CHAPTER 6

LINEAR INEQUALITIES

Rules for solving inequalities

The following rules can be applied to any inequality

- Add or subtract the same number or expressions to both sides.
- Multiply or divide both sides by the same positive number.
- By multiplying or dividing with the same negative number, the inequality is reversed.
- $a<b$ implies $b>a$
- $a<b$ implies $-a>-b$
- $a<b$ implies $1/a > 1/b$
- $x^2 \leq a^2$ implies $x \leq a$ and $x \geq -a$

Recall

- $x = 0$ is y axis
- $y=0$ is x axis
- $x=k$ is a line parallel to y axis passing through $(k,0)$of x axis.
- $y=k$ is a line parallel to x axis and passing through $(0,k)$of y axis.

Procedure to solve a linear inequality

- Simplify both sides by removing group symbols and collecting like terms.
- Remove fractions by multiplying both sides by an appropriate factor.
- Isolate all variable terms on one side and all constants on the other side.
- Make the coefficient of the variable 1 and get the solution (whenever coefficient of x is negative multiply through out by -1 so that the ineqality is reversed.

Eg $-2x \geq 5$

$2x \leq -5$

$x \leq -5/2$

$x \leq -2.5$ therefore solution is $(-\infty,-2.5]$

Note: If **$x \geq 0$, $y \geq 0$** is given in question every point in the shaded region in the **first quadrant** including the points on the line and the axis, represents the solution of the given system of ineqalities.

Method to find Graphical Solution

- Draw lines corresponding to each equation treating it as equality
- Find the Feasible Region – intersection of all the inequalities

Steps to find Feasible region

Step 1: Take any point on the left (down) or right (up) of the line and substitute that in the given inequality.

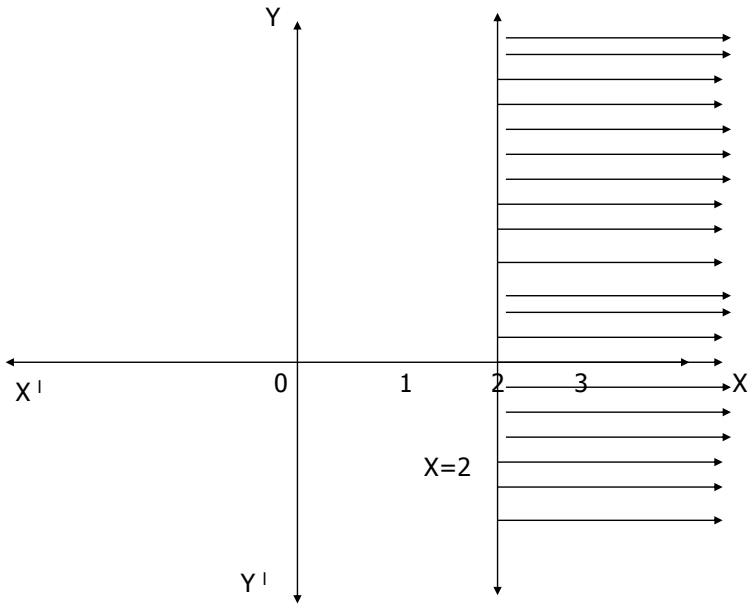
Step 2: If the point satisfies the inequality, the region containing that point is the required region. Otherwise opposite region is the required region.

Step 3: If inequality is of the type ≥ , ≤ then the points on the line are also included in the solution region, so draw dark lines.

Step 4: If inequality is of the type >, < then the points on the line are not included in the solution region, so draw dotted lines

Note: For the following in equation $x \geq 2$, substitute the point (0,0) (left side) in $x \geq 2$. Then we get $0 \geq 2$ which is false. Therefore right side is the required region.

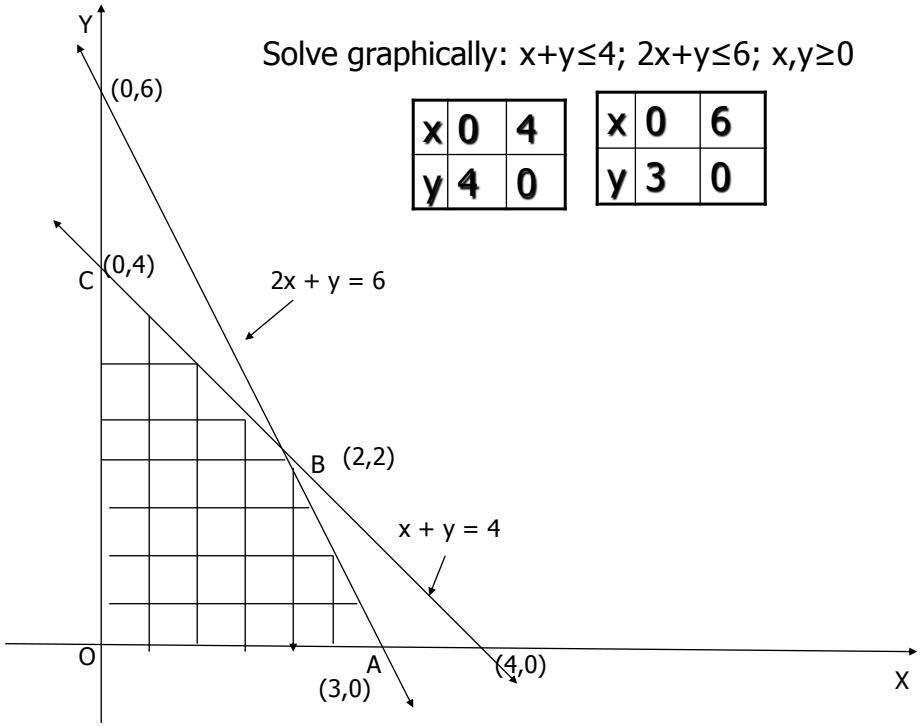
Shade the region corresponding to the inequation $x \geq 2$



Solve graphically: x+y≤4; 2x+y≤6; x,y≥0

x	0	4
y	4	0

x	0	6
y	3	0



Solve graphically

$$x + y \leq 400$$

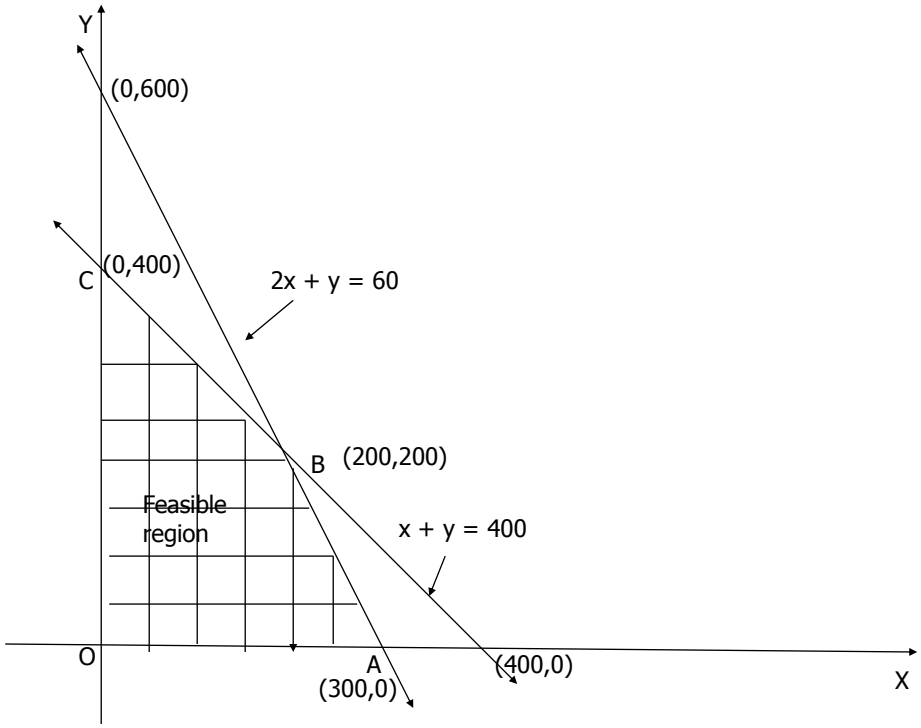
$$2x+y \leq 600$$

Consider x+y=400

x	0	400
y	400	0

Consider 2x+y=600

X	0	300
y	600	0



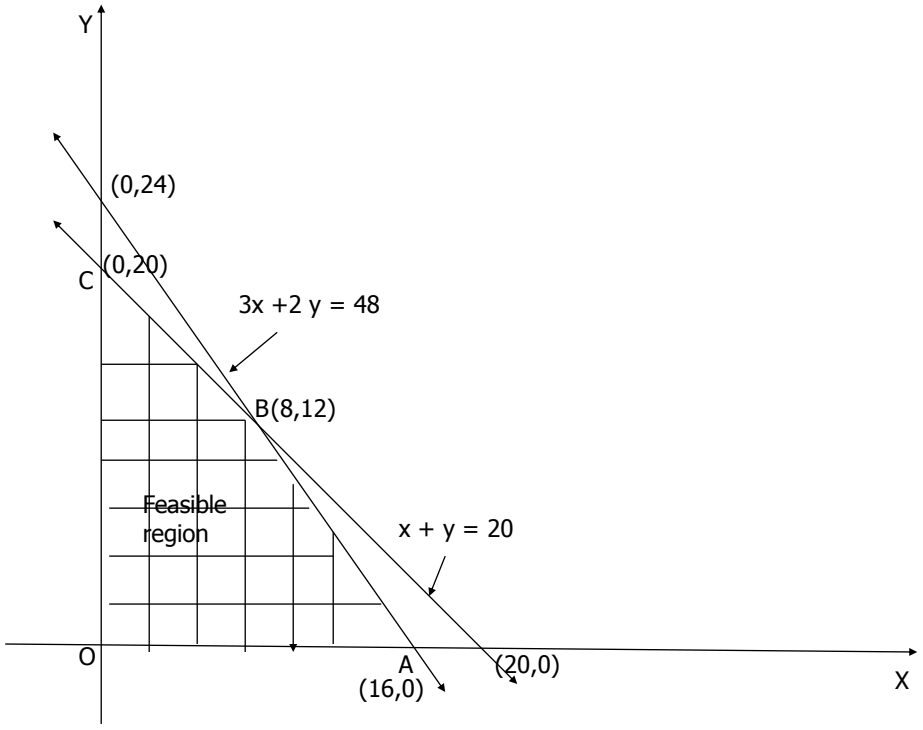
$x + y \leq 20$
$360x + 240y \leq 5760$

Consider x+y=20

x	0	20
y	20	0

Consider 3x+2y=48 (Dividing throughout by 120)

X	0	16
y	24	0



Solve graphically:

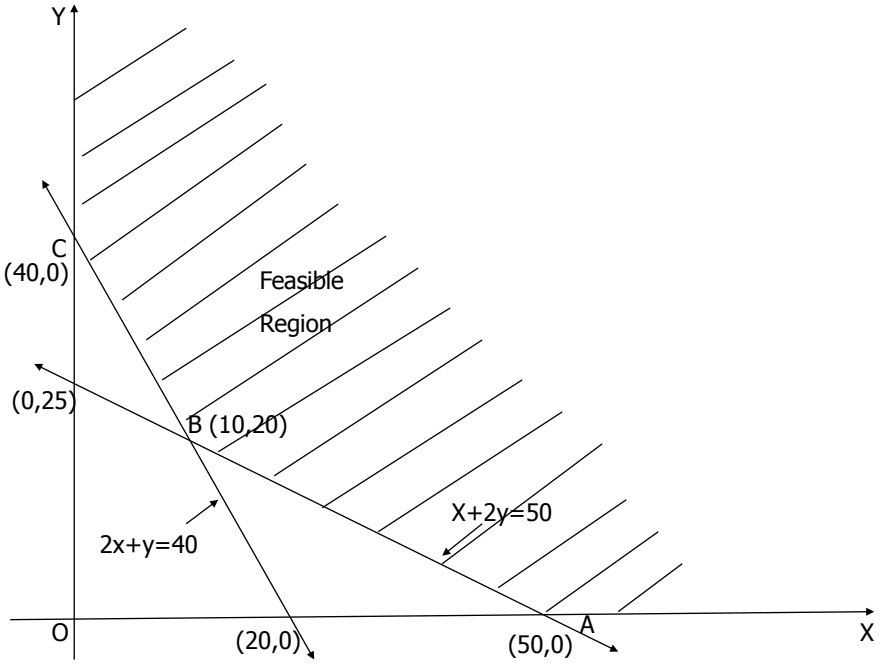
- $200X + 100Y \geq 4000$
- $X + 2Y \geq 50$

Consider 2x+y=40

X	0	20
y	40	0

Consider x+2y=40

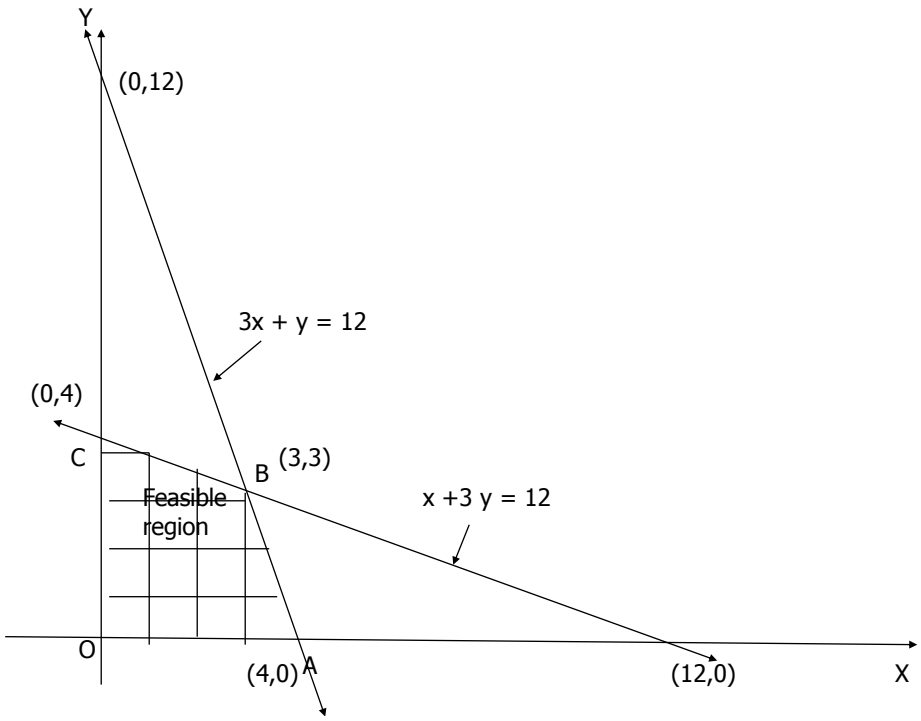
X	0	50
y	25	0



Solve graphically:

$x+3y \leq 12$

$3x+y \leq 12$



Solve graphically:

$x/10 + y/20 \geq 14$

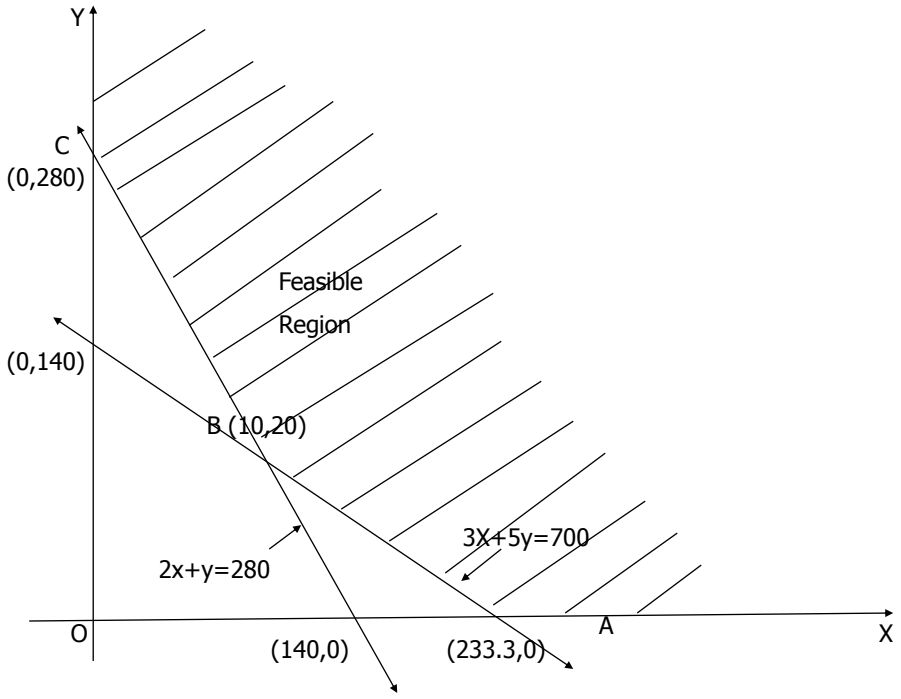
$3/50\ x + 1/10\ y \geq 14$

Consider 2x+y=280

X	0	140
y	280	0

Consider 3x+5y=700

X	0	233.3
y	140	0



Ex 6.1

1to 4 (1 mark)

11 to 15, 16**, 18**, 20**, 22**, 24**, 25**,26**

eg 15**

Ex 6.3

(8 to 15)**

eg 16**

eg17**

Misc Ex

4*, 5*,6*, 8*, 9*, 10*, (11 to 14)**

EXTRA /HOT QUESTIONS

1) Solve i) $\frac{5x-2}{3} - \frac{7x-3}{5} > \frac{x}{4}$

ii) $\frac{2x-3}{4} + 8 \geq 2 + \frac{4x}{3}$

iii) $\frac{2-3x}{5} < \frac{1-x}{3} < \frac{3+4x}{2}$

2) Solve graphically
   i) $2x+y \geq 3$, $x-2y \leq -1$, $x \geq 0$, $y \geq 0$
   ii) $x+4y \leq 4$, $2x+3y \leq 6$, $x \geq 0$, $y \geq 0$
   iii) $x+y \geq 1$, $x \leq 5$, $y \leq 4$, $2x+3y \leq 12$, $x \geq 0$, $y \geq 0$
3) The water acidity in a pool is considered normal when the average pH reading of 3 daily measurements is between 8.2 and 8.5. If the first two pH readings are 8.48 and 8.35, find the range of pH value for the third reading that will result in the acidity level being normal
4) In the first 4 papers each of hundred marks Ravi got 90, 75, 73, 85 marks. If he wants an average of greater than or equal to 75 marks and less than 80 marks, find the range of marks she should score in the fifth paper.
5) The longest side of a triangle is 3 times the shortest side and the third side is 2 cm shorter than the longest side. If the perimeter of the triangle is atleast 61 cm find the minimum length of the shortest side.

Answers

1) i) $(4,\infty)$
ii) $(-\infty, 63/10]$
iii) $(¼, \infty)$
3 Between 7.77 and 8.67
4 More than or equal to 52 but less than 77
5 9 cm