

LINEAR EQUATION

An equation in which the highest power of the unknown variable is one, is a linear equation.

SOME PROPERTIES OF EQUALITY**1. Reflexive Property**

Every number is equal to itself.

Example : $5 = 5$, $2 = 2$ and So on.

2. Symmetric Property

For any two number, if the first number is equal to the second, then the second number is equal to the first.

If x & y are two numbers and $x = y$, then $y = x$.

Example : $3 + 4 = 5 + 2$

$$\Rightarrow 5 + 2 = 3 + 4$$

3. Transitive Property

If x , y & z are three numbers such that $x = y$ & $y = z$, then $x = z$.

Example : $9 + 3 = 12$, $12 = 3 \times 4$

$$\therefore 9 + 3 = 3 \times 4.$$

4. If x , y & z are three numbers such that $x = y$ & $x = z$, then $y = z$.

Example : $24 = 8 \times 3$, $24 = 14 + 10$

$$\Rightarrow 8 \times 3 = 14 + 10$$

SIMULTANEOUS LINEAR EQUATIONS

To solve the equation involving two unknown, we require two equations.

Solving two Simultaneous Equations

When two equations, each in two variables, are given, they can be solved in four ways.

(a) Elimination by cancellation

Ex. If $2x + 3y = 10$ and $x + 2y = 5$, then find the values of x & y ?

Sol. Using this method, the two equations are reduced to a single variable equation by eliminating one of the variables.

Step.1 : Here, we eliminate the Y term and for this, we multiply the first equation with the co-efficient of y in the second equation and multiply the second equation with the coefficient of y in the first equation so that the coefficient of y terms in both the equations becomes equal.

$$(2x + 3y = 10) \times 2 \Rightarrow 4x + 6y = 20 \quad (3)$$

$$(x + 2y = 5) \times 3 \Rightarrow 3x + 6y = 15 \quad (4)$$

Step.2 : Subtract equation (3) from equation (4)

$$3x + 6y = 15$$

$$4x + 6y = 20$$

$$\begin{array}{r} - \\ - \\ \hline \end{array}$$

$$\begin{array}{r} -x \quad \quad = -5 \quad \quad \Rightarrow x = 5 \end{array}$$

Step.3 : Substitute the value of x in equation (1) or equation (2) to find the value of Y. Here, substituting the value of x in the equation (1)

We have -

$$2(5) + 3y = 10$$

$$3y = 10 - 10$$

$$y = \frac{10}{3} = 0$$

\therefore The solution of the given pair of equations is $x = 5, y = 0$.

(b) Elimination of substitution

Ex. If $5x - 2y = 17$ & $3x + y = 8$, then find the value of $x + y$.

Sol. Using this method, the two equations are reduced to a single variable equation by substituting the value of one variable obtained from one equation, in the other equation.

Step.1 : Using the first equation, find x in terms of y.

$$\text{i.e. } 5x - 2y = 17 \quad \Rightarrow \quad 5x = 17 + 2y$$

$$\Rightarrow \quad x = \frac{17 + 2y}{5}$$

Step.2 : Substitute the value of x in the equation (2) to find the value of y.

$$\text{i.e. } 3x + y = 8$$

$$\Rightarrow \quad \frac{3(17 + 2y)}{5} + y = 8$$

Step.3 : Simplify the equation in terms of y & find the value of y.

$$3(17 + 2y) + 5y = 8 \times 5$$

$$\Rightarrow \quad 51 + 6y + 5y = 40$$

$$\Rightarrow \quad 11y = 40 - 51$$

$$\Rightarrow \quad 11y = -11$$

$$\Rightarrow \quad y = -1$$

Step.4 : Substituting the value of y obtained in step (3) in equation (1) or (2), we get $x = 3$.

\therefore the solution for the given pair of equation is $x = 3$ & $y = -1$.

(c) Adding two equations and subtracting one equation from the other.

Ex. $4x + 3y = 11$ & $3x + 4y = 10$

Sol. Adding both equations, we get,

Step.1 : $7x + 7y = 21$

$$\Rightarrow 7(x + y) = 7 \times 3$$

$$\Rightarrow x + y = 3 \quad \dots (3)$$

Step.2 : Subtracting the equation (2) from the equation (1).

$$(4x + 3y) - (3x + 4y) = 11 - 10$$

$$\Rightarrow x - y = 1 \quad \dots (4)$$

Step.3 : Adding the equations (3) & (4), we get.

$$(x + y) + (x - y) = 3 + 1$$

$$2x = 4 \Rightarrow x = 2$$

$$2 + y = 3 \quad [\text{from (3)}]$$

$$y = 1$$

Substituting $y = 1$, in any of the equations (1), (2), (3) or (4).

We get $x = 2$.

The solution of the pair of equations is $x = 2$, $y = 1$.

(A) QUESTIONS

Solve the following linear equations by using the method of Elimination.

1. $3x + 2y = 11$

$$2x + 3y = 4$$

2. $8x + 5y = 9$

$$3x + 2y = 4$$

3. $\frac{x}{10} + \frac{y}{5} + 1 = 15$

$$\frac{x}{8} + \frac{y}{6} = 15$$

4. $11x + 15y + 23 = 0$

$$7x - 2y - 20 = 0$$

(B) Solve the following equations by using the method of substitution :-

5. $2x + 3y = 9$

$$3x + 4y = 5$$

6. $\frac{2x}{a} + \frac{y}{b} = 2$

$$\frac{x}{a} - \frac{y}{b} = 4$$

7. $7(y + 3) - 2(x + 2) = 14$

$$4(y - 2) + 3(x - 3) = 2$$

8. Sum of two numbers is 35 and their difference is 13. Find the numbers. (By Adding & Subtracting Rule)

9. In a two digit number, the unit's digit is twice the ten's digit. If 27 is added to the number, the digits interchange their places. Find the number. (By any method, out of 3 method)