis)





Q.9  $5x + 4y \leq 20, x \geq 1, y \geq 2$

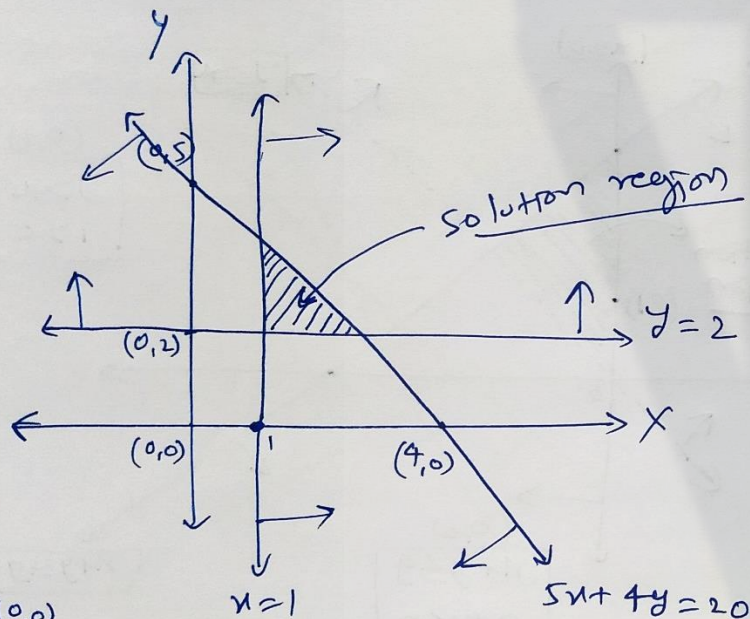
$5x + 4y = 20$

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

$x = 1$

$y = 2$

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



$(0, 0)$

$5x + 4y \leq 20$   
 $0 + 0 \leq 20$   
 $0 \leq 20$

$(0, 0)$   
 $x \geq 1$   
 $0 \geq 1$

$(0, 0)$   
 $y \geq 2$   
 $0 \geq 2$

Q.10

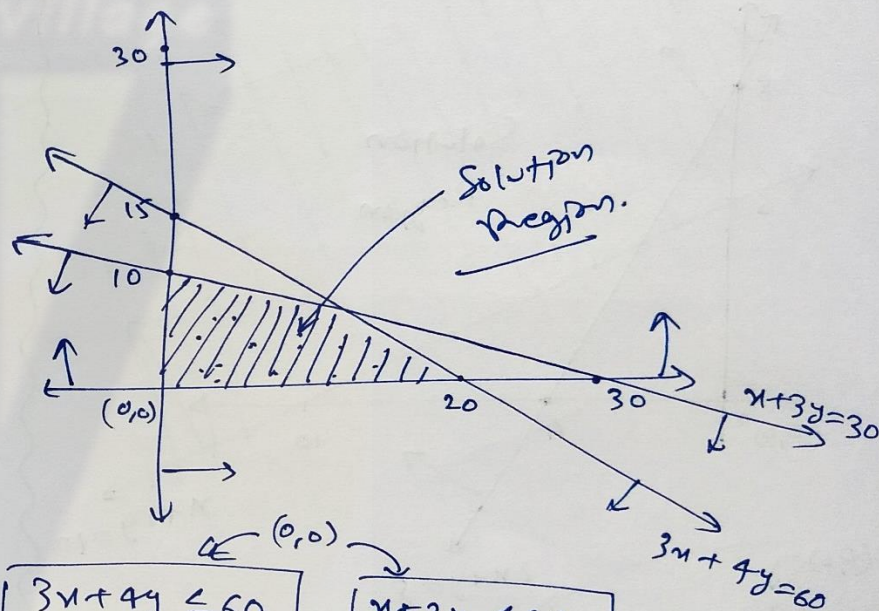
$3x + 4y \leq 60, x + 3y \leq 30, x \geq 0, y \geq 0$

$3x + 4y = 60$

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

$x + 3y = 30$

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



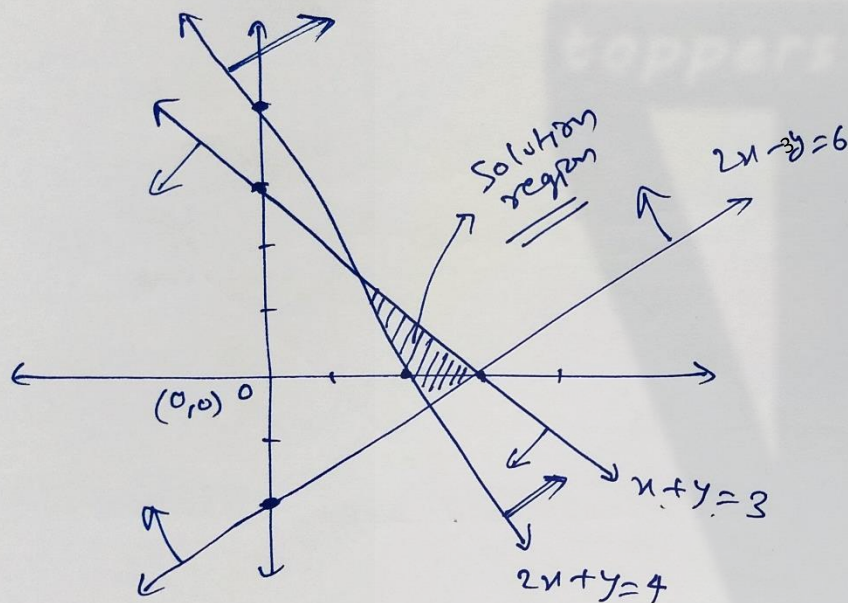
$3x + 4y \leq 60$   
 $0 + 0 \leq 60$   
 $0 \leq 60$

$x + 3y \leq 30$   
 $0 + 0 \leq 30$   
 $0 \leq 30$



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

$\downarrow$                        $\downarrow$                        $\downarrow$   
 $2x + y = 4$                        $x + y = 3$                        $2x - 3y = 6$   
 $(0, 4) (2, 0)$                        $(0, 3) (3, 0)$                        $(0, -2), (3, 0)$

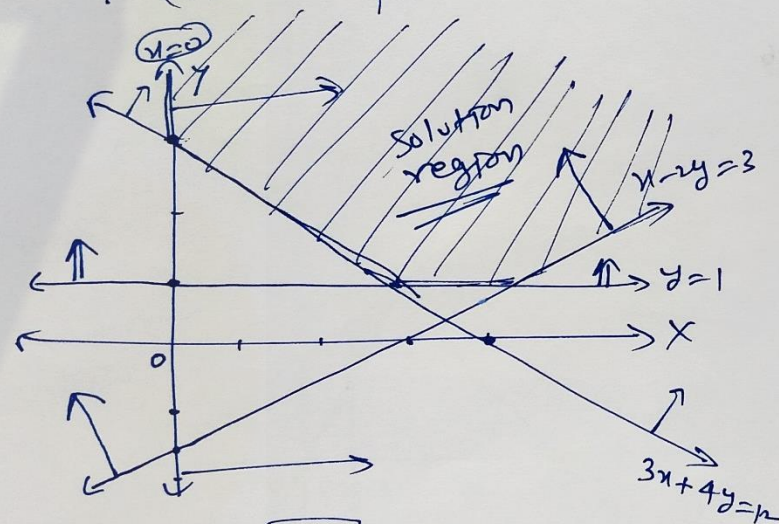


| $2x + y \geq 4$ | $x + y \leq 3$ | $2x - 3y \leq 6$ |
|-----------------|----------------|------------------|
| $0 + 0 \geq 4$  | $0 + 0 \leq 3$ | $0 - 0 \leq 6$   |
| $0 \geq 4$      | $0 \leq 3$     | $0 \leq 6$       |
| X               | ✓              | ✓                |

## Toppers Village Ex. 6.3

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

$\downarrow$                        $\downarrow$                       Direct  $\downarrow$   
 $x - y \cdot 2 = 3$                        $3x + 4y = 12$                        $y = 1$   
 $(0, -1.5) (3, 0)$                        $(0, 3) (4, 0)$                        $\leftarrow \dots$

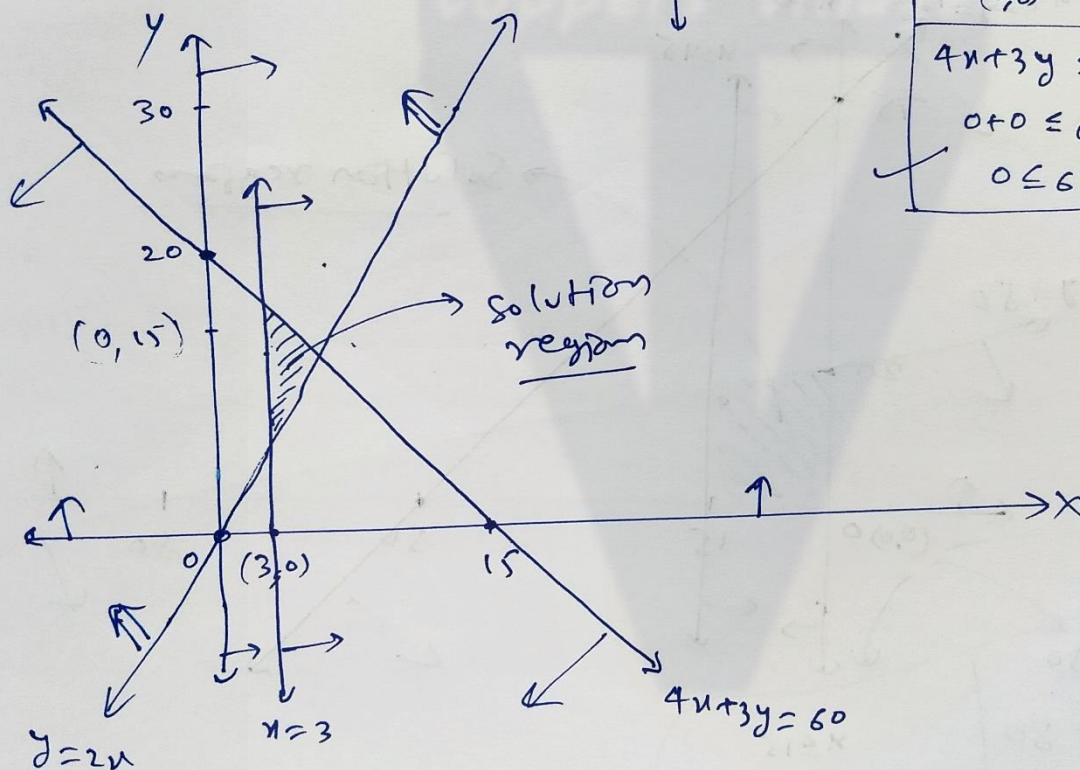


| $x - 2y \leq 3$ | $3x + 4y \geq 12$ | $y \geq 1$ |
|-----------------|-------------------|------------|
| $0 - 0 \leq 3$  | $0 + 0 \geq 12$   | $0 \geq 1$ |
| $0 \leq 3$      | $0 \geq 12$       | X          |
| ✓               | X                 |            |

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

$\downarrow$   $\downarrow$   $\downarrow$   $\swarrow \searrow$   
 $4x + 3y = 60$   $y = 2x$   $x = 3$   $x \geq 0$   $y \geq 0$   
 $(0, 20)$   $(15, 0)$   $(0, 0), (15, 30)$   $x = 3$   $\text{Direct.}$

vertical line



$(0, 0)$

|                   |
|-------------------|
| $4x + 3y \leq 60$ |
| $0 + 0 \leq 60$   |
| $0 \leq 60$       |

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

|             |
|-------------|
| $y \geq 2x$ |
| $15 \geq 0$ |

$(0, 0)$

|            |
|------------|
| $x \geq 3$ |
| $0 \geq 3$ |



⑭  $3x + 2y \leq 150$

$x + 4y \leq 80$

$x \leq 15$

$y \geq 0$     $x \geq 0$

Border    $3x + 2y = 150$

$x + 4y = 80$

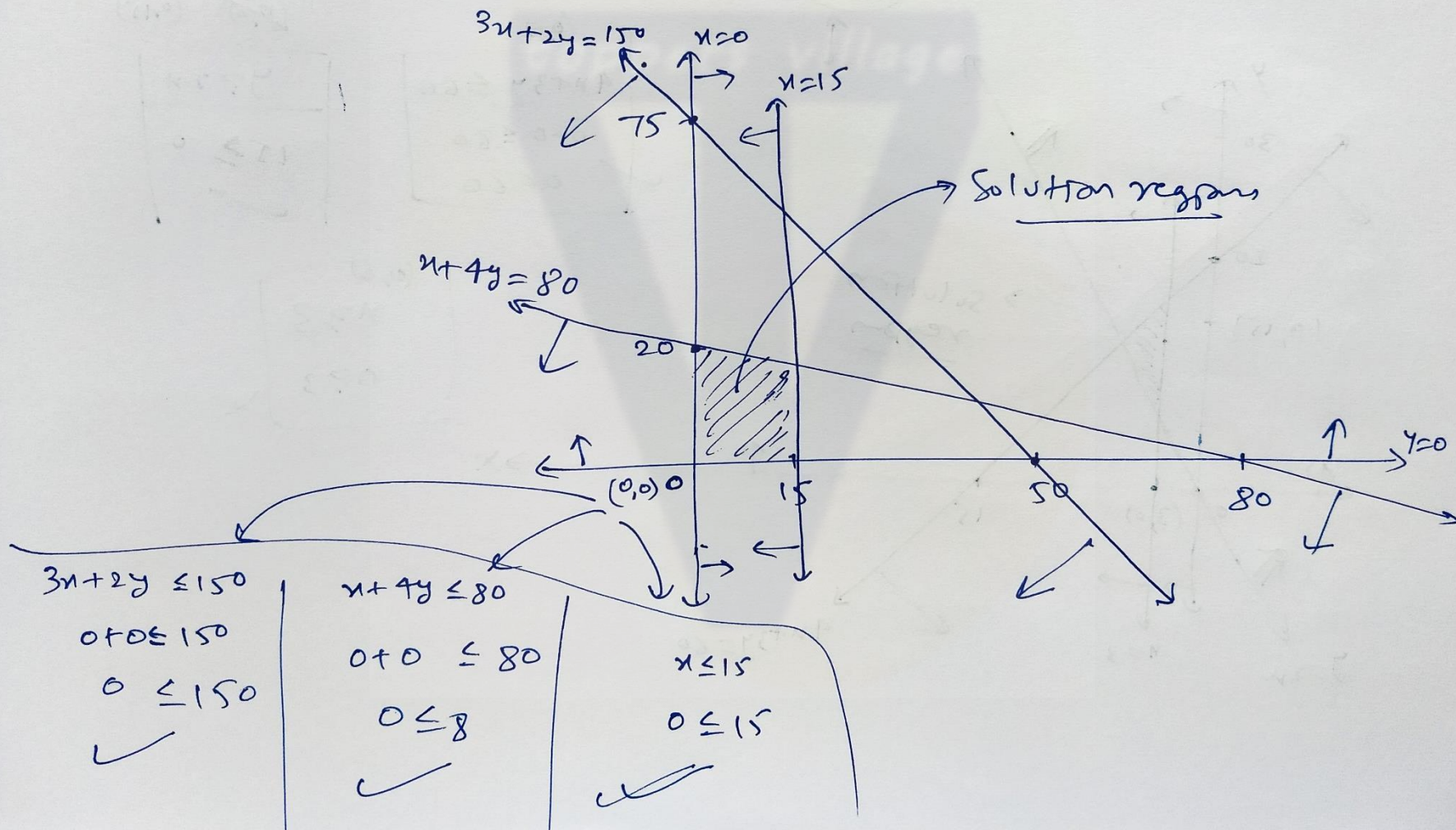
$x = 15$

Direct.

$(0, 75)$     $(50, 0)$

$(0, 20)$     $(80, 0)$

(vertical line)



(15)  $x+2y \leq 10$

Border  $x+2y=10$

$(10,0)$   $(0,5)$

$x+y \geq 1$

$x+y=1$

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

$x-y \leq 0$

$x-y=0$

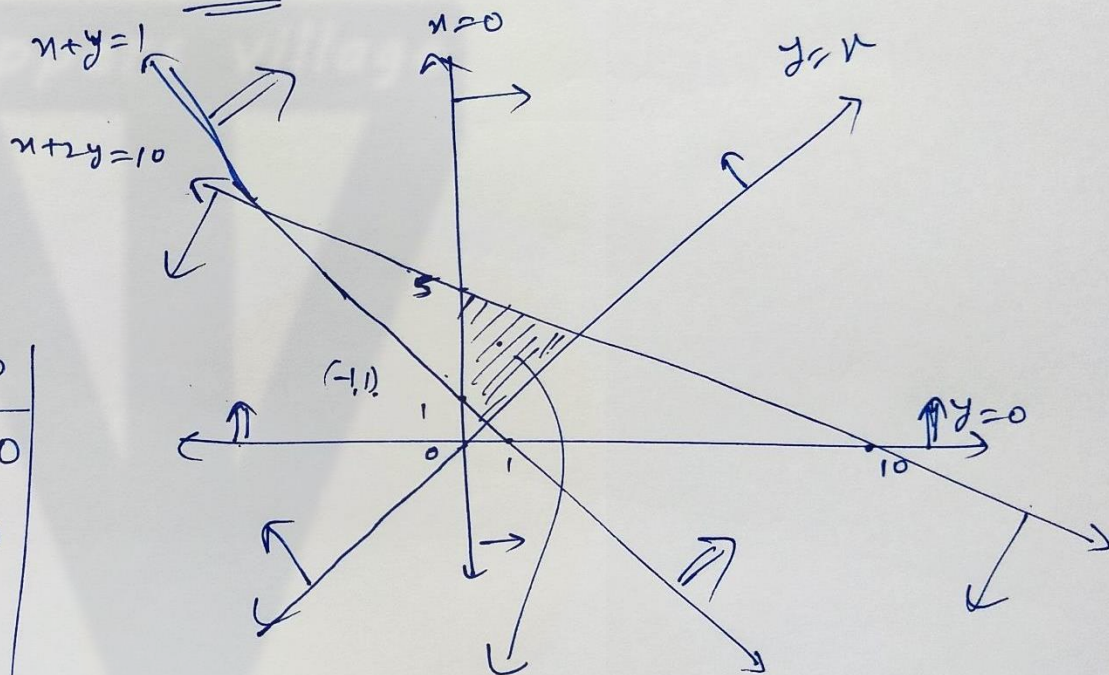
$y=x$

Direct

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

Direct.

|                                |                              |                          |
|--------------------------------|------------------------------|--------------------------|
| $(0,0)$<br>↓<br>$x+2y \leq 10$ | $(0,0)$<br>↓<br>$x+y \geq 1$ | $(-1,1)$<br>$x-y \leq 0$ |
| $0+0 \leq 10$                  | $0+0 \geq 1$                 | $(-1)-1 \leq 0$          |
| $0 \leq 10$                    | $0 \geq 1$                   | $-2 \leq 0$              |
| ✓                              | ✗                            | ✓                        |



Solution region



Miscellaneous Exercise on Chapter 6

11<sup>th</sup>

Questions 1 to 6

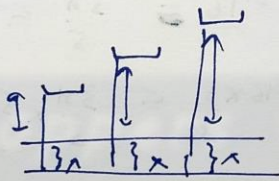
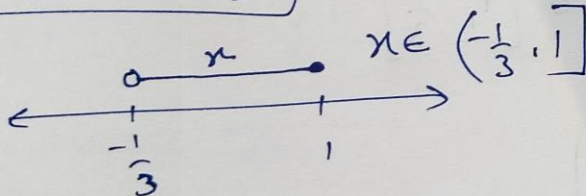
Double Inequality

e.g. 
$$\begin{array}{ccccc} 1 & \leq & -3x+4 & < & 5 \\ -4 & & -4 & & -4 \end{array}$$

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

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

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



Divide by  $-3$   
Sign of Inequality changes.

[Q.1] 
$$2 \leq 3x-4 \leq 5$$

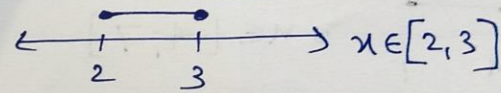
$\Rightarrow$  Add  $+4$

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

$\Rightarrow 6 \leq 3x \leq 9$

Divide '3'  $\rightarrow$   $\oplus$ ve  $\rightarrow$  No change in Sign

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



[Q.2] 
$$6 \leq -3(2x-4) < 12$$

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

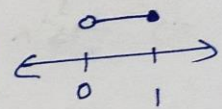
$\Rightarrow -2 \geq 2x-4 > -4$

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

$\Rightarrow 2 \geq 2x > 0$

$\Rightarrow 1 \geq x > 0$

$-3$  Divide  
 $\downarrow$   
Change



$x \in (0, 1]$

$$\boxed{\text{Q.3}} \quad -3 \leq 4 - \frac{7x}{2} \leq 18$$

$$\Rightarrow \quad \textcircled{-4} \quad \textcircled{-4} \quad \textcircled{+4}$$

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

$$\text{Divide } \textcircled{\frac{-7}{2}}:$$

$$\Rightarrow \frac{+11}{\left(\frac{+1}{2}\right)} \geq x \geq \frac{14}{\left(\frac{-1}{2}\right)}$$

$$\Rightarrow 7 \geq x \geq -4$$

$$\leftarrow \begin{array}{|c|c|} \hline \bullet & \bullet \\ \hline -4 & 7 \\ \hline \end{array} \rightarrow x \in [-4, 7]$$

$$\boxed{\text{Q.4}} \quad -15 < \frac{3(x-2)}{5} \leq 0$$

$$\bullet \text{ multiply } \frac{5}{3}$$

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

$$\Rightarrow \begin{array}{|c|c|c|} \hline -25 & x-2 & 0 \\ \hline \textcircled{+2} & \textcircled{+2} & \textcircled{+2} \\ \hline \end{array}$$

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

$$\boxed{\text{Q.5}} \quad -12 < 4 - \frac{3x}{5} \leq 2$$

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

$$\textcircled{-4} \quad \textcircled{-4} \quad \textcircled{-4}$$

$$\Rightarrow -16 \leq \frac{3x}{5} \leq -2 \quad (\text{multiply } \frac{5}{3})$$

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

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

$$\boxed{\text{Q.6}} \quad 7 \leq \frac{3x+11}{2} \leq 11$$

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

$$\Rightarrow 3 \leq 3x \leq 11$$

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

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

$$\leftarrow \begin{array}{|c|c|} \hline \bullet & \bullet \\ \hline 1 & \frac{11}{3} \\ \hline \end{array} \rightarrow$$



Miscellaneous Exercise on Chapter 6

(11th)

(7)

$$5x+1 > -24$$

Solve

$$5x-1 < 24$$

Solve

→ common

Number line

easy

$$5x+1 > -24$$

$$\Rightarrow 5x > -25$$

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

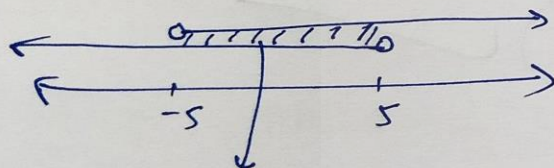
$$\boxed{x > -5}$$

$$5x-1 < 24$$

$$\Rightarrow 5x < 25$$

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

$$\Rightarrow \boxed{x < 5}$$



Solution  $x \in (-5, 5)$  ✓

(8)

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

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

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

$$\Rightarrow \boxed{x < 7}$$



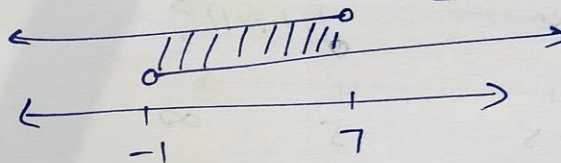
$$3(x+2) > 2-x$$

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

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

$$\Rightarrow 4x > -4$$

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



$x \in (-1, 7)$  ✓

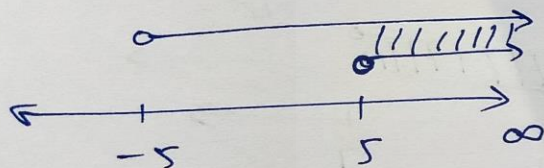
$$(9) \quad 3x - 7 > 2(x - 6)$$

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

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

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

↓



$$x \in (5, \infty) \quad \checkmark$$

$$6 - x > 11 - 2x$$

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

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

↓

(10)

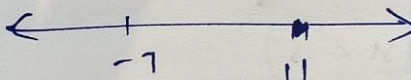
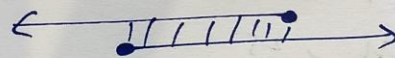
$$5(2x - 7) - 3(2x + 3) \leq 0$$

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

$$\Rightarrow 4x - 44 \leq 0$$

$$\Rightarrow 4x \leq 44$$

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



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

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

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

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

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

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



# 'Toppers Village'

## Miscellaneous Exercise on chapter 6

(11)

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

$$\underline{?} < \text{Celsius} < \underline{?}$$

$$\boxed{(F) = \left(\frac{9}{5}C + 32\right)}$$

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

$$\begin{array}{ccc} -32 & & -32 \\ \hline \end{array}$$

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

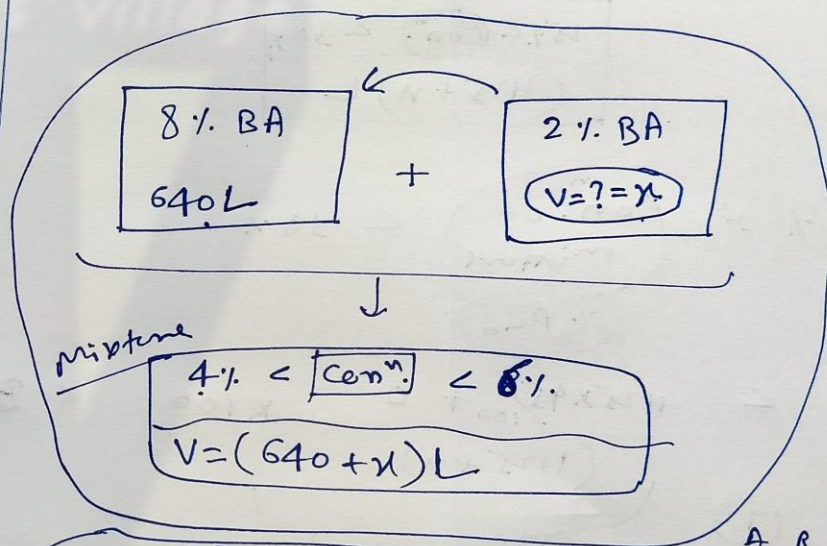
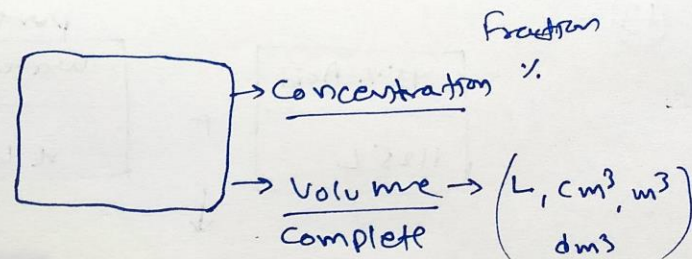
$$\Rightarrow \boxed{20 < C < 25}$$

Temperature in degree Celsius

between 20°C & 25°C

(12)

Solution



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

$$\begin{array}{ccc} A & B & C \\ \frac{0}{6} & \frac{0}{4} & \frac{0}{3} \\ \hline 20 & 10 & 30 = 60 \end{array}$$

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

$$= 50\%$$

$$4\% <$$

Concentration  
of  
mixture

$$< 6\%$$

$$4 < \frac{\text{vol.}^m \text{ of (B.A.)}}{\text{total volume}} \times 100 < 6$$

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

+

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

Double inequality.

$$\textcircled{I} \quad 2 \times \left( \frac{640+n}{100} \right) < 640 \times \frac{8}{100} + \frac{2n}{100}$$

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

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

$$\Rightarrow \boxed{n < 1280}$$

ii

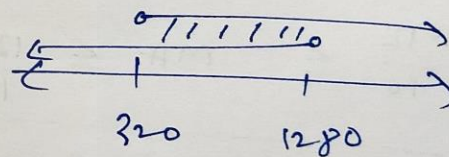
$$640 \times \frac{8}{100} + \frac{2}{100} \times n < 6 \times \left( \frac{640+n}{100} \right)$$

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

$$\Rightarrow 640 < 2n$$

$$\Rightarrow \boxed{320 < n}$$

$$320 < n, \quad n < 1280$$



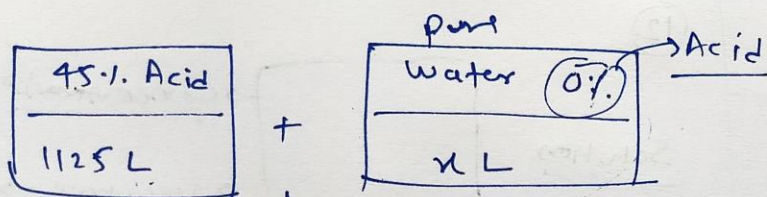
$$n \in (320, 1280)$$

2%

$$320 < n < 1280$$



13



|                   |
|-------------------|
| 25% < Conv. < 30% |
| (1125 + x) L      |

$$25\% \leq \text{Con. of mixture} < 30\%$$

(Conv. of mixture)

(Y. Acid)

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

(I)

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

(II)

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

$$\Rightarrow 25 \times x < 1125 \times 20$$

$$\Rightarrow x < \frac{45}{25} \times 1125 \times 20$$

$$\Rightarrow x < 45 \times 20$$

$$\Rightarrow x < 900$$

(II)

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

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

$$\Rightarrow 1125 \times 15 < 30x$$

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

$$\Rightarrow 562.5 < x$$

$$562.5 < x$$

$$x < 900$$

$$x \in (562.5, 900)$$

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

MA → mental Age → ?

CA → Chronological Age → 12 years

$$80 \leq IQ \leq 140$$

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

$$\Rightarrow \left[ 80 \leq \frac{MA \times 100}{12} \leq 140 \right] \times \frac{12}{100}$$

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

$$\Rightarrow \left[ 9.6 \leq \underline{MA} \leq 16.8 \right]$$



## **All Useful Links:**

- **YouTube Channel : Toppers Village** (Get full and free video lectures of Class 10 & 11 Maths) - <https://www.youtube.com/toppersvillage>
- **Website :** [www.toppersvillage.com](http://www.toppersvillage.com)
- **Instagram :** <https://www.instagram.com/toppersvillage/>
- **Facebook Page:** [www.facebook.com/ToppersVillage/](http://www.facebook.com/ToppersVillage/)
- **Facebook Group:** <https://www.facebook.com/groups/ToppersVillage>