1 LINEAR EQUATIONS AND INEQUATIONS

1. LINEAR EQUATIONS IN ONE VARIABLE-1

	♦	BASICS AND SOLVING EQUATIONS WHICH HAVE LINEAR EXPRESSIONS ON ONE SIDE AND NUMBERS ON THE OTHER SIDE.
	♦	APPLICATIONS ON LINEAR EQUATIONS WHICH HAVE LINEAR EXPRESSIONS ON ONE SIDE AND NUMBERS ON OTHER SIDE.

SYNOPSIS-1

INTRODUCTION

In previous classes we have studied above simple equations (Linear Equations) Let us recall them and we extend to converting the given equations into linear form in this chapter.

EQUATION

A statement of equality which contains one or more unknown quantity or variable is called an equation.

Ex. $3x+7=12, \frac{5}{2}x-9=1, x^2+1=5$ and $\frac{x}{3}+5=\frac{x}{2}-3$ are equations in one variable x.

Ex. $4x+3y=21, 3x-\frac{y}{5}=9$ are equations in two variables x and y.

LINEAR EQUATION IN ONE VARIABLE

An equation involving only one variable and highest degree of variable is 1 called linear equation in one variable.

Ex. $3x-2=7, \frac{3}{2}x+9=\frac{1}{2}, \frac{y}{3}+\frac{y-2}{4}=5$ are linear equations in one variable, because the highest power of the variable in each equation is one whereas the equations $3x^2-2x+1=0$, $y^2-1=8$ are not linear equations, because the highest power of the variable in each equation is not one.

Solution of a Linear Equation:

A value of the variable which when substituted for the variable in an equation, makes L.H.S. = R.H.S. is said to satisfy the equation and is called a solution of the equation.

In other words, a value of the variable which makes the equation a true statement, is called a solution of the equation.

Ex. Verify that $x=4$ is a solution of the equation $2x-3=5$.

Sol. Substituting $x=4$ in the given equation, we get

$L.H.S.=2x-3=2\times4-3=8-3=5=R.H.S.$

Hence, $x=4$ is the solution of the equation $2x-3=5$.

SYNOPSIS-2

Solving Equations which have Linear Expressions on One Side and Numbers on the Other Side

To solve the equation $2x-7=3$, we proceed as follows:

Transposing –7 from LHS to RHS, we obtain

$$2x=3+7$$

or $$2x=10$$

Next divide both sides by 2.

$$\frac{2x}{2}=\frac{10}{2}$$

or $$x=5$$

APPLICATIONS

Ex. The sum of three consecutive numbers is 54. What are the numbers?

Sol. This is a kind of puzzle. None of the three numbers is known to us. Two conditions are given.

1. Three numbers are consecutive
2. Their sum is 54.

If the first number is taken as x, the second number is $x+1$ and the third number is $x+2$. The other condition says that the sum of these three numbers $x, x+1$ and $x+2$ is 54.

This means that $x+(x+1)+(x+2)=54$

or $$3x+3=54$$

$$3x=54-3 \quad \text{(Transposing 3 to RHS)}$$

$$3x=51$$

$$x=17 \quad \text{(Dividing both sides by 3)}$$

Therefore, the first number is 17. The second number is $x+1=17+1=18$ and the third number is $x+2=17+2=19$.

The three consecutive numbers are 17, 18 and 19 and their sum is 54.

1. LINEAR EQUATIONS IN ONE VARIABLE-1

WORK SHEET LEVEL–I MAINS CORNER

SINGLE CORRECT ANSWER TYPE QUESTIONS

BASICS AND SOLVING EQUATIONS WHICH HAVE LINEAR EXPRESSIONS ON ONE SIDE AND NUMBERS ON THE OTHER SIDE

1. An equation is a statement of equality which contains an unknown quantity.
   1) False 2) True 3) can't say 4) doubt full
2. An equation in which the highest power of the variable involved is one, is called ____
   1) Quadratic equation 2) Linear equation
   3) Both (1) and (2) 4) None
3. The process in which we can drop a term from one side of an equation to other side is called
   1) Systematic method 2) Guess method
   3) Transposition method 4) Trial and error method
4. When we transpose term '+' quantity becomes _____ quantity.
   1) + 2) - 3) × 4) ÷
5. When we transpose term '×' quantity becomes _____ quantity.
   1) + 2) - 3) × 4) ÷
6. Any term of the equation may be transposed from one side of the equation to the other by changing its sign
   1) True 2) False 3) doubt full 4) can't say
7. Any value of the variable which makes the statement of equality true is called _____
   1) Root 2) Solution 3) Both (1) and (2) 4) None
8. If $ax+b=0$ is a linear equation and $a\neq 0$ then the value of x = …..
   1) $\frac{a}{b}$ 2) $\frac{b}{a}$ 3) $\frac{-a}{b}$ 4) $\frac{-b}{a}$
9. If $\frac{3}{5}x=18$, then x =
   1) 12 2) $\frac{54}{5}$ 3) 18 4) 30
10. $\frac{3}{7}+x=\frac{17}{7}$.
    1) 2 2) 1 3) 3 4) 0

APPLICATIONS ON LINEAR EQUATIONS WHICH HAVE LINEAR EXPRESSIONS ON ONE SIDE AND NUMBERS ON OTHER SIDE

11. Sum of two numbers is 58 and their difference is 12 then the numbers are
    1) 28, 30 2) 20,28 3) 23,35 4) 25,33

12. A rectangle is 8cm long and 5cm wide. Its perimeter is doubled when each of its sides is increased by x cm.
1) 15cm 2) 6.5cm 3) 10.5cm 4) 9cm

13. Shanthi scored 80 marks in her science test which is $\frac{5}{6}$ of the total marks. The total marks of the tests are
1) 96 2) 100 3) 104 4) 108

14. If the total of four consecutive odd numbers is 40, then smallest number is
1) 7 2) 9 3) 11 4) 13

LEVEL–II

BASICS AND SOLVING EQUATIONS WHICH HAVE LINEAR EXPRESSIONS ON ONE SIDE AND NUMBERS ON THE OTHER SIDE

15. If $12 = 3 - \frac{3}{4}a$, calculate the value of $a =$
1) 20 2) 12 3) –3 4) –12

16. If $\frac{1}{7} + \frac{x}{7} = 3$, the value of $x =$
1) 20 2) 7 3) 3 4) 1

17. If $-8y - (y - 5) = -13$, then y =
1) 5 2) 2 3) $\frac{13}{9}$ 4) $\frac{8}{9}$

APPLICATIONS ON LINEAR EQUATIONS WHICH HAVE LINEAR EXPRESSIONS ON ONE SIDE AND NUMBERS ON OTHER SIDE

18. Ram has Rs. 27 in the form of fifty paise and twenty-five paise coins. He has twice as many twenty-five paise coins as he has fifty paise coins. The number of coins of each kind are
1) 22 and 50 2) 27 and 54 3) 20 and 50 4) 30 and 40

19. The sum of the digits of a two –digit number is 15. If the number formed by reversing the digits is less than the original number by 27. Find the original number?
1) 96 2) 86 3) 116 4) 105

20. After 12 years I shall be 3 times as old as I was 4 years ago. Then my present age=
1) 13 years 2) 11 years 3) 12 years 4) 14 years

LEVEL-III ADVANCED CORNER

SINGLE CORRECT ANSWER TYPE QUESTIONS

21. Ramesh gives one third of his income to his son, one fourth to his daughter and one fifth to his wife. If he is left with Rs 2600, Then his income is equal to
1) Rs 11,000 2) 12,000 3) 13,000 4) 14,000

22. A number is $\frac{5}{6}th$ of the other number. If the sum of these two numbers is 22 less than 99, what is the smaller number?
1) 54 2) 7×3^2 3) 42 4) 24

23. A bus starting from stop A is carrying a certain number of passengers. At the next stop B, $\frac{1}{3}$rd of the passengers alight and 18 new passengers get in. At the next stop C, $\frac{3}{4}$th of the remaining passengers alight and 12 new passengers get in after which there are 25 passengers in the bus. How many passengers were there in the bus when it left the stop A?
1) 54 2) 53 3) 52 4) 51

LEVEL–IV

STATEMENT TYPE QUESTIONS

24. Statement I: $\frac{5}{2}\sqrt{x}+88x=9$ is not a linear equation.
Statement II: Linear equation involves only linear polynomials.
1) Both statements are true
2) Both statements are false
3) Statement I true, statement II is false
4) Statement I is false, statement II is true

25. Statement I : Sum of digits of a two digit number is 8. The digit in tens place is thrice the digit in unit place. Then the number is 62
Statement II: Sum of three consecutive multiples of 9 is 108. Then these multiples are 27, 36, 45
1) Both statements are true.
2) Both statements are false.
3) Statement I is true, Statement II is false.
4) Statement I is false, Statement II is true.

INTEGER TYPE QUESTIONS

26. The sum of three consecutive integers is 33. The difference between largest and smallest integer is

27. Twice a number increased by 8 is 20. The number is

MULTI CORRECT ANSWER TYPE QUESTIONS

28. Two angles in a triangle are in the ratio 4:5. If the sum of these angles is equal to the third angle, then the angles are

1) 180^0 2) 40^0 3) 50^0 4) 90^0

29. In a pet shop, there are twice as many cats as there are dogs, and as many parrots as $\frac{1}{6}$ the number of dogs and as many mynahs as $\frac{1}{8}$ the number of dogs. If the total number of pets in the shop is 1580, then the number of cats in the shop is.

1) 480×2 2) 960 3) 1516×2 4) 3032

LEVEL–V

COMPREHENSION TYPE QUESTIONS

PASSAGE

A rectangle has a perimeter of 60 cm.

30. If length and breadth of rectangle is $(k+4)cm$ and $(3k-2)cm$ respectively, then the value of k is

1) 7 2) 9 3) 12 4) 29

31. The length and breadth of the rectangle is

1) 11, 7 2) 11, 19 3) 19, 20 4 23, 11

32. If perimeter of rectangle is equal to perimeter of square, then side of square is

1) 60 cm 2) 18 cm 3) 225 cm 4) 15 cm

MATRIX MATCH TYPE QUESTIONS

33.

COLUMN –I	COLUMN-II
a) Kusum buys some chocolates at the rate of Rs.10 per chocolate. She also buys an equal number of candies at the rate of Rs.5 per candy. She makes a 20% profit on chocolates and 8% profit on candies. At the end of the day, all chocolates and candies are sold out and her profit is Rs.240. Therefore, number of chocolates Kusum buy?	p) 7
b) A carpenter charged Rs.2500 for making a bed. The cost of materials used is Rs.1100 and the labour charges are Rs.200/hr. So, the carpenter will work for hours.	q) 100
c) On dividing Rs.200 between A and B such that twice of A's share is less than 3 times B's share by 200. So, B's share is in Rs	r) 40
d) Madhulika thought of a number, double it and added 20 to it. On dividing the resulting number by 25, she gets 4. Hence, the required number is.	s) 120

2. LINEAR EQUATIONS IN ONE VARIABLE-2

	♦	SOLVING EQUATIONS HAVING VARIABLE ON BOTH SIDES.
	♦	APPLICATIONS OF LINEAR EQUATIONS HAVING VARIABLE ON BOTH SIDES.
	♦	REDUCING EQUATIONS TO SIMPLE FORM AND EQUATIONS REDUCIBLE TO LINEAR FORM.

SYNOPSIS-1

SOLVING EQUATIONS HAVING VARIABLE ON BOTH SIDES

An equation is the equality of the values of two expressions. Linear equations can have variables on both sides of the equation.

Ex. $2x-4=3x+2$.

Such equations can also be solved by transposing terms as:

Transposing $3x$ from RHS to LHS, $2x-4-3x=2$

Transposing –4 from LHS to RHS, $2x-3x=2+4$

or $-x=6$

or $x=-6$

APPLICATION

Ex. Rohit is thrice as old as Sonam. 7 years ago his age was four times as Sonam's age. Find their present ages.

Sol. Let us assume Sonam's present age to be x years. Then Rohit's present age would be 3x years.

Seven years ago, sonam's age was $(x-7)$ years.

Seven years ago, rohit's age was $(3x-7)$ years.

It is given that rohit's age seven years ago was four times Sonam's age.

Thus, $3x-7=4(x-7)$

$3x-7=4x-28$

$28-7=4x-3x$

$21=x$

Therefore, sonam's present age is $x=21$ years and rohit's present age is $3x=3\times21=63$ years.

REDUCING EQUATIONS TO SIMPLER FORMS

There are certain linear equations in which the denominators of expressions on both sides are not one. In such cases, both sides of the equation are multiplied by the LCM of the denominators on both sides.

Ex. To reduce the given equation $\frac{3x-1}{4}+2=\frac{2x+3}{6}+7$ into simpler form, first, take the LCM of 4 and 6, that is, 12 and then multiply both sides of the equation by 12.

$$\left(\frac{3x-1}{4}+2\right)\times 12=\left(\frac{2x+3}{6}+7\right)\times 12$$

$$\left(\frac{3x-1}{4}\right)\times 12+24=\left(\frac{2x+3}{6}\right)\times 12+84$$

$$9x-3+24=4x+6+84$$

$$9x+21=4x+90$$

This is a simple linear equations.

EQUATIONS REDUCIBLE TO LINEAR FORM

There are certain equations which can be reduced to linear equations.

Observe the given equation $\frac{2-4x}{3x-2}=\frac{3}{2}$. This is not in the linear equation form, since the expression on LHS is not linear. However, it can be put into the form of a linear equation by multiplying both sides of the equation by $(3x-2)$.

$$\left(\frac{2-4x}{3x-2}\right)\times(3x-2)=\frac{3}{2}\times(3x-2)$$

Note that $(3x-2)$ gets cancelled on the LHS as shown below:

$2-4x=\frac{3\times(3x-2)}{2}$, this is now a linear equation. Multiplying both sides by 2, we get

$$2\times(2-4x)=3\times(3x-2)$$

$$4-8x=9x-6$$

$$6+4-8x=9x$$

$$10=9x+8x$$

$$10=17x$$

$$x=\frac{10}{17}$$

Therefore, the solution is $x=\frac{10}{17}$.

2. LINEAR EQUATIONS IN ONE VARIABLE-2

WORK SHEET LEVEL–I MAINS CORNER

SINGLE CORRECT ANSWER TYPE QUESTIONS

SOLVING EQUATIONS HAVING VARIABLE ON BOTH SIDES

1. If $\frac{k}{3}-4=8-k$, then $k=$

   1) 2 2) 4 3) 6 4) 9

2. If $3x + 2 = x - 2$, then $x =$

   1) -2 2) 2 3) 1 4) -4

3. If $\frac{3}{4}(x+1)-\frac{1}{2}=x-1$, then $x =$

   1) 6 2) –5 3) 5 4) –6

4. Given that $-6x=64-2(-x)$, the value of $x=$

   1) –8 2) –4 3) 6 4) 16

APPLICATIONS OF LINEAR EQUATIONS HAVING VARIABLE ON BOTH SIDES

5. The prices of a scooter and cycle are in the ratio 9:5. If a scooter costs Rs. 4200 more than a cycle. The price of cycle is

   1) Rs. 5250 2) Rs. 5200 3) Rs. 5000 4) Rs. 4800

6. Fifteen years from now Raju's age will be four times the age 15 years ago from now. The present age is

   1) 40 years 2) 10 years 3) 25 years 4) 75 years

7. A man is five times as old as his son. after 2 years the man will be four times as old as his son then present age of father is_____

   1) 35 years 2) 30 years 3) 20 years 4) 40 years

REDUCING EQUATIONS TO SIMPLE FORM AND EQUATIONS REDUCIBLE TO LINEAR FORM

8. Solution of $\frac{5x-7}{3x}=2$

   1) 5 2) -7 3) 6 4) -6

9. Solution of $\frac{3x+5}{2x+1}=\frac{1}{3}$

   1) -2 2) -3 3) -1 4) 2

10. Solution of $\frac{x+1}{2x+3}=\frac{3}{8}$

    1) $\frac{3}{2}$ 2) $\frac{5}{2}$ 3) $\frac{1}{2}$ 4) 2

LEVEL–II

SOLVING EQUATIONS HAVING VARIABLE ON BOTH SIDES

11. Solution of $2(y+3)+3(y+1)=4(2y-3)+3$

1) 5 2) 6 3) 7 4) 8

12. Solution of $0.18(5y-4)=0.5y+0.8$

1) 3.8 2) 1.7 3) 3.28 4) 4.7

13. Solution of $3m+2(m+2)=20-(2m-5)$

1) 1 2) 2 3) 4 4) 3

APPLICATIONS OF LINEAR EQUATIONS HAVING VARIABLE ON BOTH SIDES

14. A number consists of two digits. The digit in the ten's place exceeds the digit in the unit's place by 4. The sum of the digits is $\frac{1}{7}$ of the number. The number is:

1) 27 2) 72 3) 48 4) 84

15. Divide 34 into two parts in such a way that $\left(\frac{4}{7}\right)^{th}$ of one part is equal to $\left(\frac{2}{5}\right)^{th}$ of the other.

1) 10 2) 20 3) 30 4) 40

16. A person spends $\frac{1}{3}$ of the money with him on clothes, $\frac{1}{5}$ of the remaining on food and $\frac{1}{4}$ of the remaining on travel. Now he is left with Rs. 100. How much did he have with him in the beginning?

1) Rs.200 2) Rs.250 3) Rs.300 4) Rs.450

REDUCING EQUATIONS TO SIMPLE FORM AND EQUATIONS REDUCIBLE TO LINEAR FORM

17. If $\frac{2x-1}{2x-3}=\frac{3x+1}{3x-1}$, then

1) x = 1 2) x = –1 3) x = 2 4) x = –2

18. Solve for x: $\frac{6x^2+13x-4}{2x+5}=\frac{12x^2+5x-2}{4x+3}$

1) 3 2) 2 3) 1 4) 4

19. Solve $\frac{2x-1}{x+3}+\frac{1-2x}{x-3}=\frac{4-3x}{x^2-9}$

1) $x=\frac{2}{7}$ 2) $x=\frac{2}{9}$ 3) $x=\frac{2}{5}$ 4) $x=\frac{2}{3}$

LEVEL-III ADVANCED CORNER

SINGLE CORRECT ANSWER TYPE QUESTIONS

20. In a three-digit number, the digit in the units' place is four times the digit in the hundreds' place. If the digit in the units' place and ten's place are interchanged, the new number so formed is 18 more than the original number. If the digit in the hundreds place is one-third of the digit in the tens place, what is 25% of the original number?
1) 67 2) 84 3) 73 4) 64

21. The length of a rectangle is 3 times its breadth. If the length if decreased by 3 cm and the breadth increased by 5 cm, the area of the rectangle is increased by 57 cm^2. The perimeter of the rectangle is:
1) 18 cm 2) 48 cm 3) 24 cm 4) 20 cm

22. In an examination, a candidate attempts 90% of the total questions. Out of thee 70% of his answers are correct. Each question carries 3 marks for the correct answer and (-1) mark for the wrong answer. If the marks secured by the candidate is 243, what is the total number of questions?
1) 110 2) 140 3) 150 4) 200

LEVEL–IV

STATEMENT TYPE QUESTIONS

23. Statement-1: $\frac{3}{2}x^{-1}+9=1$ is a linear equation.
Statement-2: In a linear equation power of x cannot be negative.
1) Both the statements are true
2) Both the statements are false
3) Statement I is true, statement II is false
4) Statement I is false, statement II is true.

24. Statement-1: $4x+\frac{8}{9}=\frac{6x-2}{8}$ is a linear equation.
Statement-2: Solution of the equation is –2.
1) Both the statements are true
2) Both the statements are false
3) Statement I is true, statement II is false
4) Statement I is false, statement II is true.

INTEGER TYPE QUESTIONS

25. If $\frac{3x-4}{4x+3}=2$, then x is $-a$. The value of a is

26. The value of x if $5x-(3x-1)=x-4$ is $-k$. The value of k is _____

27. The difference between two positive integers is 36. The quotient, when one integer is divided by the other, is 4. The unit's digit of largest integer is

MULTI CORRECT ANSWER TYPE QUESTIONS

28. The denominator of a fraction is 1 more than its numerator. If 1 is deducted from both the numerator and the denominator, the fraction becomes equivalent to 0.5. The fraction is not equal to

1) $\frac{3}{4}$ 2) $\frac{4}{5}$ 3) $\frac{2}{3}$ 4) $\frac{7}{8}$

29. Anand has three boxes of different fruits. Box A weighs $2\frac{1}{2}$ more than Box B and Box C weighs $10\frac{1}{4}kg$ more than Box B. The total weight of the boxes is $48\frac{3}{4}$. How many kg does Box A, Box B and Box C weigh?

1) 12 kg 2) 20 kg 3) $22\frac{1}{4}kg$ 4) $\frac{29}{2}kg$

LEVEL–V

COMPREHENSION TYPE QUESTIONS

PASSAGE:

Sabitha is three years older than Sandhya. Six years ago, Sabiths's age was four times Sandhya's age.

30. The age of Sandhya is

1) 7 2) 10 3) 0 4) 17

31. The age of Sabitha is

1) 7 2) 10 3) 0 4) 20

32. Sandhya's age six years ago is

1) 7 2) 0 3) 1 4) 9

MATRIX MATCH TYPE QUESTIONS

33. Find the variables

COLUMN-I	COLUMN-II
a) $7(s-4)=-3+2s$	p) 2
b) $7p+3=3(5-p)$	q) $\frac{6}{5}$
c) $5x-2(6+7x)=15$	r) -3
d) $\frac{6m+4}{4-m}=8$	s) 5

3. LINEAR EQUATIONS

	♦	INTRODUCTION AND NUMBER LINE
	♦	SOLVING LINEAR INEQUATIONS

SYNOPSIS-1

LINEAR INEQUATIONS

When we compare two quantities in day to day situations, it is more likely that the two quantities are unequal rather than equal.

A student may not write a three-hour examination paper in exactly three hours. He may finishit in less time or more time. It rarely happens as planned. Thus, inreality inequalities occur quite frequently in practical life, so it is natural to expect that their study is important in Mathematics.

INEQUALITY: Two numbers or algebraic expressions related by a symbol <, > is called an inequality.

Ex: $5 < 7$, $x<6$, $-3 <x< 7$, $5a + b> 0$.

INEQUATION: An open sentence which consists of one of the symbols >, <, $\geq$, $\leq$ is called an inequation, (or) A statement of inequality between two expressions is called an inequation.

Ex: Eachofthestatements(i)$x>3$, (ii)$6x + 4<28$, (iii)$3x \geq 8$, (iv)$5x - 1 \leq 6$ isan Inequation

Note: (i) The sign '<' denotes less than'.

(ii) The sign' >' denotes' greater than'.

(iii) The sign'$\leq$' denotes ' less than or equal to'.

(iv) The sign'$\geq$' denotes ' greater than or equal to'.

(v) Inequality is a true statement having the signs' <' or' >'

(vi) Inequation is an open sentence having the signs $\neq, <, \leq, >, \geq$.

LINEAR INEQUATION:

An inequation involving one variable with highest power one is called linear inequation.

Ex: (i) $5x - 6 \leq 12 - 4x$ (ii) $3x + 14 \geq x + 20$

Note: A linear inequation in one unknown variable is written as $ax + b < 0$ or $ax + b \leq 0$ or $ax + b > 0$ or $ax + b \geq 0$, where a, b are rational numbers and $a \neq 0$

REPLACEMENT SET: The set from which the values of the variable x are replaced in an inequation is called replacement set or domain of the variable or universal set.

Ex: Consider the inequation$x < 3$ and let the replacement set is N. Then we can replace x only by some members of N.

Clearly some values of x from N will satisfy the inequation x < 3 while some other values of x from N will not satisfy it.

SOLUTION SET: Solution set is the subset of the replacement set, consisting of those values of variable which satisfy the given inequation.

Ex: (i) x < 4, where replacement set is N

Solution set $=\{x \in N : x < 4\} = \{1,2,3\}$

(ii) $x > -2$, where replacement set is A= {-2, -1,0,1,2,3}

Solution set $=\{x \in A; x > -2\} = \{-1,0,1,2,3\}$.

Note: i) Every solution set is a subset of replacement set.

ii) The solution set is also called as the truth set.

iii) Root or solution of an inequation is the number which replaces the variable thatmakes it true.

iv) Aninequation can have one root or more than or none.

v) The solution may be finite or infinite depending on the replacement set.

Ex: **i)** $x + 4 > 8$, replacement set is $\{3,4,5,6,7,8,9\}$

$x + 4 > 8 \Rightarrow x > 8 - 4 \Rightarrow x > 4$

$\Rightarrow x = \{5,6,7,8,9\}$

It is finite set.

ii) $x + 4 > 8$, replacement set is integer set

$x + 4 > 8 \Rightarrow x > 8 - 4 \Rightarrow x > 4$

$\Rightarrow x = \{5,6,7,8,9,10,....\}$

It is infinite set.

INTERVALS: The set of all rational numbers between any two given rational numbers a and b called an interval.

Let a and b are two rational numbers with a < b, then the interval can be written as (a, b) or [a, b]. 'a' is sometimes called the left-hand end point and 'b'is right hand end point of the interval.

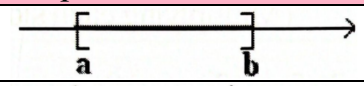
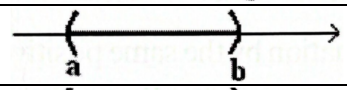
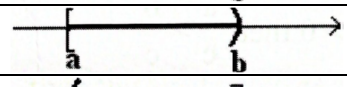
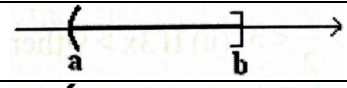
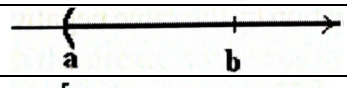
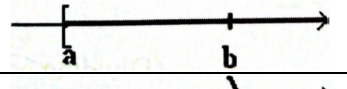
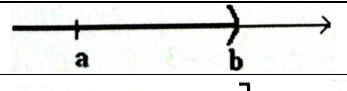
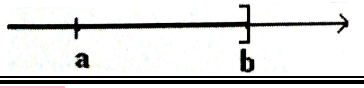
Note: In the interval (a, b),

i) The numbers a, b are known as the end points of the interval.

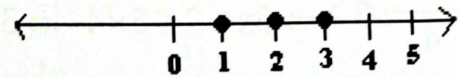
ii) The difference b-a is called the length of the interval.

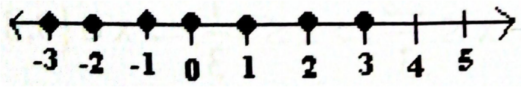
iii) The interval of numbers between a and b, including a and b, is often denoted as [a, b].

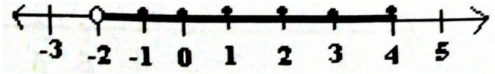
iv) The interval of numbers between a and b, excluding a and b, is often denoted as (a, b).

Inequality	Graph	Interval Notation
$a \le x \le b$		$[a,b]$
$a < x < b$		(a,b)
$a \le x < b$		$[a,b)$
$a < x \le b$		$(a,b]$
$x > a$		$(a,,\infty)$
$x \ge a$		$[a,\infty)$
$x < b$		$(-\infty,b)$
$x \le b$		$(-\infty,b]$

INEQUATIONS ON NUMBER LINE: The solution set of an inequation can be represented on the number line.

a) $x = \{1,2,3\}$ 

b) $x < 4, x \in Z$ 

c) $-2 < x \le 4, x \in Z$ 

Here -2 is represented by a hollow circle as it is not a solution.

SYNOPSIS-2

PROPERTIES OF INEQUATIONS:

1) Adding the same number to each side of an inequation does not change the inequality,
i.e., If a < b then a+c<b+c.

Ex: i) Ifx+2>5thenx+2+3 >5+3. ii) If $x \ge 5$ then $x+2 \ge 5+2 \Rightarrow x+2 \ge 7$

2) Subtracting the same number from each side of an inequation does not change the inequality
i.e., If a < b then a - c < b - c.

Ex: i) If x+2 > 5 then x+2-3 > 5-3. ii) If y < 6 then y-l< 6-1 $\Rightarrow$ y-l< 5

3) Multiplying each side of an inequation by the same positive number does not change the inequality,
i.e., If a > b and c> 0 then ac >bc.

Ex: i) Ifx>5 then $x \times 3 > 5 \times 3$ ii)If $x \ge 5$ then $3x \ge 3 \times 5 \Rightarrow 3x \ge 15$

4) Multiplying each side of an inequation by the same negative number reverses the inequality i.e., If a > b and c < 0 then ac <bc

Ex: i) If-x < 5 then x > -5. (Multiplying each side by -1)

ii) If x > 5 then $-2\times x<-2\times 5\Rightarrow -2x<-10$

5) Dividing each side of an inequation by the same positive number does not change theinequality. i.e., If a > b and c> 0 then $\frac{a}{b}>\frac{b}{c}$

Ex: (i) If y < 6 then $\frac{y}{2}<\frac{6}{2}\Rightarrow \frac{y}{2}<3$ (ii) If 3x > 9 then x > 3 (Dividing each side by 3)

6) Dividing each side of an inequation by the same negative number reverses the inequality

i.e., If $a>b$ and $c<0$ then $\frac{a}{c}<\frac{b}{c}$

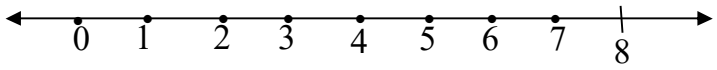
Ex: i) If-3x > -9 then x < 3 (Dividing each side by-3)

ii) If y < 6 then $\frac{y}{-2}>\frac{6}{-2}\Rightarrow -\frac{y}{2}>-3\Rightarrow -y>-6\Rightarrow y<6$

Ex: Solve: $\frac{3x-2}{4}\le 5, x\in W$. Show the solution on the number line.

Sol: $\frac{3x-2}{4}\le 5\Rightarrow 3x-2\le 5\times 4\Rightarrow 3x\le 20+2$

$\Rightarrow x\le \frac{22}{3}\Rightarrow x\le 7\frac{1}{3}\Rightarrow x\in\{0,1,2,3,4,5,6,7\}$



TYPES OF INEQUATIONS: Basically, there are two types of inequations.

i) Absoluteinequations ii) Conditional inequations

ABSOLUTE INEQUATIONS:

Let us observe an inequation $x^2>0$

Now, let's substitute some values for 'x';

$x=-1\Rightarrow (-1)^2>0\Rightarrow 1>0(True)$

$x=-2\Rightarrow (-2)^2>0\Rightarrow 4>0(True)$

$x=5\Rightarrow (5)^2>0\Rightarrow 25>0(True)$

$\therefore$The above inequation is true for all values of 'x'Such an inequation is called absolute inequation.

An inequation which is true for all values of variable is known as absolute inequation.

Ex: a)$x^4>0$ b)$y^6>0$ **c**)$a^2>0$

i.e., Any variable raised to an even power greater than zero.

CONDITIONAL INEQUATIONS:

Let us observe an inequation $x + 5 > 6$

Now, let's substitute some values for 'x';

$x=-1\Rightarrow -1+5>6\Rightarrow 4>6(False)$

$x=1\Rightarrow 1+5>6\Rightarrow 6>6(False)$

$x=2\Rightarrow 2+5>6\Rightarrow 7>6(True)$

$\therefore$The above inequation is not true for all values of 'x'It is true for some limited values of x,

i.e., $x\geq 2$. Such an inequation is called conditional inequation.

An inequation which is not true for all values of variable is known as conditional inequation

Ex: **a**)$x + 9>20$

Subtracting 9 on both sides

$\Rightarrow x+9-9>20-9\Rightarrow x>11$

It is true for $x > 11$

b) $2x-10<90$

Adding 10 on both sides

$\Rightarrow 2x-10+10<90+10\Rightarrow 2x<100$

Dividing 2 on both sides$\Rightarrow \frac{2x}{2}<\frac{100}{2}\Rightarrow x<50$

It is true for$x<50$

Ex: Solve the inequality: $5x-8<\frac{x+4}{3}$

Sol: $5x-8<\frac{x+4}{3}$

Multiply with 3 on both sides

$\Rightarrow 3\times(5x-8)<\frac{3\times(x+4)}{3}\Rightarrow 15x-24<x+4\Rightarrow 15x-x<4+24$

$\Rightarrow 14x<28\Rightarrow x<2$

GRAPHICAL REPRESENTATION OF THE SOLUTION SET OF AN INEQUATION:

The solution set of an inequation can be represented on the number line.

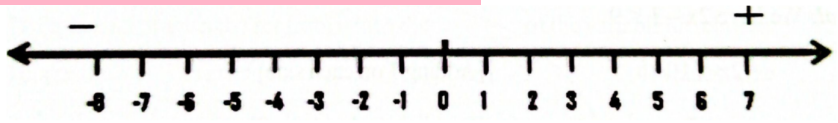
A number line is used to represent the solution set of an inequation graphically.

1. first solve the linear inequation and find the solution set.

2. Mark it on the number line by putting a dot.

3. In case the solution set is infinite, then put three more dots to indicate infiniteness.

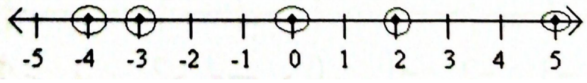
GRAPHING INEQUALITIES ON A NUMBER LINE



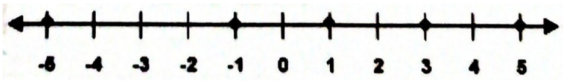
Recall that a number line is a horizontal line that has points which correspond to numbers. The points are spaced according to the value of the number they correspond to; in a number linecontaining only whole numbers or integers, the points are equally spaced.

Ex: Graph the members of each set on a number line.

$A = \{-4, -3, 0, 2, 5\}$



$B = \{-5, -1, 1, 3, 5\}$;



Ex: **i)** Solve the inequation $3x - 5 < 4, x \in N$ and represent the solution set graphically.

Sol: We have $3x - 5 < 4$

$3x - 5 + 5 < 4 + 5$ (Add 5 to both sides)

$3x < 9$

$\frac{3x}{3} < \frac{9}{3}$ (Divide on both sides by 3)

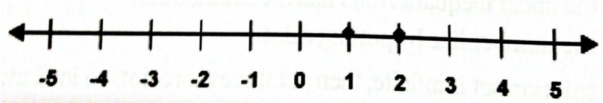
$x < 3$

So, the replacement set = {1,2,3,4,5,...}

Therefore, the solution set is { 1,2 } or S = {x: x ∈N, x < 3 }

Let us mark the solution set graphically.

Solution set is marked on the number line by black thick dots.



Ex: **ii)** Solve the inequation $2x - 1 < 9, x \in W$ Represent the solution set graphically.

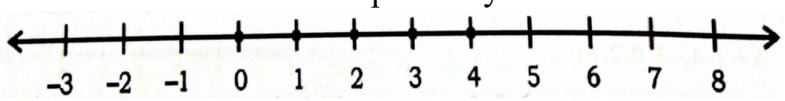
Sol: We have $2x - 1 < 9$

$\Rightarrow 2x < 10$ [Adding 1 on each side]

$\Rightarrow x < 5$ [Dividing each side by 2]

Solution Set = $\{x \in W : x < 5\} = \{0, 1, 2, 3, 4\}$

On the number line we mark these points by dark dots.



3. LINEAR INEQUATIONS

WORK SHEET LEVEL–I MAINS CORNER

SINGLE CORRECT ANSWER TYPE QUESTIONS

INTRODUCTION AND NUMBER LINE

1. A statement of inequality between two expressions is called ____
   1) aninequation 2) an equation 3) solution 4) None
2. An inequality uses one of the following symbols:

Symbol	Meaning
a) <	p) is greater than
b) >	q) is less than
c) ≤	r) is greater than or equal to
d) ≥	s) is less than or equal to

   1) a-p; b-q; c-r; d-s 2) a-q; b-p; c-s; d-r 3) a-s; b-r; c-q; d-p 4) a-r; b-q; c-p; d-s
3. An inequation involving in one variable with highest power _____ is called linear inequation.
   1) two 2) three 3) four 4) one
4. A _____ is of the form ax + b < 0 or $ax+b\le 0$ or ax + b > 0 or $ax+b\ge 0$, where a, b are rational numbers and $a\neq 0$
   1) linearinequation 2) linear equation
   3) Quadratic inequation 4) None

SOLVING LINEAR INEQUATIONS

5. Set of all rational numbers between any two given rational numbers a and b is called an interval.
   1) true 2) false 3) can't say 4) doubt full
6. In the interval (a,b) the numbers a, b are known as the _____of the interval. The difference _____ is called the length of the interval.
   1) middle points, a-b 2) end points, b-a
   3) Both (1) & (2) 4) neither (1) nor (2)
7. In the interval (a,b) the interval of numbers between a and b, including a and b, is often denoted as _____. Excluding a and b, is often denoted as ____.
   1) [a,b], (a,b) 2) (a,b), [a,b] 3) Both (1) & (2) 4) Neither (1) nor (2)
8. The set from which the values of the variable x are replaced in an inequation is called_____.
   1) replacement set 2) domain of the variable
   3) universal set 4) All of these
9. Solution set is the ____ of the replacement set, consisting of those values of variable which satisfy the given inequation.
   1) super set 2) equal 3) subset 4) None

10. The solution to an inequation is selected from _____.
1) subset 2) replacement set 3) solution set 4) placement set

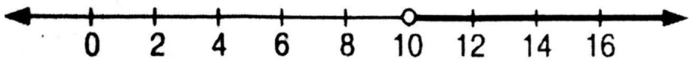
11. When each term of an inequation is multiplied or divided by the same negative number then the inequality _____ direction.
1) changes 2) in same 3) upward 4) downward

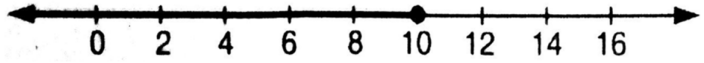
LEVEL–II

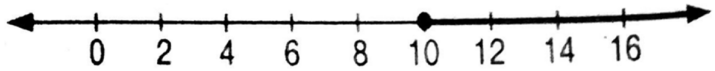
INTRODUCTION AND NUMBER LINE

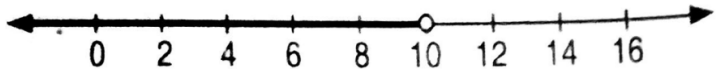
12. Water freezes at 0^0C and boils at 100^0C. Write an inequality to show the range of temperature (t) for which water is a liquid.
1) $t < 0^0 C$ 2) $0^0 C \le t \le 100^0 C$ 3) $t > 100^0 C$ 4) $0^0 C < t < 100^0 C$

13. The number line matching the statement "It was so cold in Shimla in the month of January,then the temperature never reached 10^0C" is:

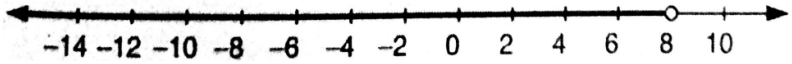
1) 

2) 

3) 

4) 

14. Which inequality has the following number line solution:



1) $2x-4<16$ 2) $2x-6<10$ 3) $2x-6>12$ 4) $2x-4>16$

SOLVING LINEAR INEQUATIONS

15. In $3x - 2 < 10$ solution is :
1) $x > 4$ 2) $x < 4$ 3) $x > 4$ 4) $x < 4$

16. Solution of $-2x < -6$ is :
1) $x < 3$ 2) $x > 3$ 3) $x \not> 3$ (or) $x \le 3$ 4) 3

17. Solution of $-3x > -9$ is
1) $x > 3$ 2) $x < 3$ 3) $x = 3$ 4) $x > -3$

18. $\frac{2}{3}x > 12$; Solution of the inequation:
1) $x > 18$ 2) $x < 18$ 3) Not possible 4) $x > 8$

19. $3x < 15$, $x \in N$ the solution set is
1) {1,2,3,4,51 2) {2,3,4,5} 3) {1,2,3,4} 4) {0,1,2,3,4}

20. The solution set of $x < 4$ where replacement set is N
1) {0, 1, 2} 2) {1, 2, 3} 3) {1, 2, 3, 4} 4) {0, 1, 2, 3}

LEVEL-III ADVANCED CORNER

SINGLE CORRECT ANSWER TYPE QUESTIONS

21. The smallest integer which is not in the solution set of $\frac{1}{x-2} < 0$ is

1) 2 2) 3 3) 4 4) 5

22. The value of x from the in equation $3x + 4 < 9$ is

1) $x < \frac{5}{3}$ 2) $x > \frac{5}{3}$ 3) $x < \frac{13}{3}$ 4) $x > \frac{13}{3}$

23. The solution set of $x + 2 < 9$ over a set of positive even integers is

1) {8,10,12,…..} 2) {2,4,6} 3) {1,2,3,4,5,6} 4) {2,4,6,8}

24. The solution set of $3x - 4 < 8$ over the set of square numbers is

1) {1,2,3} 2) {1,4} 3) {1} 4) {16}

25. Solution set of $5x - 9 < 15$ where $x \in w$

1) {0,1,2,3,4} 2) {1,2,3,4,5} 3) {0,1,2,3,4,5} 4) {2,3,4,5}

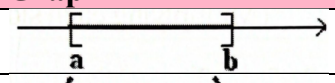
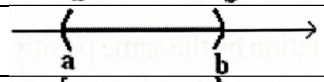
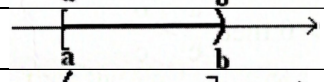
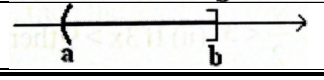
LEVEL–IV

STATEMENT TYPE QUESTIONS

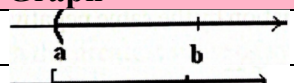
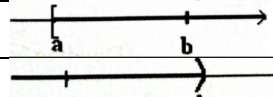
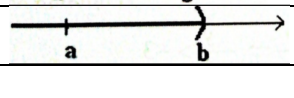
26. Statement I: Adding the same number to each side of an inequation does not change the inequality,
Statement II: Subtracting the same number from each side of an inequation does not change the inequality

1) Both the statements are true
2) Both the statements are false
3) Statement I is true, statement II is false
4) Statement I is false, statement II is true.

27. Statement I:

Inequality	Graph	Interval Notation
$a \le x \le b$		$[a,b]$
$a < x < b$		(a,b)
$a \le x < b$		$[a,b)$
$a < x \le b$		$(a,b]$

Statement II:

Inequality	Graph	Interval Notation
$x > a$		$(a,,\infty)$
$x \ge a$		$[a,\infty)$
$x < b$		$(-\infty,b)$

$x \le b$		$(-\infty, b]$

1) Both the statements are true
2) Both the statements are false
3) Statement I is true, statement II is false
4) Statement I is false, statement II is true.

INTEGER TYPE QUESTIONS

28. If $5 < x < 7$ and $2 < y < 6$, then the least value of $x - y$ is
29. If $2<x<4$ and $1<y<3$, then the least value of $x \times y$ is

MULTI CORRECT ANSWER TYPE QUESTIONS

30. If $a > 0, b > 0, x > 0$ and $a > b$ then which of the following are true.

1) $\frac{1}{a} < \frac{1}{b}$ 2) $\frac{a+x}{b+x} < \frac{a}{b}$ 3) $\frac{b^2}{a^2} < \frac{b}{a}$ 4) $ax < bx$

31. Integral value of x satisfying both $2x + 3 > 7$ and $x + 4 < 10$ is

1) 4 2) 6 3) 5 4) 10

LEVEL–V

COMPREHENSION TYPE QUESTIONS

PASSAGE:

Given $-2 \le x \le 2$

32. First inequation is

1) $x > 2$ 2) $x \ge 2$ 3) $x \le -2$ 4) $x \ge -2$

33. Second inequation is

1) $x \le -2$ 2) $x \le 2$ 3) $x > -2$ 4) $x < -2$

34. Solution set of the given inequation if $x \in z$

1) {-2, -1, 0, 1, 2} 2) { -1, 0. 1} 3) {-2, -1, 1, 2} 4) { -2, 2}

MATRIX MATCH TYPE QUESTIONS

35.

COLUMN I	COLUMN II
a) $y + 3 < 9; y \in N$	p) $\frac{a}{c} < \frac{b}{c}$
b) $a > b$ and $c < 0$	q) {1, 2, 3, 4}
c) $a < b$ and $c > 0$	r) {1, 2, 3, 4, 5,}
d) solution set of z if $0 < z < 5; z \in w$	s) $a.c<bc$