MATHEMATICS
WORKSHEET_130924
CHAPTER 05 LINEAR INEQUALITIES
(ANSWERS)

SUBJECT: MATHEMATICS **MAX. MARKS : 40**
CLASS : XI **DURATION : 1½ hrs**

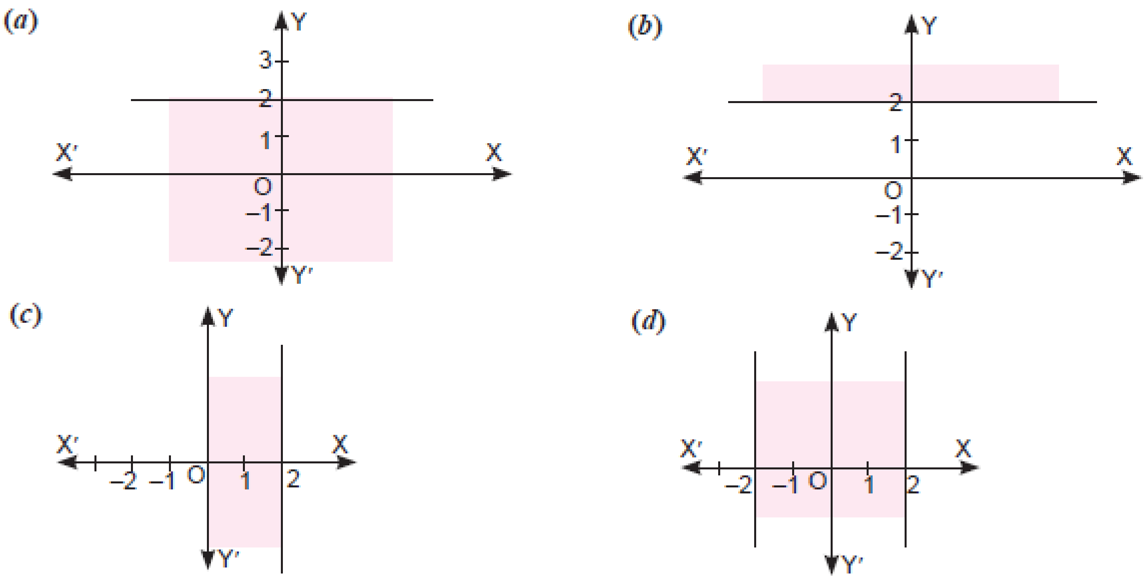
General Instructions:
(i). **All** questions are compulsory.
(ii). This question paper contains 2**0** questions divided into five Sections A, B, C, D and E.
(iii). **Section A** comprises of **10 MCQs** of **1 mark** each. **Section B** comprises of 4 questions of **2 marks** each. **Section C** comprises of 3 questions of **3 marks** each. **Section D** comprises of 1 question of **5 marks** each and **Section E** comprises of 2 Case Study Based Questions of **4 marks** each.
(iv). There is no overall choice.
(v). Use of Calculators is not permitted

SECTION – A
Questions 1 to 10 carry 1 mark each.

1. If $-3x + 17 < -13$, then

(a) $x \in (10, ¥)$ (b) $x \in [10, ¥)$ (c) $x \in (-¥, 10]$ (d) $x \in [-10, 10)$
Ans. (a) $x \in (10, ¥)$
$-3x + 17 < -13$
$\Rightarrow 3x - 17 > 13$ [on multiply both sides by (–1)]
$\Rightarrow 3x > 13 + 17$ [on adding 17 to both sides]
$\Rightarrow x > 10$
Hence, $x \in (10, ¥)$

2. Solution s et of $y \leq 2$ graphically is



Ans: (a)

3. If $| 3 - 6x | \geq 9$, then $x \in$
(a) $(-\infty, -1) \cup (3, \infty)$ (b) $(-\infty, 1] \cup (2, \infty)$
(c) $(-\infty, -1) \cup (0, \infty)$ (d) $(-\infty, -1) \cup (2, \infty)$
Ans. (d) $(-\infty, -1) \cup (2, \infty)$
We have, $| 3 - 6x | \geq 9$
$\Rightarrow 3 - 6x \leq -9$ or $3 - 6x \geq 9$

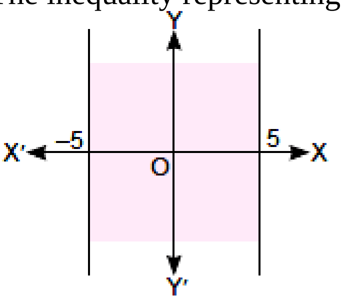
$\Rightarrow$ - 6x $\le$ -12 or - 6x $\ge$ 6
$\Rightarrow$ x $\ge$ 2 or x $\le$ - 1
$\Rightarrow$ (- ∞, -1) $\cup$ (2, ∞)

4. If x is a real number and | x | < 3, then x lies between:
(a) x $\ge$ 3 (b) x $\le$ - 3 (c) -3 $\le$ x $\le$ 3 (d) -3 < x < 3
Ans. (d) –3 < x < 3
Given, | x | < 3
Here, x is a real number
So, x < 3 $\Rightarrow$ -x < 3 $\Rightarrow$ x > -3
x $\in$ (-3, 3)

5. If 2x – 1 < 6 + x, 4 – 3x $\le$ 1, then x$\in$:
(a) [1, 7] (b) [-1, 7] (c) [1, 7) (d) (1, 7)
Ans. (c) [1, 7)
We have, 2x - 1 < 6 + x
2x – x < 6 + 1
$\Rightarrow$ x < 7
Also, we have 4 - 3x $\le$ 1
$\Rightarrow$ -3x $\le$ -3 $\Rightarrow$ x $\ge$ 1
Thus, solution of the given system are all real number lying between 1 and 7 including 1, i.e., 1 $\le$ x < 7.
$\therefore$ x $\in$ [1, 7)

6. If 3x - 1 < 5 + x, 6 - 5x $\le$ 1, then x $\in$
(a) [1, 3] (b) [- 1, 3] (c) [1, 3) (d) (1, 3)
Ans. (c) [1, 3)
We have, 3x - 1 < 5 + x
$\Rightarrow$ 3x – x < 5 + 1 $\Rightarrow$ 2x < 6 $\Rightarrow$ x < 3
Also, we have 6 - 5x $\le$ 1
$\Rightarrow$ - 5x $\le$ 1 – 6 $\Rightarrow$ - 5x $\le$ - 5 $\Rightarrow$ x $\ge$ 1
Thus, solution of the given system are all real number lying between 1 and 3 including 1, i.e., 1 $\le$ x < 3.
$\therefore$ x $\in$ [1, 3)

7. The inequality representing the following graph is:



(a) | x | < 5 (b) | x | $\le$ 5 (c) | x | > 5 (d) | x | $\ge$ 5

Ans. (b) | x | $\le$ 5

8. If $\frac{x+3}{x+5}$, then x $\in$
(a) (-6, 5) (b) (-6, -∞) (c) (-6, ∞) (d) (6, 12)
Ans. (b) (–6, –∞)
We have, x + 3 > 3x + 15
$\Rightarrow$ 3 – 15 > 3x – x $\Rightarrow$ -12 > 2x $\Rightarrow$ -6 > x $\Rightarrow$ x < -6

For Q9 and Q10, a statement of assertion (A) is followed by a statement of reason (R). Choose the correct answer out of the following choices.

(a) Both A and R are true and R is the correct explanation of A.
(b) Both A and R are true but R is not the correct explanation of A.
(c) A is true but R is false.
(d) A is false but R is true.

9. **Assertion (A):** If $11x - 9 \leq 68$, then $x \in (-\infty, 7)$.
Reason (R): If an inequality consists of sign $\leq$ or $\geq$, then the point on the line are also included in the solution region.
Ans. (d) A is false but R is true.
We have, $11x - 9 \leq 68$,
$\Rightarrow 11x \leq 77 \Rightarrow x \leq 7$
$\therefore x \in (-\infty, 7]$
So, assertion is false but the reason is true.

10. **Assertion (A):** If $-5 \leq 2x + 9 \leq 2$, then $x \in [-7, -3.5]$.
Reason (R): The representation on the number line of $-5 \leq 2x + 9 \leq 2$ is

Ans. (a) Both A and R are true and R is the correct explanation of A.
We have $-5 \leq 2x + 9 \leq 2$
$\Rightarrow -5 - 9 \leq 2x \leq 2 - 9$
$\Rightarrow -14 \leq 2x \leq -7$
$\Rightarrow -7 \leq x \leq -7/2$
$\therefore x \in [-7, -3.5]$

SECTION – B

Questions 11 to 14 carry 2 marks each.

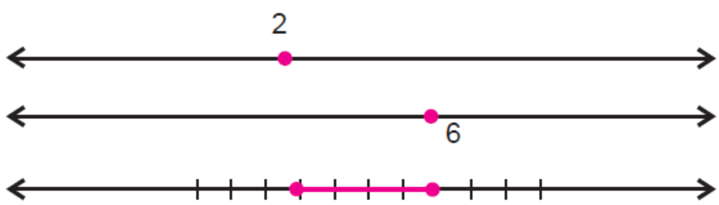
11. Find all pairs of consecutive odd positive integers both of which are smaller than 10 such that their sum is more than 11.
Ans. Let x and $x + 2$ be two consecutive odd positive integers.
Then $x + 2 < 10$ and $x + x + 2 > 11$
$\Rightarrow x < 8$ and $2x + 2 > 11 \Rightarrow x < 8$ and $2x > 11 - 2$
$\Rightarrow x < 8$ and $2x > 9$
$\Rightarrow x < 8$ and $x > 9/2$
$\Rightarrow 9/2 < x < 8$
$\Rightarrow x = 5$ and 7
Thus required pairs of odd positive integers are (5, 7) and (7, 9).

12. The water acidity in a pool is considered normal when the average pH reading of three daily measurements is between 8.2 and 8.5. If the first two pH readings are 8.48 and 8.35, then find the range of pH value for the third reading that will result in the acidity level being normal.
Ans. Given data, first pH value = 8.48 and second pH value = 8.35
Let third pH value be x.
Since, it is given that average pH value lies between 8.2 and 8.5.
$\therefore 8.2 < \dfrac{8.48 + 8.35 + x}{3} < 8.5$
$\Rightarrow 8.2 < \dfrac{16.83 + x}{3} < 8.5$
$\Rightarrow 3 \times 8.2 < 16.83 + x < 8.5 \times 3$

$\Rightarrow 24.6 < 16.83 + x < 25.5$
$\Rightarrow 24.6 - 16.83 < x < 25.5 - 16.83$
$\Rightarrow 7.77 < x < 8.67$
Thus, third pH value lies between 7.77 and 8.67.

13. Solve -15x > 45, when
(a) x is a natural number.
(b) x is an integer.
Ans. We have, -15x > 45
$\Rightarrow \frac{-15x}{-15} < \frac{45}{-15}$ [On dividing both sides by -15]
$\Rightarrow x < -3$
(a) Given that x is a natural number, i.e., $x \in N$.
Hence, the solution set of given inequality = $\{x \in N : x < -3\}$ = No Solution.
(b) Given that x is an integer, i.e., $x \in Z$.
Hence, the solution set of given inequality = $\{x \in Z : x < -3\} = \{.......,-5, -4\}$.

14. Solve the system of inequalities:
$3x – 7 < 5 + x$ ...(i)
$11 – 5x \leq 1$ ...(ii)
and represent the solution on the number line.
Ans. From inequality (i), we have
$3x – 7 < 5 + x \Rightarrow 3x – x < 5 + 7 \Rightarrow 2x < 12$
$\Rightarrow x < 6$ ...(iii)
Also, from inequality (ii), we have
$11 – 5x \leq 1$
or $–5x \leq –10$ i.e., $x \geq 2$ ...(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 pink line in Fig.



Thus, solution of the system are real numbers x lying between 2 and 6 including 2, i.e., $2 \leq x < 6$. i.e. solution set is [2, 6).

SECTION – C

Questions 15 to 17 carry 3 marks each.

15. The longest side of a triangle is twice the shortest side and the third side is 2 cm longer than the shortest side. If the perimeter of the triangle is more than 166 cm, then find the minimum length of the shortest side.
Ans. Let the length of shortest side be x cm.
According to the given information,
Longest side = 2 × shortest side = 2x cm
and third side = 2 + shortest side = (2 + x) cm
perimeter of triangle = x + 2x + (x + 2) = 4x + 2
According to the question, perimeter > 166 cm
$\Rightarrow 4x + 2 > 166 \Rightarrow 4x > 166 – 2 \Rightarrow 4x > 164$
$\Rightarrow x > 164/4$
= 41 cm

Hence, the minimum length of shortest side be 41 cm.

16. Solve for x: $|x + 1| + |x| > 3$
Ans. LHS $=|x + 1| + |x|$
As both the terms contain modulus by equating the expression within modulus to zero,
We get $x = -1, 0$ as critical points.
These critical points divide the line in three parts as $(-\infty, -1)$, $[-1, 0)$, $[0, \infty)$.
Case I: when $-\infty < x < -1$
$|x + 1| + |x| > 3$
$\Rightarrow -x - 1 - x > 3 \Rightarrow -2x > 4 \Rightarrow x < -2$
Case II: when $-1 \le x < 0$
$|x + 1| + |x| > 3$
$\Rightarrow x + 1 - x > 3 \Rightarrow 1 > 3$ (not possible)
Case III: when $0 \le x < \infty$
$|x + 1| + |x| > 3$
$\Rightarrow x + 1 + x > 3 \Rightarrow 2x > 2 \Rightarrow x > 1$
Combining the results of cases, we get $x \in (-\infty, -2) \cup (1, \infty)$

17. Solve the system of inequalities:
$5(2x - 7) -3 (2x + 3) \le 0,\ 2x + 19 \le 6x + 47$
Ans. We have $5(2x - 7) -3 (2x + 3) \le 0$ and $2x + 19 \le 6x + 47$
$\Rightarrow 10x - 35 - 6x - 9 \le 0$ and $-4x \le 28$
$\Rightarrow 4x - 44 \le 0$ and $x \ge -7$
$\Rightarrow 4x \le 44$ and $x \ge -7$
$\Rightarrow x \le 11$ and $x \ge -7 \Rightarrow x \in [-7, 11]$

Hence, Solution set is $[-7, 11]$.

SECTION – D
Questions 18 carry 5 marks.

18. How many litres of water will have to be added to 1125 litres of the 45% solution of acid so that the resulting mixture will contain more than 25% but less than 30% acid content?
Ans. Let x litres of water be added to 1125 litres of 45% acid solution.
Then total quantity of mixture = (1125 + x) litres

Percentage of acid content $= 1125\times\frac{45}{100}\times\frac{100}{(1125+x)} = \frac{2025\times100}{4(1125+x)}$

It is given that the resulting mixture must be more than 25% but less than 30% acid content.

$$\frac{25}{100}\times100 \le \frac{2025\times100}{4(1125+x)} \le \frac{30}{100}\times100$$

$$\Rightarrow\ 25 \le \frac{50625}{1125+x} \le 30$$

$$\Rightarrow\ 25 \le \frac{50625}{1125+x} \text{ and } \frac{50625}{1125+x} \le 30$$

$\Rightarrow 28125 + 25x \le 50625$ and $50625 \le 33750 + 30x$
$\Rightarrow 25x \le 22500$ and $30x \ge 1687.5$
$\Rightarrow x \le 900$ and $x \ge 562.5$
$\Rightarrow 562.5 \le x \le 900$
Thus minimum 562.5 litres and maximum 900 litres of water need to be added.

SECTION – E (Case Study Based Questions)

Questions 19 to 20 carry 4 marks each.

19. Aditya's mother gave him Rs. 200 to buy some packets of rice and maggie from the market. The cost of one packet of rice is Rs. 30 and that of one packet of maggie is Rs. 20. Let x denotes the number of packet of rice and y denotes the number of packets of maggie.

(a) Find the inequality that represents the given situation. (1)
(b) If he buys 4 packets of rice and spends entire amount of Rs. 200, then find the maximum number of packets of maggie that he can buy. (1)
(c) Solve the following inequality for real x: $4x + 3 < 5x + 7$ (2)

Ans. (a) Total amount = Rs. 200
Cost of one packet of rice = Rs. 30
And cost of one packet of maggie = Rs. 20
Here, x and y denote the number of packets of rice and maggie respectively,
Total amount spent by Aditya is $30x + 20y$.
$\therefore$ Required inequality is $30x + 20y \leq 200$
(b) If he spends his entire amount, then
We have, $30x + 20y = 200$ ...(i)
Since, number of packet of rice = 4
$\therefore$ At $x = 4$, equation (i) becomes
$30 \times 4 + 20y = 200$
$\Rightarrow 120 + 20y = 200$
$\Rightarrow 20y = 200 - 120$
$\Rightarrow 20y = 80$
$\therefore$ Maximum number of packets of maggie that he can buy is 4.
(c) Given that, $4x + 3 < 5x + 7$
Now by subtracting 7 from both the sides, we get
$4x + 3 – 7 < 5x + 7 – 7$
The above inequality becomes, $4x – 4 < 5x$
Again, by subtracting 4x from both the sides,
$4x – 4 – 4x < 5x – 4x$
$\Rightarrow x > – 4$
$\therefore$ The solutions of the given inequality are defined by all the real numbers greater than –4.
The required solution set is $(–4, \infty)$.

20. An intelligence quotient (IQ) is a total score derived from a set of standardised tests or subtests designed to assess human intelligence. The abbreviation "IQ" was coined by the psychologist William Stern for the German term Intelligence quotient, his term for a scoring method for intelligence tests at University of Breslau he advocated in a 1912 book.

Manjula is a Psychology student and nowadays she is learning about Intelligence Quotient (IQ). She calculates the result as follows:

$$\text{Intelligence Quotient} = \frac{\text{Mental Age}}{\text{Chronological Age}} \times 100$$

(a) What could be the range if mental age if a group of children with chronological age of 15 years have the IQ range as $90 \le IQ \le 150$?

(b) What could be the range of IQ if a group of children with age of 12 years have the mental age range as $9 \le MA \le 15$?

OR

(b) What could be the range of IQ if a group of children with mental age of 18 years have the mental age range as $12 \le CA \le 15$?

Ans. (a) $90 \le IQ \le 150$

$$\Rightarrow 90 \le \frac{MA}{15} \times 100 \le 150$$

$$\Rightarrow \frac{90}{100} \le \frac{MA}{15} \le \frac{150}{100} \Rightarrow \frac{90}{100} \times 15 \le MA \le \frac{150}{100} \times 15$$

$$\Rightarrow \frac{27}{2} \le MA \le \frac{45}{2} \Rightarrow 13.5 \le MA \le 22.5$$

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

As, $9 \le MA \le 15$

$$\Rightarrow 9 \le \frac{IQ \times CA}{100} \le 15 \Rightarrow 9 \le \frac{IQ \times 12}{100} \le 15 \Rightarrow 900 \le IQ \times 12 \le 1500$$

$$\Rightarrow \frac{900}{12} \le IQ \le \frac{1500}{12} \Rightarrow 75 \le IQ \le 125$$

OR

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

As $12 \le CA \le 15$,

$$\Rightarrow 12 \le \frac{MA}{IQ} \times 100 \le 15$$

$$\Rightarrow 12 \le \frac{18}{IQ} \times 100 \le 15 \Rightarrow \frac{12}{100} \le \frac{18}{IQ} \le \frac{15}{100}$$

$$\Rightarrow \frac{12}{1800} \le \frac{1}{IQ} \le \frac{15}{1800} \Rightarrow \frac{1800}{12} \ge IQ \ge \frac{1800}{15}$$

$$\Rightarrow 150 \ge IQ \ge 120$$