CHAPTER

6

LINEAR INEQUALITY

CONCEPT TYPE QUESTIONS

Directions : This section contains multiple choice questions. Each question has four choices (a), (b), (c) and (d), out of which only one is correct.

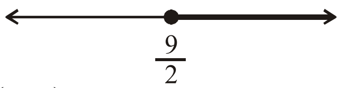
1. If x is real number and $|x| < 3$, then
(a) $x \geq 3$ (b) $-3 < x < 3$
(c) $x \leq -3$ (d) $-3 \leq x \leq 3$

2. Given that x, y and b are real numbers and $x < y$, $b < 0$, then
(a) $\frac{x}{b} < \frac{y}{b}$ (b) $\frac{x}{b} \leq \frac{y}{b}$
(c) $\frac{x}{b} > \frac{y}{b}$ (d) $\frac{x}{b} \geq \frac{y}{b}$

3. Solution of a linear inequality in variable x is represented on number line is

(a) $x \in (-\infty, 5)$ (b) $x \in (-\infty, 5]$
(c) $x \in [5, \infty)$ (d) $x \in (5, \infty)$

4. Solution of linear inequality in variable x is represented on number line is



(a) $x \in \left(\frac{9}{2}, \infty\right)$ (b) $x \in [\frac{9}{2}, \infty)$
(c) $x \in (-\infty, \frac{9}{2})$ (d) $x \in (-\infty, \frac{9}{2}]$

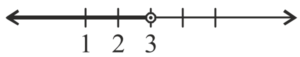
5. If $|x+3| \geq 10$, then
(a) $x \in (-13, 7]$ (b) $x \in (-13, 7)$
(c) $x \in (-\infty, 13] \cup [-7, \infty)$ (d) $x \in (-\infty, -13] \cup [7, \infty)$

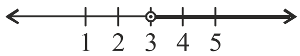
6. Let $\frac{C}{5} = \frac{F-32}{9}$. If C lies between 10 and 20, then :
(a) $50 < F < 78$ (b) $50 < F < 68$
(c) $49 < F < 68$ (d) $49 < F < 78$

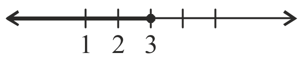
7. The solution set of the inequality $4x + 3 < 6x + 7$ is
(a) $[-2, \infty)$ (b) $(-\infty, -2)$
(c) $(-2, \infty)$ (d) None of these

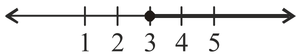
8. Which of the following is the solution set of $3x - 7 > 5x - 1 \ \forall \ x \in R$?
(a) $(-\infty, -3)$ (b) $(-\infty, -3]$
(c) $(-3, \infty)$ (d) $(-3, 3)$

9. The solution set of the inequality $37 - (3x + 5) \geq 9x - 8(x - 3)$ is
(a) $(-\infty, 2)$ (b) $(-\infty, -2)$
(c) $(-\infty, 2]$ (d) $(-\infty, -2]$

10. The graph of the solution on number line of the inequality $3x - 2 < 2x + 1$ is
(a) 

(b) 

(c) 

(d) 

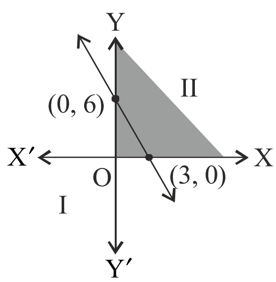
11. The solution set of the inequalities $6 \leq -3(2x - 4) < 12$ is
(a) $(-\infty, 1]$ (b) $(0, 1]$
(c) $(0, 1] \cup [1, \infty)$ (d) $[1, \infty)$

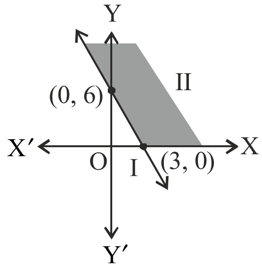
12. Which of the following is the solution set of linear inequalities $2(x - 1) < x + 5$ and $3(x + 2) > 2 - x$?
(a) $(-\infty, -1)$ (b) $(-1, 1)$ (c) $(-1, 7)$ (d) $(1, 7)$

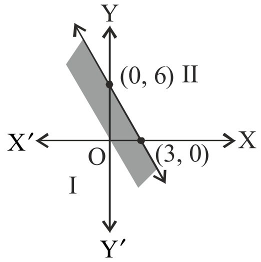
13. x and b are real numbers. If $b > 0$ and $|x| > b$, then
(a) $x \in (-b, \infty)$ (b) $x \in (-\infty, b)$
(c) $x \in (-b, b)$ (d) $x \in (-\infty, -b) \cup (b, \infty)$

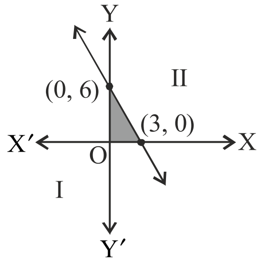
14. If $a < b$ and $c < 0$, then
(a) $\frac{a}{c} = \frac{b}{c}$ (b) $\frac{a}{c} > \frac{b}{c}$
(c) $\frac{a}{c} < \frac{b}{c}$ (d) None of these

15. The graph of the inequality $40x + 20y \leq 120$, $x \geq 0$, $y \geq 0$ is

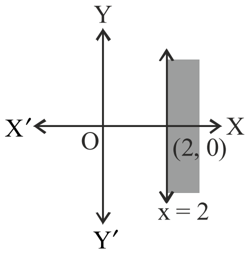
(a) 

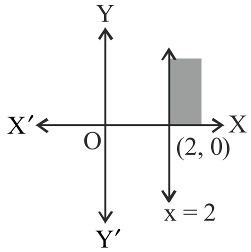
(b) 

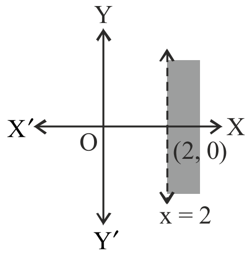
(c) 

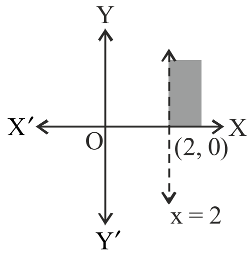
(d) 

16. The graphical solution of $3x - 6 \geq 0$ is

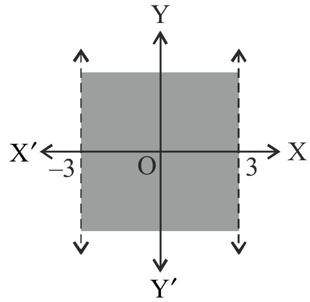
(a) 

(b) 

(c) 

(d) 

17. The inequality representing the following graph is



(a) $|x| < 3$ (b) $|x| \leq 3$ (c) $|x| > 3$ (d) $|x| \geq 3$

18. The solutions of the system of inequalities $3x - 7 < 5 + x$ and $11 - 5x \leq 1$ on the number line is

(a) 

(b) 

(c) 

(d) None of the above

19. The solution set of the inequalities $3x - 7 > 2(x - 6)$ and $6 - x > 11 - 2x$, is

(a) $(-5, \infty)$ (b) $[5, \infty)$ (c) $(5, \infty)$ (d) $[-5, \infty)$

20. If $\frac{5 - 2x}{3} \leq \frac{x}{6} - 5$, then $x \in$

(a) $[2, \infty)$ (b) $[-8, 8]$ (c) $[4, \infty)$ (d) $[8, \infty)$

21. If $\frac{3x - 4}{2} \geq \frac{x + 1}{4} - 1$, then $x \in$

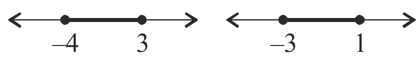
(a) $[1, \infty)$ (b) $(1, \infty)$ (c) $(-5, 5)$ (d) $[-5, 5]$

22. If $-5 \leq \frac{5 - 3x}{2} \leq 8$, then $x \in$

(a) $\left[-\frac{11}{3}, 5\right]$ (b) $[-5, 5]$

(c) $\left[-\frac{11}{3}, \infty\right)$ (d) $(-\infty, \infty)$

23. Solutions of the inequalities comprising a system in variable x are represented on number lines as given below, then



(a) $x \in (-\infty, -4] \cup [3, \infty)$
(b) $x \in [-3, 1]$
(c) $x \in (-\infty, -4) \cup [3, \infty)$
(d) $x \in [-4, 3]$

24. The inequality $\frac{2}{x} < 3$ is true, when x belongs to

(a) $\left[\frac{2}{3}, \infty\right)$ (b) $\left(-\infty, \frac{2}{3}\right]$

(c) $(-\infty, 0) \cup \left(\frac{2}{3}, \infty\right)$ (d) None of these

25. Solution of $|3x + 2| < 1$ is

(a) $\left[-1, -\frac{1}{3}\right]$ (b) $\left\{-\frac{1}{3}, -1\right\}$

(c) $\left(-1, -\frac{1}{3}\right)$ (d) None of these

26. Solution of $|x-1| \ge |x-3|$ is
(a) $x \le 2$ (b) $x \ge 2$ (c) $[1, 3]$ (d) None of these

27. If $-3x + 17 < -13$, then
(a) $x \in (10, \infty)$ (b) $x \in [10, \infty)$
(c) $x \in (-\infty, 10]$ (d) $x \in [-10, 10)$

28. If $|x+2| \le 9$, then
(a) $x \in (-7, 11)$ (b) $x \in [-11, 7]$
(c) $x \in (-\infty, -7) \cup (11, \infty)$ (d) $x \in (-\infty, -7) \cup [11, \infty)$

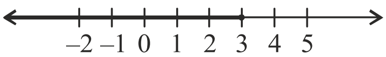
STATEMENT TYPE QUESTIONS

Directions : Read the following statements and choose the correct option from the given below four options.

29. Consider the following statements about Linear Inequalities :
I. Two real numbers or two algebraic expressions related by the symbols $<, >, \le$ or $\ge$ form an inequality.
II. When equal numbers added to (or subtracted from) both sides of an inequality then the inequality does not changed.
III. When both sides of an inequality multiplied (or divided) by the same positive number then the inequality does not changed.
Which of the above statements are true ?
(a) Only I (b) Only II
(c) Only III (d) All of the above

30. Consider the following statements:
Statement-I : Consider the inequality $30x < 200$ such that x is not a negative integer or fraction. Then, the value of x, which make the inequality a true statement are 1, 2, 3, 4, 5, 6.
Statement-II : The solution of an inequality in one variable is the value of that variable which makes it a true statement.
Choose the correct option.
(a) Statement I is true (b) Statement II is true
(c) Both are true (d) Both are false

31. Consider the following statements:
Statement-I : The solution set of $7x + 3 < 5x + 9$ is $(-\infty, 3)$.
Statement-II : The graph of the solution of above inequality is represented by



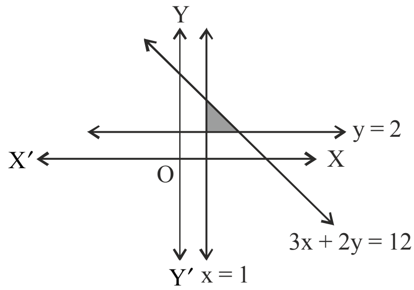
Choose the correct option.
(a) Statement I is true (b) Statement II is true
(c) Both are true (d) Both are false

32. Consider the following statements:
Statement-I : The solution set of $5x - 3 < 7$, when x is an integer, is $\{....., -3, -2, -1\}$.
Statement-II : The solution of $5x - 3 < 7$, when x is a real number, is $(-\infty, 2)$.
Choose the correct option.
(a) Statement I is true (b) Statement II is true
(c) Both are true (d) Both are false

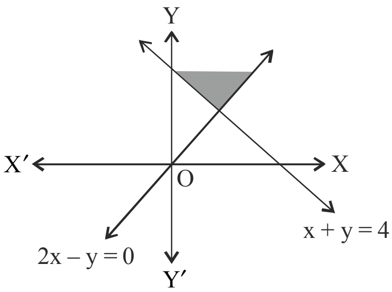
33. Consider the following statements:
Statement-I : The solution set of the inequality
$\frac{3(x-2)}{5} \le \frac{5(2-x)}{3}$ is $(-\infty, 2)$.
Statement-II : The solution set of the inequality
$\frac{1}{2}\left(\frac{3x}{5}+4\right) \ge \frac{1}{3}(x-6)$ is $(-\infty, 120]$.
Choose the correct option.
(a) Statement I is true (b) Statement II is true
(c) Both are true (d) Both are false

34. Consider the following statements:
Statement-I : The region containing all the solutions of an inequality is called the solution region.
Statement-II : The half plane represented by an inequality is checked by taking any point on the line.
Choose the correct option.
(a) Statement I is true (b) Statement II is true
(c) Both are true (d) Both are false

35. Which of the following is/are true?
I. The graphical solution of the system of inequalities $3x + 2y \le 12$, $x \ge 1$, $y \ge 2$ is

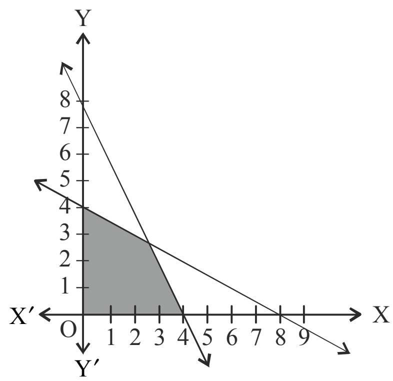


II. The region represented by the solution set of the inequalities $2x + y \ge 6$, $3x + 4y \le 12$ is bounded.
III. The solution set of the inequalities $x + y \ge 4$, $2x - y > 0$ is



(a) Only I is true (b) I and II are true
(c) I and III are true (d) Only III is true

36. Which of the following linear inequalities satisfy the shaded region of the given figure.
I. $x + 2y \le 8$ II. $x \ge 0, y \ge 0$
III. $x \le 0, y \le 0$ IV. $2x + y \le 8$
V. $4x + 5y \le 40$



(a) I, III and V (b) I, IV and V
(c) I, III and IV (d) I, II, and IV

37. Consider the following statements.

I. Inequalities involving the symbol ≥ or ≤ are called slack inequalities.

II. Inequalities which do not involve variables are called numerical inequalities.

Choose the correct option.

(a) Only I is true (b) Only II is true.
(c) Both are true. (d) Both are false.

38. Consider the following statements.

I. Solution set of the inequality $-15 < \frac{3(x-2)}{5} \le 0$ is $(-23, 2]$

II. Solution set of the inequality $7 \le \frac{3x+11}{2} \le 11$ is $\left[1, \frac{11}{3}\right]$

III. Solution set of the inequality $-5 \le \frac{2-3x}{4} \le 9$ is $[-1, 1] \cup [3, 5]$

Choose the correct option

(a) Only I and II are true. (b) Only II and III are true.
(c) Only I and III are true. (d) All are true.

39. Consider the following statements.

I. Equal numbers may be added to (or subtracted from) both sides of an inequality.

II. When both sides are multiplied (or divided) by a negative number, then the inequality is reversed.

Choose the correct option.

(a) Only I is true. (b) Only II is true.
(c) Both I and II are true. (d) Both I and II are false.

40. Consider the following statements.

I. Solution set of 24x < 100 is {1, 2, 3, 4}, when x is a natural number.

II. Solution set of 24x < 100 is {…, –3, –2, –1, 0, 1, 2, 3, 4}, when x is an integer.

Choose the correct option.

(a) Only I is false. (b) Only II is false.
(c) Both are false. (d) Both are true.

41. I. When x is an integer, the solution set of 3x + 8 > 2 is {–1, 0, 1, 2, 3, …}.

II. When x is a real number, the solution set of 3x + 8 > 2 is {–1, 0, 1}.

Choose the correct option.

(a) Only I is incorrect.
(b) Only II is incorrect.
(c) Both I and II are incorrect.
(d) Both I and II are correct.

MATCHING TYPE QUESTIONS

Directions : Match the terms given in column-I with the terms given in column-II and choose the correct option from the codes given below.

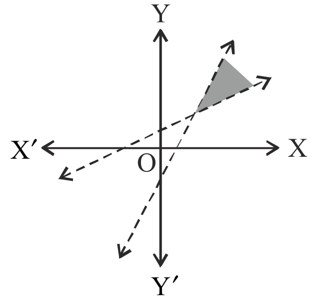
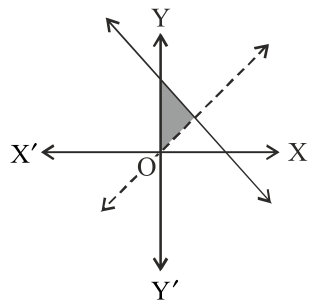
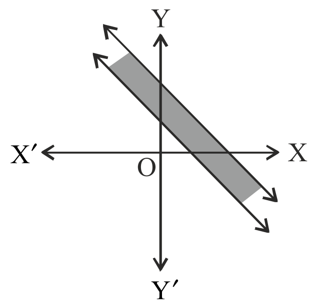
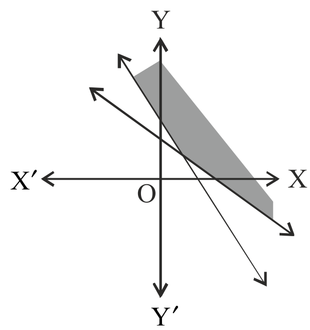
42.

Column - I (Linear inequations)	**Column - II (Solution set)**
(A) $2x-4 \le 0$	(1) $[3, \infty)$
(B) $-3x+12 < 0$	(2) $(3, \infty)$
(C) $4x-12 \ge 0$	(3) $(-\infty, 2]$
(D) $7x+9 > 30$	(4) $(4, \infty)$

Codes

	A	B	C	D
(a)	3	4	1	2
(b)	3	1	4	2
(c)	2	4	1	3
(d)	2	1	4	3

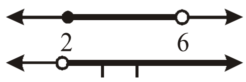
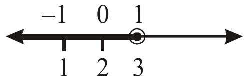
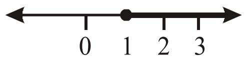
43. Match the linear inequalities given in column-I with solution set representing by graphs in column-II

Column-I	**Column-II**
A. $2x - y > 1$, $x - 2y < -1$	1. 
B. $x + y \le 6$, $x + y \ge 4$	2. 
C. $2x + y \ge 8$, $x + 2y \ge 10$	3. 
D. $x + y \le 9$, $y > x$, $x \ge 0$	4. 

Codes:

	A	B	C	D
(a)	4	3	2	1
(b)	2	1	4	3
(c)	1	3	4	2
(d)	3	4	2	1

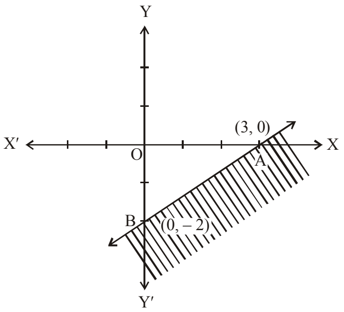
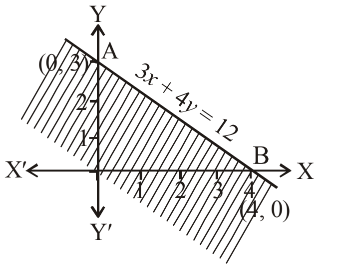
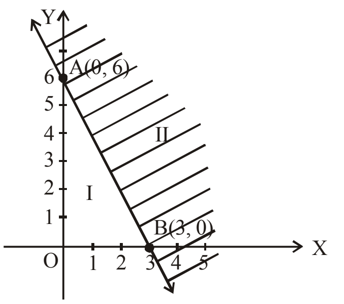
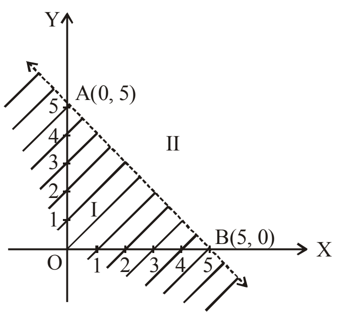
44.

Column - I (Linear inequations)	**Column - II (Solution on number line)**
(A) $\frac{3x-4}{2} \geq \frac{x+1}{4} - 1$	(1) 
(B) $3x - 2 < 2x + 1$	(2)
(C) $3(1-x) < 2(x+4)$	(3) 
(D) $3x - 7 < 5 + x$ and $11 - 5x \leq 1$	(4) 

Codes

	A	B	C	D
(a)	4	2	3	1
(b)	1	3	2	4
(c)	4	3	2	1
(d)	1	2	3	4

45.

Column - I (Inequality)	**Column - II (Graph)**
(A) $x + y < 5$	(1) 
(B) $2x + y \geq 6$	(2) 
(C) $3x + 4y \leq 12$	(3) 
(D) $2x - 3y > 6$	(4) 

Codes

	A	B	C	D
(a)	4	2	3	1
(b)	4	3	2	1
(c)	1	2	3	4
(d)	1	3	2	4

INTEGER TYPE QUESTIONS

Directions : This section contains integer type questions. The answer to each of the question is a single digit integer, ranging from 0 to 9. Choose the correct option.

46. The solution set of the inequality $4x + 3 < 6x + 7$ is $(-a, \infty)$. The value of 'a' is
(a) 1 (b) 4
(c) 2 (d) None of these

47. The set of real x satisfying the inequality $\frac{5-2x}{3} \leq \frac{x}{6} - 5$ is $[a, \infty)$. The value of 'a' is
(a) 2 (b) 4 (c) 6 (d) 8

48. The solution set of the inequality $3(2-x) \geq 2(1-x)$ is $(-\infty, a]$. The value of 'a' is
(a) 2 (b) 3 (c) 4 (d) 5

49. The solution set of $\frac{2x-1}{3} \geq \left(\frac{3x-2}{4}\right) - \left(\frac{2-x}{5}\right)$ is $(-\infty, a]$. The value of 'a' is
(a) 2 (b) 3 (c) 4 (d) 5

50. If $5x + 1 > -24$ and $5x - 1 < 24$, then $x \in (-a, a)$. The value of 'a' is
(a) 2 (b) 3 (c) 4 (d) 5

51. If x satisfies the inequations $2x - 7 < 11$ and $3x + 4 < -5$, then x lies in the interval $(-\infty, -m)$. The value of 'm' is
(a) 2 (b) 3 (c) 4 (d) 5

52. If $|x| < 3$ and x is a real number, then $-m < x < m$. The value of m is
(a) 3 (b) 4 (c) 2 (d) 1

53. 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 at least 61 cm, find the minimum length of the shortest side.
(a) 2 (b) 9 (c) 8 (d) 7

54. The solution of the inequality $-8 \leq 5x - 3 < 7$ is $[-a, b)$. Sum of 'a' and 'b' is
(a) 1 (b) 2 (c) 3 (d) 4

55. The number of pairs of consecutive odd natural numbers both of which are larger than 10, such that their sum is less than 40, is
(a) 4 (b) 6 (c) 3 (d) 8

ASSERTION - REASON TYPE QUESTIONS

Directions : Each of these questions contains two statements, Assertion and Reason. Each of these questions also has four alternative choices, only one of which is the correct answer. You have to select one of the codes (a), (b), (c) and (d) given below.
(a) Assertion is correct, reason is correct; reason is a correct explanation for assertion.
(b) Assertion is correct, reason is correct; reason is not a correct explanation for assertion
(c) Assertion is correct, reason is incorrect
(d) Assertion is incorrect, reason is correct.

56. **Assertion :** The inequality ax + by < 0 is strict inequality.
Reason : The inequality ax + b ≥ 0 is slack inequality.

57. **Assertion :** If a < b, c < 0, then $\frac{a}{c} < \frac{b}{c}$.
Reason : If both sides are divided by the same negative quantity, then the inequality is reversed.

58. **Assertion :** $|3x - 5| > 9 \Rightarrow x \in \left(-\infty, \frac{-4}{3}\right) \cup \left(\frac{14}{3}, \infty\right)$.
Reason : The region containing all the solutions of an inequality is called the solution region.

59. **Assertion :** A line divides the cartesian plane in two part(s).
Reason : If a point P(α, β) on the line ax + by = c, then aα + bβ = c.

60. **Assertion :** Each part in which a line divides the cartesian plane, is known as half plane.
Reason : A point in the cartesian plane will either lie on a line or will lie in either of half plane I or II.

61. **Assertion :** Two real numbers or two algebraic expressions related by the symbol <, >, ≤ or ≥ forms an inequality.
Reason : The inequality ax + by < 0 is strict inequality.

62. **Assertion :** The inequality 3x + 2y ≥ 5 is the linear inequality.
Reason : The solution of 5x – 3 < 7, when x is a real number, is (–∞, 2).

63. **Assertion :** If 3x + 8 > 2, then x ∈ {–1, 0, 1, 2, …}, when x is an integer.
Reason : The solution set of the inequality 4x + 3 < 5x + 7 ∀ x ∈ R is [4, ∞).

64. **Assertion :** Graph of linear inequality in one variable is a visual representation.
Reason : If a point satisfying the line ax + by = c, then it will lie in upper half plane.

65. **Assertion :** The region containing all the solutions of an inequality is called the solution region.
Reason : The values of x, which make an inequality a true statement, are called solutions of the inequality.

66. **Assertion :** A non-vertical line will divide the plane into left and right half planes.
Reason : The solution region of a system of inequalities is the region which satisfies all the given inequalities in the system simultaneously.

CRITICALTHINKING TYPE QUESTIONS

Directions : This section contains multiple choice questions. Each question has four choices (a), (b), (c) and (d), out of which only one is correct.

67. The length of a rectangle is three times the breadth. If the minimum perimeter of the rectangle is 160 cm, then what can you say about breadth?
(a) breadth = 20 (b) breadth ≤ 20
(c) breadth ≥ 20 (d) breadth ≠ 20

68. The set of real values of x satisfying |x – 1| ≤ 3 and |x – 1| ≥ 1 is
(a) [2, 4] (b) (–∞, 2]∪[4, +∞)
(c) [–2, 0]∪[2, 4] (d) None of these

69. The marks obtained by a student of class XI in first and second terminal examinations are 62 and 48, respectively. The minimum marks he should get in the annual examination to have an average of at least 60 marks, are
(a) 70 (b) 50 (c) 74 (d) 48

70. Ravi obtained 70 and 75 marks in first two unit tests. Then, the minimum marks he should get in the third test to have an average of at least 60 marks, are
(a) 45 (b) 35 (c) 25 (d) None of these

71. The pairs of consecutive even positive integers, both of which are larger than 5 such that their sum is less than 23, are
(a) (4, 6), (6, 8), (8, 10), (10, 12)
(b) (6, 8), (8, 10), (10, 12)
(c) (6, 8), (8, 10), (10, 12), (12, 14)
(d) (8, 10), (10, 12)

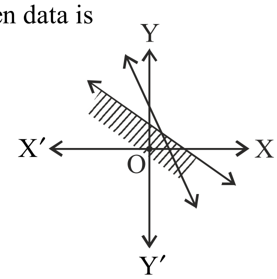
72. A man wants to cut three lengths from a single piece of board of length 91 cm. The second length is to be 3 cm longer than the shortest and the third length is to be twice as long as the shortest. The possible length of the shortest board, if the third piece is to be at least 5 cm longer than the second, is
(a) less than 8 cm
(b) greater than or equal to 8 cm but less than or equal to 22 cm
(c) less than 22 cm
(d) greater than 22 cm

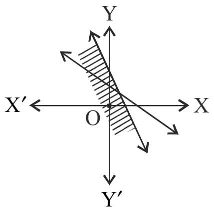
73. The length of a rectangle is three times the breadth. If the minimum perimeter of the rectangle is 160 cm, then
(a) breadth > 20 cm (b) length < 20 cm
(c) breadth ≥ 20 cm (d) length ≤ 20 cm

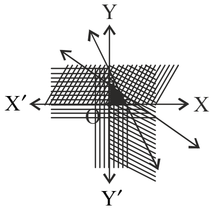
74. The set of values of x satisfying 2 ≤ |x – 3| < 4 is
(a) (–1, 1] ∪ [5, 7) (b) –4 ≤ x ≤ 2
(c) –1 < x < 7 or x ≥ 5 (d) x < 7 or x ≥ 5

75. IQ of a person is given by the formula
$$IQ = \frac{MA}{CA} \times 100$$
where, MA is mental age and CA is chronological age. If 80 ≤ IQ ≤ 140 for a group of 12 years children, then the range of their mental age is
(a) 9.8 ≤ MA ≤ 16.8 (b) 10 ≤ MA ≤ 16
(c) 9.6 ≤ MA ≤ 16.8 (d) 9.6 ≤ MA ≤ 16.6

76. A furniture dealer deals in only two items — tables and chairs. He has ` 15,000 to invest and a space to store atmost 60 pieces. A table costs him ` 750 and chair ` 150. Suppose he makes x tables and y chairs
The graphical solution of the inequations representing the given data is

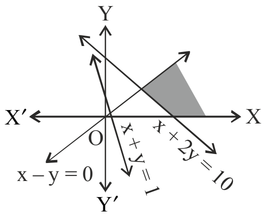
(a) 

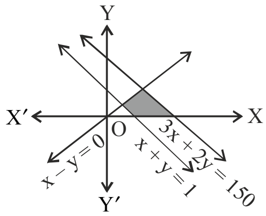
(b) 

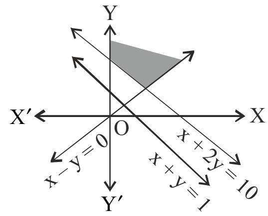
(c) 

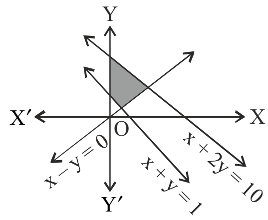
(d) None of these

77. The graphical solution of the inequalities $x + 2y \le 10$, $x + y \ge 1$, $x - y \le 0$, $x \ge 0$, $y \ge 0$ is

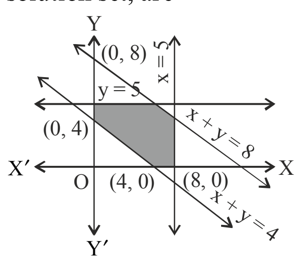
(a) 

(b) 

(c) 

(d) 

78. Linear inequalities for which the shaded region for the given figure is the solution set, are



(a) $x + y \le 8$, $x + y \le 4$, $x \le 5$, $y \le 5$, $x \ge 0$, $y \ge 0$
(b) $x + y \le 8$, $x + y \ge 4$, $x \le 5$, $y \le 5$, $x \ge 0$, $y \ge 0$
(c) $x + y \ge 8$, $x + y \ge 4$, $x \ge 5$, $y \ge 5$, $x \ge 0$, $y \ge 0$
(d) None of the above

79. A solution of 8% boric is to be diluted by adding a 2% boric acid solution to it. The resulting mixture is to be more than 4% but less than 6% boric acid. If we have 640 L of the 8% solution, of the 2% solution will have to be added is
(a) more than 320 and less than 1000
(b) more than 160 and less than 320
(c) more than 320 and less than 1280
(d) more than 320 and less than 640

80. A company manufactures cassettes. Its cost and revenue functions are $C(x) = 26000 + 30x$ and $R(x) = 43x$, respectively, where x is the number of cassettes produced and sold in a week.
The number of cassettes must be sold by the company to realise some profit, is
(a) more than 2000 (b) less than 2000
(c) more than 1000 (d) less than 1000

81. A manufacturer has 600 litres of a 12% solution of acid. How many litres of a 30% acid solution must be added to it so that acid content in the resulting mixture will be more than 15% but less than 18%?
(a) more than 120 litres but less than 300 litres
(b) more than 140 litres but less than 600 litres
(c) more than 100 litres but less than 280 litres
(d) more than 160 litres but less than 500 litres

82. If $\frac{|x+3|+x}{x+2} > 1$, then $x \in$
(a) $(-5, -2)$ (b) $(-1, \infty)$
(c) $(-5, -2) \cup (-1, \infty)$ (d) None of these

83. If $|2x - 3| < |x + 5|$, then x belongs to
(a) $(-3, 5)$ (b) $(5, 9)$ (c) $\left(-\frac{2}{3}, 8\right)$ (d) $\left(-8, \frac{2}{3}\right)$

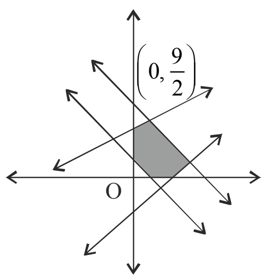
84. Solution of $(x - 1)^2 (x + 4) < 0$ is
(a) $(-\infty, 1)$ (b) $(-\infty, -4)$ (c) $(-1, 4)$ (d) $(1, 4)$

85. Solution of $\left|1 + \frac{3}{x}\right| > 2$ is
(a) $(0, 3]$ (b) $[-1, 0)$
(c) $(-1, 0) \cup (0, 3)$ (d) None of these

86. Solution of $|2x - 3| < |x + 2|$ is
(a) $\left(-\infty, \frac{1}{3}\right)$ (b) $\left(\frac{1}{3}, 5\right)$
(c) $(5, \infty)$ (d) $\left(-\infty, \frac{1}{3}\right) \cup (5, \infty)$

87. Solution of $\left|x + \frac{1}{x}\right| > 2$ is
(a) $R - \{0\}$
(b) $R - \{-1, 0, 1\}$
(c) $R - \{1\}$
(d) $R - \{-1, 1\}$

88. Which of the following linear inequalities satisfy the shaded region of the given figure?



(a) $2x + 3y \ge 3$
(b) $3x + 4y \le 18$
(c) $x - 6y \le 3$
(d) All of these

HINTS AND SOLUTIONS

CONCEPT TYPE QUESTIONS

1. **(b)** $|x| < 3 \Rightarrow -3 < x < 3$

2. **(c)** $x < y \Rightarrow \frac{x}{b} > \frac{y}{b}$

3. **(d)** 4. **(b)**

5. **(d)** $|x+3| \geq 10,$

$\Rightarrow x+3 \leq -10$ or $x+3 \geq 10$

$\Rightarrow x \leq -13$ or $x \geq 7$

$\Rightarrow x \in (-\infty, -13] \cup [7, \infty)$

6. **(b)** Given : $\frac{C}{5} = \frac{F-32}{9}$ and $10 < C < 20.$

$\Rightarrow \quad C = \frac{5F-(32)5}{9}$

Since, $10 < C < 20$

$\Rightarrow \quad 10 < \frac{5F-160}{9} < 20$

$\Rightarrow \quad 90 < 5F - 160 < 180$

$\Rightarrow \quad 90 + 160 < 5F < 180 + 160$

$\Rightarrow \quad 250 < 5F < 340$

$\Rightarrow \quad \frac{250}{5} < F < \frac{340}{5}$

$\Rightarrow \quad 50 < F < 68$

7. **(c)** We have, $4x + 3 < 6x + 7$

or $4x - 6x < 6x + 4 - 6x$

or $-2x < 4$ or $x > -2$

i.e. all the real numbers which are greater than –2, are the solutions of the given inequality. Hence, the solution set is $(-2, \infty)$.

8. **(a)** We have, $3x - 7 > 5x - 1$

Transferring the term 5x to L.H.S. and the term –7 to R.H.S.

Dividing both sides by 2,

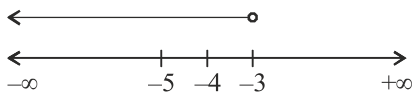
$3x - 5x > -1 + 7$

$\Rightarrow -2x > 6$

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

$\Rightarrow x < -3$

With the help of number line, we can easily look for the numbers less than –3.



$\therefore$ Solution set is $(-\infty, -3)$, i.e. all the numbers lying between $-\infty$ and –3 but $-\infty$ and –3 are not included as $x < -3$.

9. **(c)** We have, $37 - (3x + 5) \geq 9x - 8(x - 3)$

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

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

Transferring the term 24 to L.H.S. and the term (–3x) to R.H.S.

$32 - 24 \geq x + 3x$

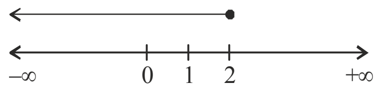
$\Rightarrow 8 \geq 4x$

$\Rightarrow 4x \leq 8$

Dividing both sides by 4,

$\frac{4x}{4} \leq \frac{8}{4}$

$\Rightarrow x \leq 2$

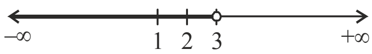


$\therefore$ Solution set is $(-\infty, 2]$.

10. **(a)** We have, $3x - 2 < 2x + 1$

Transferring the term 2x to L.H.S. and the term (–2) to R.H.S.

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



All the numbers on the left side of 3 will be less than it.

$\therefore$ Solution set is $(-\infty, 3)$.

11. **(b)** The given inequality $6 \leq -3(2x - 4) < 12$

$6 \leq -6x + 12 < 12$

Adding (–12) to each term,

$6 - 12 \leq -6x + 12 - 12 < 12 - 12$

$\Rightarrow -6 \leq -6x < 0$

Dividing by (–6) to each term,

$\frac{-6}{-6} \geq \frac{-6x}{-6} > \frac{0}{-6}$

$\Rightarrow 1 \geq x > 0 \quad \Rightarrow \quad 0 < x \leq 1$

$\therefore$ Solution set is $(0, 1]$.

12. **(c)** We have the given inequalities as

$2(x - 1) < x + 5$ and $3(x + 2) > 2 - x$

Now, $2x - 2 < x + 5$

Transferring the term x to L.H.S and the term –2 to R.H.S.

$2x - x < 5 + 2$

$\Rightarrow \quad x < 7$ ... (i)

and $\quad 3(x + 2) > 2 - x$

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

Transferring the term (–x) to L.H.S. and the term 6 to R.H.S.,

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

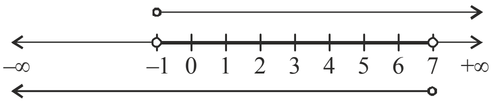
$\Rightarrow 4x > -4$

Dividing both sides by 4,

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

$\Rightarrow x > -1$ ... (ii)

$\Rightarrow$ Draw the graph of inequalities (i) and (ii) on the number line.



Hence, solution set of the inequalities are real numbers, x lying between –1 and 7 excluding 1 and 7. i.e. $-1 < x < 7$

∴ Solution set is (–1, 7) or] –1, 7[.

13. (d) We have, $|x| > b, b > 0$

$\Rightarrow x < -b$ and $x > b \Rightarrow x \in (-\infty, -b) \cup (b, \infty)$

14. (b) We have,

$a < b$ and $c < 0$

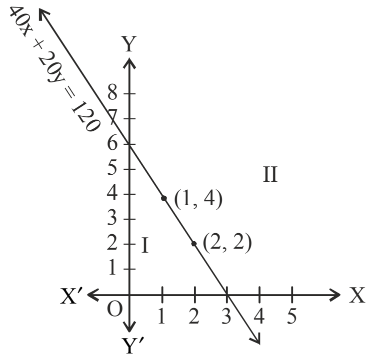
Dividing both sides of $a < b$ by c. Since, c is a negative number, sign at inequality will get reversed.

Hence, $\frac{a}{c} > \frac{b}{c}$.

15. (d) We have,

$40x + 20y \le 120, x \ge 0, y \ge 0$ ... (i)

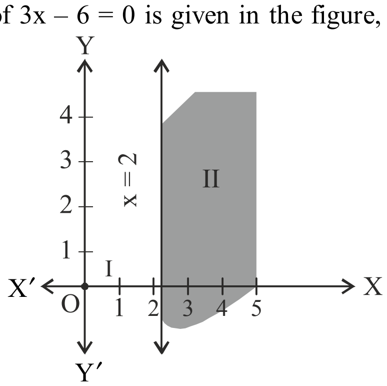
In order to draw the graph of the inequality (i), we take one point say (0, 0), in half plane I and check whether values of x and y satisfy the inequality or not.



We observe that x = 0, y = 0 satisfy the inequality. Thus, we say that the half plane I is the graph of the inequality. Since, the points on the line also satisfy the inequality (i) above, the line is also a part of the graph. Thus, the graph of the given inequality is half plane I including the line itself. Clearly, half plane II is not the part of the graph. Hence, solutions of inequality (i) will consists of all the points of its graph (half plane I including the line).

Also, since it is given $x > 0, y > 0$, x and y can only take positive values in half plane I.

16. (a) Graph of $3x - 6 = 0$ is given in the figure,



We select a point say (0, 0) and substituting it in given inequality, we see that

$3(0) - 6 \ge 0$ or $-6 \ge 0$, which is false.

Thus, the solution region is the shaded region on the right hand side of the line x = 2.

Also, all the points on the line $3x - 6 = 0$ will be included in the solution. Hence, a dark line is drawn in the solution region.

17. (a) The shaded region in the figure lies between x = –3 and x = 3 not including the line x = –3 and x = 3 (lines are dotted).

Therefore, $-3 < x < 3$

$\Rightarrow |x| < 3$ $[\because |x| < a \Leftrightarrow -a < x < a]$

18. (b) Given inequalities are

$3x - 7 < 5 + x$ ... (i)

and $11 - 5x \le 1$ ... (ii)

From inequality (i), we have

$3x - 7 < 5 + x$

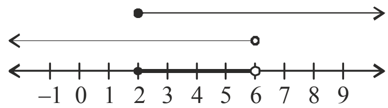
or $x < 6$ ... (iii)

Also, from inequality (ii), we have

$11 - 5x \le 1$

or $-5x \le -10$, i.e. $x \ge 2$ ... (iv)

If we draw the graph of inequalities (iii) and (iv) on the number line, we see that the values of x, which are common to both, are shown by bold line in figure.



19. (c) We have $3x - 7 > 2(x - 6)$

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

Transferring the term 2x to L.H.S. and the term (–7) to R.H.S.,

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

$\Rightarrow x > -5$ ... (i)

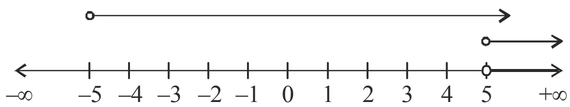
and $6 - x > 11 - 2x$

Transferring the term (–2x) to L.H.S. and the term 6 to R.H.S.,

$-x + 2x > 11 - 6$

$\Rightarrow x > 5$ ... (ii)

Draw the graph of inequations (i) and (ii) on the number line,



Hence, solution set of the equations are real numbers, x lying on greater than 5 excluding 5.

i.e., $x > 5$

∴ Solution set is (5, ∞) or]5, ∞[.

20. (d) We have $\frac{5 - 2x}{3} \le \frac{x}{6} - 5$

or $2(5 - 2x) \le x - 30$ or $10 - 4x \le x - 30$

or $-5x \le -40$ or $x \ge 8$

Thus, all real numbers which are greater than or equal to 8 are the solutions of the given inequality, i.e., $x \in [8, \infty)$.

21. (a) We have $\frac{3x - 4}{2} \ge \frac{x + 1}{4} - 1$

or $\frac{3x - 4}{2} \ge \frac{x - 3}{4}$

or $2(3x - 4) \ge (x - 3)$

or $6x - 8 \geq x - 3$
or $5x \geq 5$ or $x \geq 1$
Thus, all real numbers which are greater than or equal to 1 is the solution set of the given inequality.
$\therefore \quad x \in [1, \infty)$.

22. **(a)** We have $-5 \leq \frac{5-3x}{2} \leq 8$
or $-10 \leq 5 - 3x \leq 16$ or $-15 \leq -3x \leq 11$
or $5 \geq x \geq -\frac{11}{3}$,
which can be written as $\frac{-11}{3} \leq x \leq 5$
$\therefore \quad x \in \left[\frac{-11}{3}, 5\right]$.

23. **(a)** Common solution of the inequalities is from $-\infty$ to -4 and 3 to ∞.

24. **(c)** **Case I :**
When $x > 0$, $\frac{2}{x} < 3 \Rightarrow 2 < 3x \Rightarrow \frac{2}{3} < x$ or $x > \frac{2}{3}$
Case II :
When $x < 0$, $\frac{2}{x} < 3 \Rightarrow 2 > 3x \Rightarrow \frac{2}{3} > x$ or $x < \frac{2}{3}$,
which is satisfied when $x < 0$.
$\therefore \quad x \in (-\infty, 0) \cup \left(\frac{2}{3}, \infty\right)$.

25. **(c)** $|3x + 2| < 1 \Leftrightarrow -1 < 3x + 2 < 1$
$\Leftrightarrow \quad -3 < 3x < -1 \Leftrightarrow -1 < x < -\frac{1}{3}$.

26. **(b)** $|x - 1|$ is the distance of x from 1.
$|x - 3|$ is the distance of x from 3.
The point $x = 2$ is equidistant from 1 and 3. Hence, the solution consists of all $x \geq 2$.

27. **(a)** $-3x < -13 - 17$
$-3x < -30 \Rightarrow x > 10$
$\Rightarrow \quad x \in (10, \infty)$.

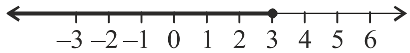
28. **(b)** Given, $|x + 2| \leq 9$
$\Rightarrow \quad -9 \leq x + 2 \leq 9$
$\Rightarrow \quad -11 \leq x \leq 7$

STATEMENT TYPE QUESTIONS

29. **(d)**

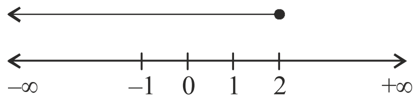
30. **(b)** For $x = 0$,
L.H.S. = 30(0) = 0 < 200 (R.H.S.), which is true.
For $x = 1$,
L.H.S. = 30(1) = 30 < 200 (R.H.S.), which is true.
For $x = 2$,
L.H.S. = 30(2) = 60 < 200, which is true.
For $x = 3$,
L.H.S. = 30(3) = 90 < 200, which is true.
For $x = 4$,
L.H.S. = 30(4) = 120 < 200, which is true.
For $x = 5$,
L.H.S. = 30(5) = 150 < 200, which is true.
For $x = 6$,
L.H.S. = 30(6) = 180 < 200, which is true.
In the above situation, we find that the values of x, which makes the above inequality a true statement are 0, 1, 2, 3, 4, 5, 6. These values of x, which make above inequality a true statement are called solutions of inequality and the set {0, 1, 2, 3, 4, 5, 6} is called its solution set.
Thus, any solution of an inequality in one variable is a value of the variable which makes it a true statement.

31. **(a)** We have, $7x + 3 < 5x + 9$
or $2x < 6$ or $x < 3$
$\Rightarrow \quad x \in (-\infty, 3)$
The graphical representation of the solutions are given in figure.



32. **(b)** We have, $5x - 3 < 7$
Adding 3 on both sides,
$5x - 3 + 3 < 7 + 3$
$\Rightarrow \quad 5x < 10$
Dividing both sides by 5,
$\frac{5x}{5} < \frac{10}{5} \quad \Rightarrow \quad x < 2$
I. When x is an integer, the solution of the given inequality is {....., –1, 0, 1}.
II. When x is a real number, the solution of given inequality is $(-\infty, 2)$, i.e. all the numbers lying between $-\infty$ and 2 but ∞ and 2 are not included as $x < 2$.

33. **(b)** I. We have, $\frac{3(x-2)}{5} \leq \frac{5(2-x)}{3}$
$\Rightarrow \quad \frac{3x-6}{5} \leq \frac{10-5x}{3}$
$\Rightarrow \quad 9x - 18 \leq 50 - 25x$
Transferring the terms (–25x) to L.H.S. and the term (–18) to R.H.S.
$9x + 25x \leq 50 + 18$
$\Rightarrow \quad 34x \leq 68$
$\Rightarrow \quad x \leq \frac{68}{34} \Rightarrow x \leq 2$



$\therefore$ Solution set is $(-\infty, 2]$

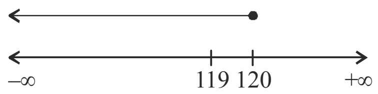
II. We have, $\frac{1}{2}\left(\frac{3x}{5} + 4\right) \geq \frac{1}{3}(x - 6)$
$\Rightarrow \quad \frac{1}{2}\left(\frac{3x}{5} + \frac{4}{1}\right) \geq \frac{1}{3}(x - 6)$
Taking L.C.M. in L.H.S.,
$\frac{1}{2}\left(\frac{3x + 20}{5}\right) \geq \frac{1}{3}(x - 6)$
$\Rightarrow \quad \frac{3x + 20}{10} \geq \frac{x - 6}{3}$
$\Rightarrow \quad 3(3x + 20) \geq 10(x - 6)$
$\Rightarrow \quad 9x + 60 \geq 10x - 60$

Transferring the term 10x to L.H.S. and the term 60 to R.H.S.

$9x - 10x \geq -60 - 60 \Rightarrow -x \geq -120$

Multiplying both sides by –1,

$x \leq 120$



$\therefore$ Solution set is $(-\infty, 120]$.

34. **(a)** I. The region containing all the solutions of an inequality is called the solution region.

II. In order to identify the half plane represented by an inequality, it is just sufficient to take any point (a, b) (not on line) and check whether it satisfies the inequality or not. If it satisfies, then the inequality represents the half plane and shade the region, which contains the point, otherwise the inequality represents that half plane which does not contains the point within it. For convenience, the point (0, 0) is preferred.

35. **(a)** I. The given system of inequalities

$3x + 2y \leq 12$ ... (i)

$x \geq 1$ ... (ii)

$y \geq 2$ ... (iii)

Step I: Consider the given inequations as strict equations

i.e. $3x + 2y = 12$, $x = 1$, $y = 2$

Step II: Draw the table for $3x + 2y = 12$

x	0	4
y	6	0

(i.e., Find the points on x-axis and y-axis)

Step III: Plot the points and draw the graph For $3x + 2y = 12$, and

Graph of $x = 1$ will be a line parallel to y-axis cutting x-axis at 1.

and Graph of $y = 2$ will be a line parallel to x-axis cutting y-axis at 2.

Step IV: Take a point (0, 0) and put it in the given inequations (i), (ii) and (iii).

i.e., $0 + 0 \leq 12$, $0 \leq 12$ [true]

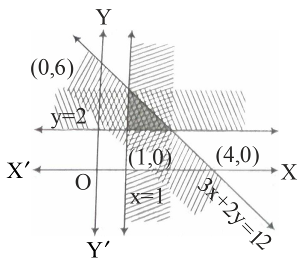
So, the shaded region will be towards the origin

$0 \geq 1$ [false]

So, the shaded region will be away from the origin

$0 \geq 2$ [false]

So, the shaded region will be away from the origin.



Thus, common shaded region shown the solution of the inequalities.

II. The given system of inequalities

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

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

Step I: Consider the given inequations as strict equations

i.e., $2x + y = 6$

$3x + 4y = 12$

Step II: Find the points on the x-axis and y-axis for

$2x + y = 6$

x	0	3
y	6	0

and $3x + 4y = 12$

x	0	4
y	3	0

Step III: Plot the points and draw the graph using the above tables.

Step IV: Take a point (0, 0) and putting in the given inequations (i) and (ii),

i.e. $0 + 0 \geq 6$

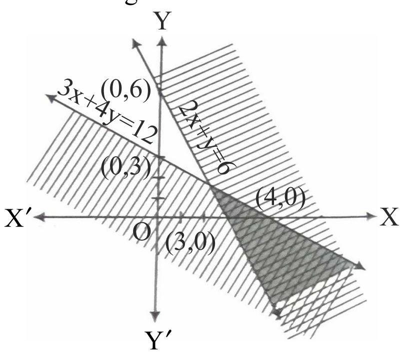
$0 \geq 6$ [false]

So, the shaded region will be away from the origin.

and $0 + 0 \leq 12$

$0 \leq 12$ (True)

So, the shaded region will be towards the origin.



Thus, common shaded region shows the solution of the inequality.

Since, common shaded region is not enclosed. So, it is not bounded.

III. The given system of inequalities

$x + y \geq 4$ ... (i)

$2x - y > 0$ ... (ii)

Step I: Consider the given inequations as strict equations

i.e., $x + y = 4$, $2x - y = 0$

Step II: Find the points on the x-axis and y-axis for

$x + y = 4$

x	0	4
y	4	0

and $2x - y = 0$

x	0	1
y	0	2

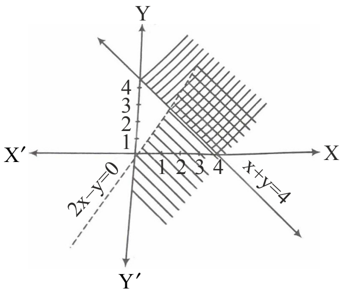
Step III: Plot the points to draw the graph using the above tables.
Step IV: Take a point (0, 0) and put it in the inequation (i)

$0 + 0 \geq 4$ [false]

So, the shaded region will be away from the origin.
Take a point (1, 0) and put it in the inequation (ii)

$2 - 0 > 0$ [true]

So, the shaded region will be towards the point (1, 0)



Thus, the common shaded region shows the solution of the inequalities.

36. **(d)** **37.** **(c)**

38. **(a)** I. $-75 < 3x - 6 \Rightarrow -23 < x$

$3x - 6 \leq 0 \Rightarrow x \leq 2$

II. $14 \leq 3x + 11 \Rightarrow 3 \leq 3x \Rightarrow 1 \leq x$

$3x + 11 \leq 22 \Rightarrow 3x \leq 11 \Rightarrow x \leq \frac{11}{3}$

III. $-20 \leq 2 - 3x \Rightarrow x \leq \frac{22}{3}$

$2 - 3x \leq 36 \Rightarrow -34 \leq 3x \Rightarrow x \geq \frac{-34}{3}$

39. **(c)** Both the statements are correct.

40. **(d)** We are given :

$24x < 100$

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

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

(I) When x is natural number, the following values of x make the statement true
$x = 1, 2, 3, 4.$
The solution set = {1, 2, 3, 4}

(II) When x is an integer, in this case the solutions of the given inequality are ......, –3, –2, –1, 0, 1, 2, 3, 4.
∴ The solution set of the inequality is {...., –3, –2, –1, 0, 1, 2, 3, 4}.

41. **(b)** Inequality is $3x + 8 > 2$
Transposing 8 to RHS $3x > 2 - 8 = -6$
Dividing by 3, $x > -2$
(I) When x is an integer the solution is {–1, 0, 1, 2, 3, ...}
(II) When x is real, the solution is $(-2, \infty)$.

MATCHING TYPE QUESTIONS

42. **(a)** (A) $2x - 4 \leq 0 \Rightarrow x \leq 2$
(B) $-3x + 12 < 0 \Rightarrow x > 4$
(C) $4x - 12 \geq 0 \Rightarrow x \geq 3$
(D) $7x + 9 > 30 \Rightarrow 7x > 21 \Rightarrow x > 3$

43. **(c)** A. The given system of inequalities

$2x - y > 1$ ... (i)

$x - 2y < -1$ ... (ii)

Step I : Consider the inequations as strict equations i.e. $2x - y = 1$ and $x - 2y = -1$
Step II: Find the points on the x-axis and y-axis for $2x - y = 1$.

x	0	$\frac{1}{2}$
y	–1	0

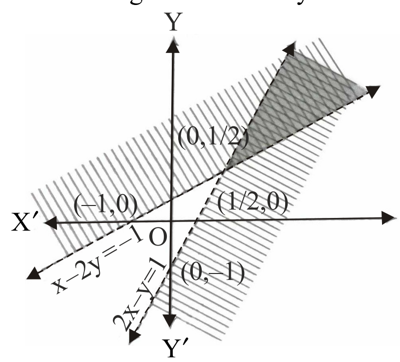
and $x - 2y = -1$

x	0	–1
y	$\frac{1}{2}$	0

Step III: Plot the graph using the above tables.
Step IV: Take a point (0, 0) and put it in the inequations (i) and (ii).

$0 - 0 > 1$, i.e., $0 > 1$ [false]

So, the shaded region will be away from the origin and $0 - 0 < -1$, i.e., $0 < -1$ [false]
So, the shaded region will be away from the origin.



Thus, common shaded region shows the solution of the inequalities.

B. The given system of inequalities

$x + y \leq 6$ ... (i)

$x + y \geq 4$ ... (ii)

Step I: Consider the inequations as strict equations i.e. $x + y = 6$ and $x + y = 4$
Step II: Find the points on the x-axis and y-axis for

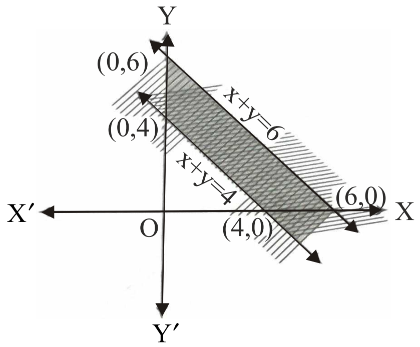
$x + y = 6.$

x	0	6
y	6	0

and $x + y = 4$

x	0	4
y	4	0

Step III: Plot the graph using the above tables.
Step IV: Take a point (0, 0) and put it in the inequations (i) and (ii),
i.e. $0 + 0 \leq 6$ i.e., $0 \leq 6$ [true]



So, the shaded region will be towards the origin.

and 0 + 0 ≥ 4 ⇒ 0 ≥ 4 [false]

So, the shaded region will be away from the origin.

Thus, common shaded region shows the solution of the inequalities.

C. The given system of inequalities

$2x + y \geq 8$ ... (i)

$x + 2y \geq 10$ ... (ii)

Step I: Consider the inequations as strict equations i.e. $2x + y = 8$ and $x + 2y = 10$

Step II: Find the points on the x-axis and y-axis for

$2x + y = 8$

x	0	4
y	8	0

and $x + 2y = 10$

x	0	10
y	5	0

Step III: Plot the points using the above tables and draw the graph.

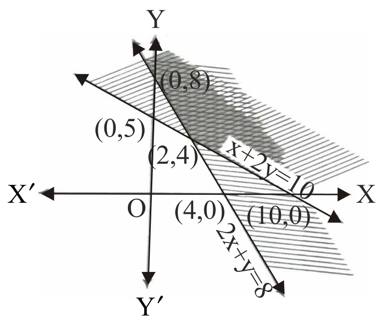
Step IV: Take a point (0, 0) and put it in the given inequations (i) and (ii),

i.e., 0 + 0 ≥ 8 i.e. 0 ≥ 8 [false]

So, the shaded region will be away from the origin.

i.e., 0 + 0 ≥ 10, i.e. 0 ≥ 10 [false]

So, the shaded region will be away from the origin.



Thus, common shaded region shows the solution of the inequalities.

D. The given system of inequalities

$x + y \leq 9$ ... (i)

$y > x$ ... (ii)

$x \geq 0$ ... (iii)

Step I: Consider the inequations as strict equations i.e. $x + y = 9$, $y = x$, $x = 0$

Step II: Find the points on the x-axis and y-axis for

$x + y = 9$

x	0	9
y	9	0

and $y = x$

x	1	2	3
y	1	2	3

Step III: Plot the points using the above tables and draw the graph

For x + y = 9 and

For y = x

Graph of x = 0 will be the y-axis.

Step IV: Take a point (0, 0), put it in the inequations (i), (ii) and (iii), we get

0 + 0 ≤ 9 [true]

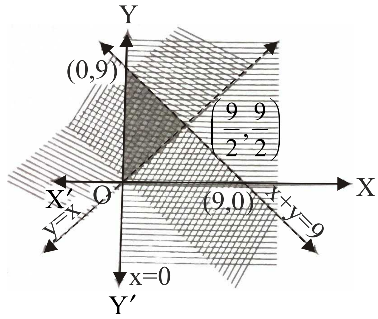
So, the shaded region will be towards the origin.

Take a point (0, 1), put in y > x, 1 > 0 [true]

So, the shaded region will be towards the origin.

Take a point (1, 0), put it in x ≥ 0, 1 ≥ 0 [true]

So, the shaded region will be towards the origin.



Thus, common shaded region shows the solution of the inequalities.

44. **(c)** (A) $\frac{3x-4}{2} \geq \frac{x+1}{4} - 1$

$\Rightarrow \frac{3x-4}{2} \geq \frac{x+1-4}{4}$

$\Rightarrow 3x-4 \geq \frac{x-3}{2}$

$\Rightarrow 6x-8 \geq x-3$

$\Rightarrow 5x \geq 5 \Rightarrow x \geq 1$

(B) $3x-2 < 2x+1 \Rightarrow x < 3$

(C) $3(1-x) < 2(x+4) \Rightarrow 3-3x < 2x+8$
$\Rightarrow -5 < 5x \Rightarrow x > -1$

(D) $3x-7 < 5+x \Rightarrow 2x < 12 \Rightarrow x < 6$
$11-5x \leq 1 \Rightarrow 10 \leq 5x \Rightarrow 2 \leq x$

45. **(b)** (A) We draw the graph of the equation

$x + y = 5$ ...(i)

Putting $y = 0$, $x = 5$, therefore the point on the x-axis is (5, 0). The point on the y-axis is (0, 5). AB is the graph of (i) (See Fig)

Putting $x = 0, y = 0$ in the given inequality, we have $0 + 0 < 5$ or $5 > 0$ which is true. Hence, origin lies in the half plane region I.

Clearly, any point on the line does not satisfy the given inequality.

Hence, the shaded region I excluding the points on the line is the solution region of the inequality.

(B) We draw the graph of the equation

$2x + y = 6$ ...(i)

Putting $x = 0, y = 6$, therefore the point on y-axis is (0, 6) and the point on x-axis is (3, 0). AB is the graph of (i).

Putting $x = 0, y = 0$ in the given inequality, we have $2(0) + 0 \geq 6$ or $0 \geq 6$, which is false.

Hence, origin does not lie in the half plane region I.

Clearly, any point on the line satisfy the given inequality.

Hence, the shaded region II including the points on the line is the solution region of the inequality.

(C) We draw the graph of the equation $3x + 4y = 12$.

The line passes through the points (4, 0), (0, 3). This line is represented by AB.

Now consider the inequality $3x + 4y \leq 12$

Putting $x = 0, y = 0$

$0 + 0 = 0 \leq 12$, which is true

$\therefore$ Origin lies in the region of $3x + 4y \leq 12$

The shaded region represents this inequality.

(D) We draw the graph of $2x - 3y = 6$

The line passes through (3, 0), (0, –2)

AB represents the equation $2x - 3y = 6$

Now consider the inequality $2x - 3y > 6$

Putting $x = 0, y = 0$

$0 = 0 > 6$ is not true.

$\therefore$ Origin does not lie in the region of $2x - 3y > 6$

The graph of $2x - 3y > 6$ is shown as shaded area.

INTEGER TYPE QUESTIONS

46. (c) $4x + 3 < 6x + 7$

$\Rightarrow -2x < 4$

$\Rightarrow -x < 2 \Rightarrow x > -2$

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

47. (d) $\frac{5-2x}{3} \leq \frac{x}{6} - 5$

$\Rightarrow \frac{5-2x}{3} \leq \frac{x-30}{6}$

$\Rightarrow 5 - 2x \leq \frac{x-30}{2}$

$\Rightarrow 10 - 4x \leq x - 30 \Rightarrow 40 \leq 5x$

$\Rightarrow 8 \leq x \Rightarrow x \in [8, \infty)$

48. (c) $3(2-x) \geq 2(1-x)$

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

$\Rightarrow -x \geq -4 \Rightarrow x \leq 4$

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

49. (a) $\frac{2x-1}{3} \geq \frac{15x-10-8+4x}{20}$

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

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

$\Rightarrow -17x \geq -34 \Rightarrow x \leq 2$

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

50. (d) Given inequality is $5x + 1 > -24$

$\Rightarrow 5x > -25 \Rightarrow x > -5$

Also, $5x - 1 < 24$

$\Rightarrow 5x < 25 \Rightarrow x < 5$

Hence, $-5 < x < 5 \Rightarrow x \in (-5, 5)$

51. (b) $2x - 7 < 11 \Rightarrow 2x < 18 \Rightarrow x < 9$

$3x + 4 < -5 \Rightarrow 3x < -9 \Rightarrow x < -3$

Hence, common solution is $x < -3$.

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

52. (a) By definition of $|x|$, we have

$|x| < 3 \Rightarrow -3 < x < 3$

$\Rightarrow m = 3$.

53. (b) Let shortest side measure x cm. Therefore the longest side will be $3x$ cm and third side will be $(3x - 2)$ cm

According to the problem,

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

$\Rightarrow 7x - 2 \geq 61$ or $7x \geq 63$

$\Rightarrow x \geq 9$cm

Hence, the minimum length of the shortest side is 9 cm and the other sides measure 27 cm and 25 cm.

54. (c) $-8 \leq 5x - 3 \Rightarrow -5 \leq 5x \Rightarrow -1 \leq x$

$5x - 3 < 7 \Rightarrow 5x < 10 \Rightarrow x < 2$

Hence, common sol is $-1 \leq x < 2$

$\Rightarrow x \in [-1, 2)$

$\Rightarrow a = 1, b = 2$ and $a + b = 3$

55. (a) Let x and x + 2 be two odd natural numbers.

we have, $x > 10$ …(i)

and $x + (x + 2) < 40$ …(ii)

On solving (i) and (ii), we get

$10 < x < 19$

So, required pairs are (11, 13), (13, 15), (15, 17) and (17, 19)

ASSERTION - REASON TYPE QUESTIONS

56. (b) Let us consider some inequalities :

$ax + b < 0$ … (i)

$ax + b > 0$ … (ii)

$ax + b \leq 0$ … (iii)

$ax + b \geq 0$ … (iv)

$ax + by > c$ … (v)

$ax + by \leq c$ … (vi)

$ax^2 + bx + c > 0$ … (vii)

$ax^2 + bx + c \leq 0$ … (viii)

Inequalities (i), (ii), (v) and (vii) are strict inequalities, while inequalities (iii), (iv), (vi) and (viii) are slack inequalities.

$\therefore$ Both Assertion and Reason are correct but Reason cannot explain Assertion.

57. **(d)** Assertion is false, Reason is true because if $a < b,\ c < 0$, then $\frac{a}{c} > \frac{b}{c}$.

58. **(b)** We have, $|3x - 5| > 9$

$\Rightarrow 3x - 5 < -9$ or $3x - 5 > 9$

$\Rightarrow 3x < -4$ or $3x > 14$

$\Rightarrow x < \frac{-4}{3}$ or $x > \frac{14}{3}$

$\therefore\ x \in \left(-\infty, \frac{-4}{3}\right) \cup \left(\frac{14}{3}, \infty\right)$.

59. **(b)** Both Assertion and Reason are correct but Reason is not correct explanation for the Assertion.

60. **(b)** Both are correct.

61. **(b)** Both are correct; Reason is not the correct explanation of Assertion.

62. **(b)** Both Assertion and Reason are correct but Reason is not the correct explanation.

Reason: $5x - 3 < 7$

$\Rightarrow 5x < 10 \Rightarrow x < 2$

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

63. **(c)** Assertion is correct.

$3x + 8 > 2 \Rightarrow 3x > -6$

$\Rightarrow x > -2$

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

Reason is incorrect.

$4x + 3 < 5x + 7$

$-x < 4 \Rightarrow x > -4$

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

64. **(c)** Assertion is correct. Reason is incorrect.

If a point satisfying the line $ax + by = c$, then it will lie on the line.

65. **(b)** Both are correct but Reason is not the correct explanation.

66. **(d)** Assertion is incorrect. Reason is correct.

CRITICAL THINKING TYPE QUESTIONS

67. **(c)** If x cm is the breadth, then

$2(3x + x) \geq 160 \Rightarrow x \geq 20$

68. **(c)** $|x - 1| \leq 3 \Rightarrow -3 \leq x - 1 \leq 3 \Rightarrow -2 \leq x \leq 4$

and $|x - 1| \geq 1 \Rightarrow x - 1 \leq -1$ or $x - 1 \geq 1$

$\Rightarrow x \leq 0$ or $x \geq 2$

Taking the common values of x, we get

$x \in [-2,\ 0] \cup [2,\ 4]$

69. **(a)** Let x be the marks obtained by student in the annual examination. Then,

$\frac{62 + 48 + x}{3} \geq 60$

or $110 + x \geq 180$

or $x \geq 70$

Thus, the student must obtain a minimum of 70 marks to get an average of at least 60 marks.

70. **(b)** Let Ravi got x marks in third unit test.

$\therefore$ Average marks obtained by Ravi

$= \frac{\text{Sum of marks in all tests}}{\text{Number of tests}} = \frac{70 + 75 + x}{3} = \frac{145 + x}{3}$

Now, it is given that he wants to obtain an average of at least 60 marks.

At least 60 marks means that the marks should be greater than or equal to 60.

i.e. $\frac{145 + x}{3} \geq 60$

$\Rightarrow 145 + x \geq 60 \times 3$

$\Rightarrow 145 + x \geq 180$

Now, transferring the term 145 to R.H.S.,

$x \geq 180 - 145 \quad \Rightarrow \quad x \geq 35$

i.e. Ravi should get greater than or equal to 35 marks in third unit test to get an average of at least 60 marks.

$\therefore$ Minimum marks Ravi should get = 35.

71. **(b)** Let numbers are 2x and 2x + 2

Then, according to the question,

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

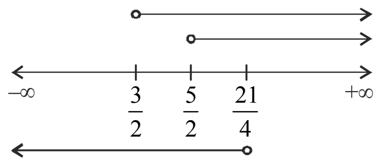
and $2x + 2 > 5 \Rightarrow 2x > 5 - 2$

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

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

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

Now, plotting all these values on number line



From above graph, it is clear that $x \in \left(\frac{5}{2}, \frac{21}{4}\right)$ in which integer values are x = 3, 4, 5.

When x = 3, pair is $(2 \times 3, 2 \times 3 + 2) = (6, 8)$

When x = 4, pair is $(2 \times 4, 2 \times 4 + 2) = (8, 10)$

When x = 5, pair is $(2 \times 5, 2 \times 5 + 2) = (10, 12)$

$\therefore$ Required pairs are (6, 8), (8, 10), (10, 12).

72. **(b)** Let the shortest side be x cm.

Then, by given condition, second length = x + 3 cm

Third length = 2x cm

Also given, total length = 91

Hence, sum of all the three lengths should be less than or equal to 91

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

$\Rightarrow 4x + 3 \leq 91$

Subtracting (–3) to each term,

$-3 + 4x + 3 \leq 91 - 3$

$\Rightarrow 4x \leq 88$

$\Rightarrow \frac{4x}{4} \leq \frac{88}{4} \quad \Rightarrow \quad x \leq \frac{88}{4}$

$\Rightarrow x \leq 22$ cm ... (i)

Again, given that

Third length ≥ second length + 5

$\Rightarrow$ $2x \geq (x + 3) + 5$
$\Rightarrow$ $2x \geq x + (3 + 5)$
Transferring the term x to L.H.S.,
$2x - x \geq 8$
$\Rightarrow$ $x \geq 8$ ... (ii)
From equations (i) and (ii), length of shortest board should be greater than or equal to 8 but less than or equal to 22, i.e., $8 \leq x \leq 22$.

73. **(c)** Let breadth of rectangle be x cm.
$\therefore$ Length of rectangle = 3x
Perimeter of rectangle = 2(Length + Breadth)
$= 2(x + 3x) = 8x$
Given, Perimeter $\geq$ 160 cm
$8x \geq 160$
Dividing both sides by 8,
$x \geq 20$ cm

74. **(a)** We have, $2 \leq |x - 3| < 4$
Case I : If $x < 3$, then
$2 \leq |x - 3| < 4$
$\Rightarrow$ $2 \leq -(x - 3) < 4$
$\Rightarrow$ $2 \leq -x + 3 < 4$
Subtracting 3 from both sides,
$-1 \leq -x < 1$
Multiplying (–1) on both sides,
$-1 < x \leq 1$
$\Rightarrow$ $x \in (-1, 1]$
Case II : If $x > 3$, then
$2 \leq |x - 3| < 4$
$\Rightarrow$ $2 \leq x - 3 < 4$
Adding 3 on both sides,
$\Rightarrow$ $5 \leq x < 7$
Hence, the solution set of given inequality is $x \in (-1, 1] \cup [5, 7)$.

75. **(c)** We have

$$IQ = \frac{MA}{CA} \times 100$$

$\Rightarrow$ $IQ = \frac{MA}{12} \times 100$ [$\because$ CA = 12 years]

$= \frac{25}{3} MA$

Given, $80 \leq IQ \leq 140$

$\Rightarrow$ $80 \leq \frac{25}{3} MA \leq 140$

$\Rightarrow$ $240 \leq 25MA \leq 420$

$\Rightarrow$ $\frac{240}{25} \leq MA \leq \frac{420}{25}$

$\Rightarrow$ $9.6 \leq MA \leq 16.8$

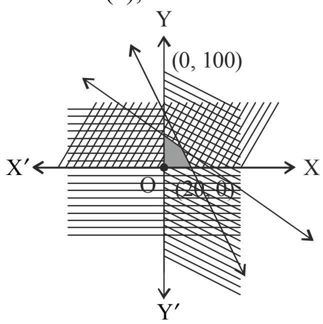
76. **(c)** The inequalities are :
$750x + 150y \leq 15000$
i.e. $5x + y \leq 100$ … (i)
$x + y \leq 60$ … (ii)
$x \geq 0$ … (iii)
$y \geq 0$ … (iv)
The lines corresponding to (i) and (ii) are
$5x + y = 100$ … (v)
$x + y = 60$ … (vi)
Table for $5x + y = 100$

x	0	20
y	100	0

Table for $x + y = 60$

x	0	60
y	60	0

First, draw the lines (v) and (vi)
$\because$ $5(0) + 0 \leq 100$
i.e., $0 \leq 100$, which is true.
Therefore, inequality (i) represent the half plane made by the line (v), which contains the origin.



Again, $0 + 0 \leq 60$
i.e. $0 \leq 60$, which is true.
Therefore, inequality (ii) represent the half plane made by the line (vi) which contains origin. Inequality $x \geq 0$ represent the half plane on the right of y-axis. Inequality $y \geq 0$ represent the half plane above x-axis.

77. **(d)** The given system of inequalities
$x + 2y \leq 10$ ... (i)
$x + y \geq 1$ ... (ii)
$x - y \leq 0$ ... (iii)
$x \geq 0, y \geq 0$ ... (iv)
Step I: Consider the given inequations as strict equations,
i.e. $x + 2y = 10$, $x + y = 1$, $x - y = 0$
and $x = 0$, $y = 0$
Step II: Find the points on the x-axis and y-axis for
$x + 2y = 10$

x	0	10
y	5	0

and $x + y = 1$

x	0	1
y	1	0

For $x - y = 0$

x	1	2
y	1	2

Step III: Plot the graph of $x + 2y = 10$, $x + y = 1$, $x - y = 0$ using the above tables.
Step IV: Take a point (0, 0) and put it in the inequations (i) and (ii),
$0 + 0 \leq 10$ [true]
So, the shaded region will be towards origin,
and $0 + 0 \geq 1$ [false]
So, the shaded region will be away from the origin.

Again, take a point (2, 2) and put it in the inequation (iv), we get

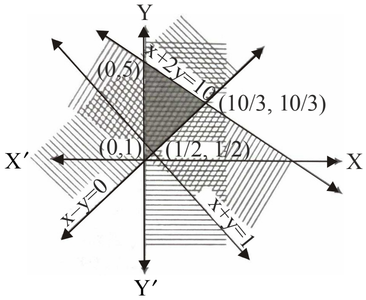
$2 \geq 0, 2 \geq 0$ [true]

So, the shaded region will be towards point (2, 2).

And take a point (0, 1) and put it in the inequation (iii), we get

$0 - 1 \leq 0$ [true]

So, the shaded region will be towards point (0, 1).



Thus, the common shaded region shows the solution of the inequalities.

78. **(b)** (i) Consider the line $x + y = 8$. We observe that the shaded region and origin lie on the same side of this line and (0, 0) satisfies $x + y \leq 8$. Therefore, $x + y \leq 8$ is the linear inequality corresponding to the line $x + y = 8$.

(ii) Consider $x + y = 4$. We observe that shaded region and origin are on the opposite side of this line and (0, 0) satisfies $x + y \leq 4$. Therefore, we must have $x + y \geq 4$ as linear inequalities corresponding to the line $x + y = 4$.

(iii) Shaded portion lie below the line $y = 5$. So, $y \leq 5$ is the linear inequality corresponding to $y = 5$.

(iv) Shaded portion lie on the left side of the line $x = 5$. So, $x \leq 5$ is the linear inequality corresponding to $x = 5$.

(v) Also, the shaded region lies in the first quadrant only. Therefore, $x \geq 0$, $y \geq 0$.

In view of (i), (ii), (iii), (iv) and (v) above the linear inequalities corresponding to the given solutions are:

$x + y \leq 8$, $x + y \geq 4$, $y \leq 5$, $x \leq 5$, $x \geq 0$ and $y \geq 0$.

79. **(c)** Let the 2% boric acid solution be x L.

$\therefore$ Mixture = (640 + x)L

Now, according to the question, two conditions arise :

I. 2% of x + 8% of 640 > 4% of (640 + x)

II. 2% of x + 8% of 640 < 6% of (640 + x)

From condition I,

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

Multiplying both sides by 100,

$$100 \times \left[\frac{2x}{100} + \frac{8}{100} \times 640\right] > \frac{4}{100} \times (640 + x) \times 100$$

$\Rightarrow 2x + 8 \times 640 > 4 \times 640 + 4x$

Transferring the term 4x to L.H.S. and the term (8×640) to R.H.S.

$2x - 4x > 4 \times 640 - 8 \times 640$

$\Rightarrow -2x > 640(4 - 8)$

$\Rightarrow -2x > -4 \times 640$

Dividing both sides by –2,

$$\frac{-2x}{-2} < \frac{-4 \times 640}{-2}$$

$\Rightarrow x < 2 \times 640$

$\Rightarrow x < 1280$ ... (i)

From condition II,

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

$$\Rightarrow 100 \times \left[\frac{2x}{100} + \frac{8}{100} \times 640\right] < [6 \times 640 + 6x] \times \frac{100}{100}$$

$\Rightarrow 2x + 8 \times 640 < 6 \times 640 + 6x$

Transferring the term 6x to L.H.S. and the term (8×640) to R.H.S.,

$2x - 6x < 6 \times 640 - 8 \times 640$

$\Rightarrow -4x < 640(6 - 8) \Rightarrow -4x < -2 \times 640$

Dividing both sides by –4,

$$\frac{-4x}{-4} > \frac{-2 \times 640}{-4}$$

$\Rightarrow x > 320$ ... (ii)

Hence, from equations (i) and (ii),

$320 < x < 1280$ i.e., $x \in (320, 1280)$

The number of litres to be added should be greater than 320 L and less than 1280 L.

80. **(a)** Given, $C(x) = 26000 + 30x$

and $R(x) = 43x$

$\therefore$ Profit = R(x) – C(x)

$= 43x - (26000 + 30x) = 13x - 26000$

For some profit, $13x - 26000 > 0$

$\Rightarrow 13x > 26000$

$\Rightarrow x > 2000$

81. **(a)** Let x litres of 30% acid solution is required to be added. Then,

Total mixture = (x + 600) litres

$\therefore$ 30% of x + 12% of 600 > 15% of (x + 600)

and 30% of x + 12% of 600 < 18% of (x + 600)

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

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

or $30x + 7200 > 15x + 9000$

and $30x + 7200 < 18x + 10800$

or $15x > 1800$ and $12x < 3600$

or $x > 120$ and $x < 300$

i.e. $120 < x < 300$

Thus, the number of litres of the 30% solution of acid will have to be more than 120 litres but less than 300 litres.

82. **(c)** We have $\frac{|x + 3| + x}{x + 2} > 1$

$$\Rightarrow \frac{|x + 3| + x}{x + 2} - 1 > 0 \Rightarrow \frac{|x + 3| - 2}{x + 2} > 0$$

Now, two cases arise :

Case I : When $x + 3 \geq 0$, i.e. $x \geq -3$. Then,

$\frac{|x+3|-2}{x+2} > 0 \Rightarrow \frac{x+3-2}{x+2} > 0$

$\Rightarrow \frac{x+1}{x+2} > 0$

$\Rightarrow \{(x+1) > 0 \text{ and } x+2 > 0\}$
or $\{x+1 < 0 \text{ and } x+2 < 0\}$
$\Rightarrow \{x > -1 \text{ and } x > -2\}$ or $\{x < -1 \text{ and } < -2\}$
$\Rightarrow x > -1$ or $x < -2$
$\Rightarrow x \in (-1, \infty)$ or $x \in (-\infty, -2)$
$\Rightarrow x \in (-3, -2) \cup (-1, \infty)$ [Since $x \geq -3$] ... (i)

Case II : When $x + 3 < 0$, i.e. $x < -3$

$\frac{|x+3|-2}{x+2} > 0 \Rightarrow \frac{-x-3-2}{x+2} > 0$

$\Rightarrow \frac{-(x+5)}{x+2} > 0 \Rightarrow \frac{x+5}{x+2} < 0$

$\Rightarrow (x+5<0 \text{ and } x+2>0)$ or $(x+5>0 \text{ and } x+2<0)$
$\Rightarrow (x < -5 \text{ and } x > -2)$ or $(x > -5 \text{ and } x < -2)$
it is not possible.
$\Rightarrow x \in (-5, -2)$ ... (ii)

Combining (i) and (ii), the required solution is $x \in (-5, -2) \cup (-1, \infty)$.

83. (c) We have, $|2x-3| < |x+5|$

$\Rightarrow |2x-3| - |x+5| < 0$

$$\Rightarrow \begin{cases} 3-2x+x+5<0, & x \leq -5 \\ 3-2x-x-5<0, & x-5<x\leq \frac{3}{2} \\ 2x-3-x-5<0, & x > \frac{3}{2} \end{cases}$$

$$\Rightarrow \begin{cases} x > 8, & x \leq -5 \\ x > -\frac{2}{3}, & -5 < x \leq \frac{3}{2} \\ x < 8, & x > \frac{3}{2} \end{cases}$$

$\Rightarrow x \in \left(-\frac{2}{3}, \frac{3}{2}\right] \cup \left(\frac{3}{2}, 8\right) \Rightarrow x \in \left(-\frac{2}{3}, 8\right)$

84. (b) $(x-1)^2$ is always positive except when $x = 1$ (and then it is 0)
$\therefore$ Solution is when $x + 4 < 0$ and $x \neq 1$
i.e. $x < -4, x \neq 1$
$\therefore x \in (-\infty, -4)$.

85. (c) $\left|1+\frac{3}{x}\right| > 2$

Case I : $1 + \frac{3}{x} > 2 \Rightarrow \frac{3}{x} > 1$ (Clearly $x > 0$)

$\Rightarrow 3 > x$ or $x < 3$

Case II : $1 + \frac{3}{x} < -2 \Rightarrow \frac{3}{x} < -3$ (Clearly $x < 0$)

$\Rightarrow 3 > -3x \Rightarrow -1 < x$ or $x > -1$
Hence, either $0 < x < 3$ or $-1 < x < 0$

86. (b) $|2x-3| < |x+2|$
$\Rightarrow -|x+2| < 2x-3 < |x+2|$ ... (i)

Case I : $x + 2 \geq 0$. Then by (i),
$-(x+2) < 2x-3 < x+2$
$\Rightarrow -x-2 < 2x-3 < x+2$

$\Rightarrow 1 < 3x$ and $x < 5 \Rightarrow \frac{1}{3} < x < 5$

Case II : $x + 2 < 0$. Then by (i),
$(x+2) < 2x-3 < -(x+2)$
$\Rightarrow -(x+2) > 2x-3 > (x+2)$

$\Rightarrow 1 > 3x$ and $x > 5 \Rightarrow \frac{1}{3} \leq x$ and $x > 5$, Not possible.

87. (b) $\left|x+\frac{1}{x}\right| > 2$ [Clearly $x \neq 0$]

$\Rightarrow \left|\frac{x^2+1}{x}\right| > 2 \Rightarrow \frac{x^2+1}{|x|} > 2$ [$\because x^2+1 > 0$]

$\Rightarrow x^2 + 1 > 2|x|$
$\Rightarrow |x|^2 - 2|x| + 1 > 0 \Rightarrow (|x|-1)^2 > 0$
$\Rightarrow |x| \neq 1 \Rightarrow x \neq -1, 1$
$\therefore x \in R - \{-1, 0, 1\}$.

88. (d) From the graph,
$-7x + 4y \leq 14$, $x - 6y \leq 3$
$3x + 4y \leq 18$, $2x + 3y \geq 3$