

1

Linear Equations in Two Variables

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**Points to Remember:**

- Linear Equations in two variables:**

An equation which contains two variables the degree of each term containing variable is one is called a linear equation in two variables.

An equation of the form $ax + by + c = 0$ where $a \neq 0$ and $b \neq 0$ is called the standard form of linear equation in two variables x and y where $a, b, c \in \mathbb{R}$.

Here c may or may not be zero

For example, The standard form of linear equation

$$3x = 4y - 12 \text{ is } 3x - 4y + 12 = 0$$

Activity : Complete the following table:

(Textbook Page No. 1)

Sr. No.	Equation	Is the equation a linear equation in two variables or not
(1)	$4m + 3n = 12$	Yes
(2)	$3x^2 - 7y = 13$	No
(3)	$\sqrt{2}x - \sqrt{5}y = 16$	Yes
(4)	$0x + 6y - 3 = 0$	No
(5)	$0.3x + 0y - 36 = 0$	No
(6)	$\frac{4}{x} + \frac{5}{y} = 4$	No
(7)	$4xy - 5y - 8 = 0$	No

- Simultaneous linear Equations:**

- When we consider two linear equations in two variables at the same time and we get unique common solution, then such set of equations is known as **simultaneous equations**.
- In the previous standard we have studied two methods of solving simultaneous equations
 - Elimination by equating the coefficients
 - Elimination by substitution.

- Solve the following simultaneous equations:**

(1) $5x - 3y = 8; 3x + y = 2.$

Solution:

Method I – Elimination by equating the coefficients

$$5x - 3y = 8 \quad \dots(i)$$

$$3x + y = 2 \quad \dots(ii)$$

Multiplying both sides of equation (ii) by 3,

$$9x + 3y = 6 \quad \dots(iii)$$

Adding (i) and (iii)

$$\begin{array}{r} 5x - 3y = 8 \\ + \quad 9x + 3y = 6 \\ \hline 14x = 14 \end{array}$$

$$\therefore x = 1$$

Substituting $x = 1$ in (ii).

$$3x + y = 2$$

$$\therefore 3 \times 1 + y = 2$$

$$\therefore 3 + y = 2$$

$$\therefore y = 2 - 3$$

$$\therefore y = -1$$

$\therefore (x, y) = (1, -1)$ is the solution of the given simultaneous equations.

Method II : Elimination by Substitution

$$5x - 3y = 8 \quad \dots(i)$$

$$3x + y = 2 \quad \dots(ii)$$

Writing y in terms of x from (ii)

$$y = 2 - 3x \quad \dots(iii)$$

Substituting the value of y in (i)

$$5x - 3y = 8$$

$$\therefore 5x - 3(2 - 3x) = 8$$

$$\therefore 5x - 6 + 9x = 8$$

$$\therefore 14x - 6 = 8$$

$$\therefore 14x = 8 + 6$$

$$\therefore 14x = 14$$

$$\therefore x = 1$$

Substituting the value of x in (iii)

$$y = 2 - 3x$$

$$\therefore y = 2 - 3 \times 1$$

$$\therefore y = 2 - 3$$

$$\therefore y = -1$$

$\therefore x = 1, y = -1$ is the solution of the given simultaneous equations.

(2) Solve: $3x + 2y = 29$; $5x - y = 18$

Solution:

$$3x + 2y = 29 \quad \dots(i)$$

$$5x - y = 18 \quad \dots(ii)$$

To solve the equations, fill in the boxes below.

Multiplying (ii) by 2

$$5x \times \boxed{2} - y \times \boxed{2} = 18 \times \boxed{2}$$

$$\therefore 10x - 2y = \boxed{36} \quad \dots(iii)$$

Adding (i) and (iii)

$$3x + 2y = 29$$

$$\boxed{10x} - \boxed{2y} = \boxed{36}$$

$$\boxed{13x} = \boxed{65}$$

$$\therefore x = \boxed{5}$$

Substituting $x = 5$ in (i)

$$3x + 2y = 29$$

$$\therefore 3 \times \boxed{5} + 2y = 29$$

$$\therefore \boxed{15} + 2y = 29$$

$$\therefore 2y = 29 - \boxed{15}$$

$$\therefore 2y = \boxed{14}$$

$$\therefore y = \boxed{7}$$

$\therefore (x, y) = (\boxed{5}, \boxed{7})$ is the solution of the given equations.

MASTER KEY QUESTION SET - 1

Practice Set - 1.1 (Textbook Page No. 4)

(1) Complete the following activity to solve the simultaneous equations.

$$5x + 3y = 9; 2x - 3y = 12$$

(2 marks)

Solution:

$$5x + 3y = 9 \quad \dots(i)$$

$$2x - 3y = 12 \quad \dots(ii)$$

Adding (i) and (ii)

$$\begin{array}{r} 5x + 3y = 9 \\ + 2x - 3y = 12 \\ \hline \boxed{7}x = \boxed{21} \end{array}$$

$$\therefore x = \frac{\boxed{21}}{\boxed{7}}$$

$$\therefore x = \boxed{3}$$

Place $x = 3$ in (i),

$$5 \times \boxed{3} + 3y = 9$$

$$\therefore 3y = 9 - \boxed{15}$$

$$\therefore 3y = \boxed{-6}$$

$$\therefore y = \frac{\boxed{-6}}{3}$$

$$\therefore y = \boxed{-2}$$

$$\therefore \text{Solution is } (x, y) = (\boxed{3}, \boxed{-2}).$$

(2) Solve the following simultaneous equations.

(i) $3a + 5b = 26$; $a + 5b = 22$

(2 marks)

Solution:

$$3a + 5b = 26 \quad \dots(i)$$

$$a + 5b = 22 \quad \dots(ii)$$

Subtracting (ii) from (i) we get,

$$\begin{array}{r} 3a + 5b = 26 \\ a + 5b = 22 \\ \hline (-) \quad (-) \quad (-) \\ 2a = 4 \\ \therefore a = \frac{4}{2} \\ \therefore a = 2 \end{array}$$

Substituting $a = 2$ in (ii), we get

$$2 + 5b = 22$$

$$\therefore 5b = 22 - 2$$

$$\therefore 5b = 20$$

$$\therefore b = \frac{20}{5}$$

$$\therefore b = 4$$

$\therefore (a, b) = (2, 4)$ is the solution of the given simultaneous equations.

(ii) $x + 7y = 10$; $3x - 2y = 7$ (2 marks)

Solution:

$$x + 7y = 10 \quad \dots(i)$$

$$3x - 2y = 7 \quad \dots(ii)$$

(i) can be written as

$$x = 10 - 7y \quad \dots(iii)$$

Substituting the value of x in (ii),

$$3(10 - 7y) - 2y = 7$$

$$\therefore 30 - 21y - 2y = 7$$

$$\therefore -23y = 7 - 30$$

$$\therefore -23y = -23$$

$$\therefore y = \frac{-23}{-23}$$

$$\therefore y = 1$$

Substituting $y = 1$ in (iii),

$$\therefore x = 10 - 7y$$

$$\therefore x = 10 - 7 \times 1$$

$$\therefore x = 10 - 7$$

$$\therefore x = 3$$

$\therefore (x, y) = (3, 1)$ is the solution of the given simultaneous equations.

(iii) $2x - 3y = 9$; $2x + y = 13$ (2 marks)

Solution:

$$2x - 3y = 9 \quad \dots(i)$$

$$2x + y = 13 \quad \dots(ii)$$

(ii) can be written as

$$y = 13 - 2x \quad \dots(iii)$$

Substituting (iii) in (i),

$$2x - 3(13 - 2x) = 9$$

$$\therefore 2x - 39 + 6x = 9$$

$$\therefore 8x - 39 = 9$$

$$\therefore 8x = 9 + 39$$

$$\therefore 8x = 48$$

$$\therefore x = \frac{48}{8}$$

$$\therefore x = 6$$

Substituting $x = 6$ in (iii),

$$y = 13 - 2x$$

$$\therefore y = 13 - 2 \times 6$$

$$\therefore y = 13 - 12$$

$$\therefore y = 1$$

$\therefore (x, y) = (6, 1)$ is the solution of the given simultaneous equations.

(iv) $5m - 3n = 19$; $m - 6n = -7$ (2 marks)

Solution:

$$5m - 3n = 19 \quad \dots(i)$$

$$m - 6n = -7 \quad \dots(ii)$$

Multiplying (i) by 2,

$$10m - 6n = 38 \quad \dots(iii)$$

Subtracting (iii) from (ii)

$$\begin{array}{r r r r} m & - & 6n & = & -7 \\ 10m & - & 6n & = & 38 \\ (-) & & (+) & & (-) \\ \hline & -9m & & = & -45 \end{array}$$

$$\therefore m = \frac{-45}{-9}$$

$$\therefore m = 5$$

Substituting $m = 5$ in (i)

$$\therefore 5(5) - 3n = 19$$

$$\therefore 25 - 3n = 19$$

$$\therefore -3n = 19 - 25$$

$$\therefore -3n = -6$$

$$\therefore n = \frac{-6}{-3}$$

$$\therefore n = 2$$

$\therefore (m, n) = (5, 2)$ is the solution of the given simultaneous equations.

(v) $5x + 2y = -3$; $x + 5y = 4$ (2 marks)

Solution:

$$5x + 2y = -3 \quad \dots(i)$$

$$x + 5y = 4 \quad \dots(ii)$$

Multiplying (ii) by 5

$$5x + 25y = 20 \quad \dots(iii)$$

Subtracting (iii) from (i)

$$\begin{array}{r r r r} 5x & + & 2y & = & -3 \\ 5x & + & 25y & = & 20 \\ (-) & & (-) & & (-) \\ \hline & & -23y & = & -23 \\ & & y & = & \frac{-23}{-23} \\ & & y & = & 1 \end{array}$$

Substituting $y = 1$ in (ii),

$$\therefore x + 5(1) = 4$$

$$\therefore x = 4 - 5$$

$$\therefore x = -1$$

$\therefore$

$(x, y) = (-1, 1)$ is the solution of the given simultaneous equations.

(vi) $\frac{1}{3}x + y = \frac{10}{3}$; $2x + \frac{1}{4}y = \frac{11}{4}$ (3 marks)

Solution:

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

...(given)

Multiplying both sides by 3

$$x + 3y = 10$$

...(i)

$$2x + \frac{1}{4}y = \frac{11}{4}$$

...(given)

Multiplying both sides by 4

$$8x + y = 11$$

...(ii)

Multiplying (ii) by 3,

$$24x + 3y = 33$$

...(iii)

Subtracting (iii) from (i)

$$\begin{array}{r} x + 3y = 10 \\ 24x + 3y = 33 \\ (-) \quad (-) \quad (-) \\ \hline -23x = -23 \end{array}$$

$$\therefore x = \frac{-23}{-23}$$

$$\therefore x = 1$$

Substituting $x = 1$ in (i)

$$1 + 3y = 10$$

$$\therefore 3y = 10 - 1$$

$$\therefore 3y = 9$$

$$\therefore y = \frac{9}{3}$$

$$\therefore y = 3$$

$\therefore$

$(x, y) = (1, 3)$ is the solution of the given simultaneous equations.



Points to Remember:

• Solving special types of Equations:

Let us now understand how to solve equations of type $a_1x + b_1y = c_1$ and $b_1x + a_1y = c_2$.

We shall follow the three steps.

(i) Add (ii) Subtract (iii) Add

Let us see an example

Example Solve :

$$5x + 10y = 35 ; 10x + 5y = 40$$

Solution:

$$5x + 10y = 35$$

...(i)

$$10x + 5y = 40$$

...(ii)

Adding (i) and (ii)

$$\begin{array}{r} 5x + 10y = 35 \\ 10x + 5y = 40 \\ \hline 15x + 15y = 75 \end{array}$$

$$\therefore x + y = 5$$

...(iii)

Subtracting (i) from (ii)

$$\begin{array}{r} 10x + 5y = 40 \\ 5x + 10y = 35 \\ (-) \quad (-) \quad (-) \\ \hline 5x - 5y = 5 \end{array}$$

Dividing both sides by 5.

$$\therefore x - y = 1$$

...(iv)

Adding (iii) and (iv)

$$\begin{array}{r} x + y = 5 \\ x - y = 1 \\ \hline 2x = 6 \end{array}$$

$$\therefore x = 3$$

Substituting $x = 3$ in (iii),

$$3 + y = 5$$

$$y = 5 - 3$$

$$\therefore y = 2$$

$\therefore$

$x = 3, y = 2$ is the solution of the given simultaneous equations.

(vii) $99x + 101y = 499$; $101x + 99y = 501$ (3 marks)

Solution:

$$99x + 101y = 499$$

...(i)

$$101x + 99y = 501$$

...(ii)

Adding (i) and (ii)

$$\begin{array}{r} 99x + 101y = 499 \\ 101x + 99y = 501 \\ \hline 200x + 200y = 1000 \end{array}$$

$\therefore$ Dividing both sides by 200,

$$\therefore x + y = \frac{1000}{200}$$

$$\therefore x + y = 5$$

...(iii)

Subtracting (ii) from (i)

$$\begin{array}{rcl} 99x + 101y & = & 499 \\ 101x + 99y & = & 501 \\ (-) & & (-) \quad (-) \\ \hline -2x + 2y & = & -2 \end{array}$$

Dividing both sides by -2 ,

$$\therefore x - y = 1 \quad \dots(\text{iv})$$

Adding (iii) and (iv)

$$\begin{array}{rcl} x + y & = & 5 \\ x - y & = & 1 \\ \hline 2x & = & 6 \end{array}$$

$$\therefore x = \frac{6}{2}$$

$$\therefore x = 3$$

Substituting $x = 3$ in (iii),

$$3 + y = 5$$

$$\therefore y = 5 - 3$$

$$\therefore y = 2$$

$$\therefore (x, y) = (3, 2) \text{ is the solution of the given simultaneous equations.}$$

(viii) $49x - 57y = 172$; $57x - 49y = 252$ (3 marks)

Solution:

$$49x - 57y = 172 \quad \dots(\text{i})$$

$$57x - 49y = 252 \quad \dots(\text{ii})$$

Adding (i) and (ii)

$$\begin{array}{rcl} 49x - 57y & = & 172 \\ 57x - 49y & = & 252 \\ \hline 106x - 106y & = & 424 \end{array}$$

Dividing both sides by 106,

$$\therefore x - y = \frac{424}{106}$$

$$\therefore x - y = 4 \quad \dots(\text{iii})$$

Subtracting (iii) from (i)

$$\begin{array}{rcl} 49x - 57y & = & 172 \\ 57x - 49y & = & 252 \\ (-) & & (+) \quad (-) \\ \hline -8x - 8y & = & -80 \end{array}$$

Dividing both sides by -8 .

$$x + y = \frac{80}{8}$$

$$\therefore x + y = 10 \quad \dots(\text{iv})$$

Adding (iii) and (iv)

$$\begin{array}{rcl} x - y & = & 4 \\ x + y & = & 10 \\ \hline 2x & = & 14 \end{array}$$

$$\therefore x = \frac{14}{2}$$

$$\therefore x = 7$$

Substituting $x = 7$ in (iv),

$$7 + y = 10$$

$$y = 10 - 7$$

$$\therefore y = 3$$

$$\therefore (x, y) = (7, 3) \text{ is the solution of the given simultaneous equations.}$$

Points to Remember:

Graph of a linear equation in two variables:

In previous standard we have studied that a linear equation in two variables represents a line. The ordered pair which will satisfy the given equation is the solution of that equation and also it is one of the points which lies on that graph of the given equation.

Note : A linear equation such as $y = a$ (constants) is also write as $0x + y = a$. The graph of this line is parallel to x-axis. Similarly, equation such as $x = 2$ (constants) is written as $x + 0y = 2$ and its graph is parallel to Y-axis.

The graphical method of solving simultaneous equations involves the following steps:

Step 1: To draw the graphs of the two given equations, first find three solutions of each equations and make the table for each equation.

Step 2: Now plot the points on same graph paper and join them to get the graph of each equation.

Step 3: The lines of the two given simultaneous equations will intersect each other at a point. The co-ordinates of the point of intersection of the two lines is the solution of the given simultaneous equations.

Note : Avoid two digit coordinates and using decimal coordinates while finding ordered pairs so that plotting points becomes easy.

Solution of simultaneous equations by Graphical method:

Ex. : Solve the following simultaneous equations by using Graphical method.

$$x + y = 4 ; 2x - y = 2$$

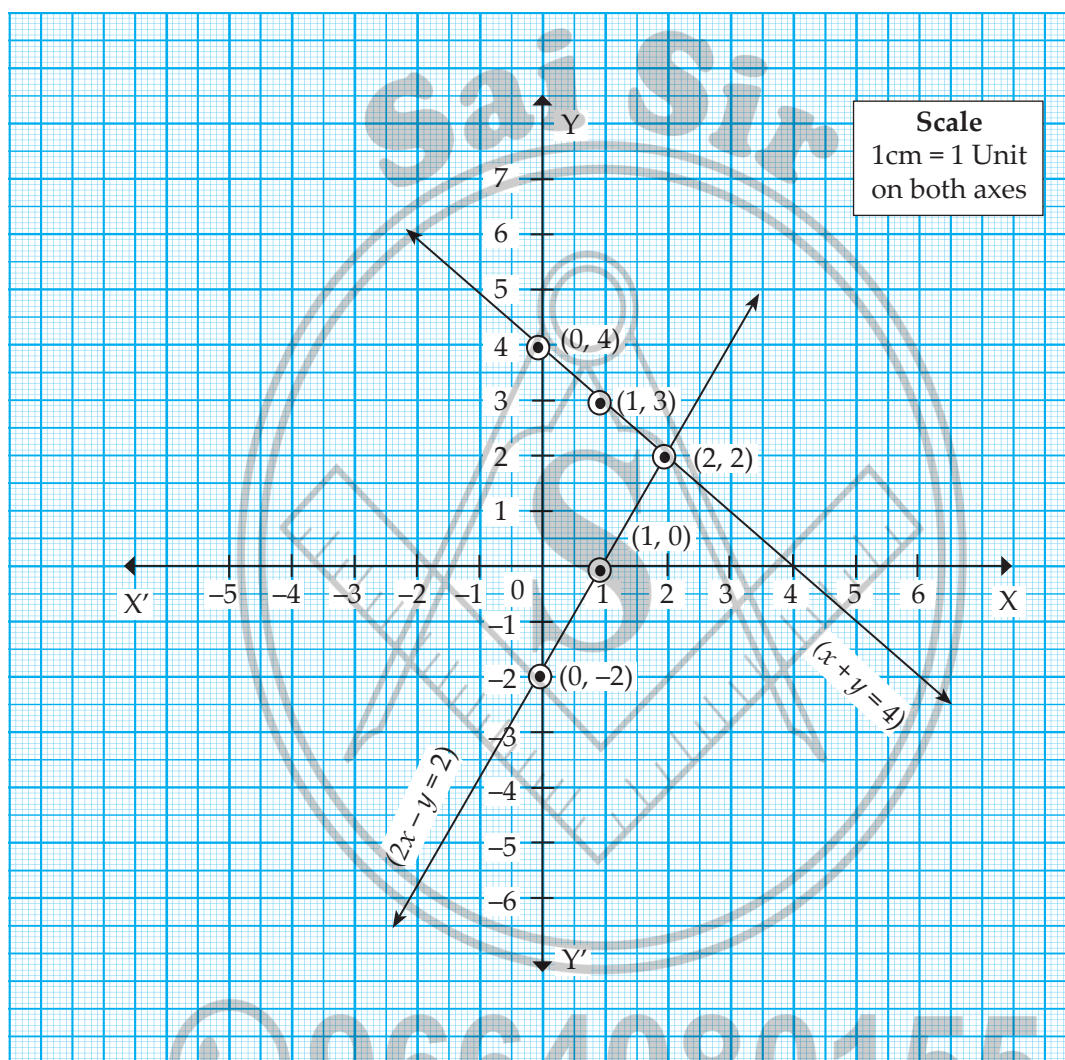
$$\text{Sol. } x + y = 4 \text{ i.e. } y = 4 - x$$

x	0	1	2
y	4	3	2
(x, y)	(0, 4)	(1, 3)	(2, 2)

when $x = 0$ $\therefore y = 4 - (0)$ $\therefore y = 4$ $2x - y = 2$ i.e. $y = 2x - 2$	when $x = 1$ $\therefore y = 4 - 1$ $\therefore y = 3$	when $x = 2$ $\therefore y = 4 - 2$ $\therefore y = 2$
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x	0	1	2
y	-2	0	2
(x, y)	(0, -2)	(1, 0)	(2, 2)

when $x = 0$ $\therefore y = 2(0) - 2$ $\therefore y = 0 - 2$ $\therefore y = -2$	when $x = 1$ $\therefore y = 2(1) - 2$ $\therefore y = 2 - 2$ $\therefore y = 0$	when $x = 2$ $\therefore y = 2(2) - 2$ $\therefore y = 4 - 2$ $\therefore y = 2$
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The lines of the two given simultaneous equations intersect each other at $(2, 2)$

$\therefore$ The solution of the given simultaneous equations is $(2, 2)$ i.e. $x = 2, y = 2$

Activity (I) : Solve the following simultaneous equations by graphical method.

- Complete the following tables to get ordered pairs. (Textbook Page No. 8)

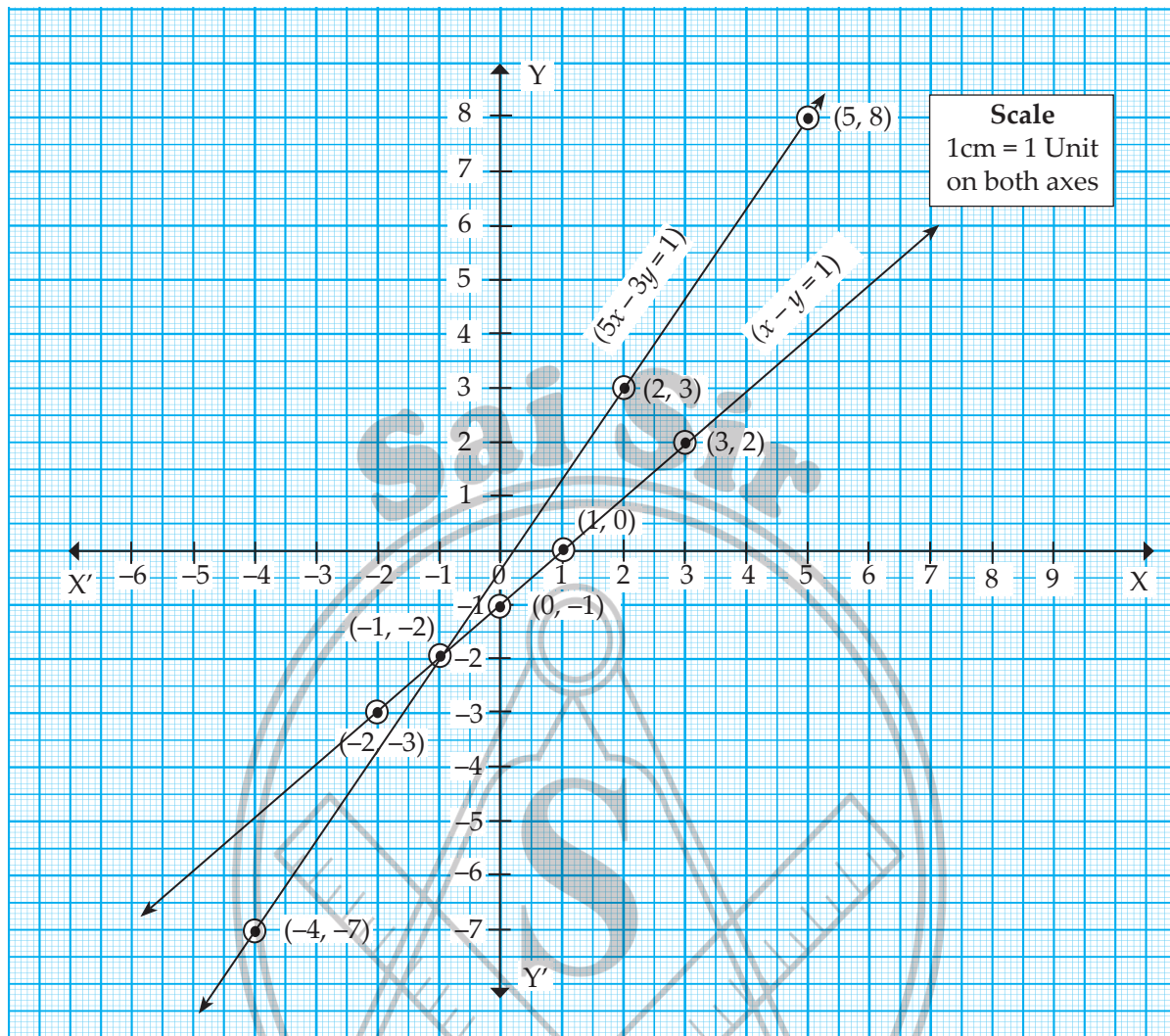
$$x - y = 1$$

x	0	1	3	-2
y	-1	0	2	-3
(x, y)	(0, -1)	(1, 0)	(3, 2)	(-2, -3)

$$5x - 3y = 1$$

x	2	5	-1	-4
y	3	8	-2	-7
(x, y)	(2, 3)	(5, 8)	(-1, -2)	(-4, -7)

- Plot the above ordered pair on the same co-ordinate plane.



The lines intersect each other at $(-1, -2)$

$\therefore$ The solution of the given simultaneous equations is $(-1, -2)$ i.e. $x = -1, y = -2$

Activity (I) : Solve the above equations by method of elimination. Check your solution with the solution obtained by graphical method.

(Textbook Page No. 8)

Solution:

$$x - y = 1 \quad \dots(i)$$

$$5x - 3y = 1 \quad \dots(ii)$$

Multiplying (i) by 3 we get,

$$3x - 3y = 3 \quad \dots(iii)$$

Subtracting (iii) from (ii) we get,

$$\begin{array}{r} 5x - 3y = 1 \\ - 3x - 3y = 3 \\ \hline (-) \quad (+) \quad (-) \\ 2x \quad \quad = -2 \end{array}$$

$$\therefore x = \frac{-2}{2}$$

$$\therefore x = -1$$

Substituting $x = -1$ in (i) we get,

$$-1 - y = 1$$

$$\therefore y = -1 - 1$$

$$\therefore y = -2$$

$$\therefore x = -1, y = -2 \text{ is the solution.}$$

The solution is same as obtained by graphical method.

Practice Set - 1.2 (Textbook Page No. 8)

- (1) Complete the following table to draw graph of the equations. (1 mark)

$$x + y = 3; x - y = 4$$

$$x + y = 3$$

x	3		
y		5	3
(x, y)	(3, 0)		(0, 3)

$$x - y = 4$$

x		-1	0
y	0		-4
(x, y)			(0, -4)

Solution:

$$x + y = 3$$

x	3	-2	0
y	0	5	3
(x, y)	(3, 0)	(-2, 5)	(0, 3)

when $x = 3$

$$\therefore 3 + y = 3$$

$$\therefore y = 3 - 3$$

$$\therefore y = 0$$

when $y = 5$

$$\therefore x + y = 3$$

$$\therefore x + 5 = 3$$

$$\therefore x = 3 - 5$$

$$\therefore x = -2$$

when $y = 3$

$$\therefore x + 3 = 3$$

$$\therefore x = 3 - 3$$

$$\therefore x = 0$$

$$x - y = 4$$

x	4	-1	0
y	0	-5	-4
(x, y)	(4, 0)	(-1, -5)	(0, -4)

when $y = 0$

$$\therefore x - 0 = 4$$

$$\therefore x = 4$$

when $x = -1$

$$\therefore -1 - y = 4$$

$$\therefore -y = 4 + 1$$

$$\therefore y = -5$$

Problem Set - 1 (Textbook Page No. 27)

- (2) Complete the following table to draw the graph of $2x - 6y = 3$ (2 marks)

x	-5	
y		0
(x, y)		

Solution:

When $x = -5$

$$\therefore 2x - 6y = 3$$

$$\therefore 2(-5) - 6y = 3$$

$$\therefore -10 - 6y = 3$$

$$\therefore -6y = 3 + 10$$

When $y = 0$

$$\therefore 2x - 6y = 3$$

$$\therefore 2x - 6(0) = 3$$

$$\therefore 2x = 3$$

$$\therefore x = \frac{3}{2}$$

$$\therefore -6y = 13$$

$$\therefore y = \frac{-13}{6}$$

x	-5	$\frac{3}{2}$
y	$\frac{-13}{6}$	0
(x, y)	$(-5, \frac{-13}{6})$	$(\frac{3}{2}, 0)$

Practice Set - 1.2 (Textbook Page No. 8)

- (2) Solve the following simultaneous equations graphically. (4 marks)

(i) $x + y = 6; x - y = 4$

Solution:

$$x + y = 6 \text{ i.e. } y = 6 - x$$

x	0	1	2
y	6	5	4
(x, y)	(0, 6)	(1, 5)	(2, 4)

when $x = 0$

$$\therefore y = 6 - 0$$

$$\therefore y = 6$$

when $x = 1$

$$\therefore y = 6 - 1$$

$$\therefore y = 5$$

when $x = 2$

$$\therefore y = 6 - (2)$$

$$\therefore y = 4$$

$$x - y = 4 \text{ i.e. } y = x - 4$$

x	0	1	2
y	-4	-3	-2
(x, y)	(0, -4)	(1, -3)	(2, -2)

when $x = 0$

$$\therefore y = 0 - 4$$

$$\therefore y = -4$$

when $x = 1$

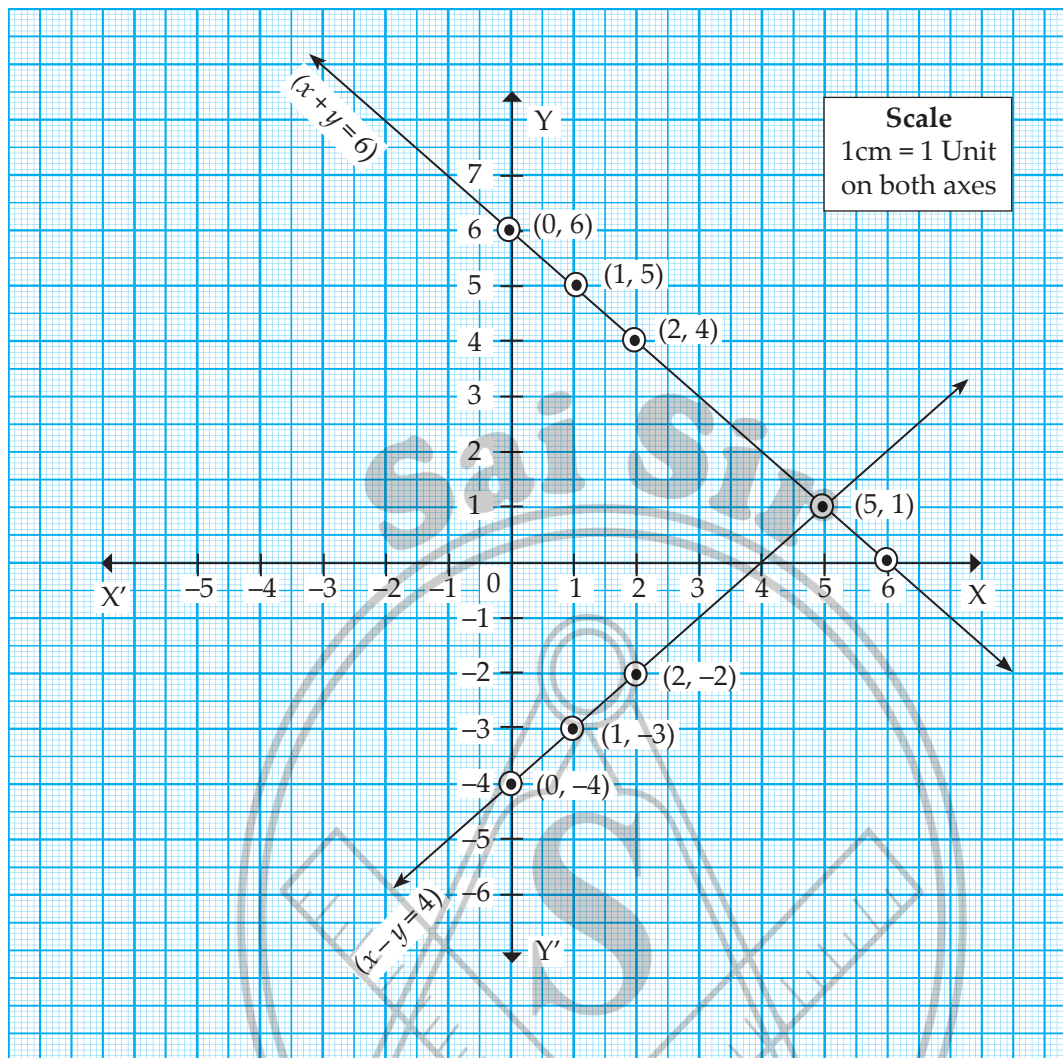
$$\therefore y = 1 - 4$$

$$\therefore y = -3$$

when $x = 2$

$$\therefore y = 2 - 4$$

$$\therefore y = -2$$



The lines of the two given simultaneous equations intersect each other at (5, 1)

∴ **The solution of given the simultaneous equations is (5, 1) i.e. $x = 5, y = 1$**

(ii) $x + y = 5$; $x - y = 3$

(4 marks)

Solution:

$$x + y = 5 \text{ i.e. } y = 5 - x$$

x	0	1	2
y	5	4	3
(x, y)	(0, 5)	(1, 4)	(2, 3)

when $x = 0$

$$\therefore y = 5 - 0$$

$$\therefore y = 5$$

when $x = 1$

$$\therefore y = 5 - (1)$$

$$\therefore y = 5 - 1$$

$$\therefore y = 4$$

when $x = 2$

$$\therefore y = 5 - 2$$

$$\therefore y = 3$$

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

x	0	1	2
y	-3	-2	-1
(x, y)	(0, -3)	(1, -2)	(2, -1)

when $x = 0$

$$\therefore y = 0 - 3$$

$$\therefore y = -3$$

when $x = 1$

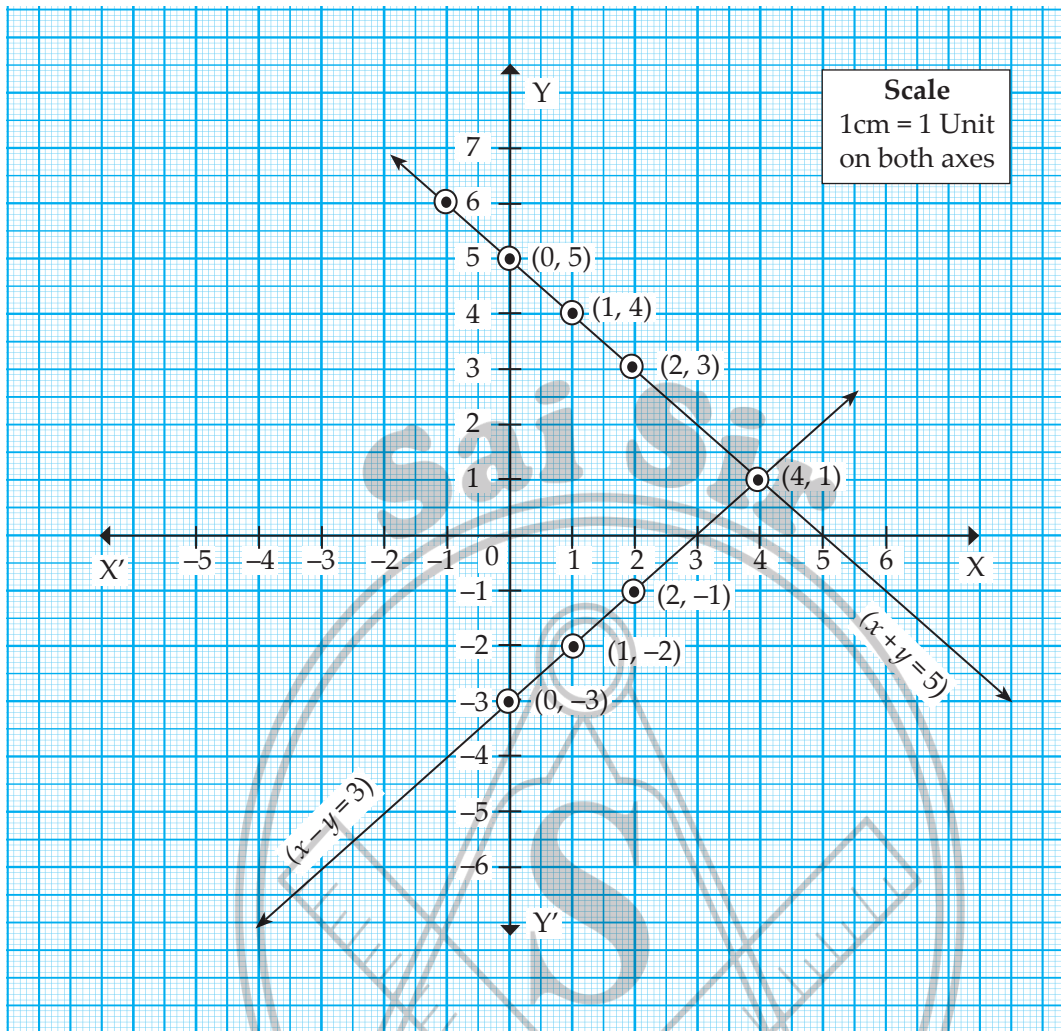
$$\therefore y = 1 - 3$$

$$\therefore y = -2$$

when $x = 2$

$$\therefore y = 2 - 3$$

$$\therefore y = -1$$



The lines of the two given simultaneous equations intersect each other at $(4, 1)$

∴ **The solution of the given simultaneous equations is $(4, 1)$ i.e. $x = 4, y = 1$**

(iii) $x + y = 0$; $2x - y = 9$

(4 marks)

Solution:

$$x + y = 0 \text{ i.e. } y = -x$$

x	0	1	2
y	0	-1	-2
(x, y)	(0, 0)	(1, -1)	(2, -2)

when $x = 0$

$$\therefore y = (-0)$$

$$\therefore y = 0$$

when $x = 1$

$$\therefore y = -(1)$$

$$\therefore y = -1$$

when $x = 2$

$$\therefore y = (-2)$$

$$\therefore y = -2$$

$$2x - y = 9 \text{ i.e. } y = 2x - 9$$

x	0	1	2
y	-9	-7	-5
(x, y)	(0, -9)	(1, -7)	(2, -5)

when $x = 0$

$$\therefore y = 2(0) - 9$$

$$\therefore y = 0 - 9$$

$$\therefore y = -9$$

when $x = 1$

$$\therefore y = 2(1) - 9$$

$$\therefore y = 2 - 9$$

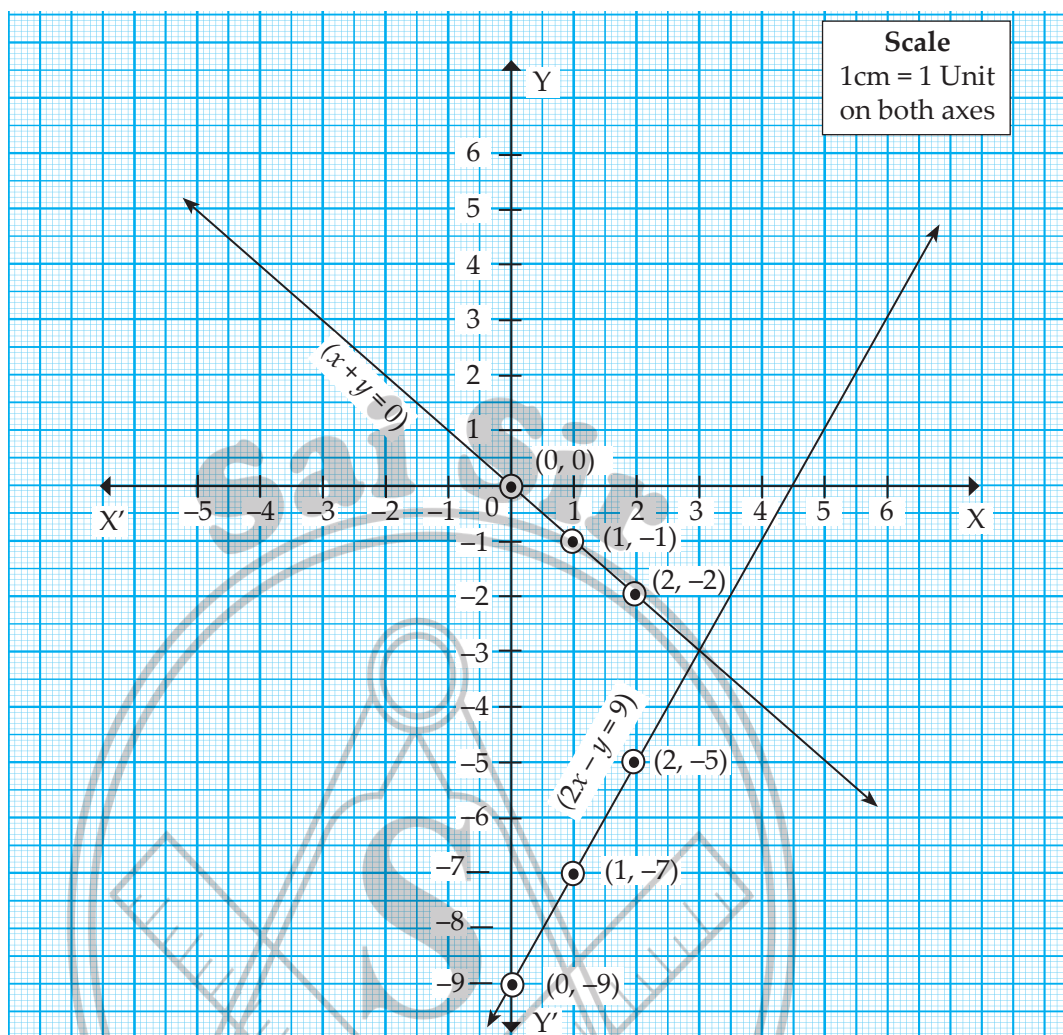
$$y = -7$$

when $x = 2$

$$\therefore y = 2(2) - 9$$

$$\therefore y = 4 - 9$$

$$\therefore y = -5$$



The lines of the two given simultaneous equations intersect each other at $(3, -3)$

∴ The solution of given simultaneous equations is $(3, -3)$ i.e. $x = 3, y = -3$

(iv) $3x - y = 2$; $2x - y = 3$

(4 marks)

Solution:

$3x - y = 2$ i.e. $y = 3x - 2$

x	0	1	2
y	-2	1	4
(x, y)	(0, -2)	(1, 1)	(2, 4)

when $x = 0$

∴ $y = 3(0) - 2$

∴ $y = 0 - 2$

∴ $y = -2$

when $x = 2$

∴ $y = 3(2) - 2$

∴ $y = 6 - 2$

∴ $y = 4$

when $x = 1$

∴ $y = 3(1) - 2$

∴ $y = 3 - 2$

∴ $y = 1$

$2x - y = 3$ i.e. $y = 2x - 3$

x	0	1	2
y	-3	-1	1
(x, y)	(0, -3)	(1, -1)	(2, 1)

when $x = 0$

∴ $y = 2(0) - 3$

∴ $y = 0 - 3$

∴ $y = -3$

when $x = 2$

∴ $y = 2(2) - 3$

∴ $y = 4 - 3$

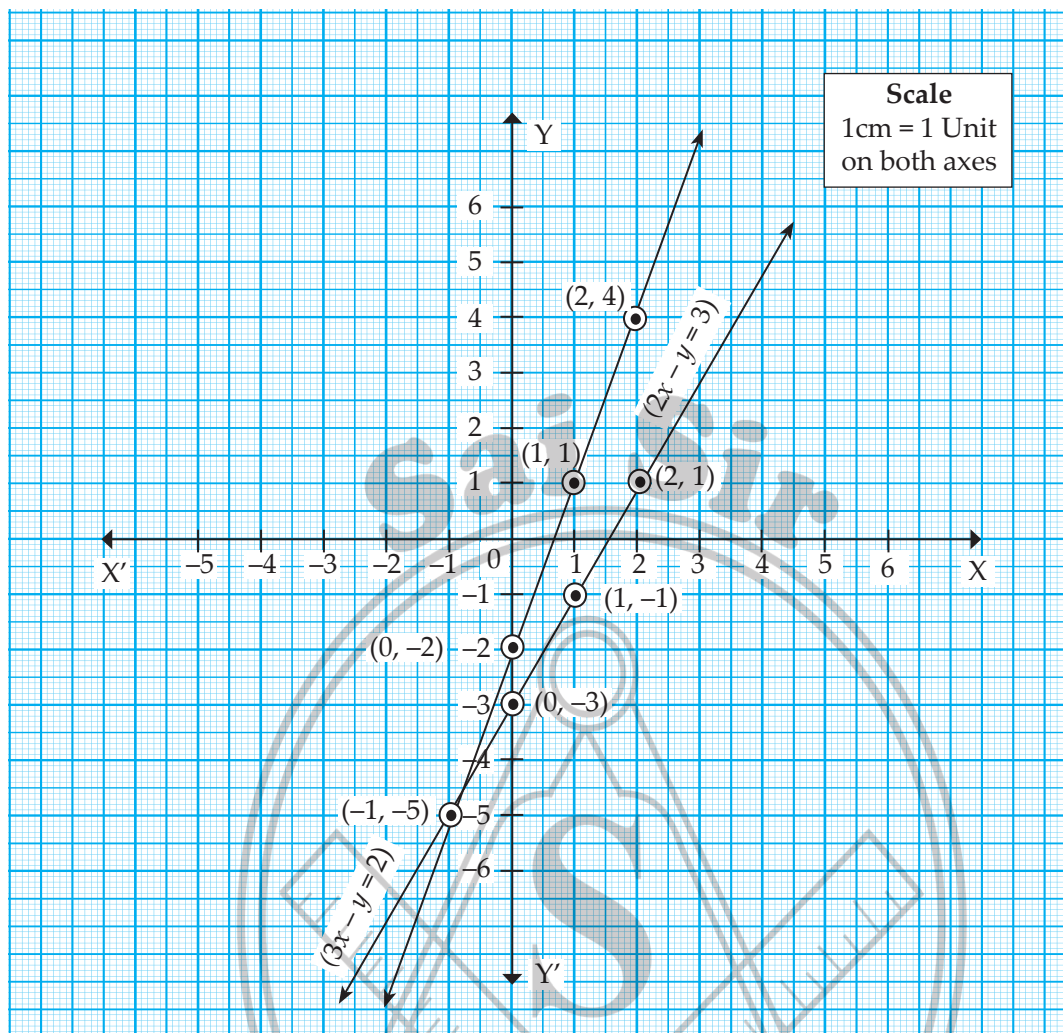
∴ $y = 1$

when $x = 1$

∴ $y = 2(1) - 3$

∴ $y = 2 - 3$

∴ $y = -1$



The lines of the two given simultaneous equations intersect each other at $(-1, -5)$

∴ **The solution of given simultaneous equations is $(-1, -5)$ i.e. $x = -1, y = -5$**

(v) $3x - 4y = -7$; $5x - 2y = 0$

(4 marks)

Solution:

$$3x - 4y = -7 \text{ i.e. } y = \frac{3x+7}{4}$$

x	-1	3	-5
y	1	4	-2
(x, y)	$(-1, 1)$	$(3, 4)$	$(-5, -2)$

when $x = -1$

$$\therefore y = \frac{3(-1)+7}{4}$$

$$\therefore y = \frac{-3+7}{4}$$

$$\therefore y = \frac{4}{4}$$

$$\therefore y = 1$$

when $x = 3$

$$\therefore y = \frac{3(3)+7}{4}$$

$$\therefore y = \frac{9+7}{4}$$

$$\therefore y = \frac{16}{4}$$

$$\therefore y = 4$$

when $x = -5$

$$\therefore y = \frac{3(-5)+7}{4}$$

$$\therefore y = \frac{-15+7}{4}$$

$$\therefore y = \frac{-8}{4}$$

$$\therefore y = -2$$

$$5x - 2y = 0 \text{ i.e. } y = \frac{5}{2}x$$

x	0	2	-2
y	0	5	-5
(x, y)	$(0, 0)$	$(2, 5)$	$(-2, -5)$

when $x = 0$

$$\therefore y = \frac{5}{2} \times 0$$

$$\therefore y = 0$$

when $x = 2$

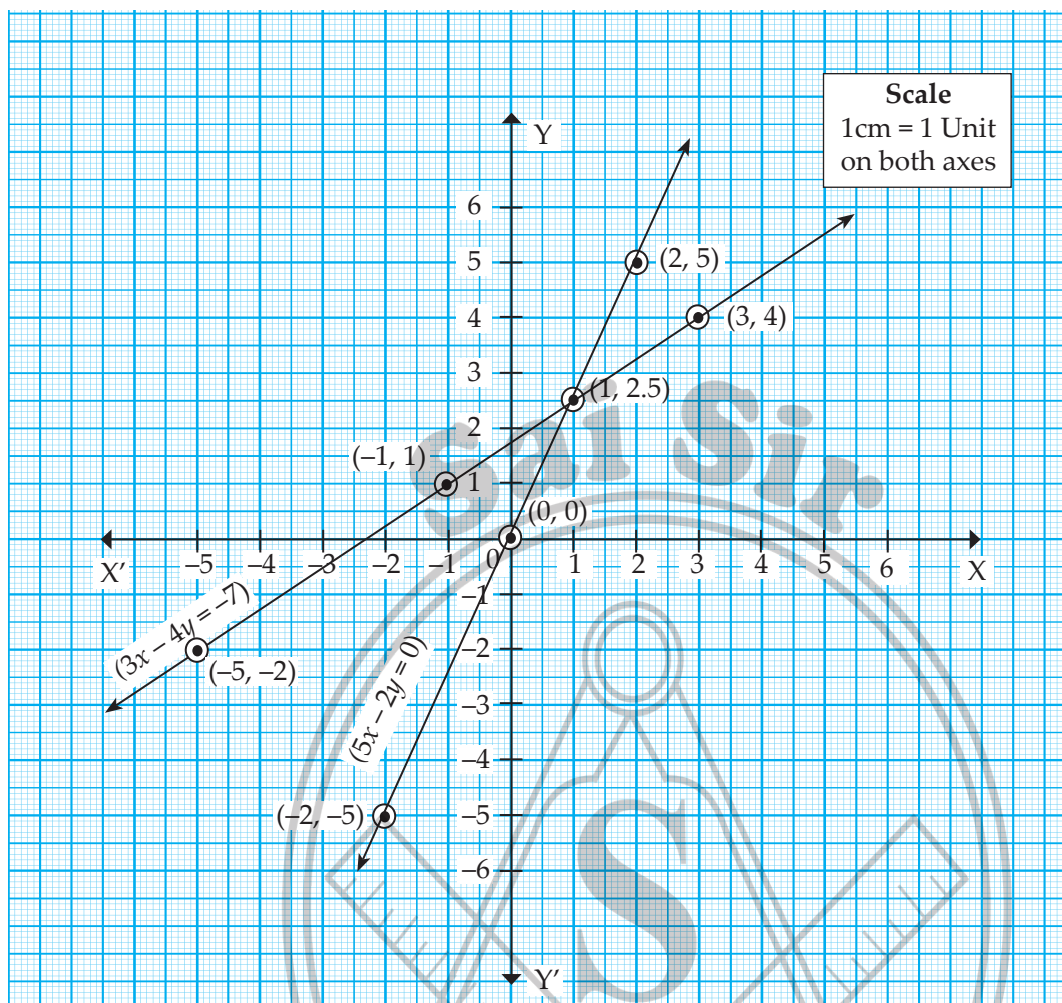
$$\therefore y = \frac{5}{2} \times 2$$

$$\therefore y = 5$$

when $x = -2$

$$\therefore y = \frac{5}{2}(-2)$$

$$\therefore y = -5$$



The lines of the two given simultaneous equations intersect each other at (1, 2.5)

∴ **The solution of given simultaneous equations is (1, 2.5) i.e. $x = 1, y = 2.5$**

(vi) $2x - 3y = 4$; $3y - x = 4$

(4 marks)

when $y = -2$

Solution:

$$2x - 3y = 4$$

$$\therefore 2x = 4 + 3y$$

$$\therefore x = \frac{4 + 3y}{2}$$

x	2	5	-1
y	0	2	-2
(x, y)	(2, 0)	(5, 2)	(-1, -2)

when $y = 0$

$$x = \frac{4 + 3(0)}{2}$$

$$\therefore x = \frac{4 + 0}{2}$$

$$\therefore x = \frac{4}{2}$$

$$\therefore x = 2$$

when $y = 2$

$$x = \frac{4 + 3(2)}{2}$$

$$\therefore x = \frac{4 + 6}{2}$$

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

$$\therefore x = 5$$

$$x = \frac{4 + 3(-2)}{2}$$

$$\therefore x = \frac{4 - 6}{2}$$

$$\therefore x = \frac{-2}{2}$$

$$\therefore x = -1$$

$3y - x = 4$ i.e. $x = 3y - 4$

x	-4	-1	2
y	0	1	2
(x, y)	(-4, 0)	(-1, 1)	(2, 2)

when $y = 0$

$$\therefore x = 3(0) - 4$$

$$\therefore x = 0 - 4$$

$$\therefore x = -4$$

when $y = 1$

$$\therefore x = 3(1) - 4$$

$$\therefore x = 3 - 4$$

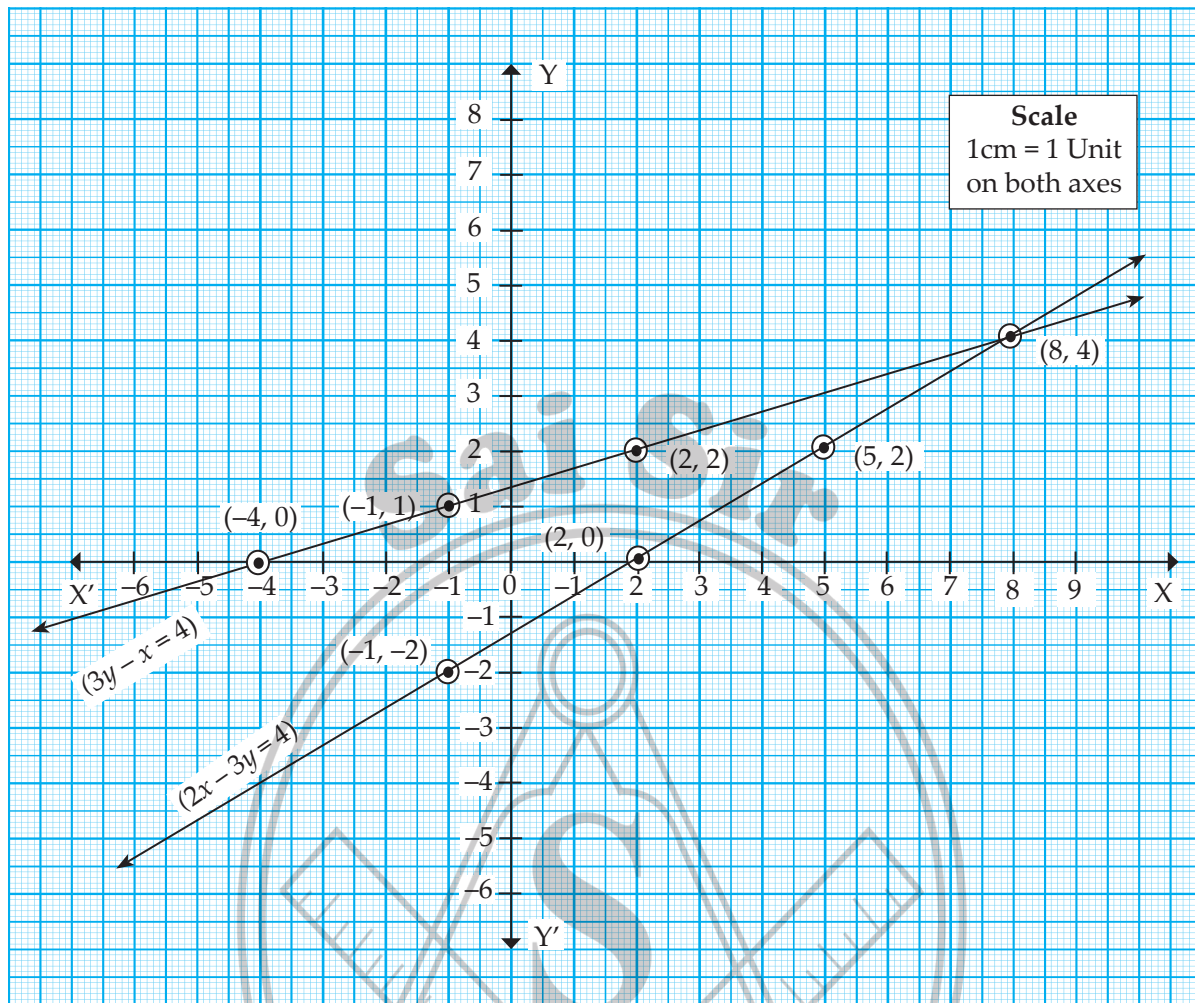
$$\therefore x = -1$$

when $y = 2$

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

$$\therefore x = 6 - 4$$

$$\therefore x = 2$$



The lines of the two given simultaneous equations intersect each other at (8, 4)

∴ The solution of given simultaneous equations is (8,4) i.e. $x = 8, y = 4$

Problem Set - 1 (Textbook Page No. 27)

- (3) Solve the following simultaneous equations by using Graphical method. (4 marks)

(i) $2x + 3y = 12$; $x - y = 1$

Solution:

$$2x + 3y = 12, \quad 2x = 12 - 3y \quad \therefore x = \frac{12 - 3y}{2}$$

x	6	3	0
y	0	2	4
(x, y)	(6, 0)	(3, 2)	(0, 4)

When $y = 0$

$$\therefore x = \frac{12 - 3(0)}{2}$$

$$\therefore x = \frac{12 - 0}{2}$$

$$\therefore x = \frac{12}{2}$$

$$\therefore x = 6$$

When $y = 2$

$$\therefore x = \frac{12 - 3(2)}{2}$$

$$\therefore x = \frac{12 - 6}{2}$$

$$\therefore x = \frac{6}{2}$$

$$\therefore x = 3$$

When $y = 4$

$$\therefore x = \frac{12 - 3(4)}{2}$$

$$\therefore x = \frac{12 - 12}{2}$$

$$\therefore x = \frac{0}{2}$$

$$\therefore x = 0$$

$$x - y = 1 \quad \text{i.e.} \quad y = x - 1$$

x	0	1	2
y	-1	0	1
(x, y)	(0, -1)	(1, 0)	(2, 1)

When $x = 0$

$$\therefore y = x - 1$$

$$\therefore y = 0 - 1$$

$$\therefore y = -1$$

When $x = 1$

$$\therefore y = x - 1$$

$$\therefore y = 1 - 1$$

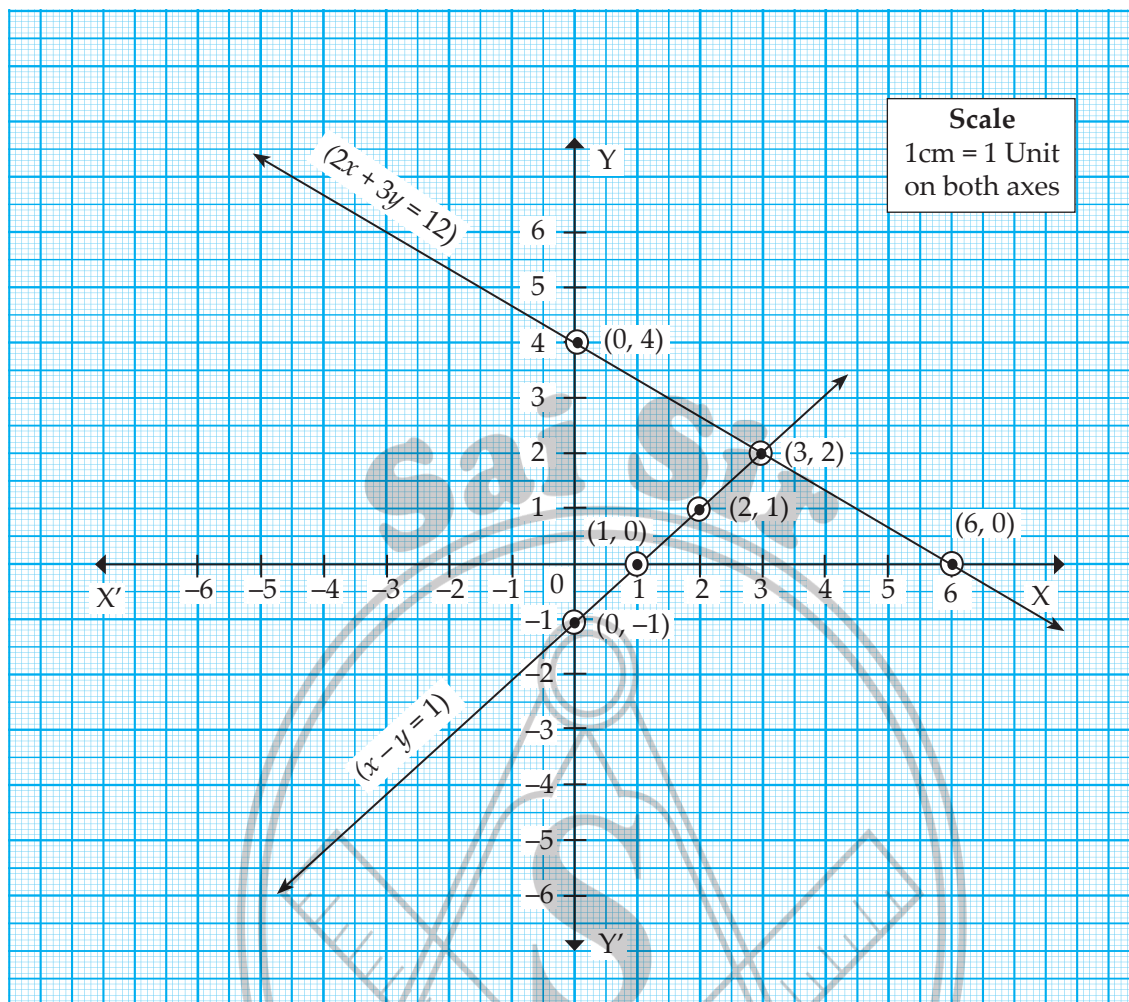
$$\therefore y = 0$$

When $x = 2$

$$\therefore y = x - 1$$

$$\therefore y = 2 - 1$$

$$\therefore y = 1$$



The lines of the two given simultaneous equations intersect each other at (3, 2)

∴ $x = 3, y = 2$ is the solution of the given simultaneous equations.

(ii) $x - 3y = 1$; $3x - 2y + 4 = 0$

Solution:

$$x - 3y = 1 \quad ; \quad x = 1 + 3y$$

x	1	4	7
y	0	1	2
(x, y)	(1, 0)	(4, 1)	(7, 2)

When $y = 0$

$$x = 1 + 3y$$

$$\therefore x = 1 + 3(0)$$

$$\therefore x = 1 + 0$$

$$\therefore x = 1$$

When $y = 1$

$$x = 1 + 3y$$

$$\therefore x = 1 + 3(1)$$

$$\therefore x = 1 + 3$$

$$\therefore x = 4$$

When $y = 2$

$$x = 1 + 3y$$

$$\therefore x = 1 + 3(2)$$

$$\therefore x = 1 + 6$$

$$\therefore x = 7$$

$$3x - 2y + 4 = 0 \quad \text{i.e.} \quad 2y = 3x + 4 \quad \therefore y = \frac{3x+4}{2}$$

x	0	1	2
y	2	3.5	5
(x, y)	(0, 2)	(1, 3.5)	(2, 5)

When $x = 0$

$$y = \frac{3x+4}{2}$$

$$\therefore y = \frac{3(0)+4}{2}$$

$$\therefore y = \frac{0+4}{2}$$

$$\therefore y = \frac{4}{2}$$

$$\therefore y = 2$$

When $x = 2$

$$y = \frac{3x+4}{2}$$

$$\therefore y = \frac{3(2)+4}{2}$$

$$\therefore y = \frac{6+4}{2}$$

$$\therefore y = \frac{10}{2}$$

$$\therefore y = 5$$

When $x = 1$

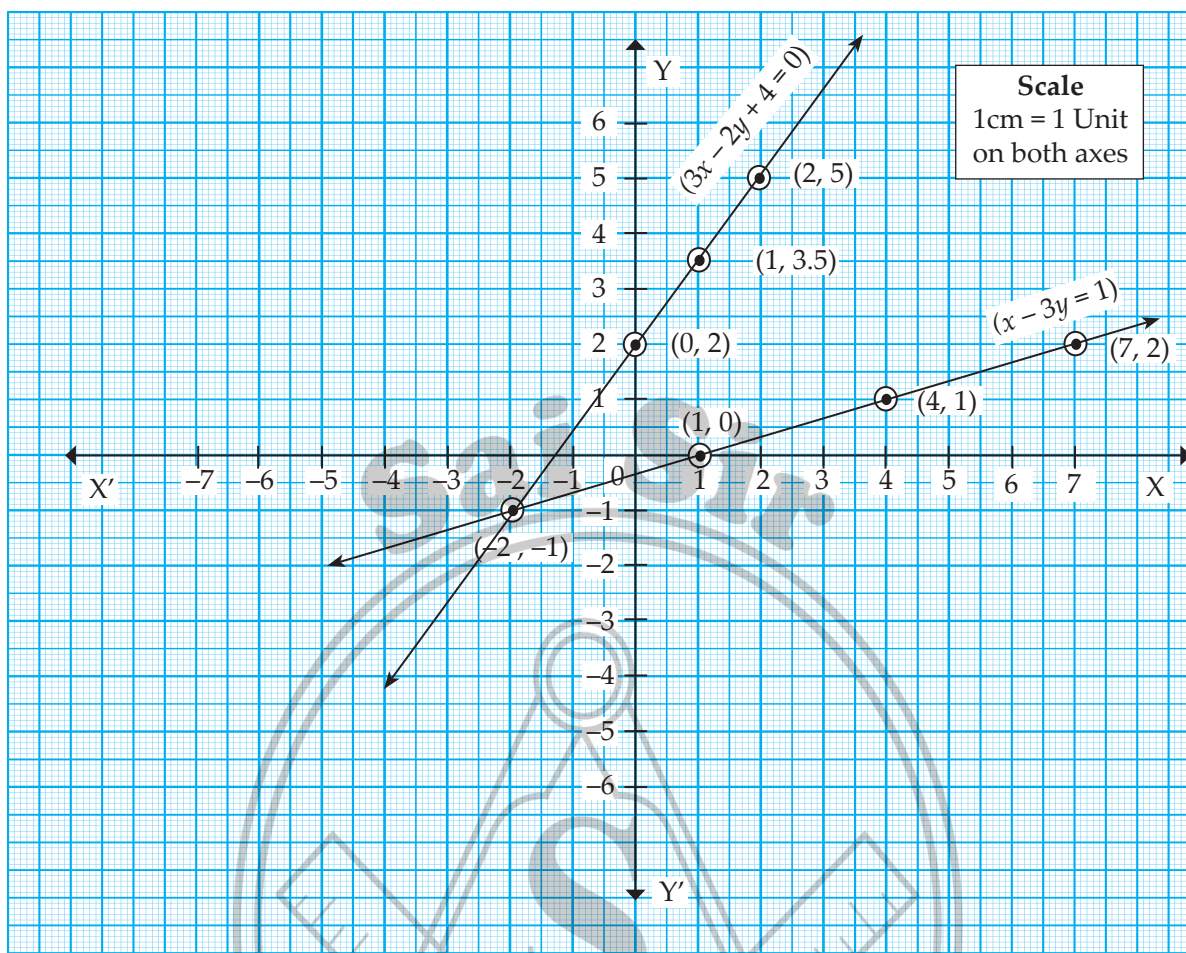
$$y = \frac{3x+4}{2}$$

$$\therefore y = \frac{3(1)+4}{2}$$

$$\therefore y = \frac{3+4}{2}$$

$$\therefore y = \frac{7}{2}$$

$$\therefore y = 3.5$$



The lines of the two given simultaneous equations intersect each other at $(-2, -1)$

$\therefore x = -2$ and $y = -1$ is the solution of given simultaneous equations.

(iii) $5x - 6y + 30 = 0$; $5x + 4y - 20 = 0$ (4 marks)

Solution:

$$5x - 6y + 30 = 0 \text{ i.e. } 5x = 6y - 30 \therefore x = \frac{6y - 30}{5}$$

x	-6	0	6
y	0	5	10
(x, y)	$(-6, 0)$	$(0, 5)$	$(6, 10)$

When $y = 0$

$$x = \frac{6(0) - 30}{5}$$

$$\therefore x = \frac{0 - 30}{5}$$

$$\therefore x = \frac{-30}{5}$$

$$\therefore x = -6$$

When $y = 10$

$$x = \frac{6(10) - 30}{5}$$

When $y = 5$

$$x = \frac{6(5) - 30}{5}$$

$$\therefore x = \frac{30 - 30}{5}$$

$$\therefore x = \frac{0}{5}$$

$$\therefore x = 0$$

$$\therefore x = \frac{60 - 30}{5}$$

$$\therefore x = \frac{30}{5}$$

$$\therefore x = 6$$

$$5x + 4y - 20 = 0 \text{ i.e. } y = \frac{20 - 5x}{4}$$

x	0	4	-4
y	5	0	10
(x, y)	$(0, 5)$	$(4, 0)$	$(-4, 10)$

When $x = 0$

$$y = \frac{20 - 5x}{4}$$

$$\therefore y = \frac{20 - 5(0)}{4}$$

$$\therefore y = \frac{20}{4}$$

$$\therefore y = 5$$

When $x = 4$

$$y = \frac{20 - 5x}{4}$$

$$\therefore y = \frac{20 - 5(4)}{4}$$

$$\therefore y = \frac{20 - 20}{4}$$

$$\therefore y = \frac{0}{4}$$

$$\therefore y = 0$$

When $x = -4$

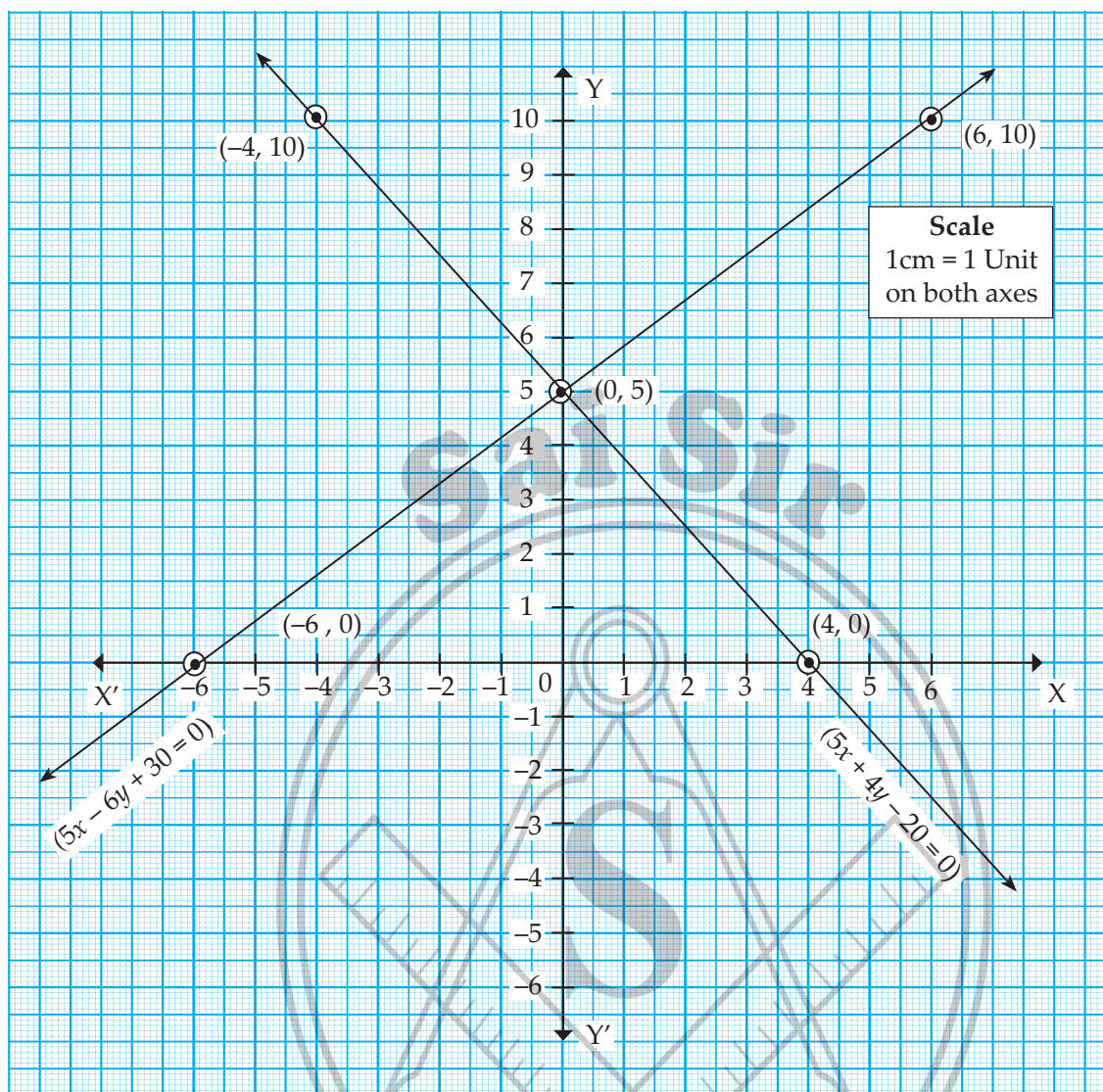
$$y = \frac{20 - 5x}{4}$$

$$\therefore y = \frac{20 - 5(-4)}{4}$$

$$\therefore y = \frac{20 + 20}{4}$$

$$\therefore y = \frac{40}{4}$$

$$\therefore y = 10$$



The lines of the two given simultaneous equations intersect each other at (0, 5)

∴ **$x = 0$ and $y = 5$ is the solution of given simultaneous equations.**

(iv) $3x - y - 2 = 0$; $2x + y = 8$

(4 marks)

Solution:

$3x - y - 2 = 0$ i.e. $y = 3x - 2$

x	0	1	2
y	-2	1	4
(x, y)	(0, -2)	(1, 1)	(2, 4)

When $x = 0$

$y = 3x - 2$

∴ $y = 3(0) - 2$

∴ $y = 0 - 2$

∴ $y = -2$

When $x = 2$

$y = 3x - 2$

∴ $y = 3(2) - 2$

∴ $y = 6 - 2$

∴ $y = 4$

When $x = 1$

∴ $y = 3x - 2$

∴ $y = 3(1) - 2$

∴ $y = 3 - 2$

∴ $y = 1$

$2x + y = 8$ i.e. $y = 8 - 2x$

x	0	1	2
y	8	6	4
(x, y)	(0, 8)	(1, 6)	(2, 4)

When $x = 0$

$y = 8 - 2x$

∴ $y = 8 - 2(0)$

∴ $y = 8 - 0$

∴ $y = 8$

When $x = 2$

$y = 8 - 2x$

∴ $y = 8 - 2(2)$

∴ $y = 8 - 4$

∴ $y = 4$

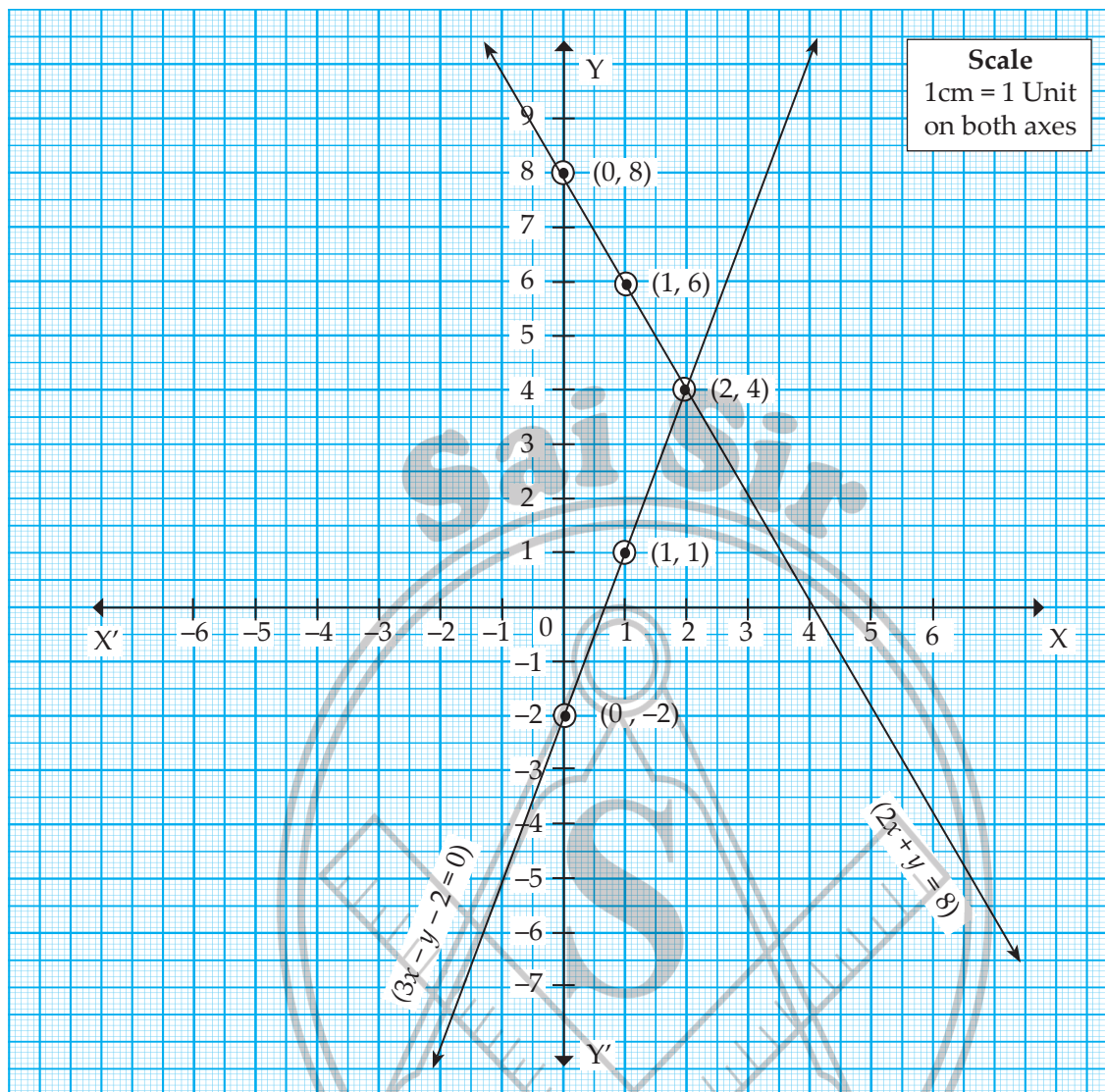
When $x = 1$

$y = 8 - 2x$

∴ $y = 8 - 2(1)$

∴ $y = 8 - 2$

∴ $y = 6$



The lines of the two given simultaneous equations intersect each other at (2, 4)

∴ $x = 2, y = 4$ is the solution of given simultaneous equations.

(v) $3x + y = 10$; $x - y = 2$

(4 marks)

Solution:

$$3x + y = 10 \text{ i.e. } y = 10 - 3x$$

x	1	2	3
y	7	4	1
(x, y)	(1, 7)	(2, 4)	(3, 1)

When $x = 1$

$$y = 10 - 3x$$

$$\therefore y = 10 - 3(1)$$

$$\therefore y = 10 - 3$$

$$\therefore y = 7$$

When $x = 2$

$$y = 10 - 3x$$

$$\therefore y = 10 - 3(2)$$

$$\therefore y = 10 - 6$$

$$\therefore y = 4$$

When $x = 3$

$$y = 10 - 3x$$

$$\therefore y = 10 - 3(3)$$

$$\therefore y = 10 - 9$$

$$\therefore y = 1$$

$$x - y = 2 \text{ i.e. } y = x - 2$$

x	0	1	2
y	-2	-1	0
(x, y)	(0, -2)	(1, -1)	(2, 0)

When $x = 0$

$$y = x - 2$$

$$\therefore y = 0 - 2$$

$$\therefore y = -2$$

When $x = 1$

$$y = x - 2$$

$$\therefore y = 1 - 2$$

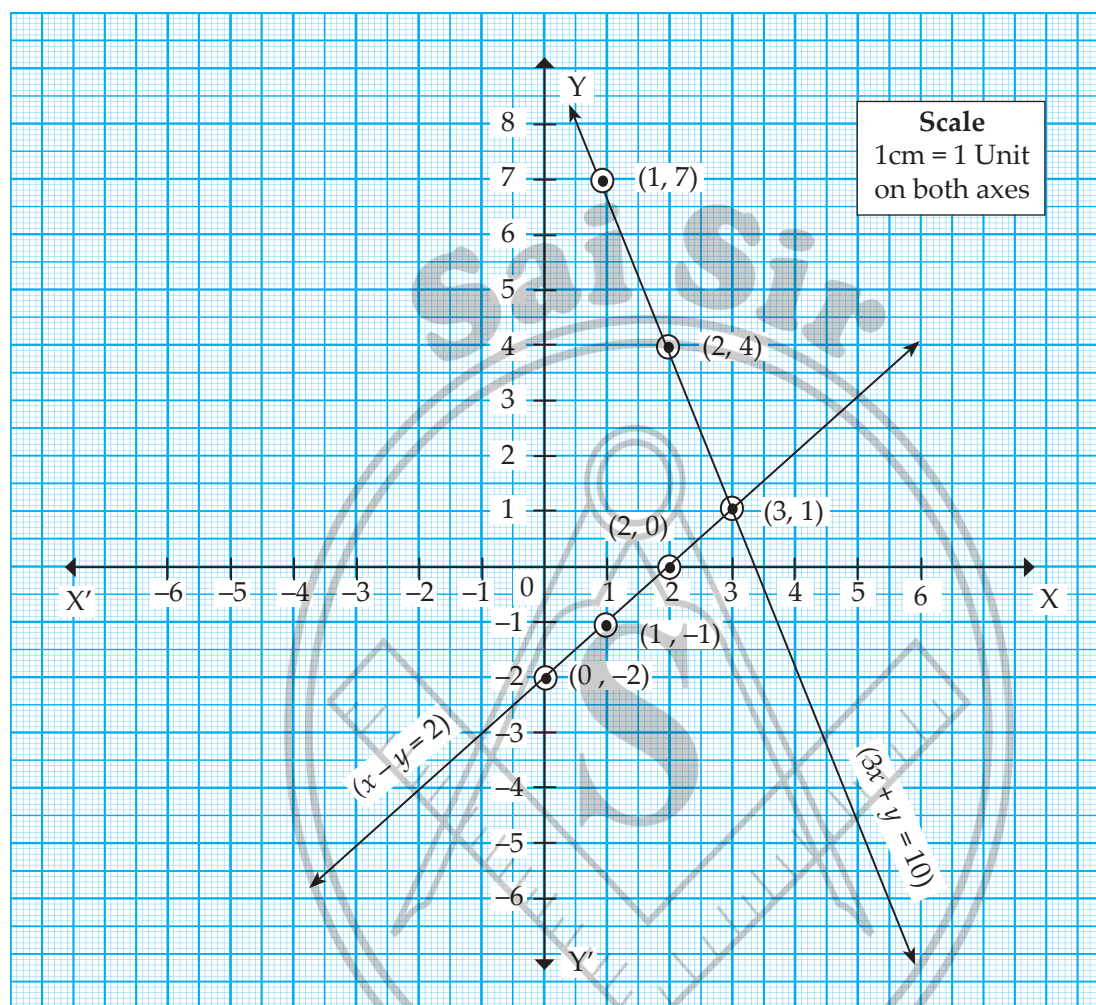
$$\therefore y = -1$$

When $x = 2$

$$y = x - 2$$

$$\therefore y = 2 - 2$$

$$\therefore y = 0$$



The lines of the two given simultaneous equations intersect each other at $(3, 1)$

$\therefore x = 3$ and $y = 1$ is the solution of given simultaneous equations.



Points to Remember:

- (1) To solve simultaneous equations $x + 2y = 4$; $3x + 6y = 12$ graphically, following are the ordered pairs. Plotting the above ordered pairs, graph is drawn. Observe it and find answers of the following questions:

(Textbook Page No. 9)

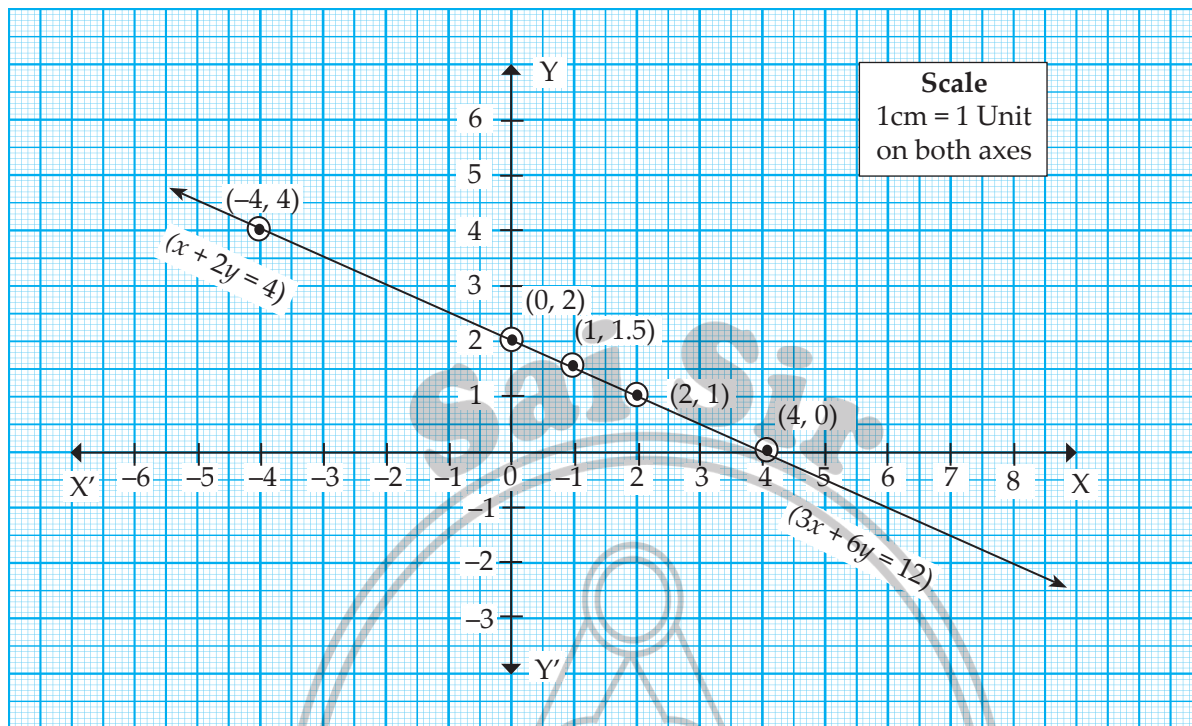
$$x + 2y = 4; x = 4 - 2y$$

$$3x + 6y = 12; 6y = 12 - 3x$$

$$\therefore y = \frac{12 - 3x}{6}$$

x	4	2	0
y	0	1	2
(x, y)	(4, 0)	(2, 1)	(0, 2)

x	-4	1	4
y	4	1.5	0
(x, y)	(-4, 4)	(1, 1.5)	(4, 0)



- (i) Are the graphs of both the equations different or same?

Ans. The graphs of both the equations are same.

- (ii) What are the solutions of the two equations $x + 2y = 4$ and $3x + 6y = 12$? How many solutions are possible?

Ans. Infinite solutions are possible.

- (iii) What are the relations between coefficients of x , coefficients of y and constant terms in both the equations?

Ans. When equation (i) is multiplied by 3 we get equation (ii).

- (iv) What conclusion can you draw when two equations are given but the graph is only one line?

Ans. The simultaneous equations of above type are consistent and will have infinity many solutions..

- (2) Draw graphs of $x - 2y = 4$, $2x - 4y = 12$ on the same co-ordinate plane. Observe it. Think of the solutions of the given equations. (Textbook page no. 10)

$$x - 2y = 4 ;$$

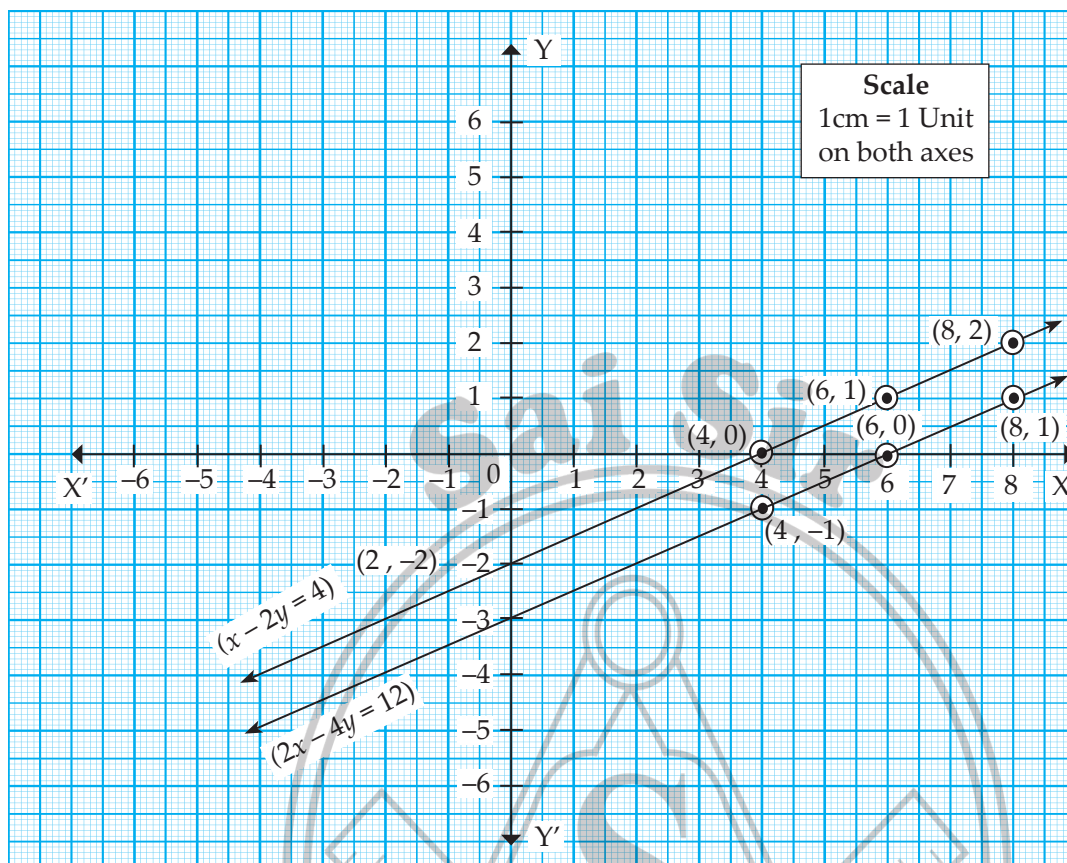
$$2x - 4y = 12$$

$$\therefore 2x = 12 + 4y$$

$$\therefore x = \frac{12 + 4y}{2}$$

x	4	6	8
y	0	1	2
(x, y)	(4, 0)	(6, 1)	(8, 2)

x	6	8	4
y	0	1	-1
(x, y)	(6, 0)	(8, 1)	(4, -1)



The lines represented by given simultaneous equations are parallel. Thus the given simultaneous equations will not have a common solution.

Determinant:

If a, b, c and d are any four numbers, the value

$ad - bc$ is represented as $\begin{vmatrix} a & b \\ c & d \end{vmatrix}$

This type of representation of the numbers is called as determinant of order two as it has two rows and two columns.

The value of the determinant $\begin{vmatrix} a & b \\ c & d \end{vmatrix} = ad - bc$

To name determinants, generally English capital letters such as A, B, C, D ... are used.

Determinant method (Cramer's rule):

Let the given simultaneous equations be:

$$a_1 x + b_1 y = c_1 \text{ and } a_2 x + b_2 y = c_2,$$

Where a_1, a_2, b_1, b_2, c_1 and c_2 are the real numbers such that $a_1 b_2 - a_2 b_1 \neq 0$ and x and y are variables. Let us solve these equations by equating the coefficients:

$$a_1 x + b_1 y = c_1 \quad \dots(i)$$

$$a_2 x + b_2 y = c_2 \quad \dots(ii)$$

Multiplying (i) by b_2

and (ii) by b_1 ,

$$a_1 b_2 x + b_1 b_2 y = c_1 b_2 \quad \dots(iii)$$

$$a_2 b_1 x + b_1 b_2 y = c_2 b_1 \quad \dots(iv)$$

Subtracting (iv) from (iii),

$$\begin{array}{rcl} a_1 b_2 x & + & b_1 b_2 y = c_1 b_2 \\ a_2 b_1 x & + & b_1 b_2 y = c_2 b_1 \\ \hline (a_1 b_2 - a_2 b_1) x & = & c_1 b_2 - c_2 b_1 \\ \therefore x = \frac{c_1 b_2 - c_2 b_1}{a_1 b_2 - a_2 b_1} & \dots & (v) \end{array}$$

Similarly we get,

$$y = \frac{a_1 c_2 - a_2 c_1}{a_1 b_2 - a_2 b_1} \quad \dots(vi)$$

From (v) and (vi), we can write the value of x and y in determinant form as follows:

$$x = \frac{c_1 b_2 - c_2 b_1}{a_1 b_2 - a_2 b_1} = \frac{\begin{vmatrix} c_1 & b_1 \\ c_2 & b_2 \end{vmatrix}}{\begin{vmatrix} a_1 & b_1 \\ a_2 & b_2 \end{vmatrix}}$$

$$y = \frac{a_1 c_2 - a_2 c_1}{a_1 b_2 - a_2 b_1} = \frac{\begin{vmatrix} a_1 & c_1 \\ a_2 & c_2 \end{vmatrix}}{\begin{vmatrix} a_1 & b_1 \\ a_2 & b_2 \end{vmatrix}}, (a_1 b_2 - a_2 b_1) \neq 0$$

We denote,

$$D = \begin{vmatrix} a_1 & b_1 \\ a_2 & b_2 \end{vmatrix}, Dx = \begin{vmatrix} c_1 & b_1 \\ c_2 & b_2 \end{vmatrix} \text{ and } Dy = \begin{vmatrix} a_1 & c_1 \\ a_2 & c_2 \end{vmatrix}$$

$$\therefore x = \frac{Dx}{D} \text{ and } y = \frac{Dy}{D}$$

This method of obtaining solution of simultaneous equations by using determinants is known as **Cramer's rule**:

- Steps for solving simultaneous equations using Cramer's rule are as follows:

Step I: Write the given equations in the form of $ax + by = c$

Step II: Find the value of D , Dx and Dy

Step III: Now apply Cramer's rule to get the value of x and y .

$$x = \frac{Dx}{D} \text{ and } y = \frac{Dy}{D}$$

- Activity 1 : Fill in the blanks to solve simultaneous equations using Cramer's rule.**

(1) $y + 2x - 19 = 0$; $2x - 3y + 3 = 0$ (Textbook Pg. No. 14)

Solution:

By writing the equation in the form of $ax + by = c$

$$2x + y = 19$$

$$2x - 3y = -3$$

$$D = \begin{vmatrix} 2 & 1 \\ 2 & -3 \end{vmatrix}$$

$$= [2 \times (-3)] - [2 \times 1]$$

$$= -6 - 2$$

$$= -8$$

$$Dx = \begin{vmatrix} 19 & 1 \\ -3 & -3 \end{vmatrix}$$

$$= [19 \times (-3)] - [-3 \times 1]$$

$$= -57 - (-3)$$

$$= -54$$

$$Dy = \begin{vmatrix} 2 & 19 \\ 2 & -3 \end{vmatrix}$$

$$= 2 \times (-3) - 2 \times 19$$

$$= -6 - 38$$

$$= -44$$

By Cramer's rule

$$x = \frac{Dx}{D}$$

$$x = \frac{-54}{-8}$$

$$\therefore x = 6.75$$

$$y = \frac{Dy}{D}$$

$$y = \frac{-44}{-8}$$

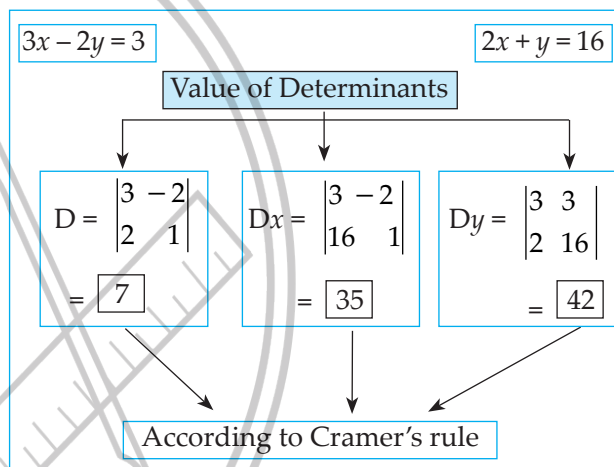
$$\therefore y = 5.5$$

$\therefore (x, y) = (6.75, 5.5)$ is the solution of given simultaneous equations.

- Activity 2 : Complete the following activity.**

(Textbook Page No. 15)

Solution:



$$x = \frac{35}{7}$$

$$\therefore x = 5$$

$$y = \frac{42}{7}$$

$$\therefore y = 6$$

$\therefore (x, y) = (5, 6)$ is the solution.

- Let's think :** (Textbook Page No. 16)

- What is the nature of solution if $D = 0$?
- What can you say about lines if common solution is not possible?

Ans. If $D = 0$, then there is no common solution possible.

$D = 0$ means $a_1b_2 - a_2b_1 = 0$ i.e. $\frac{a_1}{a_2} = \frac{b_1}{b_2}$, for this condition. There are two possibilities.

- If $\frac{a_1}{a_2} = \frac{b_1}{b_2} = \frac{c_1}{c_2}$ then the given simultaneous equations will have infinitely many solutions.

The lines represented by them are overlapping.

(iii) If $\frac{a_1}{b_2} = \frac{b_1}{b_2} \neq \frac{c_1}{c_2}$ then the given simultaneous equations will have no solution. The lines represented by them are parallel.

Practice Set - 1.3 (Textbook Page No. 16)

(1) Fill in the blanks with correct number.

$$\begin{vmatrix} 3 & 2 \\ 4 & 5 \end{vmatrix} = 3 \times \square - \square \times 4 \quad (1 \text{ mark})$$

$$= \square - 8$$

$$= \square$$

Solution:

$$\begin{vmatrix} 3 & 2 \\ 4 & 5 \end{vmatrix} = 3 \times \square - \square \times 4$$

$$= \square - 8$$

$$= \square$$

(2) Find the values of the following determinants.

(i) $\begin{vmatrix} -1 & 7 \\ 2 & 4 \end{vmatrix}$ (1 mark)

Solution:

$$\begin{vmatrix} -1 & 7 \\ 2 & 4 \end{vmatrix}$$

$$= (-1 \times 4) - (7 \times 2)$$

$$= -4 - 14$$

$$= \square$$

(ii) $\begin{vmatrix} 5 & 3 \\ -7 & 0 \end{vmatrix}$

Solution:

$$\begin{vmatrix} 5 & 3 \\ -7 & 0 \end{vmatrix}$$

$$= (-5 \times 0) - (3 \times -7)$$

$$= 0 - (-21)$$

$$= 0 + 21$$

$$= \square$$

(iii) $\begin{vmatrix} \frac{7}{3} & \frac{5}{3} \\ \frac{3}{2} & \frac{1}{2} \end{vmatrix}$

Solution:

$$\begin{vmatrix} \frac{7}{3} & \frac{5}{3} \\ \frac{3}{2} & \frac{1}{2} \end{vmatrix}$$

$$\begin{vmatrix} \frac{7}{3} & \frac{5}{3} \\ \frac{3}{2} & \frac{1}{2} \end{vmatrix}$$

$$= \left(\frac{7}{3} \times \frac{1}{2} \right) - \left(\frac{5}{3} \times \frac{3}{2} \right)$$

$$= \frac{7}{6} - \frac{15}{6}$$

$$= \frac{7-15}{6}$$

$$= \frac{-8}{6}$$

$$= \frac{-4}{3}$$

Problem Set- 1 (Textbook Page No. 27)

(4) Find the value of the following determinants.

(i) $\begin{vmatrix} 4 & 3 \\ 2 & 7 \end{vmatrix}$ (1 mark)

Solution:

$$\begin{vmatrix} 4 & 3 \\ 2 & 7 \end{vmatrix}$$

$$= (4 \times 7) - (3 \times 2)$$

$$= 28 - 6$$

$$= \square$$

(ii) $\begin{vmatrix} 5 & -2 \\ -3 & 1 \end{vmatrix}$ (1 mark)

Solution:

$$\begin{vmatrix} 5 & -2 \\ -3 & 1 \end{vmatrix}$$

$$= (5 \times 1) - [(-2 \times -3)]$$

$$= 5 - 6$$

$$= \square$$

(iii) $\begin{vmatrix} 3 & -1 \\ 1 & 4 \end{vmatrix}$ (1 mark)

Solution:

$$\begin{vmatrix} 3 & -1 \\ 1 & 4 \end{vmatrix}$$

$$= (3 \times 4) - (-1 \times 1)$$

$$= 12 - (-1)$$

$$= 12 + 1$$

$$= \square$$

Practice Set - 1.3 (Textbook Page No. 16)

(3) Solve the following simultaneous equations using Cramer's rule.

(i) $3x - 4y = 10$; $4x + 3y = 5$ (3 marks)

Solution:

$$3x - 4y = 10 \quad \dots(i)$$

$$4x + 3y = 5 \quad \dots(ii)$$

$$\begin{aligned} D &= \begin{vmatrix} 3 & -4 \\ 4 & 3 \end{vmatrix} \\ &= (3 \times 3) - (-4 \times 4) \\ &= 9 - (-16) \\ &= 9 + 16 \end{aligned}$$

$$\therefore D = 25$$

$$\begin{aligned} D_x &= \begin{vmatrix} 10 & -4 \\ 5 & 3 \end{vmatrix} \\ &= (10 \times 3) - (-4 \times 5) \\ &= 30 - (-20) \\ &= 30 + 20 \end{aligned}$$

$$\therefore D_x = 50$$

$$\begin{aligned} D_y &= \begin{vmatrix} 3 & 10 \\ 4 & 5 \end{vmatrix} \\ &= (3 \times 5) - (10 \times 4) \\ &= 15 - 40 \end{aligned}$$

$$\therefore D_y = -25$$

By Cramer's rule

$$x = \frac{D_x}{D} = \frac{50}{25} = 2 \text{ and}$$

$$y = \frac{D_y}{D} = \frac{-25}{25} = -1$$

$\therefore x = 2 \text{ and } y = -1 \text{ is the solution of the given simultaneous equations.}$

$$(ii) \quad 4x + 3y - 4 = 0; \quad 6x = 8 - 5y \quad (3 \text{ marks})$$

Solution:

$$4x + 3y - 4 = 0$$

$$\therefore 4x + 3y = 4 \quad \dots(i)$$

$$6x = 8 - 5y$$

$$\therefore 6x + 5y = 8 \quad \dots(ii)$$

$$\begin{aligned} D &= \begin{vmatrix} 4 & 3 \\ 6 & 5 \end{vmatrix} \\ &= (4 \times 5) - (3 \times 6) \\ &= 20 - 18 \end{aligned}$$

$$\therefore D = 2$$

$$\begin{aligned} D_x &= \begin{vmatrix} 4 & 3 \\ 8 & 5 \end{vmatrix} \\ &= (4 \times 5) - (3 \times 8) \\ &= 20 - 24 \end{aligned}$$

$$\therefore D_x = -4$$

$$\begin{aligned} D_y &= \begin{vmatrix} 4 & 4 \\ 6 & 8 \end{vmatrix} \\ &= (4 \times 8) - (4 \times 6) \\ &= 32 - 24 \end{aligned}$$

$$\therefore D_y = 8$$

By Cramer's rule

$$x = \frac{D_x}{D} = \frac{-4}{2} = -2 \text{ and}$$

$$y = \frac{D_y}{D} = \frac{8}{2} = 4$$

$\therefore x = -2 \text{ and } y = 4 \text{ is the solution of the given simultaneous equations.}$

$$(iii) \quad x + 2y = -1; \quad 2x - 3y = 12 \quad (3 \text{ marks})$$

Solution:

$$x + 2y = -1 \quad \dots(i)$$

$$2x - 3y = 12 \quad \dots(ii)$$

$$\begin{aligned} D &= \begin{vmatrix} 1 & 2 \\ 2 & -3 \end{vmatrix} \\ &= (1 \times -3) - (2 \times 2) \\ &= -3 - 4 \end{aligned}$$

$$\therefore D = -7$$

$$\begin{aligned} D_x &= \begin{vmatrix} -1 & 2 \\ 12 & -3 \end{vmatrix} \\ &= (-1 \times -3) - (2 \times 12) \\ &= 3 - 24 \end{aligned}$$

$$\therefore D_x = -21$$

$$\begin{aligned} D_y &= \begin{vmatrix} 1 & -1 \\ 2 & 12 \end{vmatrix} \\ &= (1 \times 12) - (-1 \times 2) \\ &= 12 - (-2) \\ &= 12 + 2 \end{aligned}$$

$$\therefore D_y = 14$$

By Cramer's rule

$$x = \frac{D_x}{D} = \frac{-21}{-7} = 3 \text{ and}$$

$$y = \frac{D_y}{D} = \frac{14}{-7} = -2$$

$\therefore x = 3 \text{ and } y = -2 \text{ is the solution of the given simultaneous equations.}$

Problem Set - 1 (Textbook Page No. 28)

- (5) Solve the following simultaneous equations using Cramer's method.

(i) $6x - 3y = -10$; $3x + 5y - 8 = 0$ (4 marks)

Solution:

$$6x - 3y = -10 \quad \dots (i)$$

Expressing the given equation $3x + 5y - 8 = 0$ in the form $ax + by = c$ we get,

$$3x + 5y = 8 \quad \dots (ii)$$

$$D = \begin{vmatrix} 6 & -3 \\ 3 & 5 \end{vmatrix}$$

$$\therefore = (6 \times 5) - (-3 \times 3)$$

$$\therefore = 30 - (-9)$$

$$\therefore = 30 + 9$$

$$\therefore D = 39$$

$$D_x = \begin{vmatrix} -10 & -3 \\ 8 & 5 \end{vmatrix}$$

$$= (-10 \times 5) - (-3 \times 8)$$

$$= -50 - (-24)$$

$$= -50 + 24$$

$$\therefore D_x = -26$$

$$D_y = \begin{vmatrix} 6 & -10 \\ 3 & 8 \end{vmatrix}$$

$$= (6 \times 8) - (-10 \times 3)$$

$$= 48 - (-30)$$

$$= 48 + 30$$

$$\therefore D_y = 78$$

By Cramer's rule

$$x = \frac{D_x}{D} = \frac{-26}{39} = \frac{-2}{3} \text{ and}$$

$$y = \frac{D_y}{D} = \frac{78}{39} = 2$$

$$\therefore x = \frac{-2}{3} \text{ and } y = 2 \text{ is the solution of the given simultaneous equations.}$$

(ii) $4m - 2n = -4$; $4m + 3n = 16$ (4 marks)

Solution:

$$4m - 2n = -4 \text{ ; } 4m + 3n = 16$$

$$D = \begin{vmatrix} 4 & -2 \\ 4 & 3 \end{vmatrix}$$

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

$$= 12 - (-8)$$

$$= 12 + 8$$

$$\therefore D = 20$$

$$D_m = \begin{vmatrix} -4 & -2 \\ 16 & 3 \end{vmatrix}$$

$$= (-4 \times 3) - (-2 \times 16)$$

$$= -12 - (-32)$$

$$= -12 + 32$$

$$\therefore D_m = 20$$

$$D_n = \begin{vmatrix} 4 & -4 \\ 4 & 16 \end{vmatrix}$$

$$= (4 \times 16) - (-4 \times 4)$$

$$= 64 - (-16)$$

$$= 64 + 16$$

$$\therefore D_n = 80$$

By Cramer's rule

$$m = \frac{D_m}{D} = \frac{20}{20} = 1$$

and

$$n = \frac{D_n}{D} = \frac{80}{20} = 4$$

$$\therefore m = 1 \text{ and } n = 4 \text{ is the solution of given simultaneous equations.}$$

(iv) $7x + 3y = 15$; $12y - 5x = 39$ (4 marks)

Solution:

$$7x + 3y = 15 \quad \dots (i)$$

Expressing the equation $12y - 5x = 39$ in the form of $ax + by = c$, we get

$$-5x + 12y = 39 \quad \dots (ii)$$

$$D = \begin{vmatrix} 7 & 3 \\ -5 & 12 \end{vmatrix}$$

$$= (7 \times 12) - (3 \times -5)$$

$$= 84 - (-15)$$

$$= 84 + 15$$

$$\therefore D = 99$$

$$D_x = \begin{vmatrix} 15 & 3 \\ 39 & 12 \end{vmatrix}$$

$$= (15 \times 12) - (3 \times 39)$$

$$= 180 - 117$$

$$\therefore D_x = 63$$

$$D_y = \begin{vmatrix} 7 & 15 \\ -5 & 39 \end{vmatrix}$$

$$= (7 \times 39) - (15 \times -5)$$

$$= 273 - (-75)$$

$$= 273 + 75$$

$$\therefore D_y = 348$$

By Cramer's rule

$$x = \frac{D_x}{D} = \frac{63}{99} = \frac{7}{11} \text{ and}$$

$$y = \frac{D_y}{D} = \frac{348}{99} = \frac{116}{33}$$

$$\therefore x = \frac{7}{11} \text{ and } y = \frac{116}{33} \text{ is the solution of the given simultaneous equations.}$$

Practice Set - 1.3 (Textbook Page No. 16)

(3) Solve the following simultaneous equations using Cramer's rule.

(iv) $6x - 4y = -12$; $8x - 3y = -2$ (3 marks)

Solution:

$$6x - 4y = -12 \quad \dots(i)$$

$$8x - 3y = -2 \quad \dots(ii)$$

$$D = \begin{vmatrix} 6 & -4 \\ 8 & -3 \end{vmatrix}$$

$$= (6 \times -3) - [(-4) \times 8]$$

$$= -18 - (-32)$$

$$= -18 + 32$$

$$\therefore D = 14$$

$$D_x = \begin{vmatrix} -12 & -4 \\ -2 & -3 \end{vmatrix}$$

$$= (-12 \times -3) - (-4 \times -2)$$

$$= 36 - 8$$

$$\therefore D_x = 28$$

$$D_y = \begin{vmatrix} 6 & -12 \\ 8 & -2 \end{vmatrix}$$

$$= (6 \times -2) - (-12 \times 8)$$

$$= -12 - (-96)$$

$$= -12 + 96$$

$$\therefore D_y = 84$$

By Cramer's value

$$x = \frac{D_x}{D} = \frac{28}{14} = 2 \text{ and}$$

$$y = \frac{D_y}{D} = \frac{84}{14} = 6$$

$$\therefore x = 2 \text{ and } y = 6 \text{ is the solution of the given simultaneous equations.}$$

(v) $4m + 6n = 54$; $3m + 2n = 28$. (3 marks)

Solution:

$$4m + 6n = 54 \quad \dots(i)$$

$$3m + 2n = 28 \quad \dots(ii)$$

$$D = \begin{vmatrix} 4 & 6 \\ 3 & 2 \end{vmatrix}$$

$$= (4 \times 2) - (6 \times 3)$$

$$= 8 - 18$$

$$\therefore D = -10$$

$$D_m = \begin{vmatrix} 54 & 6 \\ 28 & 2 \end{vmatrix}$$

$$= (54 \times 2) - (6 \times 28)$$

$$= 108 - 168$$

$$\therefore D_m = -60$$

$$D_n = \begin{vmatrix} 4 & 54 \\ 3 & 28 \end{vmatrix}$$

$$= (4 \times 28) - (54 \times 3)$$

$$= 112 - 162$$

$$\therefore D_n = -50$$

By Cramer's rule

$$m = \frac{D_m}{D} = \frac{-60}{-10} = 6 \text{ and}$$

$$n = \frac{D_n}{D} = \frac{-50}{-10} = 5$$

$$\therefore m = 6 \text{ and } n = 5 \text{ is the solution of the given simultaneous equations.}$$

(vi) $2x + 3y = 2$; $x - \frac{y}{2} = \frac{1}{2}$. (3 marks)

Solution:

Method - I

$$2x + 3y = 2 \quad \dots(i)$$

$$x - \frac{y}{2} = \frac{1}{2} \quad \dots(ii)$$

$$D = \begin{vmatrix} 2 & 3 \\ 1 & -\frac{1}{2} \end{vmatrix}$$

$$= \left(2 \times \frac{-1}{2} \right) - (3 \times 1)$$

$$= -1 - 3$$

$$\therefore D = -4$$

$$D_x = \begin{vmatrix} 2 & 3 \\ \frac{1}{2} & -\frac{1}{2} \end{vmatrix}$$

$$= \left(2 \times \frac{-1}{2} \right) - \left(3 \times \frac{1}{2} \right)$$

$$= -1 - \frac{3}{2}$$

$$= \frac{-2-3}{2}$$

$$\therefore D_x = \frac{-5}{2}$$

$$D_y = \begin{vmatrix} 2 & 2 \\ 1 & \frac{1}{2} \end{vmatrix}$$

$$= \left(2 \times \frac{1}{2} \right) - (2 \times 1)$$

$$= 1 - 2$$

$$\therefore D_y = -1$$

By Cramer's rule

$$x = \frac{D_x}{D} = \frac{-\frac{5}{2}}{-4} = \frac{-5}{2} \times \frac{1}{-4} = \frac{5}{8}$$

$$y = \frac{D_y}{D} = \frac{-1}{-4} = \frac{1}{4}$$

$$\therefore x = \frac{5}{8} \text{ and } y = \frac{1}{4} \text{ is the solution of the given simultaneous equations.}$$

Method - II

$$2x + 3y = 2 \quad \dots(i)$$

$$x - \frac{y}{2} = \frac{1}{2} \quad \dots(ii)$$

Multiply both the sides of (ii) by 2, we get

$$\therefore 2x - y = 1 \quad \dots(iii)$$

Now consider $2x + 3y = 2$; $2x - y = 1$

$$D = \begin{vmatrix} 2 & 3 \\ 2 & -1 \end{vmatrix}$$

$$= (2 \times -1) - (3 \times 2)$$

$$= -2 - 6$$

$$\therefore D = -8$$

$$D_x = \begin{vmatrix} 2 & 3 \\ 1 & -1 \end{vmatrix}$$

$$= (2 \times -1) - (3 \times 1)$$

$$= -2 - 3$$

$$\therefore D_x = -5$$

$$D_y = \begin{vmatrix} 2 & 2 \\ 2 & 1 \end{vmatrix}$$

$$= (2 \times 1) - (2 \times 2)$$

$$= 2 - 4$$

$$\therefore D_y = -2$$

By Cramer's rule

$$x = \frac{D_x}{D} = \frac{-5}{-8} = \frac{5}{8} \quad \text{and}$$

$$y = \frac{D_y}{D} = \frac{-2}{-8} = \frac{1}{4}$$

$x = \frac{5}{8}$ and $y = \frac{1}{4}$ is the solution of the given simultaneous equations.

Problem Set - 1 (Textbook Page No. 28)

(5) Solve the following simultaneous equations using Cramer's rule.

(iii) $3x - 2y = \frac{5}{2}$; $\frac{1}{3}x + 3y = \frac{-4}{3}$ (3 marks)

Solution:

$$3x - 2y = \frac{5}{2}; \quad \frac{1}{3}x + 3y = \frac{-4}{3}$$

$$D = \begin{vmatrix} 3 & -2 \\ \frac{1}{3} & 3 \end{vmatrix}$$

$$= (3 \times 3) - \left(-2 \times \frac{1}{3} \right)$$

$$= 9 - \left(-\frac{2}{3} \right)$$

$$= 9 + \frac{2}{3}$$

$$= \frac{27+2}{3}$$

$$\therefore D = \frac{29}{3}$$

$$D_x = \begin{vmatrix} \frac{5}{2} & -2 \\ -\frac{4}{3} & 3 \end{vmatrix}$$

$$= \left(\frac{5}{2} \times 3 \right) - \left[\left(-2 \times \frac{-4}{3} \right) \right]$$

$$= \frac{15}{2} - \left(\frac{8}{3} \right)$$

$$= \frac{45-16}{6}$$

$$\therefore D_x = \frac{29}{6}$$

$$D_y = \begin{vmatrix} 3 & \frac{5}{2} \\ \frac{1}{3} & -\frac{4}{3} \end{vmatrix}$$

$$= \left(3 \times -\frac{4}{3} \right) - \left(\frac{5}{2} \times \frac{1}{3} \right)$$

$$= -4 - \left(\frac{5}{6} \right)$$

$$= \frac{-24-5}{6}$$

$$= \frac{-29}{6}$$

$$\therefore D_y = \frac{-29}{6}$$

By Cramer's rule,

$$x = \frac{D_x}{D} = \frac{\frac{29}{6}}{\frac{29}{3}} = \frac{29}{6} \times \frac{3}{29} = \frac{1}{2} \quad \text{and}$$

$$y = \frac{D_y}{D} = \frac{\frac{-29}{6}}{\frac{29}{3}} = \frac{-29}{6} \times \frac{3}{29} = \frac{-1}{2}$$

$\therefore x = \frac{1}{2}$ and $y = \frac{-1}{2}$ is the solution of given simultaneous equations.

(v) $\frac{x+y-8}{2} = \frac{x+2y-14}{3} = \frac{3x-y}{4}$ (4 marks)

Solution:

$$\frac{x+y-8}{2} = \frac{x+2y-14}{3} = \frac{3x-y}{4}$$

From the above statement we get,

$$\frac{x+y-8}{2} = \frac{x+2y-14}{3}$$

$$\therefore 3(x+y-8) = 2(x+2y-14)$$

$$\therefore 3x+3y-24 = 2x+4y-28$$

$$\therefore 3x-2x+3y-4y = -28+24$$

$$\therefore x-y = -4 \quad \dots(i)$$

$$\text{Similarly } \frac{x+2y-14}{3} = \frac{3x-y}{4}$$

$$\therefore 4(x+2y-14) = 3(3x-y)$$

$$\therefore 4x+8y-56 = 9x-3y$$

$$\therefore 4x-9x+8y+3y = 56$$

$$\therefore -5x+11y = 56 \quad \dots(ii)$$

$$D = \begin{vmatrix} 1 & -1 \\ -5 & 11 \end{vmatrix}$$

$$= (1 \times 11) - [(-1 \times -5)]$$

$$= 11 - (5)$$

$$\therefore D = 6$$

$$D_x = \begin{vmatrix} -4 & -1 \\ 56 & 11 \end{vmatrix}$$

$$= (-4 \times 11) - (-1 \times 56)$$

$$= -44 - (-56)$$

$$= -44 + 56$$

$$\therefore D_x = 12$$

$$D_y = \begin{vmatrix} 1 & -4 \\ -5 & 56 \end{vmatrix}$$

$$= (1 \times 56) - [(-4 \times -5)]$$

$$= 56 - (20)$$

$$\therefore D_y = 36$$

By Cramer's rule

$$x = \frac{D_x}{D} = \frac{12}{6} = 2 \quad \text{and}$$

$$y = \frac{D_y}{D} = \frac{36}{6} = 6$$

$\therefore x = 2$ and $y = 6$ is the solution of given simultaneous equations.



Points to Remember:

- Equation reducible to a pair of linear equations in two variables:

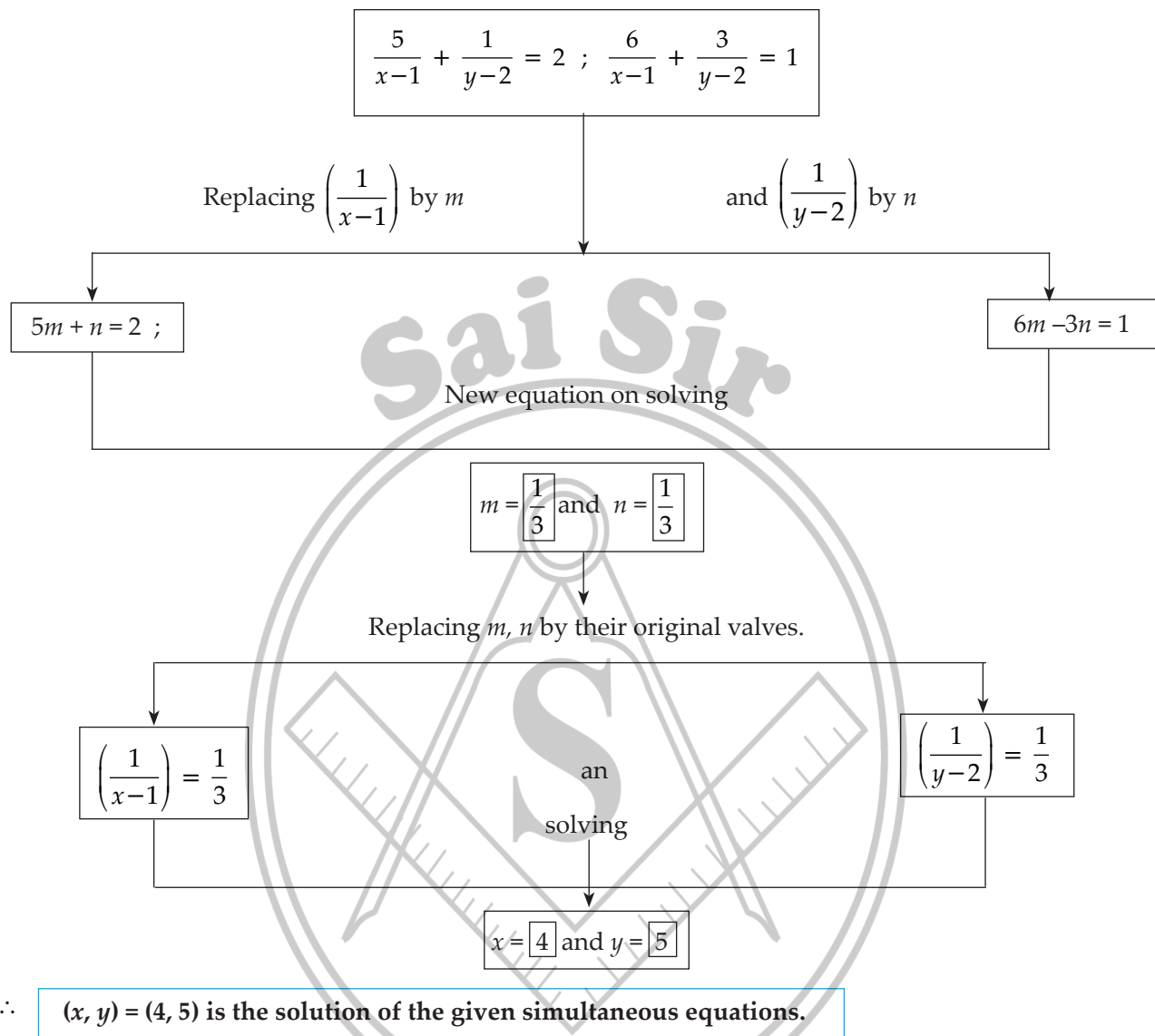
Consider the simultaneous equations

$$\frac{4}{x} + \frac{3}{y} = 1; \quad \frac{8}{x} - \frac{9}{y} = 7$$

($x \neq 0, y \neq 0$) which are not linear. Such equation can be reduced to pair of linear equations by making suitable substitutions

Activity: To solve given equations fill the boxes below suitably.

(Textbook Page No. 19)



Practice Set - 1.4 (Textbook Page No. 19)

(1) Solve the following simultaneous equations.

(i) $\frac{2}{x} - \frac{3}{y} = 15 ; \frac{8}{x} + \frac{5}{y} = 77$ (4 marks)

Solution:

$$\frac{2}{x} - \frac{3}{y} = 15 \quad \dots(i)$$

$$\frac{8}{x} + \frac{5}{y} = 77 \quad \dots(ii)$$

Substituting $\frac{1}{x} = m$ and $\frac{1}{y} = n$ in the above equations, we get

$$2m - 3n = 15 \quad \dots(iii)$$

$$8m + 5n = 77 \quad \dots(iv)$$

Multiplying (iii) by 5 and (iv) by 3, we get,

$$10m - 15n = 75 \quad \dots(v)$$

$$24m + 15n = 231 \quad \dots(vi)$$

Adding (v) and (vi), we get,

$$\begin{array}{r} 10m - 15n = 75 \\ 24m + 15n = 231 \\ \hline 34m = 306 \end{array}$$

$$\therefore m = \frac{306}{34}$$

$$\therefore m = 9$$

Substituting $m = 9$ in (iii) we get

$$2 \times 9 - 3n = 15$$

$$\therefore 18 - 3n = 15$$

$$\therefore -3n = 15 - 18$$

$$\therefore 3n = -3$$

$$\therefore y = 3 - 1$$

$$\therefore y = 2$$

$\therefore$ $x = 1$ and $y = 2$ is the solution of the given simultaneous equations.

(iv) $\frac{7x-2y}{xy} = 5$; $\frac{8x+7y}{xy} = 15$ (4 marks)

Solution:

$$\frac{7x-2y}{xy} = 5 \quad (\text{given})$$

$$\therefore \frac{7x}{xy} - \frac{2y}{xy} = 5$$

$$\therefore \frac{7}{y} - \frac{2}{x} = 5$$

$$\text{i.e. } \frac{-2}{x} + \frac{7}{y} = 5$$

$$\text{Also } \frac{8x+7y}{xy} = 15$$

$$\therefore \frac{8x}{xy} + \frac{7y}{xy} = 15$$

$$\text{i.e. } \frac{7}{x} + \frac{8}{y} = 15$$

Substituting $\frac{1}{x} = m$ and $\frac{1}{y} = n$ in (i) and (ii) we get,

$$-2m + 7n = 5$$

$$7m + 8n = 15$$

Multiplying (iii) by 7 and (iv) by 2 we get,

$$-14m + 49n = 35$$

$$14m + 16n = 30$$

Adding (v) and (vi) we get,

$$-14m + 49n = 35$$

$$14m + 16n = 30$$

$$65n = 65$$

$$\therefore n = \frac{65}{65}$$

$$\therefore n = 1$$

Substituting $n = 1$ in (iv) we get,

$$7m + 8n = 15$$

$$\therefore 7m + 8(1) = 15$$

$$\therefore 7m + 8 = 15$$

$$\therefore 7m = 15 - 8$$

$$\therefore 7m = 7$$

$$\therefore m = \frac{7}{7}$$

$$\therefore m = 1$$

Resubstituting the values of m and n we get,

$$\frac{1}{x} = 1 \text{ and } \frac{1}{y} = 1$$

$$x = 1 \text{ and } y = 1$$

$\therefore$ $x = 1$ and $y = 1$ is the solution of the given simultaneous equations.

Practice Set - 1.4 (Textbook Page No. 19)

(1) Solve the following simultaneous equations.

(iii) $\frac{27}{x-2} + \frac{31}{y+3} = 85$; $\frac{31}{x-2} + \frac{27}{y+3} = 89$

(4 marks)

Solution:

$$\frac{27}{x-2} + \frac{31}{y+3} = 85 \quad \dots(i)$$

$$\frac{31}{x-2} + \frac{27}{y+3} = 89 \quad \dots(ii)$$

$$\text{Substituting } \frac{1}{x-2} = m \text{ and } \frac{1}{y+3} = n$$

in (i) and (ii) we get,

$$27m + 31n = 85 \quad \dots(iii)$$

$$31m + 27n = 89 \quad \dots(iv)$$

Adding (iii) and (iv) we get,

$$27m + 31n = 85$$

$$31m + 27n = 89$$

$$58m + 58n = 174$$

Dividing throughout by 58

$$\therefore m + n = \frac{174}{58}$$

$$m + n = 3$$

$\dots(v)$

Subtracting (iv) from (iii)

$$27m + 31n = 85$$

$$31m + 27n = 89$$

$$(-) \quad (-) \quad (-)$$

$$-4m + 4n = -4$$

Dividing throughout by -4

$$m - n = \frac{-4}{-4}$$

$$\therefore m - n = 1$$

$\dots(vi)$

Adding (v) and (vi), we get

$$m + n = 3$$

$$m - n = 1$$

$$2m = 4$$

$$\therefore m = \frac{4}{2}$$

$$\therefore m = 2$$

Substituting $m = 2$ in (v) we get,

$$m + n = 3$$

$$\therefore 2 + n = 3$$

$$\therefore n = 3 - 2$$

$$\therefore n = 1$$

Resubstituting the values of m and n we get,

$$\frac{1}{x-2} = 2 \text{ and } \frac{1}{y+3} = 1$$

$$\therefore x - 2 = \frac{1}{2} \text{ and } y + 3 = 1$$

$$\therefore x = \frac{1}{2} + 2 \text{ and } y = 1 - 3$$

$$\therefore x = \frac{1+4}{2} \text{ and } y = -2$$

$$\therefore x = \frac{5}{2} \text{ and } y = -2$$

$$\therefore x = \frac{5}{2}, y = -2 \text{ is the solution of the given simultaneous equations.}$$

Problem Set - 1 (Textbook Page No. 28)

(6) Solve the following simultaneous equations.

(ii) $\frac{7}{2x+1} + \frac{13}{y+2} = 27$; $\frac{13}{2x+1} + \frac{7}{y+2} = 33$ (4 marks)

Solution:

$$\frac{7}{2x+1} + \frac{13}{y+2} = 27 \quad \dots(i)$$

$$\frac{13}{2x+1} + \frac{7}{y+2} = 33 \quad \dots(ii)$$

$$\text{Substituting } \frac{1}{2x+1} = m \text{ and } \frac{1}{y+2} = n$$

in (i) and (ii) respectively, we get,

$$7m + 13n = 27 \quad \dots(iii)$$

$$13m + 7n = 33 \quad \dots(iv)$$

Adding (iii) and (iv) we get,

$$\begin{array}{r} 7m + 13n = 27 \\ 13m + 7n = 33 \\ \hline 20m + 20n = 60 \end{array}$$

Dividing throughout by 20,

$$\therefore m + n = \frac{60}{20}$$

$$\therefore m + n = 3 \quad \dots(v)$$

Subtracting (iv) from (iii), we get

$$\begin{array}{r} 7m + 13n = 27 \\ 13m + 7n = 33 \\ (-) \quad (-) \quad (-) \\ \hline -6m + 6n = -6 \end{array}$$

Dividing throughout by -6

$$m - n = 1 \quad \dots(vi)$$

Adding (v) and (vi) we get,

$$m + n = 3$$

$$m - n = 1$$

$$\hline 2m = 4$$

$$\therefore m = \frac{4}{2}$$

$$\therefore m = 2$$

Substituting $m = 2$ in (v) we get,

$$m + n = 3$$

$$\therefore 2 + n = 3$$

$$\therefore n = 3 - 2$$

$$\therefore n = 1$$

Resubstituting the values of m and n we get,

$$\frac{1}{2x+1} = 2 \text{ and } \frac{1}{y+2} = 1$$

$$\therefore 2x + 1 = \frac{1}{2} \text{ and } y + 2 = 1$$

$$\therefore 4x + 2 = 1 \text{ and } y = 1 - 2$$

$$\therefore 4x = 1 - 2 \text{ and } y = -1$$

$$\therefore 4x = -1$$

$$\therefore x = \frac{-1}{4}$$

$$\therefore x = \frac{-1}{4} \text{ and } y = -1 \text{ is the solution of the given simultaneous equations.}$$

Practice Set - 1.4 (Textbook Page No. 19)

(1) Solve the following simultaneous equations.

(ii) $\frac{10}{x+y} + \frac{2}{x-y} = 4$; $\frac{15}{x+y} - \frac{5}{x-y} = -2$ (4 marks)

Solution:

$$\frac{10}{x+y} + \frac{2}{x-y} = 4 \quad \dots(i)$$

$$\frac{15}{x+y} - \frac{5}{x-y} = -2 \quad \dots(ii)$$

$$\text{Substituting } \frac{1}{x+y} = a \text{ and } \frac{1}{x-y} = b$$

in (i) and (ii) we get,

$$10a + 2b = 4 \quad \dots(iii)$$

$$15a - 5b = -2 \quad \dots(iv)$$

Multiplying (iii) by 5 and (iv) by 2 we get,

$$50a + 10b = 20 \quad \dots(v)$$

$$30a - 10b = -4 \quad \dots(vi)$$

Adding (v) and (vi), we get

$$\begin{array}{rcl} 50a + 10b & = & 20 \\ 30a - 10b & = & -4 \\ \hline 80a & = & 16 \end{array}$$

$$\therefore a = \frac{16}{80}$$

$$\therefore a = \frac{1}{5}$$

Substituting $a = \frac{1}{5}$ in (iii), we get,

$$\therefore 10a + 2b = 4$$

$$\therefore 10 \times \frac{1}{5} + 2b = 4$$

$$\therefore 2 + 2b = 4$$

$$\therefore 2b = 4 - 2$$

$$\therefore 2b = 2$$

$$\therefore b = \frac{2}{2}$$

$$\therefore b = 1$$

Resubstituting the values of a and b we get,

$$\frac{1}{x+y} = \frac{1}{5} \text{ and } \frac{1}{x-y} = 1$$

$$\therefore x+y = 5$$

$$\therefore x-y = 1$$

Adding (vii) and (viii), we get,

$$\begin{array}{rcl} x+y & = & 5 \\ + x-y & = & 1 \\ \hline 2x & = & 6 \end{array}$$

$$\therefore x = \frac{6}{2}$$

$$x = 3$$

Substituting $x = 3$ in equation (vii) we get,

$$x+y = 5$$

$$\therefore 3+y = 5$$

$$y = 5 - 3$$

$$\therefore y = 2$$

$$\therefore \boxed{x = 3, y = 2 \text{ is the solution of the given simultaneous equations.}}$$

(iv) $\frac{1}{3x+y} + \frac{1}{3x-y} = \frac{3}{4}; \frac{1}{2(3x+y)} - \frac{1}{2(3x-y)} = -\frac{1}{8}$
(4 marks)

Solution:

$$\frac{1}{3x+y} + \frac{1}{3x-y} = \frac{3}{4} \quad \dots(i)$$

$$\frac{1}{2(3x+y)} - \frac{1}{2(3x-y)} = -\frac{1}{8}$$

Multiplying both sides by 2 we get,

$$\frac{1}{3x+y} - \frac{1}{3x-y} = -\frac{1}{4} \quad \dots(ii)$$

Substituting $\frac{1}{3x+y} = m$ and $\frac{1}{3x-y} = n$

in (i) and (ii) we get,

$$m+n = \frac{3}{4}$$

Multiplying both sides by 4

$$4m+4n = 3 \quad \dots (iii)$$

$$m-n = -\frac{1}{4}$$

Multiplying both sides by 4

$$4m-4n = -1 \quad \dots (iv)$$

Adding (iii) and (iv)

$$4m+4n = 3$$

$$4m-4n = -1$$

$$\hline 8m = 2$$

$$\therefore m = \frac{2}{8}$$

$$\therefore m = \frac{1}{4}$$

Substituting $m = \frac{1}{4}$ in (iii) we get,

$$4m+4n = 3$$

$$\therefore 4\left(\frac{1}{4}\right) + 4n = 3$$

$$\therefore 1 + 4n = 3$$

$$\therefore 4n = 2$$

$$\therefore n = \frac{2}{4}$$

$$\therefore n = \frac{1}{2}$$

Resubstituting the values of m and n we get,

$$\frac{1}{3x+y} = \frac{1}{4} \text{ and } \frac{1}{3x-y} = \frac{1}{2}$$

$$\therefore 3x+y = 4 \text{ and } 3x-y = 2$$

$$\therefore 3x+y = 4$$

$$\therefore 3x-y = 2$$

Adding (v) and (vi) we get,

$$3x+y = 4$$

$$+ 3x-y = 2$$

$$\hline 6x = 6$$

$$\therefore x = \frac{6}{6}$$

$$\therefore x = 1$$

Substituting $x = 1$ in (v) we get,

$$3(1) + y = 4$$

$$\therefore 3 + y = 4$$

$$\therefore y = 4 - 3$$

$$\therefore y = 1$$

$\therefore x = 1, y = 1$ is the solution of the given simultaneous equations.

Problem Set - 1 (Textbook Page No. 28)

(6) Solve the following simultaneous equations.

(v) $\frac{1}{2(3x+4y)} + \frac{1}{5(2x-3y)} = \frac{1}{4};$

$$\frac{5}{(3x+4y)} - \frac{2}{(2x-3y)} = -\frac{3}{2} \quad (4 \text{ marks})$$

Solution:

$$\frac{1}{2(3x+4y)} + \frac{1}{5(2x-3y)} = \frac{1}{4}$$

Multiplying both sides of above equation by 20 we get,

$$\frac{10}{(3x+4y)} + \frac{4}{(2x-3y)} = 5 \quad \dots (i)$$

$$\frac{5}{(3x+4y)} - \frac{2}{(2x-3y)} = -\frac{3}{2} \quad \dots (ii)$$

Substituting $\frac{1}{3x+4y} = m$ and $\frac{1}{2x-3y} = n$

in (i) and (ii) we get,

$$\therefore 10m + 4n = 5 \quad \dots (iii)$$

$$5m - 2n = -\frac{3}{2}$$

Multiplying by 2 we get,

$$10m - 4n = -3 \quad \dots (iv)$$

Adding (iii) and (iv) we get

$$10m + 4n = 5$$

$$10m - 4n = -3$$

$$20m = 2$$

$$\therefore m = \frac{2}{20}$$

$$\therefore m = \frac{1}{10}$$

Substituting $m = \frac{1}{10}$ in (iii) we get,

$$10m + 4n = 5$$

$$\therefore 10\left(\frac{1}{10}\right) + 4n = 5$$

$$\therefore 1 + 4n = 5$$

$$\therefore 4n = 5 - 1$$

$$\therefore 4n = 4$$

$$\therefore n = \frac{4}{4}$$

$$\therefore n = 1$$

$$\frac{1}{3x+4y} = \frac{1}{10} \quad \text{and} \quad \frac{1}{2x-3y} = 1$$

$$\therefore 3x + 4y = 10 \quad \text{and} \quad 2x - 3y = 1$$

$$3x + 4y = 10 \quad \dots (v)$$

$$2x - 3y = 1 \quad \dots (vi)$$

Multiplying (v) by 3 and (vi) by 4, we get,

$$9x + 12y = 30 \quad \dots (vii)$$

$$8x - 12y = 4 \quad \dots (viii)$$

Adding (vii) and (viii) we get

$$9x + 12y = 30$$

$$+ 8x - 12y = 4$$

$$17x = 34$$

$$\therefore x = \frac{34}{17}$$

$$\therefore x = 2$$

Substituting $x = 2$ in equation (vi) we get,

$$3x + 4y = 10$$

$$\therefore 3(2) + 4y = 10$$

$$\therefore 6 + 4y = 10$$

$$\therefore 4y = 10 - 6$$

$$\therefore 4y = 4$$

$$\therefore y = \frac{4}{4}$$

$$\therefore y = 1$$

$\therefore x = 2$ and $y = 1$ is the solution of given simultaneous equations.

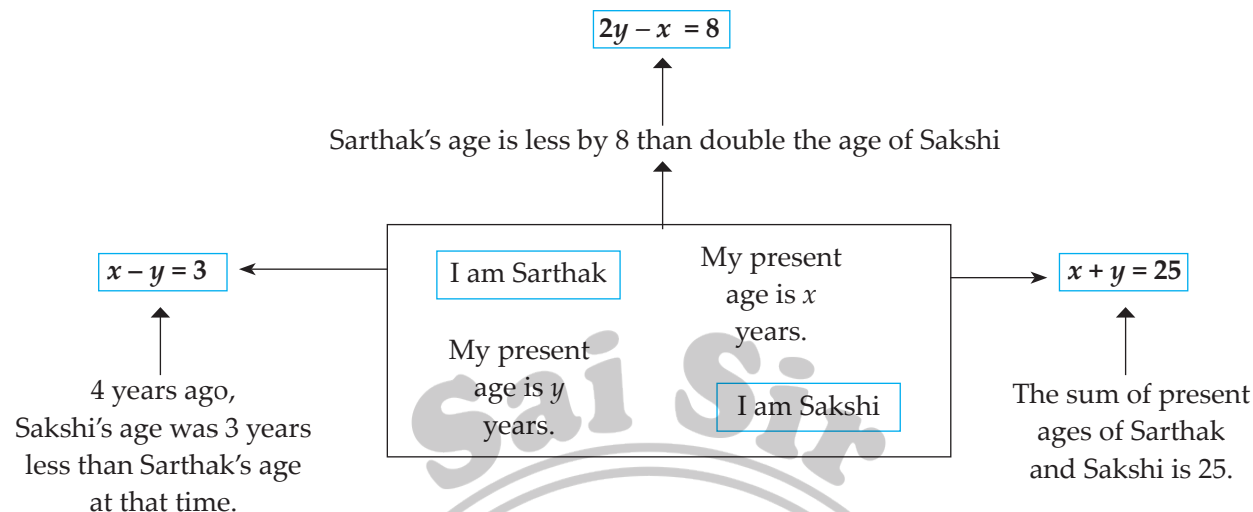
Points to Remember:

• Application of simultaneous equations:

Use of simultaneous equations is common in science and mathematics. Thus, the study of linear equations, system of linear equations and related concepts has its own importance. Let us see how the simultaneous equations are used in solving word problems.

Activity: There are some instructions given below. Frame the equations from the information

and write them in the blank boxes shown by arrows. (Textbook Page No. 20)



Practice Set - 1.5 (Textbook Page No. 26)

- (1) Two numbers differ by 3. The sum of twice the smaller number and thrice the greater number is 19. Find the numbers. (3 marks)

Solution:

Let the greater number be x and the smaller number be y .

According to the first condition

$$x - y = 3 \quad \dots(i)$$

Three times the greater number = $3x$ and twice the smaller number = $2y$

According to the second condition

$$3x + 2y = 19 \quad \dots(ii)$$

Multiplying (i) by 2 we get,

$$2x - 2y = 6 \quad \dots(iii)$$

Adding (ii) and (iii)

$$3x + 2y = 19$$

$$2x - 2y = 6$$

$$5x = 25$$

$$\therefore x = \frac{25}{5}$$

$$\therefore x = 5$$

Substituting the value of x in equation (i)

$$x - y = 3$$

$$\therefore 5 - y = 3$$

$$\therefore -y = 3 - 5$$

$$\therefore -y = -2$$

$$\therefore y = 2$$

$\therefore$

The greater number is 5 and smaller number is 2.

- (4) The denominator of a fraction is 4 more than twice the numerator. Denominator becomes 12 times the numerator, if both the numerator and denominator are reduced by 6. Find the fraction. (3 marks)

Solution:

Let the numerator of the fraction be x and the denominator be y .

$\therefore$ The fraction is $\frac{x}{y}$

According to first condition,

$$y = 2x + 4$$

$$\therefore -2x + y = 4 \quad \dots(i)$$

According to second condition,

$$(y - 6) = 12(x - 6)$$

$$\therefore y - 6 = 12x - 72$$

$$\therefore -6 + 72 = 12x - y$$

$$\therefore 66 = 12x - y$$

$$\therefore 12x - y = 66 \quad \dots(ii)$$

Adding (i) and (ii) we get,

$$-2x + y = 4$$

$$12x - y = 66$$

$$10x = 70$$

$$\therefore x = \frac{70}{10}$$

$$\therefore x = 7$$

Substituting $x = 7$ in equation (i) we get

$$-2x + y = 4$$

$$\therefore -2(7) + y = 4$$

$$\therefore -14 + y = 4$$

$$\therefore y = 4 + 14$$

$$\therefore y = 18$$

$$\therefore \frac{x}{y} = \frac{7}{18}$$

$$\therefore \text{The required fraction is } \frac{7}{18}$$

Problem Set - 1 (Textbook Page No. 28)

(7) Solve the following problems using two variables.

(i) A two digit number and the number with digits interchanged add up to 143. In the given number the digit in unit's place is 3 more than the digit in the ten's place. Find the original number.

(4 marks)

Solution:

Let the digit in units place is x and that in tens place is y .

$$\therefore \text{The number} = 10y + x$$

$$\therefore \text{The number obtained by interchanging the digits is } 10x + y$$

According to first condition,

Two digit number + Number obtained by interchanging the digits = 143

$$10y + x + 10x + y = 143$$

$$11x + 11y = 143$$

$$\therefore x + y = 13 \quad \dots(i)$$

According to second condition,

Digit in units place = Digit in ten's place + 3

$$\therefore x = y + 3$$

$$\therefore x - y = 3 \quad \dots(ii)$$

Adding (i) and (ii) we get

$$2x = 16$$

$$x = 8$$

Putting this value at x in (i) we get,

$$\therefore x + y = 13$$

$$\therefore 8 + y = 13$$

$$\therefore y = 5$$

$$\therefore \text{The Original number is } 10y + x = 50 + 8 = 58$$

(iii) To find number of notes that Anushka had, complete the following activity.

(3 marks)

Suppose that Anushka had x notes of ₹ 100 and y notes of ₹ 50 each

Anushka got ₹ 2500/- from Anand as denominations mentioned above

$$\therefore 100x + 50y = 2500 \quad \dots(i)$$

If Anand would have given her the amount by interchanging number of notes, Anushka would have received

₹ 500 less than the previous amount

$$\therefore 50x + 100y = 2000 \quad \dots(ii)$$

Solution:

$$100x + 50y = 2500 \quad \dots(i)$$

$$50x + 100y = 2000 \quad \dots(ii)$$

Multiplying (ii) by 2 we get,

$$100x + 200y = 4000 \quad \dots(iii)$$

Subtracting equation (iii) from equation (i)

$$100x + 50y = 2500$$

$$100x + 200y = 4000$$

$$\begin{array}{r} - \\ - \\ - \\ -150y = -1500 \end{array}$$

$$150y = 1500$$

$$\therefore y = \frac{1500}{150}$$

$$\therefore y = 10$$

Substituting $y = 10$ in equation (i) we get,

$$100x + 50y = 2500$$

$$\therefore 100x + 50(10) = 2500$$

$$\therefore 100x + 500 = 2500$$

$$\therefore 100x = 2500 - 500$$

$$\therefore 100x = 2000$$

$$\therefore x = \frac{2000}{100}$$

$$\therefore x = 20$$

$\therefore$ Number of 100 rupees notes is 20 and number of 50 rupees notes is 10

- (ii) Kantabai bought $1\frac{1}{2}$ kg tea and 5 kg sugar from a shop. She paid ₹ 50 as return fare for rickshaw. Total expense was ₹ 700. Then she realised that by ordering online the goods can be bought with free home delivery at the same price. So next month she placed the order online for 2 kg tea and 7 kg sugar. She paid ₹ 880 for that. Find the rate of sugar and tea per kg.

(4 marks)

Solution:

Let the cost of 1 kg. of tea be ₹ x and 1 kg. of Sugar be ₹ y

Amount paid as Rickshaw fare = ₹ 50

$\therefore$ Total Amount spent by Kantabai = ₹ 700

$\therefore$ Total cost of tea and sugar = ₹ 700 – ₹ 50
= ₹ 650

According to first condition,

$$\frac{3}{2}x + 5y = 650$$

Multiplying both sides by 2

$$\therefore 3x + 10y = 1300 \quad \dots(i)$$

According to second condition,

$$2x + 7y = 880 \quad \dots(ii)$$

Multiplying (i) by 2 and (ii) by 3 we get,

$$6x + 20y = 2600 \quad \dots(iii)$$

$$6x + 21y = 2640 \quad \dots(iv)$$

Subtracting equation (iv) from equation (iii) we get,

$$6x + 20y = 2600$$

$$6x + 21y = 2640$$

$$\begin{array}{r} - \\ - \\ - \\ -y = -40 \end{array}$$

$$\therefore y = 40$$

Substituting $y = 40$ in (ii) we get,

$$2x + 7y = 880$$

$$\therefore 2x + 7(40) = 880$$

$$\therefore 2x + 280 = 880$$

$$\therefore 2x = 880 - 280$$

$$\therefore 2x = 600$$

$$\therefore x = \frac{600}{2}$$

$$\therefore x = 300$$

$\therefore$ The cost of 1 Kg. tea is ₹ 300 and 1 Kg. Sugar is ₹ 40

- (v) In a factory the ratio of salary of skilled and unskilled workers is 5 : 3. Total salary of one day of both of them is ₹ 720. Find daily wages of skilled and unskilled workers. (4 marks)

Solution:

Let the per day salary of skilled workers be ₹ x and per day salary of unskilled workers be ₹ y

According to the first condition

$$\frac{x}{y} = \frac{5}{3}$$

$$3x = 5y$$

$$3x - 5y = 0 \quad \dots(i)$$

According to the second condition

$$x + y = 720 \quad \dots(ii)$$

Multiplying (ii) by 5 we get

$$5x + 5y = 3600 \quad \dots(iii)$$

Adding (i) and (iii) we get,

$$3x - 5y = 0$$

$$5x + 5y = 3600$$

$$8x = 3600$$

$$\therefore x = \frac{3600}{8}$$

$$\therefore x = 450$$

Substituting $x = 450$ equation (ii) we get,

$$x + y = 720$$

$$\therefore 450 + y = 720$$

$$\therefore y = 720 - 450$$

$$\therefore y = 270$$

$\therefore$ Daily wages of skilled workers is ₹ 450 and that of unskilled worker is ₹ 270

Practice Set - 1.5 (Textbook Page No. 26)

- (5) Two types of boxes A, B are to be placed in a truck having capacity of 10 tons. When 150 boxes of type A and 100 boxes of type B are loaded in the truck, it weighs 10 tons. But when 260 boxes of type A are loaded in the truck, it can still accommodate 40 boxes of type B, so that it is fully loaded. Find the weight of each type of box? (4 marks)

Solution:

$$1 \text{ ton} = 1000 \text{ kg.}$$

$$\therefore 10 \text{ ton} = 10,000 \text{ kg.}$$

∴ Capacity of truck = 10 ton = 10,000 kg.

Let the weight of type A box be x kg. and the weight of each of type B box be y kg.

According to the first condition,

$$150x + 100y = 10,000$$

$$\therefore 15x + 10y = 1000 \dots (i) \text{ [Dividing both sides by 10]}$$

According to the second condition,

$$260x + 40y = 10,000$$

Dividing throughout by 4,

$$\therefore 65x + 10y = 2500 \dots (ii)$$

Subtracting (i) from (ii),

$$\begin{array}{r} 65x + 10y = 2500 \\ 15x + 10y = 1000 \\ (-) \quad (-) \quad (-) \\ \hline 50x = 1500 \end{array}$$

$$\therefore x = \frac{1500}{50}$$

$$\therefore x = 30$$

Substituting $x = 30$ in (i) we get,

$$15x + 10y = 1000$$

$$\therefore 15(30) + 10y = 1000$$

$$\therefore 450 + 10y = 1000$$

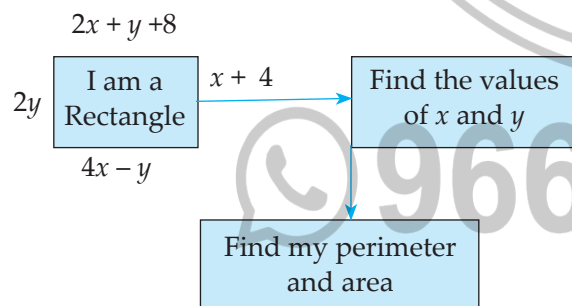
$$\therefore 10y = 1000 - 450$$

$$\therefore 10y = 550$$

$$\therefore y = 55$$

∴ The weight of type A box is 30 kg and the weight of type B box is 55 kg

(2) Complete the following activity. (4 marks)



Solution:

In a rectangle, opposite sides are equal in length.

$$\therefore 2x + y + 8 = 4x - y$$

$$\therefore 2x - 4x + y + y = -8$$

$$\therefore -2x + 2y = -8$$

$$\therefore 2(-x + y) = -8$$

$$\therefore -x + y = \frac{-8}{2}$$

$$\therefore -x + y = -4 \dots (i)$$

$$\text{Also, } 2y = x + 4$$

$$\therefore -4 = x - 2y$$

$$\text{i.e. } x - 2y = -4 \dots (ii)$$

Adding (i) and (ii) we get,

$$\begin{array}{r} -x + y = -4 \\ + x - 2y = -4 \\ \hline -y = -8 \end{array}$$

$$\therefore y = 8$$

Substituting $y = 8$ in (i) we get,

$$-x + 8 = -4$$

$$\therefore -x = -4 - 8$$

$$\therefore -x = -12$$

$$\therefore x = 12$$

$$\begin{aligned} \therefore \text{The length of rectangle} &= 2x + y + 8 \\ &= 2(12) + 8 + 8 \\ &= 24 + 16 \\ &= 40 \text{ units} \end{aligned}$$

$$\begin{aligned} \text{The breadth of rectangle} &= 2y \\ &= 2 \times 8 \\ &= 16 \text{ units} \end{aligned}$$

$$\begin{aligned} \therefore \text{Perimeter of rectangle} &= 2[\text{length} + \text{breadth}] \\ &= 2[40 + 16] \\ &= 2 \times 56 \end{aligned}$$

$$\therefore \text{Perimeter of rectangle} = 112 \text{ units}$$

$$\begin{aligned} \text{Area of rectangle} &= \text{length} \times \text{breadth} \\ &= 40 \times 16 \end{aligned}$$

$$\therefore \text{Area of rectangle} = 640 \text{ Sq. units}$$

(3) The sum of father's age and twice the age of his son is 70. If we double the age of the father and add it to the age of his son the sum is 95. Find their present ages. (3 marks)

Solution:

Let the age of son be x years and the age of father be y years.

According to the first condition,

$$2x + y = 70 \dots (i)$$

According to the second condition,

$$x + 2y = 95 \dots (ii)$$

Multiplying (i) by 2 we get,

$$4x + 2y = 140 \dots (iii)$$

Subtracting (iii) from (ii)

$$\begin{array}{r} x + 2y = 95 \\ 4x + 2y = 140 \\ (-) \quad (-) \quad (-) \\ \hline -3x = -45 \end{array}$$

$$\therefore x = \frac{-45}{-3}$$

$$\therefore x = 15$$

Substituting $x = 15$ in (i), we get,

$$2x + y = 70$$

$$\therefore 2(15) + y = 70$$

$$\therefore 30 + y = 70$$

$$\therefore y = 70 - 30$$

$$\therefore y = 40$$

$\therefore$ The age of son is 15 years and the age of father is 40 years.

Problem Set - 1 (Textbook Page No. 29)

(7) Solve the following problems using two variables.

(iv) Sum of the present ages of Manish and Savita is 31. Manish's age 3 years ago was 4 times the age of Savita. Find their present ages. (3 marks)

Solution:

Let the present age of Manish be x years and age of Savita y years.

According to the first condition

$$x + y = 31 \quad \dots(i)$$

Three years ago,

Manish's Age = $(x - 3)$ years and

Savita's age = $(y - 3)$ years

According to second condition,

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

$$\therefore x - 3 = 4y - 12$$

$$\therefore x - 4y = -12 + 3$$

$$\therefore x - 4y = -9 \quad \dots(ii)$$

Subtracting equation (ii) from equation (i) we get,

$$x + y = 31$$

$$x - 4y = -9$$

$$\begin{array}{r} (-) \quad (+) \quad (+) \\ \hline \end{array}$$

$$5y = 40$$

$$\therefore y = \frac{40}{5}$$

$$\therefore y = 8$$

Substituting $y = 8$ in equation (i) we get,

$$\therefore x + y = 31$$

$$\therefore x + 8 = 31$$

$$\therefore x = 31 - 8$$

$$\therefore x = 23$$

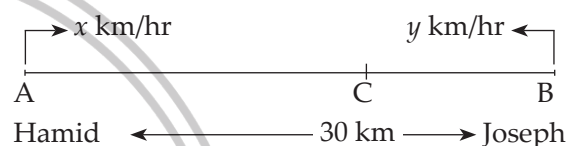
$\therefore$ The present age of Manisha is 23 years and the present age of Savita is 8 years.

(vi) Places A and B are 30 km apart and they are on a straight road. Hamid travels from A to B on bike. At the same time Joseph starts from B on bike, travels towards A. They meet each other after 20 minutes. If Joseph would have started from B at the same time but in the opposite direction (instead of towards A) Hamid would have caught up with him after 3 hours. Find the speed of Hamid and Joseph. (4 marks)

Solution:

Let the speed at which Hamid is driving his motorcycle be x km/hr. and the speed at which Joseph is driving his motorcycle be y km/hr. [$x > y$]

Case I: When they move towards each other.



In this case, both motorcycles are moving towards each other and they meet at C after 20

minutes i.e. $\frac{20}{60} = \frac{1}{3}$ hours

Then $AC + BC = AB$

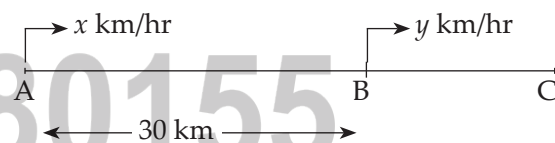
i.e. distance covered by

Hamid in $\frac{1}{3}$ hours + distance covered by Joseph in $\frac{1}{3}$ hours = 30 km.

$$\therefore \frac{1}{3}x + \frac{1}{3}y = 30 \quad [\text{Distance} = \text{speed} \times \text{time}]$$

$$\therefore x + y = 90 \quad \dots(i)$$

Case II: When Joseph move in opposite direction. (Instead of towards A)



As shown in figure, both are moving in the same direction and they meet at C after 3 hours

Then $AC - BC = AB$

i.e. Distance covered by Hamid in 3 hours - distance covered by Joseph in 3 hours = 30km.

$$3x - 3y = 30 \quad [\text{Distance} = \text{speed} \times \text{time}]$$

$$x - y = 10 \quad \dots(ii)$$

Adding (i) and (ii) we get,

$$x + y = 90$$

$$x - y = 10$$

$$\begin{array}{r} \hline 2x = 100 \end{array}$$

$$\therefore x = \frac{100}{2}$$

$$\therefore x = 50$$

Substituting $x = 50$ in (i) we get

$$\therefore x + y = 90$$

$$\therefore 50 + y = 90$$

$$\therefore y = 90 - 50$$

$$\therefore y = 40$$

Speed of Hamids motorcycle = 50 km/hr.
and Speed of Joseph's Motorcycle is 40 Km/hr.

Practice Set - 1.5 (Textbook Page No. 26)

- (6) Out of 1900 km, Vishal travelled some distance by bus and some by aeroplane. Bus travels with average speed 60 km/hr and the average speed of aeroplane is 700 km/hr. It takes 5 hours to complete the journey. Find the distance, Vishal travelled by bus. (4 marks)

Solution:

Let the distance travelled by bus be x km and the distance travelled by aeroplane be y km.

$\therefore$ According to the first condition.

$$x + y = 1900 \quad \dots(i)$$

$$\text{Time} = \frac{\text{Distance}}{\text{Speed}}$$

Time taken by bus to cover x km at 60 km/hr

$$= \frac{x}{60} \text{ hours}$$

Time taken by aeroplane to cover y km at 700 km/hr.

$$= \frac{y}{700} \text{ hours}$$

The journey was completed in 5 hours

$\therefore$ According to second condition,

$$\frac{x}{60} + \frac{y}{700} = 5$$

Multiplying both the sides of above equation by 2100 i.e. LCM of 60 and 70,

$$\therefore 35x + 3y = 10500 \quad \dots(ii)$$

Multiplying equation (i) by 3 we get,

$$\therefore 3x + 3y = 5700 \quad \dots(iii)$$

Subtracting (iii) from (ii)

$$35x + 3y = 10500$$

$$3x + 3y = 5700$$

$$\begin{array}{r} (-) \quad (-) \quad (-) \\ 32x \quad \quad \quad = 4800 \end{array}$$

$$\therefore x = \frac{4800}{32}$$

$$\therefore x = 150$$

$\therefore$ Vishal travelled 150 km by bus.

Problem Set - 1 (Textbook Page No. 29)

MCQ's

Choose correct alternative for each of the following questions: (1 mark each)

- (1) To draw graph of $4x + 5y = 19$, Find y when $x = 1$.
(A) 4 (B) 3 (C) 2 (D) -3
- (2) For simultaneous equations in variables x and y , $D_x = 49$, $D_y = -63$, $D = 7$ then what is x ?
(A) 7 (B) -7 (C) $\frac{1}{7}$ (D) $-\frac{1}{7}$
- (3) Find the value of $\begin{vmatrix} 5 & 3 \\ -7 & -4 \end{vmatrix}$
(A) -1 (B) -41 (C) 41 (D) 1
- (4) To solve $x + y = 3$; $3x - 2y - 4 = 0$ by determinant method find D .
(A) 5 (B) 1 (C) -5 (D) -1
- (5) $ax + by = c$ and $mx + ny = d$ and $a \neq bm$ then these simultaneous equations have -
(A) Only one common solution.
(B) No solution
(C) Infinite number of solutions.
(D) Only two Solutions

Additional MCQ's

- (6) The general form of linear equation in two variables is
(A) $ax + b = 0$ (B) $ax + by = c$
(C) $ax^2 + bx + c = 0$ (D) None of these
- (7) is one of the solution of equation $3x - 5y = 10$.
(A) (0, 2) (B) (2, 0) (C) (-2, 0) (D) (0, -2)
- (8) If $12x + 13y = 29$ and $13x + 12y = 21$ then the value of $x + y$ is
(A) 1 (B) 25 (C) 2 (D) 50
- (9) Express the following information in mathematical form using x and y variables: one number is 5 more than seven times the other number.
(A) $x - 5y = 7$ (B) $x - 7y = 5$
(C) $x + 7y = 5$ (D) $x - 7y = -5$
- (10) Write D_x for the following simultaneous equations. $3x + 4y = 8$; $x - 2y = 5$

(A) $\begin{vmatrix} 3 & 4 \\ 1 & -2 \end{vmatrix}$

(B) $\begin{vmatrix} 8 & 4 \\ 5 & -2 \end{vmatrix}$

(C) $\begin{vmatrix} 4 & 8 \\ -2 & 5 \end{vmatrix}$

(D) $\begin{vmatrix} 3 & 8 \\ 1 & 5 \end{vmatrix}$

- (11) is the solution of given simultaneous equations.
- $x - y = 7$
- ,
- $x + y = 11$
- .

- (A)
- $(-3, -8)$
- (B)
- $(-9, -2)$
-
- (C)
- $(9, 2)$
- (D)
- $(6, 5)$

- (12) When we consider two linear equations in two variables, such equations are called as

- (A) simultaneous equations
-
- (B) linear equations
-
- (C) quadratic equations
-
- (D) non-linear equations.

- (13) Which is not a linear equation in two variables

- (A)
- $x + 7y = 1$
- (B)
- $3x + 4y - xy = 0$
-
- (C)
- $3x + 9 = 4y - 1$
- (D)
- $3x = 4y$

- (14) Which is linear equation in two variables

- (A)
- $3x + 9 = \sqrt{2}y + 2$
- (B)
- $3x - 4y + xy = 0$
-
- (C)
- $2m - 8 = 4m$
- (D)
- $3x - 14 = 9$

- (15) Select pair of simultaneous equations from the following

- (1)
- $2x + 2y = 7$
- (2)
- $4x + 3z = 9$
-
- (3)
- $3y + 4z = 8$
- (4)
- $3z + 9x = 18$
-
- (A) 1 and 2 (B) 2 and 3
-
- (C) 3 and 4 (D) 2 and 4

- (16) Equation of X axis is

- (A)
- $x = 0$
- (B)
- $x = b$
- (C)
- $y = 0$
- (D)
- $y = a$

- (17) The co-ordinates of the point of origin are

- (A)
- $(0, 0)$
- (B)
- $(1, 0)$
- (C)
- $(0, 1)$
- (D)
- $(1, 1)$

- (18) If the value of the determinant
- $\begin{vmatrix} m & -2 \\ 2 & 1 \end{vmatrix}$
- is 7, then value of
- m
- is

- (A)
- -3
- (B)
- 3
- (C)
- -7
- (D)
- 7

- (19) The perimeter of a rectangle is 64, is expressed in the mathematical equation form as

- (A)
- $\frac{1}{2}(x + y) = 64$
- (B)
- $2(x + y) = 64$
-
- (C)
- $x \times y = 64$
- (D)
- $\frac{xy}{2} = 64$

- (20) The value of determinant
- $\begin{vmatrix} 5 & 2 \\ 7 & 4 \end{vmatrix}$
- is

- (A)
- 6
- (B)
- -6
- (C)
- 34
- (D)
- -34

- (21) If
- $D_x = -18$
- and
- $D = 3$
- are values of determinant for certain simultaneous equation in
- x
- and
- y
- then value of
- x
- is

- (A)
- $+6$
- (B)
- -15
- (C)
- -6
- (D)
- $+15$

- (22) Find
- m
- if value of determinant
- $\begin{vmatrix} m & 2 \\ -5 & 7 \end{vmatrix}$
- is 31.

- (A)
- 14
- (B)
- 3
- (C)
- 28
- (D)
- 21

- (23) If
- $\frac{a_1}{a_2} = \frac{b_1}{b_2} = \frac{c_1}{c_2}$
- then the two simultaneous equations have

- (A) one solution (B) no solution
-
- (C) infinitely many solutions (D) two solutions

- (24) If
- $\frac{a_1}{a_2} = \frac{b_1}{b_2} \neq \frac{c_1}{c_2}$
- then the two simultaneous equations have

- (A) one solution (B) no solution
-
- (C) infinitely many solutions (D) two solutions

- (25) If
- $(a, 3)$
- is point lying on graph of equation
- $5x + 2y = -4$
- then
- $a =$
-

- (A)
- 2
- (B)
- -2
- (C)
- $\frac{2}{5}$
- (D)
- $-\frac{2}{5}$

- (26) Without solving simultaneous equation decide
- $3x + 5y = 16$
- and
- $4x - y = 6$
- have

- (A) unique solution (B) no solution
-
- (C) infinitely many solutions (D) none of these

- (27) If simultaneous equations do not have any solution then their graphical interpretation contains

- (A) parallel lines (B) coincident lines
-
- (C) intersecting lines (D) can't determine

- (28) By Cramer's rule the value of
- x
- is

- (A)
- $\frac{D}{D_x}$
- (B)
- $\frac{D_x}{D}$
- (C)
- $\frac{D_y}{D}$
- (D)
- $\frac{D}{D_y}$

ANSWERS

- (1) (B) 3 (2) (A) 7 (3) (D) 1 (4) (C)
- -5
-
- (5) (A) Only one common solution (6) (B)
- $ax + by = c$
-
- (7) (D)
- $(0, -2)$
- (8) (C) 2 (9) (B)
- $x - 7y = 5$
-
- (10) (B)
- $\begin{vmatrix} 8 & 4 \\ 5 & -2 \end{vmatrix}$
- (11) (C)
- $(9, 2)$
-
- (12) (A) simultaneous equations (13) (B)
- $3x + 4y - xy = 0$
-
- (14) (A)
- $3x + 9 = \sqrt{2}y + 2$
- (15) (D) 2 and 4
-
- (16) (C)
- $y = 0$
- (17) (A)
- $(0, 0)$
- (18) (B) 3
-
- (19) (B)
- $2(x + y) = 64$
- (20) (A) 6 (21) (C)
- -6
-
- (22) (B) 3 (23) (C) infinitely many solutions

- (24) (B) no solution (25) (B) -2
 (26) (A) unique solution (27) (A) parallel lines
 (28) (B) $\frac{D_x}{D}$

PROBLEMS FOR PRACTICE**Based on Practice Set 1.1**

- (1) Solve the following simultaneous equations:
 (i) $3x - y = 2$; $5x - 2y = 1$ (2 marks)
 (ii) $47x + 31y = 63$; $31x + 47y = 15$ (3 marks)
 (iii) $4m + 3n = 18$; $3m - 2n = 5$ (2 marks)
 (iv) $2x - 3y = 14$; $5x + 2y = 16$ (2 marks)
 (v) $\frac{1}{3}x + 5y = 13$; $2x + \frac{1}{2}y = 19$ (3 marks)
 (vi) $\frac{1}{3}x + \frac{1}{4}y = 4$; $\frac{5}{6}x - \frac{1}{8}y = 4$ (3 marks)
 (vii) $64m - 45n = 289$; $45m - 64n = 365$ (3 marks)

Based on Practice Set 1.2

- (2) Solve the following simultaneous equations using Graphical method: (4 marks each)
 (i) $x + y = 8$; $x - y = 2$
 (ii) $3x + 4y = -5$; $x - y = -4$
 (iii) $x + 3y = 7$; $2x + y = -1$
 (iv) $x + 2y = 5$; $2x + y = -2$
 (v) $4x - y = -5$; $2x - y = -1$

Based on Practice Set 1.3

- (3) Find the value of following determinants: (1 mark each)
 (i) $\begin{vmatrix} 5 & -2 \\ -3 & 1 \end{vmatrix}$ (ii) $\begin{vmatrix} -3 & 8 \\ 6 & 0 \end{vmatrix}$ (iii) $\begin{vmatrix} 1 & -2 \\ 2 & 3 \\ 3 & -4 \\ 4 & 5 \end{vmatrix}$

- (4) Solve the following simultaneous equations using Cramer's method: (4 marks each)
 (i) $3x - 2y = 3$; $2x + y = 16$ (ii) $x + 2y + 4 = 0$; $3x = -4y - 16$
 (iii) $3x - y = 7$; $x + 4y = 11$ (iv) $3x + y = 1$; $2x = 11y + 3$
 (v) $4x + 3y = 4$; $6x + 5y = 8$

Based on Practice Set 1.4

- (5) Solve the following simultaneous equations: (4 marks each)
 (i) $\frac{4}{x} + \frac{3}{y} = 1$; $\frac{8}{x} - \frac{9}{y} = 7$
 (ii) $\frac{7}{2x+1} + \frac{13}{y+2} = 27$; $\frac{13}{2x+1} + \frac{7}{y+2} = 33$

- (iii) $\frac{14}{x+y} + \frac{3}{x-y} = 5$; $\frac{21}{x+y} - \frac{2}{x-y} = 1$
 (iv) $\frac{5}{x-1} + \frac{1}{y-2} = 2$; $\frac{6}{x-1} - \frac{3}{y-2} = 1$

Based on Practice Set 1.5

- (6) Solve the following simultaneous equations:
 (i) Shabana's age 10 years hence, will be twice juhi's present age. 6 years back shabana's age was $\frac{5}{3}$ times Juhi's at that time find their present ages. (3 marks)
 (ii) If 1 is added to the numerator of a certain fraction its value becomes $\frac{1}{2}$ and if 1 is added to its denominator $\frac{1}{3}$. Find the original fraction. (3 marks)
 (iii) Sum of two number is 45 and the greater number is twice the smaller number. Find the numbers. (3 marks)
 (iv) A man travels 370 km partly by train and partly by car. If he covers 250 km by train and the rest by car, it takes him 4 hours. But, If he travels 130 km by train and the rest by car, he takes 18 minutes longer. Find the speed of the train and that of the car. (4 marks)

ANSWERS

- (1) (i) $x = 3$, $y = 7$ (ii) $x = 2$, $y = -1$ (iii) $m = 3$, $n = 2$
 (iv) $x = 4$, $y = -2$ (v) $x = 9$, $y = 2$ (vi) $x = 6$, $y = 8$
 (vii) $m = 1$, $n = -5$
 (2) (i) $x = 5$, $y = 3$ (ii) $x = -3$, $y = 1$ (iii) $x = -2$, $y = 3$
 (iv) $x = -3$, $y = 4$ (v) $x = -2$, $y = -3$
 (3) (i) -1 (ii) -48 (iii) $\frac{1}{10}$
 (4) (i) $x = 5$, $y = 6$ (ii) $x = -8$, $y = 2$ (iii) $x = 3$, $y = 2$
 (iv) $x = \frac{2}{5}$, $y = \frac{-1}{5}$, (v) $x = -2$, $y = 4$
 (5) (i) $x = 2$, $y = -3$ (ii) $x = \frac{-1}{4}$, $y = -1$ (iii) $x = 4$, $y = 3$
 (iv) $x = 4$, $y = 5$
 (6) (i) 26 years, 18 years (ii) $\frac{3}{8}$ (iii) 30, 15
 (iv) 100 km/hr and 80 km/hr.

ASSIGNMENT - 1

Time : 1 Hr.

Marks : 20

Q.1. (A) Choose the correct alternative answer and fill in the blanks:

(2)

- (1) Select pair of simultaneous equations from the following
 (1) $2x + 2y = 7$ (2) $4x + 3z = 9$ (3) $3y + 4z = 8$ (4) $3z + 9x = 18$
- (2) $ax + by = c$ and $mx + ny = d$ and $a \neq bm$ then these simultaneous equations have
 (A) Only one common solution. (B) No Solution
 (C) Infinite number of solutions (D) Only two Solutions

(B) Perform the following question:

(3)

- (1) Write D_x for the following simultaneous questions: $5x + 2y = 10$; $-3x + y = -11$
 Solution: $5x + 2y = 10$; $-3x + y = -11$ $\therefore D_x = \begin{vmatrix} 5 & 2 \\ -3 & 1 \end{vmatrix}$

- (2) Find the value of the following determinant: $\begin{vmatrix} 5 & 7 \\ 2 & 4 \end{vmatrix}$
 Solution: $\begin{vmatrix} 5 & 7 \\ 2 & 4 \end{vmatrix}$

$$= 5 \times \square - \square \times 7 = \square - 14 = \square$$

- (3) If $3x + 4y = -10$; $4x + 3y = 3$; then find the value of $x + y$.
 Solution:

$$3x + 4y = -10 \quad \dots (i) \quad 4x + 3y = 3 \quad \dots (ii)$$

Adding (i) and (ii)

$$3x + 4y = 10$$

$$+ 4x + 3y = 3$$

$$7x + 7y = \square$$

$$\therefore x + y = \square$$

Q.2. Perform the following activities: (Any 2)

(4)

- (1) Complete the following table to draw graph for equation $x + 2y = 5$

x	0	$\square$
y	$\square$	-2
(x, y)	$\square$	$\square$

- (2) Solve the following simultaneous equations. (3) Find the value of the following determinants:
 $x + y = 8$, $x - y = 2$ (i) $\begin{vmatrix} 7 & 5 \\ 8 & 3 \end{vmatrix}$ (ii) $\begin{vmatrix} 3 & -1 \\ 1 & 4 \end{vmatrix}$

$$x + y = 8 \quad \dots (i)$$

$$x - y = 2 \quad \dots (ii)$$

Adding (i) and (ii)

$$x + y = 8$$

$$+ x - y = 2$$

$$\therefore \square x = \square$$

$$\therefore x = \square$$

Substituting the value of x in (i)

$$\therefore \square + y = 8$$

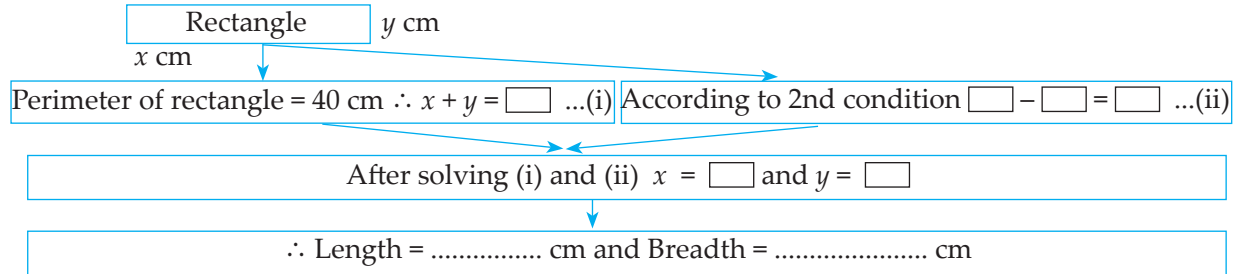
$$\therefore y = \square$$

Q.3. Perform the following activities: (Any 1)

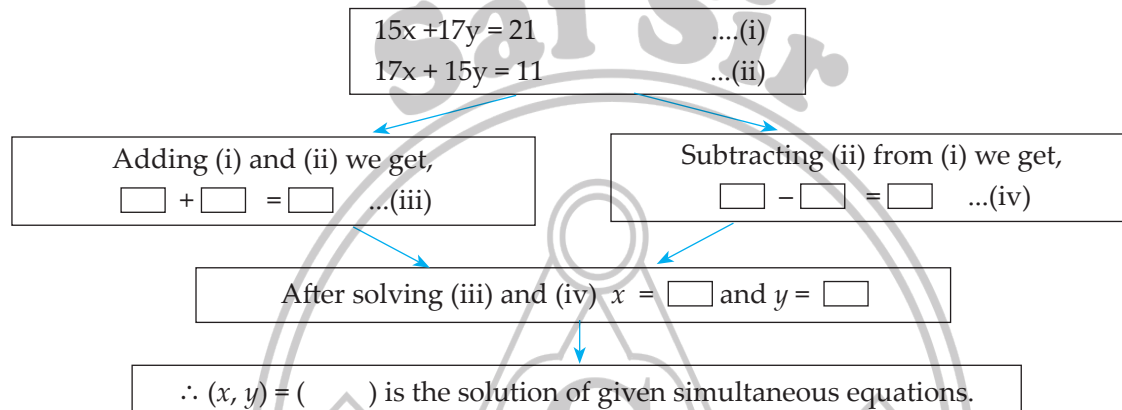
(3)

- (1) The perimeter of rectangle is 40 cm. The length of rectangle is 2cm more than twice its breadth then find the length and the breadth of rectangle.

Complete the following activity.



- (2) Solve: $15x + 17y = 21$; $17x + 15y = 11$
Complete the following activity.



Q.4. Attempt the following: (Any 2)

(8)

- (1) A boat takes 6 hours to travel 8 km up stream and 32 km down stream and it takes 7 hours to travel 20 km upstream and 16 km downstream. Find the speed of the boat in still water and the speed of the stream.
- (2) Solve the following simultaneous equations using Graphical method: $2x + 3y = 12$; $x - y = 1$
- (3) The sum of two digit number and the number obtained by reversing the order of its digits is 143. The digit at ten's place is greater than digit of units place by 3 then find the original number.

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