SHIKSHA NATION

# Linear Equations in two Variables

**Linear Equations in Two Variables:**

An equation of the form Ax + By + C = 0 is called a linear equation.

Where A is called coefficient of x, B is called coefficient of y and C is the constant term (free form x & y) A, B, C, $\in$ R [$\in \rightarrow$ belongs, to R $\rightarrow$ Real No.]

But A and B ca not be simultaneously zero.

If A $\neq$ 0, B = 0 equation will be of the form Ax + C = 0. [Line || to Y-axis]

If A = 0, B $\neq$ 0, equation will be of the form By + C = 0. [Line || to X-axis]

If A $\neq$ 0, B $\neq$ 0, C = 0 equation will be of the form Ax + By = 0. [Line passing through origin]

If A $\neq$ 0, B $\neq$ C, C $\neq$ 0 equation will be of the form A x + By + C = 0.

It is called a linear equation in two variable because the two unknown (x & y) occurs only in the first power, and the product of two unknown equalities does not occur.

Since it involves two variable therefore a single equation will have infinite set of solution i.e. indeterminate solution. So we require a pair of equation i.e. simultaneous equations.

**Standard form of linear equation :** (Standard form refers to all positive coefficient)

$a_1x + b_1y + c_1 = 0$ ....(i)

$a_2x + b_2y + c_2 = 0$ ....(ii)

For solving such equations we have three methods.

(i) Elimination by substitution

(ii) Elimination by equating the coefficients

(iii) Elimination by cross multiplication.



**Elimination By Substitution :**

**Example:** Solve x + 4y = 14 .....(i)

7x - 3y = 5 ....(ii)

**Sol.** From equation (i) x = 14 - 4y ....(iii)

Substitute the value of x in equation (ii)

$\Rightarrow$ 7 (14 - 4y) - 3y = 5

$\Rightarrow$ 98 - 28y - 3y = 5

$\Rightarrow$ 98 - 31y = 5

$\Rightarrow$ 93 = 31y

$\Rightarrow \quad y = \frac{93}{31} \Rightarrow y = 3$

Now substitute value of y in equation (iii)

$\Rightarrow \quad 7x - 3\,(3) = 5$

$\Rightarrow \quad 7x - 3\,(3) = 5$

$\Rightarrow \quad 7x = 14$

$\Rightarrow \quad x = \frac{14}{7} = 2$

So, solution is x = 2 and y = 3

**Elimination by Equating the Coefficients:**

**Example:** Solve $9x - 4y = 8$ .....(i)

$13x + 7y = 101$ ....(ii)

**Sol.** Multiply equation (i) by 7 and equation (ii) by 4, we get

Add $63x - 28y = 56$

$52x + 28y = 404$

$115x = 460$

$\Rightarrow \quad x = \frac{460}{115} \Rightarrow x = 4$ .

Substitute x = 4 in equation (i)

$9\,(4) - 4y = 8 \quad \Rightarrow \quad 36 - 8 = 4y \quad \Rightarrow \quad 28 = 4y \Rightarrow \quad y = \frac{28}{4} = 7$

So, solution is x = 4 and y = 7.



**Elimination by Cross Multiplication:**

$a_1x + b_1y + c_1 = 0$

$a_2x + b_2y + c_2 = 0 \qquad \left[\because \frac{a_1}{a_2} \neq \frac{b_1}{b_2}\right]$

$\begin{matrix} b_1 & & c_1 \\ & \times & \\ b_2 & & c_2 \end{matrix} \qquad \begin{matrix} a_1 & & b_1 \\ & \times & \\ a_2 & & b_2 \end{matrix}$ [Write the coefficient in this manner]

$$\frac{x}{b_1c_2 - b_2c_1} = \frac{y}{a_2c_1 - a_1c_2} = \frac{1}{a_1b_2 - a_2b_1} \Rightarrow \therefore \frac{x}{b_1c_2 - b_2c_1} = \frac{1}{a_1b_2 - a_2b_1}$$

$$\Rightarrow \quad x = \frac{b_1c_2 - b_2c_1}{a_1b_2 - a_2b_1}$$

Also, $\dfrac{y}{a_2c_1 - a_1c_2} = \dfrac{1}{a_1b_2 - a_2b_1}$

$\therefore$ $y = \dfrac{a_2c_1 - a_1c_2}{a_1b_2 - a_2b_1}$

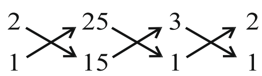
**Example:** Solve $3x + 2y + 25 = 0$ .....(i)

$x + y + 15 = 0$ ....(ii)

**Sol.** Here, $a_1 = 3\ b_1 = 2,\ c_1 = 25$

$a_2 = 1\ b_2 = 1,\ c_2 = 15$

$\therefore$




$$\frac{x}{2\times15 - 25\times1} = \frac{y}{25\times1 - 15\times3} = \frac{1}{3\times1 - 2\times1};\ \frac{x}{30-25} = \frac{y}{25-45} = \frac{1}{3-2}$$

$\dfrac{x}{5} = \dfrac{y}{-20} = \dfrac{1}{1}$ .....(i)

$\dfrac{x}{5} = 1, \dfrac{y}{-20} = \dfrac{1}{1}$

$X = 5,\ y = -20$

So, solution is $x = 5$ and $y = -20$.

**Conditions for solvability (or consistency) of system of equations:**

**(a) Unique Solution :**

Two lines $a_1 + b_1y + c_1 = 0$ and $a_2x + b_2y + c_2 = 0$, if the denominator $a_1b_2 - a_2b_1 \neq 0$ then the given system of equations have unique solution (i.e. only one solution) and solutions are said to be consistent.

$\therefore$ $a_1b_2 - a_2b_1 \neq 0 \Rightarrow \dfrac{a_1}{b_2} \neq \dfrac{b_1}{b_2}$



**(b) No Solution :**

Two lines $a_1x + b_1y + c_1 = 0$ and $a_2x + b_2y + c_2 = 0$, if the denominator $a_1b_2 - a_2b_1 = 0$ then the given system of equations have no solution and solutions are said to be consistent.

$\therefore$ $a_1b_2 - a_2b_1 \neq 0 \Rightarrow \dfrac{a_1}{a_2} \neq \dfrac{b_1}{b_2}$

**(c) Many Solution (Infinite Solutions)**

Two lines $a_1x + b_1y + c_1 = 0$ and $a_2x + b_2y + c_2 = 0$, if $\dfrac{a_1}{a_2} = \dfrac{b_1}{b_2} = \dfrac{c_1}{c_2}$ then system of equations has many solution and solutions are said to be consistent.

**Example:** Find the value of 'P' for which the given system of equations has only one solution (i.e. unique solution).

Px - y = 2 ....(i)

6x - 2y = 3 ....(ii)

**Sol.** $a_1 = P, b_1 = -1, c_1 = -2$

$a_2 = 6\ b_2 = -2, c_2 = -3$

Conditions for unique solution is $\frac{a_1}{a_2} \neq \frac{b_1}{b_2}$

$\Rightarrow \quad \frac{P}{6} \neq \frac{+1}{+2} \quad \Rightarrow \quad P \neq \frac{6}{2} \quad \Rightarrow \quad P \neq 3$

$\therefore$ P can have all real values except 3.

**Example:** Find the value of k for which the system of linear equation

kx + 4y = k - 4

16x + ky = k has infinite solution.

**Sol.** $a_1 = k, b_1 = 4, c_1 = -(k - 4)$

$a_2 = 16, b_2 = k, c_2 = -k$

Here condition is $\frac{a_1}{a_2} = \frac{b_1}{b_2} = \frac{c_1}{c_2}$

$\Rightarrow \quad \frac{k}{16} = \frac{4}{k} = \frac{(k-4)}{(k)}$

$\Rightarrow \quad \frac{k}{16} = \frac{4}{k}$ also $\frac{4}{k} = \frac{k-4}{k}$

$\Rightarrow \quad k^2 = 64 \quad \Rightarrow \quad 4k = k^2 - 4k$

$\Rightarrow \quad k = \pm 8 \quad \Rightarrow \quad k(k-8) = 0$

k = 0 or k = 8 but k = 0 is not possible other wise equation will be one variable.

$\therefore$ k = 8 is correct value for infinite solution.

**Example:** Determine the value of k so that the following linear equations has no solution.

(3x + 1) x + 3y - 2 = 0

$(k^2 + 1)$ x + (k - 2) y - 5 = 0

**Sol.** Here $a_1 = 3k + 1, b_1 = 3$ and $c_1 = -2$

$a_2 = k^2 + 1, b_2 = k - 2$ and $c_2 = -5$

For no solution, condition is $\frac{a_1}{a_2} = \frac{b_1}{b_2} \neq \frac{c_1}{c_2}$

$$\frac{3k+1}{k^2+1} = \frac{3}{k-2} \neq \frac{-2}{-5}$$

$$\Rightarrow \frac{3k+1}{k^2+1} = \frac{3}{k-2} \text{ and } \frac{3}{k-2} \neq \frac{2}{5}$$

Now, $\frac{3k+1}{k^2+1} = \frac{3}{k-2}$

$\Rightarrow$ $(3k + 1)(k - 2) = 3(k^2 + 1)$

$\Rightarrow$ $3k^2 - 5k - 2 = 3k^2 + 3$

$\Rightarrow$ $-5k - 2 = 3$

$\Rightarrow$ $-5k = 5$

$\Rightarrow$ $k = -1$

Clearly, $\frac{3}{k-2} \neq \frac{2}{5}$ for $k = -1$.

Hence, the given system of equations will have no solution for $k = -1$.

**Objective**

**1.** If $29x + 37y = 103$, $37x + 29y = 95$ then :

(A) $x = 1, y = 2$ (B) $x = 2, y = 1$ (C) $x = 2, y = 3$ (D) $x = 3, y = 2$

**2.** On solving $\frac{25}{x+y} - \frac{3}{x-y} = 1, \frac{40}{x+y} + \frac{2}{x-y} = 5$ we get :

(A) $x = 8, y = 6$ (B) $x = 4, y = 6$ (C) $x = 6, y = 4$ (D) None of these



**3.** If the system $2x + 3y - 5 = 0$, $4x + ky - 10 = 0$ has an infinite number of solutions then :

(A) $k = \frac{3}{2}$ (B) $k \neq \frac{3}{2}$ (C) $k \neq 6$ (D) $k = 6$

**4.** The equation $x + 2y = 4$ and $2x + y = 5$

(A) Are consistent and have a unique solution (B) Are consistent and have infinitely many solution

(C) are inconsistent (B) Are homogeneous linear equations

**5.** If $\frac{1}{x} - \frac{1}{y} = \frac{1}{z}$ then z will be:

(A) y - x (B) x - y (C) $\frac{y-x}{xy}$ (D) $\frac{xy}{y-x}$

SHIKSHA NATION

**6.** The equations 3x - 5y + 2 = 0, and 6x + 4 = 10 y have:

(A) No solution (B) A single solution

(C) Two solutions (D) An infinite number of solution

**7.** If p + q = 1 and the ordered pair (p, q) satisfy 3x + 2y = 1 then is also satisfies :

(A) 3x + 4y = 5 (B) 5x + 4y = 4 (C) 5x + 5y = 4 (D) None of these.

**8.** If x = y, 3x - y = 4 and x + y + x = 6 then the value of z is :

(A) 1 (B) 2 (C) 3 (D) 4

**9.** The system of linear equation ax + by = 0, cx + dy = 0 has no solution if :

(A) ad - bc > 0 (B) ad - bc < 0 (C) ad + bc = 0 (D) ad - bc = 0

**10.** The value of k for which the system kx + 3y = 7 and 2x - 5y = 3 has no solution is :

(A) $7 \ \& \ k = -\frac{3}{14}$ (B) $4 \ \& \ k = \frac{3}{14}$ (C) $\frac{6}{5} \ \& \ k \neq \frac{14}{3}$ (D) $-\frac{6}{5} \ \& \ k \neq \frac{14}{3}$

**Solve each of the following pair of simultaneous equations.**

**1.** Solve : $\frac{1}{3x} + \frac{1}{5y} = 1; \ \frac{1}{5x} + \frac{1}{3y} = 1\frac{2}{15}$

**2.** Solve
x - y + z = 6

x - 22y - 2z = 5

2x + y - 3z = 1

**3.** Solve, px + qy = r and qx = 1 + r

**4.** Find the value of k for which the given system of equations

(A) has a Unique solution. (B) becomes consistent.

(i) 3x + 5y = 12

4x - 7y = k

(ii)3x - 7y = 6

21x - 49y = 1 - 1

**5.** Find the value of k for which the following system of linear equation becomes infinitely many solution. or represent the coincident lines.

(i) $6x + 3y = k - 3$
$2k\,x + 6y = 6$

(ii) $x + 2y + 7 = 0$
$2x + ky + 14 = 0$

**6.** Find the value of k or C for which the following systems of equations be in consistent or no solution.

(i) $2\,x\,ky + k + 2 = 0$
$kx + 8y + 3k = 0$

(ii) $Cx + 3y = 3$
$12x + Cy = 6$

**7.** Solve for x and y :

$(a - b)\,x + (a + b)\,y = a^2 - 2ab - b^2$

$(a + b)\,(x + y) = a^2 + b^2$ **[CBSE - 2008]**

**8.** Solve for x and y :

$37x + 43y = 123$

$43x + 37y = 117$ **[CBSE - 2008]**

**9.** $\frac{x}{3} + \frac{y}{12} = \frac{7}{2}$ and $\frac{x}{6} - \frac{y}{8} = \frac{6}{8}$

**10.** $0.2\,x + 0.3y = 0.11 = 0,\quad 0.7x - 0.5y + 0.08 = 0$



**11.** $3\sqrt{2}x - 5\sqrt{3}y + \sqrt{5} = 0$

$2\sqrt{3}x + 7\sqrt{2}y - 2\sqrt{5} = 0$

**12.** $\frac{x}{3} + y = 1.7$ and $\frac{11}{x + \frac{y}{3}} = 10 \forall \left[x + \frac{y}{3} \neq 0\right]$

**13.** Prove that the positive square root of the reciprocal of the solutions of the equations $\frac{3}{x}+\frac{5}{y}=29$ and $\frac{7}{x}-\frac{4}{y}=5(x \neq 0,\ y \neq 0)$ satisfy both the equation $2(\sqrt{3}x+4)-3(4y-5)=5$ and $7\left(\frac{9x}{\sqrt{3}}+8\right)+5(7y-25)=64$.

**14.** For what value of a and b, the following system of equations have an infinite no. of solutions. 2x + 3y = 7; (a-b) x + (a +b) + b - 2

**15.** Solve :

(i) $\frac{7}{x^3}-\frac{6}{2^y}=15; \frac{8}{3^x}=\frac{9}{2^y}$

(ii) 119x - 381y = 643; 381x - 119y = -143

**16.** Solve: $\frac{bx}{a}-\frac{ay}{b}+a+b=0$; bx - ay + 2ab = 0

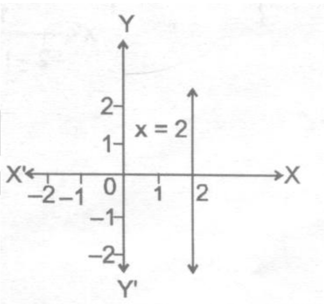
### Graphical Solution of Linear Equations In Two Variables:

**Graphs of the type (i) ax = b**

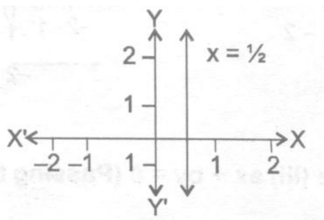
**Ex.** Draw the graph of following : (i) x = 2, (ii) 2x = 1 (iii) x + 4 = 0 (iv) x = 0

**Sol.**

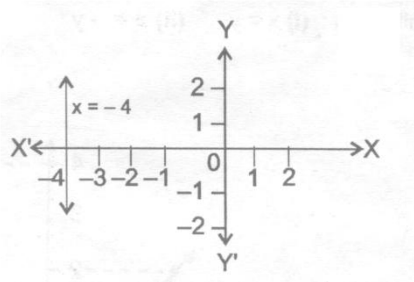
(i) x = 2



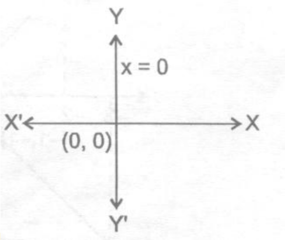

(ii) $2x = 1 \Rightarrow x = \frac{1}{2}$



(iii) $x + 4 = 0 \Rightarrow x = -4$



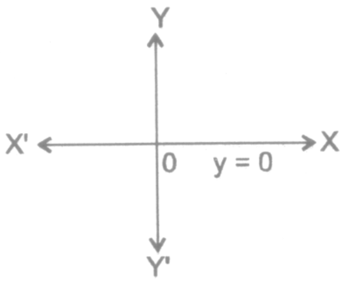

(iv) $x = 0$



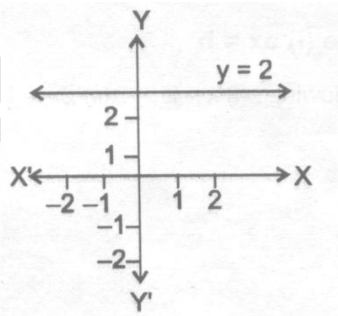

**Graphs of the type (ii) ay = b.**

**Examples:** Draw the graph of following : (i) $y = 0$, (ii) $y - 2 = 0$, (iii) $2y + 4 = 0$

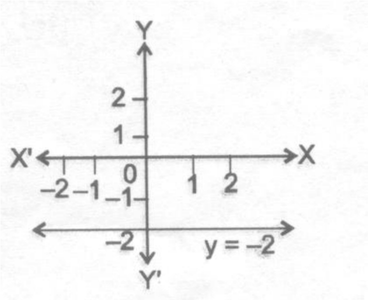
(i) $y = 0$




(ii) $y - 2 = 0$



(iii) 2y + 4 = 0 ⇒ y = - 2




### Graphs of the type (iii) ax + by = 0 (Passing through origin)

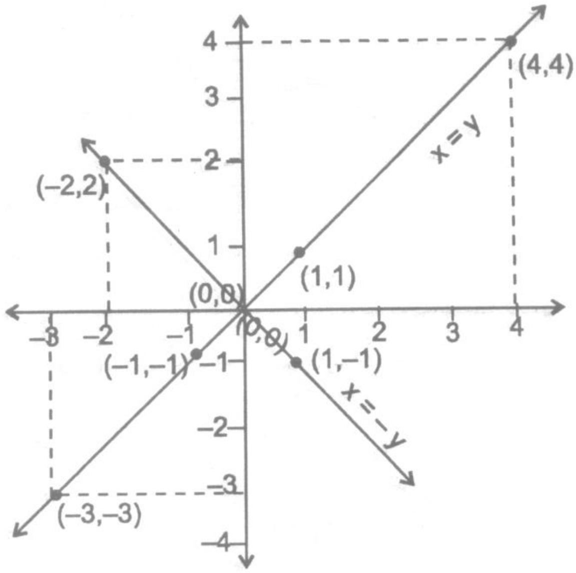
**Examples:** Draw the graph of following : (i) x = y (ii) x = -y

**Sol.** (i) x – y

| x | 1 | 4 | -3 | 0 |
|---|---|---|---|---|
| y | 1 | 4 | -3 | 0 |

(ii) x = - y

| x | 1 | -2 | 0 |
|---|---|---|---|
| y | -1 | 2 | 0 |




### Graphs of the Type (iv) ax + by + c = 0. (Making Interception x - axis, y-axis)

**Example:** Solve the following system of linear equations graphically : x - y = 1, 2x + y = 8. Shade the area bounded by these two lines and y-axis. Also, determine this area.



**Sol.** (i) x - y = 1

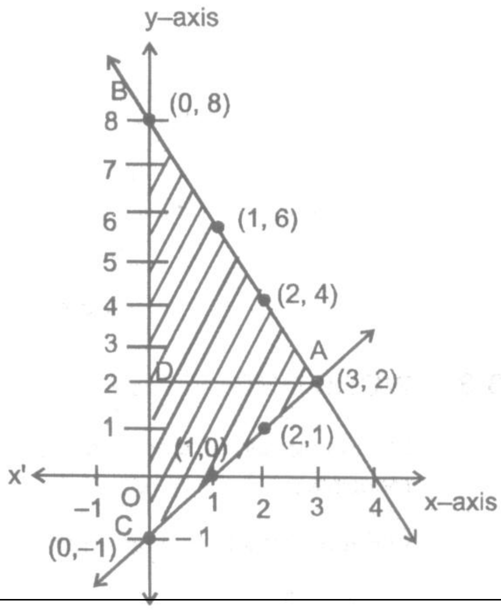
x - y + 1

| x | 0 | 1 | 2 |
|---|---|---|---|
| y | -1 | 0 | 1 |

(ii) 2x + y = 8

(ii) 2 x + y = 8

y = 8 - 2x




| X | 0 | 1 | 2 |
|---|---|---|---|

| | | | |
|---|---|---|---|
| Y | 8 | 6 | 4 |

Solution is x = 3 and y = 2

Area of is x = 3 and y = 2

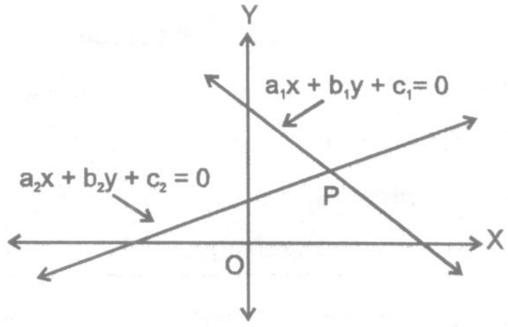
Area of $\Delta ABC = \frac{1}{2} \times BC \times AD$

$= \frac{1}{2} \times 9 \times 3 = 13.5$ Sq. unit.

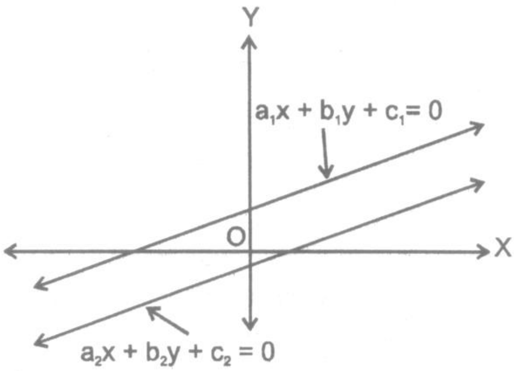
## NATURE OF GRAPHICAL SOLUTION :

Let equations of two lines are $a_1x + b_1y + c_1 = 0$ and $a_2x + b_2y + c_2 = 0$.

(i) Lines are consistent (**unique solution)** i.e. they meet at one point condition is $\frac{a_1}{a_2} \neq \frac{b_1}{b_2}$



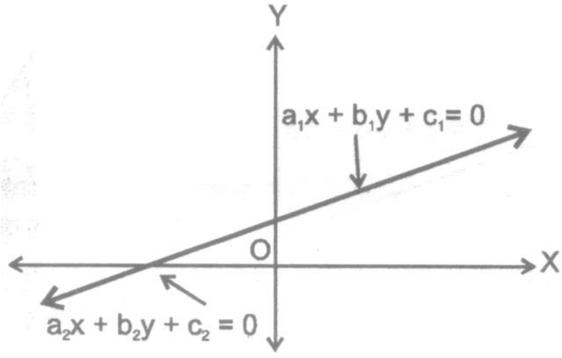

(ii) Lines are inconsistent **(no solution)** i.e. they do not meet at one point condition is $\frac{a_1}{a_2} = \frac{b_1}{b_2} \neq \frac{c_1}{c_2}$






(iii) Lines are coincident **(infinite solution)** i.e. overlapping lines (or they are on one another) condition is

$$\frac{a_1}{a_2} = \frac{b_1}{b_2} = \frac{c_1}{c_2}$$




**Word Probles:**

For solving daily - life problems with the help of simultaneous linear equation in two variables or equations reducible to them proceed as :-

(i) Represent the unknown quantities by same variable x and y, which are to be determined.

(ii) Find the conditions given in the problem and translate the verbal conditions into a pair of simultaneous linear equation.

(iii) Solve these equations & obtain the required quantities with appropriate units.

**Type of Problems:**

(i) Determining two numbers when the relation between them is given,

(ii) Problems regarding fractions, digits of a number ages of persons.

(iii) Problems regarding current of a river, regarding time & distance.

(iv) Problems regarding menstruation and geometry.

(v) Problems regarding time & work

(vi) Problems regarding mixtures, cots of articles, porting & loss, discount et.



**Examples:** Find two numbers such that the sum of twice the first and thrice the second is 89 and four times the first exceeds five times the second by 13.

**Sol.** Let the two numbers be x and y.

Then, equation formed are $2x + 3y = 89$ ....(i)

$4x - 5y = 13$ ...(ii)

On solving eq. (i) & (ii) we get

$x = 22$

$y = 15$

Hence required numbers are 22 & 15.

**Examples:** The numerator of a fraction is 4 less than the denominator If the numerator is decreased and the denominator is increased by 1, then the denominator is eight time the numerator, find the reaction.

**Sol.** Let the numerator and denominator of a fraction be x and y

Then, equation formed are $y - x = 4$ ....(i)

$y + 1 = 8(x - 2)$ ....(ii)

On solving eq. (i) & (ii) we get

$x = 3$

and $y = 7$

Hence, fractions is $\frac{3}{7}$.

**Examples:** A number consists of two digits, the sum of the digits being 12. If 18 is subtracted from the number, the digits are reversed. Find the number

**Sol.** Let the two digits number be 1y + x

Then, equations formed are

$10y + x - 18 = 10x + y \Rightarrow y - x = 2$ ......(i)

and $x + y = 12$ ......(ii)

On solving eq. (i) & (ii) we get

$x = 5$

and $y = 7$

Hence number is 75.



**Examples:** The sum of a two - digit number and the number obtained by reversing the order of its digits is 165. If the digits differ by 3, find the number

**Sol.** Let unit digit be x ten's digit be y no. will be 10y + x.

Acc. to problem $(10y + x) + (10x + y) = 165$

$\Rightarrow x + y = 15$ ...(i)

and $x - y = 3$ ...(ii)

or $-(x - y) = 3$ ....(iii)

On solving eq. (i) and (ii)

we gets = 9 and y = 6

$\therefore$ The number will be 69. **Ans.**

On solving eq. (i) and (iii)

we gets x = 6 and y = 9

∴ The number will be 96. **Ans.**

**Examples:** Six years hence a men's age will be three times the age of his son and three years ago he was nine times as old as his son. Find their present ages

**Sol.** Let man's present age be x yrs & son's present age be 'y' yrs.

According to problem $x + 6 = 3(y + 6)$ [After 6 yrs]

and $x - 3 = 9(y - 3)$ [Before 3 yrs.]

On solving equation (i) & (ii) we gets x = 30, y = 6.

So, the present age of man = 30 years, present age of son = 6 years.

**Examples:** A boat goes 12 km upstream and 40 km downstream in 8 hrs. It can go 16 km. upstream and 32 km downstream in the same time. Find the speed of the boat it still water and the speed of the stream.

**Sol.** Let the speed of the boat in still water be x km/hr and the speed of the stream be y km/hr then speed of boat in downstream is (x + y) km/hr and the speed of boat upstream is (x - y) km/hr.

Time taken to cover 12 km upstream $= \frac{12}{x-y}$ hrs.

Time taken to cover 40 km downstream $= \frac{40}{x+y}$ hrs.

But, total time taken 8 hr

$$\therefore \quad \frac{12}{x-y} + \frac{40}{x+y} = 8 \qquad .....(i)$$

Time taken to cover 16 km upstream $= \frac{16}{x-y}$ hrs.

Time taken to cover 32 km downstream $= \frac{32}{x+y}$ hrs.

Total time taken = 8 hr

$$\therefore \quad \frac{16}{x-y} + \frac{32}{x+y} = 8 \qquad .....(ii)$$

Solving equation (i) & (ii) we gets x = 6 and y = 2.

Hence, speed of boat in still water = 6 km/hr and speed of stream = 2 km/hr.

**Examples:** Ramesh travels 760 km to his home partly by train and partly by car. He taken 8 hr, if he travels 160 km by train and the rest by car. He takes 12 minutes more, if he travels 240 km by train and the rest by car. Find the speed of train and the car.

**Sol.** Let the speed of train be x km/hr & car be y km/hr respectively.

Acc. to problem $\frac{160}{x} + \frac{600}{y} = 8$ ....(i)

$\frac{240}{x} + \frac{520}{y} = \frac{41}{5}$ ....(ii)

Solving equation (i) & (ii) we gets x = 80 and y = 100.

Hence , speed ot train = 80 km/hr and speed of car = 100km/hr.

**Examples:** Points A and B are 90 km apart from each other on a highway. A car starts from A and another from B at the same time. If they go in the same direction, they meet in 9 hrs and if they go in opposite direction, they meet in $\frac{9}{7}$ hrs. Find their speeds.

**Sol.** Let the speeds of the cars starting from A and B be x km/hr and y km/hr respectively.

Acc to problem $9x - 90 = 9y$ ……..(i)

& $\frac{9}{7}x + \frac{9}{7}y = 90$ …..(ii)

Solving (i) & (ii) we gets x = 40 & y = 30.

Hence, speed of car starting from point A = 40 km/hr & speed of car starting from point B = 30 km/hr.



**Examples:** In a cyclic quadrilateral ABCD, $\angle A = (2x + 11)^0$, $\angle B = (y + 12)^0$, $\angle C = (3y + 6)^0$ and $\angle D = (5x - 25)^0$, find the angles of the quadrilateral.

**Sol.** Acc. to problem $(2x + 11)^0 + (3y + 6)^0 = 180^0$

$(y + 12)^0 + (5x - 25)^0 = 180^0$

Solving we get $x = \frac{416}{13}$ & $y = \frac{429}{13}$

$\Rightarrow$ x = 32 and y = 33

$\therefore$ $\angle A = 75^0$, $\angle B = 45^0$, $\angle C = 105^0$, $\angle D = 135^0$

**Examples:** A vessel contains mixture of $24\ell$ milk and $6\ell$ water and a second vessel contains a mixture of $15\ell$ milk & $10\ell$ water. How much mixture of milk and water should be taken from the first and the second vessel separately and kept in a third vessel so that the third vessel may contain a mixture of $25\ell$ milk and $10\ell$ water ?

**Sol.** Let x $\ell$ of mixture be taken from Ist vessel & y $\ell$ of the mixture be taken from 2nd vessel and kept in 3rd vessel so that (x + y) $\ell$ of the mixture in third vessel may contain 25 $\ell$ of milk & 10$\ell$ of water.

A mixture of x $\ell$ from 1st vessel contains $\frac{24}{30}x = \frac{4}{5}x\ell$ of milk & $\frac{x}{5}\ell$ of water and a mixture of $y\ell$ from 2nd vessel contains $\frac{3y}{5}\ell$ of milk & $\frac{2y}{5}\ell$ of water.

$\therefore \quad \frac{4}{5}x + \frac{3}{5}y = 25 \quad$ ....(i)

$\frac{x}{5} + \frac{2}{5}y = 10 \quad$ ....(ii)

Solving (i) & (ii) x = 20 litres and y = 15 litres.

**Examples:** A lady has 25 p and 50 p coins in her purse. If in all she has 40 coins totaling Rs. 12.50, find the number of coins of each type she has.

**Sol.** Let the lady has x coins of 25 p and y coins of 50 p.

Then acc. to problem x + y = 40 .....(i)

and 25 x + 50 y = 1250 ....(ii

Solving for x & y we get x = 30 (25 p coins) & y = 10 (50 P coins).

**Examples:** Students of a class are made to stand in rows. If one student is extra in a row, there would be 2 rows less. If one students is less in row, there would be 3 rows more. Find the total number of students in the class.

**Sol.** Let x be the original no. of rows & y be the original no. of student s in each row.

$\therefore$ Total no. of students = xy.

Acc. to problem

(y + 1) (x - 2) = x y ....(i)

and (y - 1) (x + 3) = xy ....(ii)

Solving (i) & (ii) to get

x = 12 & y = 5

$\therefore$ Total no. of students = 60

**Examples:** A man started his job with a certain monthly salary and earned a fixed increment every year. If his salary was Rs. 4500 after 5 years. of service and Rs. 5550 after 12 years of service, what was his starting salary and what his annual increment.

**Sol.** Let his initial monthly salary be Rs x and annual increment be Rs y.

Then, Acc. to problem x + 5y = 4500 ......(i)

x + 12 y = 5550 ....(ii)

Solving these two equations, we get x= Rs. 3750 y = Rs 150.

**Examples:** A dealer sold A VCR and a TV for Rs. 38560 making a profit of 12% on CVR and 15% on TV. By selling them for Rs. 38620, he would have realised a profit of 15% on CVR and 12% on TV. Find the cost price of each.

**Sol.** Let C.P. of CVR be Rs x & C.P. of T.V. be Rs y.

Acc. to problem $\frac{112}{100}x + \frac{115}{100}y = 38560$ .....(i)

and $\frac{115}{100}x + \frac{112}{100}y = 38620$ ....(ii)

Solving for x & y we get x = Rs. 18000 & y = Rs. 16000.