CHAPTER 5

Linear Inequalities

1. Draw the graph for the following set of in-equalities and indicate the feasible region:

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

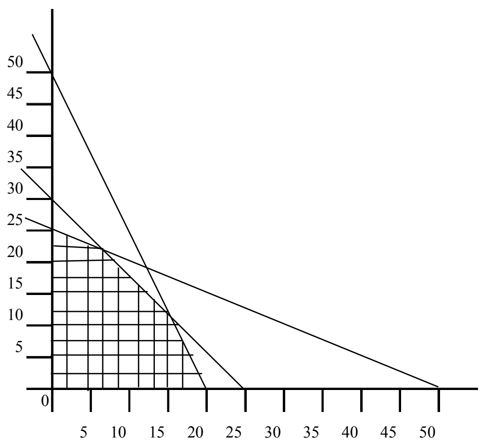
   b) $2x - 3y \geq 6$

   c) $x + 2y \leq 6$, $5x + 3y \leq 15$, $x \geq 0$, $y \geq 0$

   d) $x + y \leq 4$, $3x + y \geq 3$, $x + 4y \geq 4$, $x \leq 3$, $y \leq 2$

   e) $x - y \geq 4$, $2x + 3y \geq 18$, $y \leq 4$, $x \leq 7$

2. Graph of five linear in-equations are given below. These are $15x + 6y = 30$, $5x + 4y = 120$, $x + 2y = 50$, $x \geq 0$ and $y \geq 0$. Identify the set of five in-equations which satisfy the common region as shown in the figure:



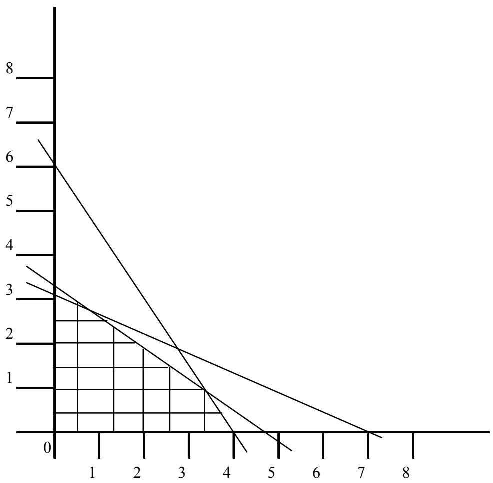
a) $\left.\begin{array}{l} 15x + 6y \leq 300 \\ 5x + 4y \leq 120 \\ x + 2y = 50 \\ x \geq 0, y \geq 0 \end{array}\right\}$

b) $\left.\begin{array}{l} 15x + 6y \leq 300 \\ 5x + 4y \leq 120 \\ x + 2y \leq 50 \\ x \geq 0, y \geq 0 \end{array}\right\}$

c) $\left.\begin{array}{l} 15x+6y \le 300 \\ 5x+4y \le 120 \\ x+2y \le 50 \\ x>0, y>0 \end{array}\right\}$

d) None of the given

3. Graph of five linear inequations are given below. These are $3x+2y=12$, $x+2.3y=6.9$, $x+1.4y=4.90$, $x \ge 0$ and $y \ge 0$. Identify the set of five inequations which satisfy the common region as shown in the figure:



a) $\left.\begin{array}{l} 3x+2y \le 12 \\ x+2.3y \le 6.90 \\ x+1.4y \le 4.90 \\ x \ge 0, y \ge 0 \end{array}\right\}$

b) $\left.\begin{array}{l} 3x+2y \ge 12 \\ x+2.3y \le 6.90 \\ x+1.4y \le 4.90 \\ x \ge 0, y \ge 0 \end{array}\right\}$

c) $\left.\begin{array}{l} 3x+2y \le 12 \\ x+2.3y \le 6.90 \\ x+1.4y \le 4.90 \end{array}\right\}$

d) None of the given

4. A car manufacturing company manufactures cars of two types A and B. Model A requires 150 man-hours for assembling, 50 man-hours for painting and 10 man-hours for checking and testing. Model B requires 60 man-hours for assembling, 40 man-hours for painting and 20 man-hours for checking and testing. There are available 30 thousand man-hours for assembling, 13 thousand man-hours for painting and 5 thousand man-hours for testing and checking. Let the company manufacture x units

of type A model of car and y units of type B model of the car. Then, the inequalities are:

a) $5x + 2y = 1000$, $5x + 4y \le 1300$, $x + 2y \le 500$, $x \ge 0$, $y \ge 0$

b) $5x + 2y \le 1000$, $5x + 4y \le 1300$, $x + 2y \le 500$, $x \ge 0$, $y \ge 0$

c) $5x + 2y \le 1000$, $5x + 4y = 1300$, $x + 2y = 500$, $x \ge 0$, $y \ge 0$

d) $5x + 2y \le 1000$, $5x + 4y \ge 1300$, $x + 2y \ge 500$, $x \ge 0$, $y \ge 0$

5. A scooter company manufacturers two scooters A and B. Model A requires 15 man-hours for assembly, 5 man-hours for painting and finishing and 1 man-hour for checking and testing. Model B requires 6 man-hours for assembly, 4 man-hours for painting and finishing and 2 man-hours for checking and testing. There are 300 man-hours available in the assembly shop, 120 man-hours in painting and finishing shop and 50 man-hours are available in checking and testing division. Express this using linear inequalities

a) $\left.\begin{array}{l} 15x + 6y \le 300 \\ 5x + 4y \le 120 \\ x + 2y = 50 \\ x \ge 0, y \ge 0 \end{array}\right\}$

b) $\left.\begin{array}{l} 15x + 6y \ge 300 \\ 5x + 4y \le 120 \\ x + 2y \ge 50 \\ x \ge 0, y \ge 0 \end{array}\right\}$

c) $\left.\begin{array}{l} 15x + 6y \le 300 \\ 5x + 4y \le 120 \\ x + 2y \le 50 \\ x \ge 0, y \ge 0 \end{array}\right\}$

d) None of the above

6. A dealer wishes to purchase a number of fans and sewing machines. He has only ₹ 5760 to invest and has space for at most 20 items. A fan costs him ₹ 360 and sewing machine ₹ 240. Express the above situation in terms of linear inequalities. Express this using linear inequalities

a) $\left.\begin{array}{l} x + y \leq 30 \\ 360x + 240y \leq 5760 \end{array}\right\}$

b) $\left.\begin{array}{l} x + y \leq 20 \\ 360x + 240y \leq 5760 \end{array}\right\}$

c) $\left.\begin{array}{l} x + y \leq 30 \\ 36x + 24y \leq 576 \end{array}\right\}$

d) None of the above

7. A firm is engaged in breeding pigs. The pigs are fed on various products grown on the farm. In view of the need to ensure certain nutrient constituents, it is necessary to buy two additional products, say A and B. The contents of the various products (per unit) in nutrient constituent (eg., vitamins, proteins, etc.) is given in the following table:

Nutrient	Nutrient content in product		Minimum amount of Nutrient
	A	B	
M1	36	6	108
M2	3	12	36
M3	20	10	100

The last column of the above table gives the minimum amounts of nutrients constituents M1, M2 and M3 which must be given to the pigs. Express the above situation in terms of linear inequalities.

a) $\left.\begin{array}{l} 36x + 6y \geq 108 \\ 3x + 12y \geq 36 \\ 20x + 10y \geq 100 \\ x \geq 0, y \geq 0 \end{array}\right\}$

b) $\left.\begin{array}{l} 6x + y \geq 18 \\ x + 4y \geq 12 \\ x + 0.5y \geq 5 \\ x \geq 0, y \geq 0 \end{array}\right\}$

c) $\left.\begin{array}{l} 36x + 6y \leq 108 \\ 3x + 12y \leq 36 \\ 20x + 10y \leq 100 \\ x \geq 0, y \geq 0 \end{array}\right\}$

d) (a) & (b) both

8. The rules and regulations demand that the employers should employ not more than 5 experienced hands to 1 fresh one and this fact is represented by: (Taking experienced person as x and fresh person as y)

a) y ≥ x/5

b) y ≥ x

c) y ≤ x/5

d) None of the above

9. Which of the following represents the linear relationship between two variables in an in-equality:

a) ax + by ≤ c

b) ax x by ≤ c

c) axy + by ≤ c

d) ax + bxy ≤ c

10. The solution of the in-equality $\frac{(5-2x)}{3} \leq \frac{x}{6} - 5$ is:

a) x ≤ 8

b) x = 8

c) x ≥ 8

d) None of the above

11. Solution space of the in-equalities 2x + y ≤ 10 and x – y ≤ 5 are:

I. Includes the origin

II. Includes the point (4, 3)

Which one of the following is correct?

a) Only I

b) Only II

c) Both I and II

d) Neither I nor II

12. On an average, experienced person does 5 units of work while a fresh person does 3 units of work daily but the employer has to maintain the output of at least 30 units of work per day. The situation can be expressed as:

a) $5x + 3y \le 30$

b) $5x + 3y < 30$

c) $5x + 3y \ge 30$

d) $5x + 3y = 30$

13. Find the range of real values of x satisfying the in-equalities $3x - 2 > 7$ and $4x - 13 > 15$.

a) $x > 3$

b) $x < 7$

c) $x > 7$

d) $x < 3$

14. If $\left|x+\frac{1}{4}\right| > \frac{7}{4}$, then which of the following is correct?

a) $x < -\frac{3}{2}$ or $x > 2$

b) $x < -2$ or $x > \frac{3}{2}$

c) $-2 < x < \frac{3}{2}$

d) None of the above

15. If $a > 0$ and $b < 0$, then which of the following follows:

a) $1/a > 1/b$

b) $1/a < 1/b$

c) $1/a = 1/b$

d) None of the above

16. On solving the in-equations $6x + y \geq 18$, $x + 4y \geq 12$, $2x + y \geq 10$, we get the following situation:

    a) (0, 18), (12, 0), (4, 2) & (7, 6)

    b) (0, 3), (3, 0), (4, 2) & (7, 6)

    c) (0, 10), (5, 0), (4, 2) & (7, 6)

    d) (0, 18), (12, 0), (4, 2), (0, 0) & (7, 6)

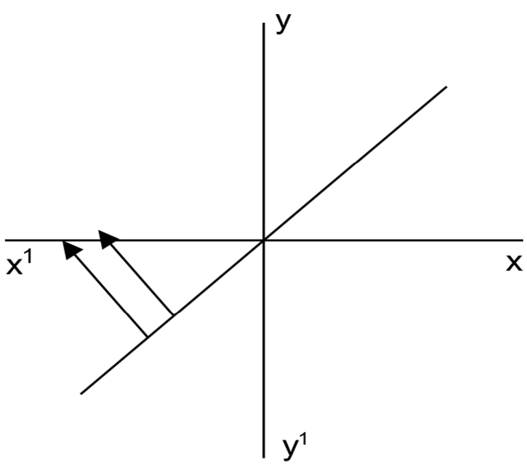
17. **For 17 Do as Directed**

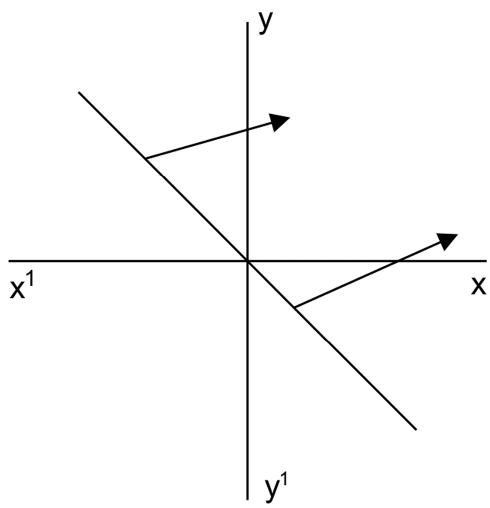
    Mark (a) if $x - y \leq 0$

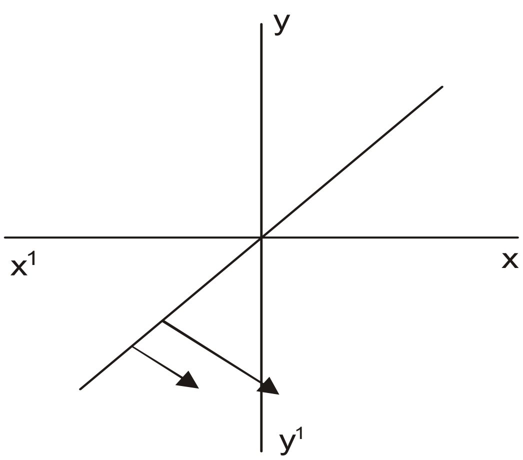
    Mark (b) if $x - y \geq 0$

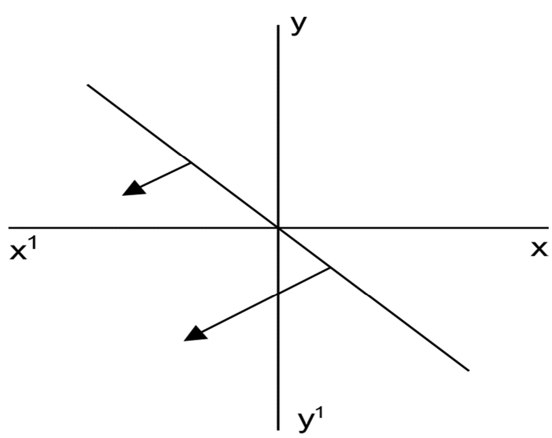
    Mark (c) if $x + y \leq 0$

    Mark (d) if $x + y \geq 0$









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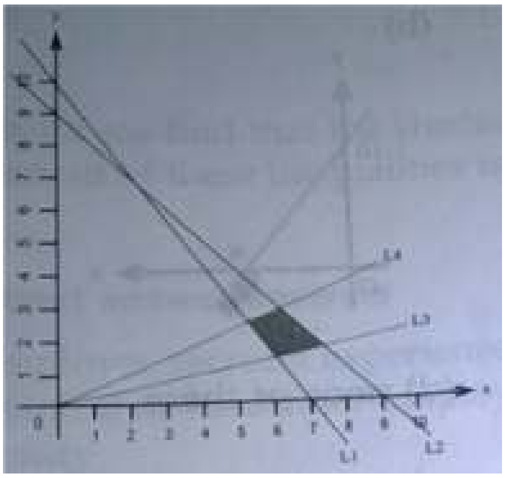


L1 : $5x + 3y = 30$ L2 : $x+y = 9$ L3 : $y = x/3$ L4 : $y = x/2$

The common region (shaded part) shown in the diagram refers to

(a) $5x + 3y \le 30$
$x + y \le 9$
$y \le 1/5\ x$
$y \le x/2$

(b) $5x + 3y \ge 30$
$x + y \le 9$
$y \ge x/3$
$y \le x/2$
$x \ge 0, y \ge 0$

(c) $5x + 3y \ge 30$
$x + y \ge 9$
$y \le x/3$
$y \ge x/2$
$x \ge 0, y \ge 0$

(d) $5x + 3y \ge 30$
$x + y \le 9$
$y \ge 9$
$y \le x/2$
$x \ge 0, y \ge 0$

19. A dietitian wishes to mix together two kinds of food so that the vitamin content of the mixture is at least 9 units of vitamin A, 7 units of vitamin B, 10 units of vitamin C and 12 units of vitamin D. The vitamin content per Kg. of each food is shown below:

	A	**B**	**C**	**D**
Food I :	2	1	1	2
Food II:	1	1	2	3

Assuming x units of food I is to be mixed with y units of food II the situation can be expressed as :

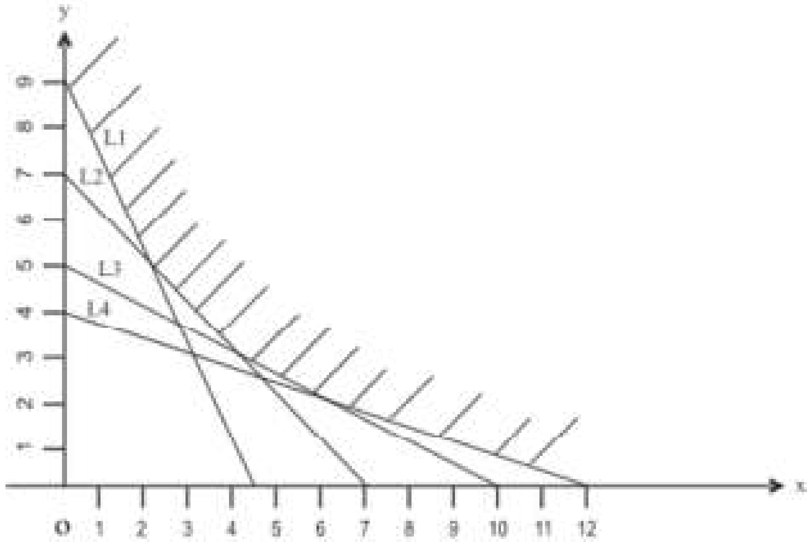
(a) $2x + y \le 9$
$x + y \le 7$
$x + 2y \le 10$
$2x + 3y \le 12$
$x > 0, y > 0$

(b) $2x + y \ge 30$
$x + y \le 7$
$x + 2y \ge 10$
$x + 3y \ge 12$

(c) $2x + y \ge 9$
$x + y \ge 7$
$x + y \le 10$
$2x + 3y \ge 12$

(d) $2x + y \ge 9$
$x + y \ge 7$
$x + 2y \ge 10$
$2x + 3y \ge 12$
$x \ge 0, y \ge 0$

20.

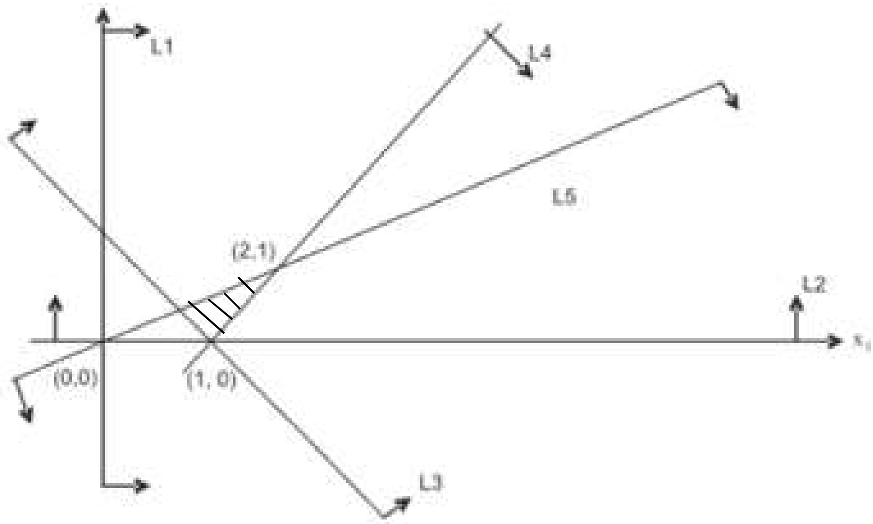


L1 : $2x + y = 9$ L2 : $x + y = 7$ L3 : $x + 2y = 10$ L4 : $x + 3y = 12$

The common region (shaded part) indicated on the diagram is expressed by the set of inequalities

(a)	$2x + y \le 9$	**(b)**	$2x + y \ge 9$	**(c)**	$2x + y \ge 9$	**(d)**	none of these
	$x + y \ge 7$		$x + y \le 7$		$x + y \ge 7$		
	$x + 2y \ge 10$		$x + 2y \ge 10$		$x + 2y \ge 10$		
	$x + 3y \ge 12$		$x + 3y \ge 12$		$x + 3y \ge 12$		
					$x \ge 0, y \ge 0$		

21.



The common region indicated on the graph is expressed by the set of five inequalities

(a)	L1 : $x_1 \ge 0$	**(b)**	L1 : $x_1 \ge 0$	**(c)**	L1 : $x_1 \le 0$	**(d)**	None of these
	L2 : $x_2 \ge 0$		L2 : $x_2 \ge 0$		L2 : $x_2 \le 0$		
	L3 : $x_1 + x_2 \le 1$		L3 : $x_1 + x_2 \ge 1$		L3 : $x_1 + x_2 \ge 1$		
	L4 : $x_1 - x_2 \ge 1$		L4 : $x_1 - x_2 \le 1$		L4 : $x_1 - x_2 \ge 1$		
	L5 : $-x_1 + 2x_2 \le 0$		L5 : $-x_1 + 2x_2 \le 0$		L5 : $-x_1 + 2x_2 \le 0$		

22. A company produces two types of leather belts, say A and B. Belt A is of superior quality and belt B is of lower quality. Each belt of type A requires twice as much as required by a belt of type B. If all belts were of type B, the company could produce 1000 belts per day. But the supply of leather is sufficient only for 800 belts per day. Belt A requires fancy buckles and only 400 fancy buckles are available per day. For belt of type B only 700 buckles are available per day.

Constraints can be formulated by assuming that the company produce x units of belt A and y units of belt B as :

(a) $2x + y \leq 1000$; $x + y \geq 800$; $x \leq 400$; $y \leq 700$; $x \geq 0$; $y \geq 0$

(b) $2x + y \leq 1000$; $x + y \leq 800$; $x \leq 400$; $y \leq 700$; $x \geq 0$; $y \geq 0$

(c) $2x + y \geq 1000$; $x + y \leq 800$; $x \leq 400$; $y \leq 700$; $x \geq 0$; $y \geq 0$

d) None of these