

PRACTICE PAPER 05 (2024-25)
CHAPTER 05 LINEAR INEQUALITIES

SUBJECT: MATHEMATICS

MAX. MARKS : 40

CLASS : XI

DURATION : 1½ hrs

General Instructions:

- (i). All questions are compulsory.
- (ii). This question paper contains 20 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.

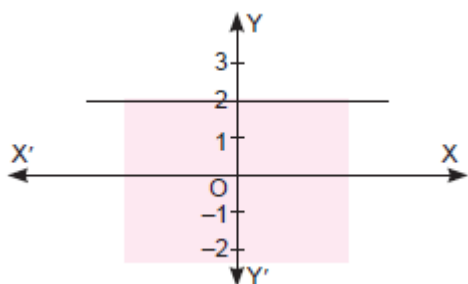
1. If $-3x + 17 < -13$, then

- (a) $x \in (10, \infty)$ (b) $x \in [10, \infty)$ (c) $x \in (-\infty, 10]$ (d) $x \in [-10, 10]$

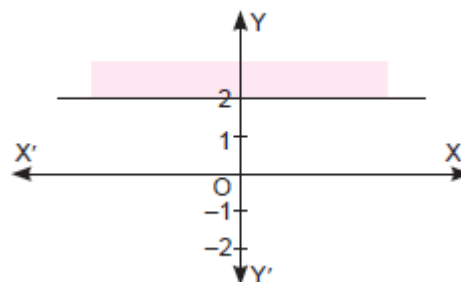
Ans. (a) $x \in (10, \infty)$

2. Solution set of $y \leq 2$ graphically is

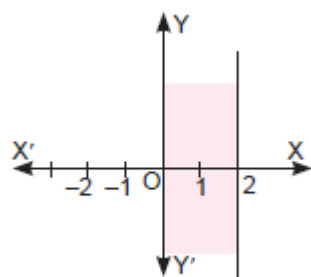
(a)



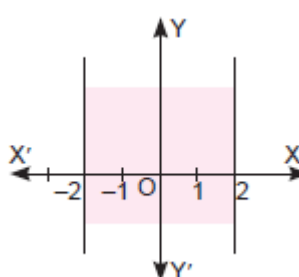
(b)



(c)



(d)



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) $(-\infty, -1) \cup (2, \infty)$

4. If x is a real number and $|x| < 3$, then x lies between:

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

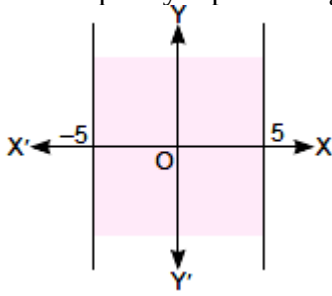
5. If $2x - 1 < 6 + x$, $4 - 3x \leq 1$, then $x \in$:

- (a) $[1, 7]$ (b) $[-1, 7]$ (c) $[1, 7)$ (d) $(1, 7)$

6. If $3x - 1 < 5 + x$, $6 - 5x \leq 1$, then $x \in$

- (a) $[1, 3]$ (b) $[-1, 3]$ (c) $[1, 3)$ (d) $(1, 3)$

7. The inequality representing the following graph is:



- (a) $|x| < 5$ (b) $|x| \leq 5$ (c) $|x| > 5$ (d) $|x| \geq 5$

8. If $\frac{x+3}{x+5}$, then $x \in$

- (a) $(-6, 5)$ (b) $(-6, -\infty)$ (c) $(-6, \infty)$ (d) $(6, 12)$

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.

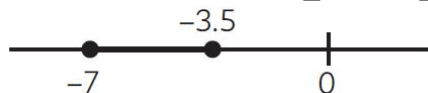
- (a) Both A and R are true and R is the correct explanation of A.
 (b) Both A and R are true but R is not the correct explanation of A.
 (c) A is true but R is false.
 (d) A is false but R is true.

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.

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



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.
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.
13. Solve $-15x > 45$, when (a) x is a natural number. (b) x is an integer.
14. Solve the system of inequalities: $3x - 7 < 5 + x$ and $11 - 5x \leq 1$. Also, represent the solution on the number line.

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.

16. Solve for x : $|x + 1| + |x| > 3$

17. Solve the system of inequalities:

$$5(2x - 7) - 3(2x + 3) \leq 0, 2x + 19 \leq 6x + 47$$

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?

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 maggi from the market. The cost of one packet of rice is Rs. 30 and that of one packet of maggi is Rs. 20. Let x denotes the number of packet of rice and y denotes the number of packets of maggi.



(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 maggi that he can buy. (1)

(c) Solve the following inequality for real x : $4x + 3 < 5x + 7$ (2)

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 of mental age if a group of children with chronological age of 15 years have the IQ range as $90 \leq \text{IQ} \leq 150$?

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

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 $12 \leq \text{CA} \leq 15$?

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(ANSWERS)

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SECTION – A

Questions 1 to 10 carry 1 mark each.

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

- (a) $x \in (10, \infty)$ (b) $x \in [10, \infty)$ (c) $x \in (-\infty, 10]$ (d) $x \in [-10, 10)$

Ans. (a) $x \in (10, \infty)$

$$-3x + 17 < -13$$

$$\Rightarrow 3x - 17 > 13 \text{ [on multiply both sides by } (-1)]$$

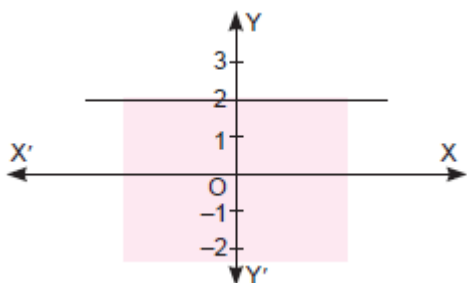
$$\Rightarrow 3x > 13 + 17 \text{ [on adding 17 to both sides]}$$

$$\Rightarrow x > 10$$

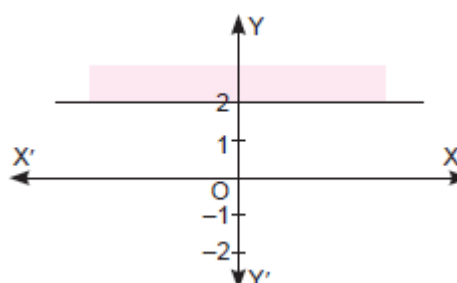
Hence, $x \in (10, \infty)$

2. Solution set of $y \leq 2$ graphically is

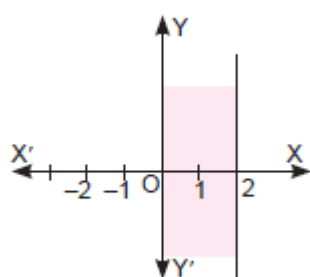
(a)



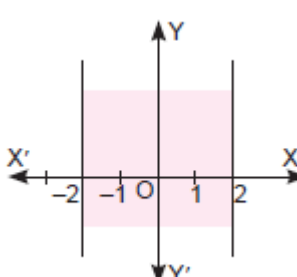
(b)



(c)



(d)



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) $(-\infty, -1) \cup (2, \infty)$

$$\text{We have, } |3 - 6x| \geq 9$$

$$\Rightarrow 3 - 6x \leq -9 \text{ or } 3 - 6x \geq 9$$

$$\Rightarrow -6x \leq -12 \text{ or } -6x \geq 6$$

$$\Rightarrow x \geq 2 \text{ or } x \leq -1$$

$$\Rightarrow (-\infty, -1) \cup (2, \infty)$$

4. If x is a real number and $|x| < 3$, then x lies between:

(a) $x \geq 3$ (b) $x \leq -3$ (c) $-3 \leq x \leq 3$ (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 $2x - 1 < 6 + x$, $4 - 3x \leq 1$, 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 $4 - 3x \leq 1$

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

Thus, solution of the given system are all real number lying between 1 and 7 including 1, i.e., $1 \leq x < 7$.

$\therefore x \in [1, 7)$

6. If $3x - 1 < 5 + x$, $6 - 5x \leq 1$, then $x \in$

(a) $[1, 3]$ (b) $[-1, 3]$ (c) $[1, 3)$ (d) $(1, 3)$

Ans. (c) $[1, 3)$

We have, $3x - 1 < 5 + x$

$\Rightarrow 3x - x < 5 + 1 \Rightarrow 2x < 6 \Rightarrow x < 3$

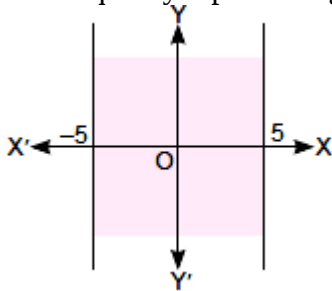
Also, we have $6 - 5x \leq 1$

$\Rightarrow -5x \leq 1 - 6 \Rightarrow -5x \leq -5 \Rightarrow x \geq 1$

Thus, solution of the given system are all real number lying between 1 and 3 including 1, i.e., $1 \leq x < 3$.

$\therefore x \in [1, 3)$

7. The inequality representing the following graph is:



(a) $|x| < 5$ (b) $|x| \leq 5$ (c) $|x| > 5$ (d) $|x| \geq 5$

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

8. If $\frac{x+3}{x+5}$, then $x \in$

(a) $(-6, 5)$ (b) $(-6, -\infty)$ (c) $(-6, \infty)$ (d) $(6, 12)$

Ans. (b) $(-6, -\infty)$

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, $11x - 9 \leq 68$,

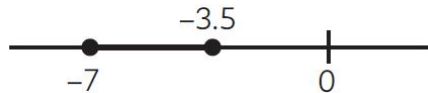
$$\Rightarrow 11x \leq 77 \Rightarrow x \leq 7$$

$$\therefore x \in (-\infty, 7]$$

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 $x + x + 2 > 11$

$$\Rightarrow x < 8 \text{ and } 2x + 2 > 11 \Rightarrow x < 8 \text{ and } 2x > 11 - 2$$

$$\Rightarrow x < 8 \text{ and } 2x > 9$$

$$\Rightarrow x < 8 \text{ and } x > 9/2$$

$$\Rightarrow 9/2 < x < 8$$

$$\Rightarrow x = 5 \text{ and } 7$$

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.

$$\therefore 8.2 < \frac{8.48 + 8.35 + x}{3} < 8.5$$

$$\Rightarrow 8.2 < \frac{16.83 + x}{3} < 8.5$$

$$\Rightarrow 3 \times 8.2 < 16.83 + x < 8.5 \times 3$$

$$\Rightarrow 24.6 < 16.83 + x < 25.5$$

$$\Rightarrow 24.6 - 16.83 < x < 25.5 - 16.83$$

$$\Rightarrow 7.77 < x < 8.67$$

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, $-15x > 45$

$$\Rightarrow \frac{-15x}{-15} < \frac{45}{-15} \quad [\text{On dividing both sides by } -15]$$

$$\Rightarrow x < -3$$

(a) Given that x is a natural number, i.e., $x \in \mathbb{N}$.

Hence, the solution set of given inequality = $\{x \in \mathbb{N} : x < -3\} = \text{No Solution}$.

(b) Given that x is an integer, i.e., $x \in \mathbb{Z}$.

Hence, the solution set of given inequality = $\{x \in \mathbb{Z} : x < -3\} = \{\dots, -5, -4\}$.

14. Solve the system of inequalities:

$$3x - 7 < 5 + x \dots(i)$$

$$11 - 5x \leq 1 \dots(ii)$$

and represent the solution on the number line.

Ans. From inequality (i), we have

$$3x - 7 < 5 + x \Rightarrow 3x - x < 5 + 7 \Rightarrow 2x < 12$$

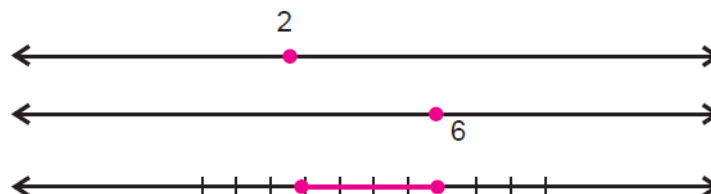
$$\Rightarrow x < 6 \dots(iii)$$

Also, from inequality (ii), we have

$$11 - 5x \leq 1$$

$$\text{or } -5x \leq -10 \text{ i.e., } x \geq 2 \dots(iv)$$

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 = $2 \times$ 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

$$\Rightarrow 4x + 2 > 166 \Rightarrow 4x > 166 - 2 \Rightarrow 4x > 164$$

$$\Rightarrow x > 164/4$$

$$= 41 \text{ cm}$$

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 $-1 \leq x < 0$

$$|x + 1| + |x| > 3$$

$$\Rightarrow x + 1 - x > 3 \Rightarrow 1 > 3 \text{ (not possible)}$$

Case III: when $0 \leq x < \infty$

$$|x + 1| + |x| > 3$$

$$\Rightarrow x + 1 + x > 3 \Rightarrow 2x > 2 \Rightarrow x > 1$$

Combining the results of cases, we get $x \in (-\infty, -2) \cup (1, \infty)$

17. Solve the system of inequalities:

$$5(2x - 7) - 3(2x + 3) \leq 0, 2x + 19 \leq 6x + 47$$

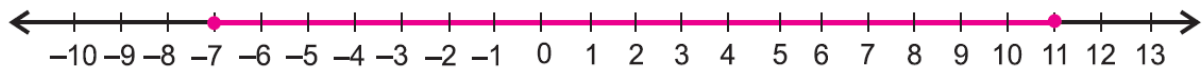
Ans. We have $5(2x - 7) - 3(2x + 3) \leq 0$ and $2x + 19 \leq 6x + 47$

$$\Rightarrow 10x - 35 - 6x - 9 \leq 0 \text{ and } -4x \leq 28$$

$$\Rightarrow 4x - 44 \leq 0 \text{ and } x \geq -7$$

$$\Rightarrow 4x \leq 44 \text{ and } x \geq -7$$

$$\Rightarrow x \leq 11 \text{ and } x \geq -7 \Rightarrow x \in [-7, 11]$$



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

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

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

$$\frac{25}{100} \times 100 \leq \frac{2025 \times 100}{4(1125 + x)} \leq \frac{30}{100} \times 100$$

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

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

$$\Rightarrow 28125 + 25x \leq 50625 \text{ and } 50625 \leq 33750 + 30x$$

$$\Rightarrow 25x \leq 22500 \text{ and } 30x \geq 16875$$

$$\Rightarrow x \leq 900 \text{ and } x \geq 562.5$$

$$\Rightarrow 562.5 \leq x \leq 900$$

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 maggi from the market. The cost of one packet of rice is Rs. 30 and that of one packet of maggi is Rs. 20. Let x denotes the number of packet of rice and y denotes the number of packets of maggi.



- (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 maggi 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 maggi = Rs. 20

Here, x and y denote the number of packets of rice and maggi 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 maggi 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 of mental age if a group of children with chronological age of 15 years have the IQ range as $90 \leq IQ \leq 150$?

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

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 $12 \leq CA \leq 15$?

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

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

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

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

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

As, $9 \leq MA \leq 15$

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

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

OR

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

As $12 \leq CA \leq 15$,

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

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

$$\Rightarrow \frac{12}{1800} \leq \frac{1}{IQ} \leq \frac{15}{1800} \Rightarrow \frac{1800}{12} \geq IQ \geq \frac{1800}{15}$$

$$\Rightarrow 150 \geq IQ \geq 120$$