Linear Equation

Linear equations in two variables is an equation of form ax + by + c = 0, where x and y are two variables and a, b, and c are real numbers and a and b are non-zero. It comes under the section of Linear Algebra in various government competitive examinations as well as in various entrance exams. To solve linear equations in two variables, one must have strong basic knowledge of the mathematical concepts and methods involved.

What are Linear Equations in Two Variables?

Linear equations in two variables is an equation of the form ax + by + c = 0, where x and y are the two variables and a, b, and c are real numbers and a and b are non-zero.

It is popularly known as simultaneous linear equation. Linear equations in two variables are usually used in geometry to find the coordinates of a straight line.

Example: x+y–3=0 is a linear equation in two variables x and y.

Solution of Linear Equations in Two Variables

x and y are a solution of the linear equation ax+by+c=0 if and only if a+b+c=0, where and are real numbers. Every linear equation in two variables has an unlimited number of solutions.

Example: Consider the equation x+y–3=0

When x = 0, y = 3
When x = 1, y = 2
When x = 2, y = 1
When x = 3, y = 0
When x = 7, y = -4 etc are all solutions of the linear equation

Nature of Solution of Linear Equations in Two Variables

A system of linear equations in two variables can have one solution or no solution or infinitely many solutions.

A system of linear equations is consistent if it has a solution, meaning that there is at least one set of values that satisfies all the equations. On the other hand, an inconsistent system does not have a solution, indicating that no set of values can satisfy all the equations simultaneously.

Similarly, a system of linear equations is considered independent if it has a unique solution, meaning that the values of the variables can be determined uniquely. In contrast, a dependent system has an infinite number of solutions.

Unique Solution of Linear Equations in Two Variables

A system of linear equations in two variables has a unique solution if and only if the equations represent two non-parallel lines that intersect at exactly one point. In other words, the lines must have different slopes, indicating that they are not parallel, and they must intersect at one point only.

Therefore, if m1 and m2 are the slopes of the equations of the two lines, then m1 should not be equal to m2 in order for the equations to have a unique solution, that is, $m1 \neq m2$.

The unique solution can be found by solving the equations simultaneously using various methods, including substitution, elimination, or matrices. It is important to note that a system of linear equations may have zero solutions or infinitely many solutions if the lines are parallel or coincide with each other.

No Solution of Linear Equations in Two Variables

A system of linear equations in two variables has no solution if and only if the equations represent two parallel lines that do not intersect. In other words, the lines must have the same slope, indicating that they are parallel, and they do not intersect.

This can be represented mathematically as m1=m2, where m_1 and m_2 are the slopes of the lines.

When a system of linear equations has no solution, it means that there is no value for each variable that satisfies both equations simultaneously. This situation is often called an inconsistent system, and it arises when the lines represented by the equations do not cross each other.

Infinite Solutions of Linear Equations in Two Variables

It is important to note that a system of linear equations may have infinitely many solutions if the equations represent the same line or coincident lines. In such a case on of the linear equation is a scalar multiple of the other equation, like in the case of $x + y = 2$ and $2x + 2y = 4$.

How to Solve Linear Equations in Two Variables

The various methods to solve linear equations in two variables are given below:

1. Substitution Method
2. Elimination Method
3. Cross-multiplication method
4. Graphical Method
5. Determinant Method

Substitution Method to Solve Linear Equations in Two Variables

Procedure of Substitution Method to Solve Linear Equations in Two Variables is as follows:

Step 1. Solve one of the given equations to get the value of one of the variables in terms of the other, whichever is convenient.

Step 2. Substitute the value of the variable so obtained in the other equation.

Step 3. Solve the resulting single variable equation. Now substitute this value into either of the two original equations and solve it to find the value of the second variable.

Some Examples

Example . Solve the following system of linear equations:

$4x-3y=8$
$x-2y=-3$

Solution: The given equations are

$4x-3y=8$ …….(i)

$x-2y=-3$ …….(ii)

We can solve either equation for either variable. But to avoid fractions, we solve the second equation for x,

$x=2y-3$ …….(iii)

Substituting this value of x in equation (i), we get

$4(2y-3)-3y=8$

$8y-12-3y=8$

$5y=20$

$y=4.$

Substituting this value of y in (ii), we get

$x-24=-3$

$x-8=-3$

$x=5.$

Hence, the solution is x = 5, y = 4.

Example . Twice one number minus three times a second is equal to 2, and the sum of these numbers is 11. Find the numbers.

Solution: let the two numbers be x & y.

According to the problem,
2x-3y=2 …….(i)
x+y=11 …….(ii)

Multiplying both sides of (ii) by 3, we get

3x+3y=33 …….(iii)

On adding (i) and (iii), we get

5x=35
x=7

Substituting this value of x in (ii), we get

7+y=11
y=4.

Hence, the required numbers are 7 and 4.

Example . Sohail buys postage stamps of 25 paise and 50 paise for Rs10. He buys 28 stamps in all. Find the total number of 25 paise stamps bought by him.

Solution: Let the number of 25 paise stamps be x and the number of 50 paise stamps be y.

According to the problem,
x+y=28 …….(i)
25x+50y=1000 [since, Rs10 = 1000 paise] i.e., x+2y=40 …….(ii)

Subtracting (i) from (ii), we get, y=12.

Substituting this value of y in (i), we get
x+12=28
x=16.

Hence, the total number of 25 paise stamps =16.

EXERCISE

1. Which of the following is not a linear equation in one variable?

A. $33z+5 = 0$

B. $33(x+y) = 0$

C. $33x+5 = 0$

D. $33y+5 = 0$

2. The solution of $2x-3=7$ is:

A. 5

B. 7

C. 12

D. 11

3. The solution of $2y + 9 = 4$ is:

A. 9/2

B. 4/9

C. -2/3

D. -5/2

4. The solution of $y/5 = 10$ is:

A. 15

B. 10

C. 50

D. 5

5. What should be added to -7/3 to get 3/7?

A. 21/58

B. 58/21

C. 47/21

D. 50/21

Answer Key

1. B

2. A

3. D

4. C

5. B

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