Maharashtra Board Solutions for Class 10-Maths (Part 1): Chapter 1- Linear Equations in Two Variables

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Maharashtra Board Solutions for Class 10-Maths (Part 1): Chapter 1-Linear Equations in Two Variables

Class 10: Maths Chapter 1 solutions. Complete Class 10 Maths Chapter 1 Notes.

Maharashtra Board Solutions for Class 10-Maths (Part 1): Chapter 1- Linear Equations in Two Variables

Maharashtra Board 10th Maths Chapter 1, Class 10 Maths Chapter 1 solutions

Practice Set 1.1

Question 1.

Complete the following activity to solve the simultaneous equations.

$5x + 3y = 9$ …(i)

$2x-3y=12$ …(ii)

Solution:

$5x + 3y = 9$ …(i)

$2x-3y=12$ …(ii)

Add equations (i) and (ii).

$$\begin{array}{rcrl} 5x + 3y & = & 9 & \dots (1) \\ 2x - 3y & = & 12 & \dots (2) \\ \hline \boxed{7}x & = & \boxed{21} & \end{array}$$

$\therefore x = \dfrac{\boxed{21}}{\boxed{7}}$ $\therefore x = \boxed{3}$

Place $x = 3$ in equation (1),

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

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

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

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

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

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

Question 2.

Solve the following simultaneous equations.

i. $3a + 5b = 26$; $a + 5b = 22$

ii. $x + 7y = 10$; $3x – 2y = 7$

iii. $2x – 3y = 9$; $2x + y = 13$

iv. $5m – 3n = 19$; $m – 6n = -7$

v. $5x + 2y = -3$;$x + 5y = 4$

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

vii. $99x + 101y = 499$; $101x + 99y = 501$

viii. $49x – 57y = 172$; $57x – 49y = 252$

Solution:

i. $3a + 5b = 26$ …(i)

$a + 5b = 22$ …(ii)

Subtracting equation (ii) from (i), we get

$$\begin{array}{rcrl} 3a + 5b & = & 26 & \ldots(1) \\ a + 5b & = & 22 & \ldots(2) \\ - \quad - & & - & \\ \hline 2a & = & 4 & \end{array}$$

$\therefore a = 2$ … (Dividing both the sides by 2)

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

$2 + 5b = 22$

$\therefore 5b = 22 – 2$

$\therefore 5b = 20$

$\therefore b = \frac{20}{5} = 4$

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

ii. $x + 7y = 10$

$\therefore x = 10 – 7y$ …(i)

$3x – 2y = 7$ …1(ii)

Substituting x = 10 – ly in equation (ii), we get

$3 (10 – 7y) – 2y = 7$

∴ 30 – 21y – 2y = 7

∴ -23y = 7 – 30

∴ -23y = -23

∴ y = −23−23

Substituting y = 1 in equation (i), we get

x = 10 – 7 (1)

= 10 – 7 = 3

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

iii. 2x – 3y = 9 …(i)

2x + y = 13 …(ii)

Subtracting equation (ii) from (i), we get

$$\begin{array}{r} 2x - 3y = 9 \\ 2x + y = 13 \\ - \quad - \quad - \\ \hline -4y = -4 \end{array}$$

$\therefore \quad y = \frac{-4}{-4} = 1$

Substituting $y = 1$ in equation (ii), we get

$2x + 1 = 13$

$\therefore \quad 2x = 12$

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

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

iv. $5m - 3n = 19$ …(i)

$m - 6n = -7$

∴ $m = 6n - 7$ …(ii)

Substituting $m = 6n - 7$ in equation (i), we get

$5(6n - 7) - 3n = 19$

∴ $30n - 35 - 3n = 19$

∴ $27n = 19 + 35$

∴ $27n = 54$

∴ $n = \frac{54}{27} = 2$

Substituting $n = 2$ in equation (ii), we get

$m = 6(2) - 7$

$= 12 - 7 = 5$

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

v. $5x + 2y = -3$ …(i)

$x + 5y = 4$

∴ $x = 4 - 5y$ …(ii)

Substituting $x = 4 - 5y$ in equation (i), we get

$5(4 - 5y) + 2y = -3$

∴ $20 - 25y + 2y = -3$

∴ $-23y = -3 - 20$

∴ $-23y = -23$

∴ $y = \frac{-23}{-23} = 1$

Substituting $y = 1$ in equation (ii), we get

$x = 4 - 5(1)$

$= 4 - 5 = -1$

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

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

$\therefore$ $x + 3y = 10$ …[Multiplying both sides by 3]

$\therefore$ $x = 10 - 3y$ …(i)

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

$\therefore$ $8x + y = 11$

…(ii)[Multiplying both sides by 4]

Substituting $x = 10 - 3y$ in equation (ii), we get

$8(10 - 3y) + y = 11$

$\therefore$ $80 - 24y + y = 11$

$\therefore$ $-23y = 11 - 80$

$\therefore$ $-23y = -69$

$\therefore$ $y = \frac{-69}{-23} = 3$

Substituting y = 3 in equation (i), we get

x = 10 – 3(3)

= 10 – 9 = 1

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

vii. 99x + 101 y = 499 …(i)

101 x + 99y = 501 …(ii)

Adding equations (i) and (ii), we get

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

$\therefore \quad x + y = \frac{1000}{200}$ ...[Dividing both sides by 200]

$\therefore \quad x + y = 5$ ...(iii)

Subtracting equation (ii) from (i), we get

$$\begin{array}{r} 99x + 101y = 499 \\ 101x + 99y = 501 \\ - \quad - \quad - \\ \hline -2x + 2y = -2 \end{array}$$

$\therefore \quad x - y = \frac{-2}{-2}$ ...[Dividing both sides by –2]

$\therefore \quad x - y = 1$ ...(iv)

Adding equations (iii) and (iv), we get

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

$\therefore \quad x = \frac{6}{2} = 3$

Substituting x = 3 in equation (iii), we get

3 + y = 5

∴ y = 5 – 3 = 2

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

viii. 49x – 57y = 172 …(i)

57x – 49y = 252 …(ii)

Adding equations (i) and (ii), we get

$$\begin{array}{r} 49x - 57y = 172 \\ + \quad 57x - 49y = 252 \\ \hline 106x - 106y = 424 \end{array}$$

$\therefore \quad x - y = \frac{424}{106}$ ...[Dividing both sides by 106]

$\therefore \quad x - y = 4$ ...(iii)

Subtracting equation (ii) from (i), we get

$$\begin{array}{r} 49x - 57y = 172 \\ 57x - 49y = 252 \\ - \quad + \qquad - \\ \hline -8x - 8y = -80 \end{array}$$

$\therefore \quad x + y = \frac{-80}{-8}$ ...[Dividing both sides by –8]

$\therefore \quad x + y = 10$ ...(iv)

Adding equations (iii) and (iv), we get

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

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

Substituting x = 7 in equation (iv), we get

7 + y = 10

∴ y = 10 – 7 = 3

∴ (x, y) = (7, 3) is the solution of the given simultaneous equations.

Complete the following table. (Textbook pg. no. 1)

No.	Equation	Is the equation a linear equation in 2 variables	Reason
1	$4m + 3n = 12$	Yes	Two variables each with degree 1
2	$3x^2 - 7y = 13$	No	The degree of variable x is 2
3	$\sqrt{2}x - \sqrt{5}y = 16$	Yes	Two variables each with degree 1
4	$0x + 6y - 3 = 0$	No	Only one variable y
5	$0.3x + 0y - 36 = 0$	No	Only one variable x
6	$\frac{4}{x} + \frac{5}{y} = 4$	No	The degree of variables is -1
7	$4xy - 5y - 8 = 0$	No	The degree of xy is 2

Question 1.

Solve: 3x+ 2y = 29; 5x – y = 18 (Textbook pg. no. 3)

Solution:

$3x + 2y = 29$ …(i)

and $5x - y = 18$ …(ii)

Let's solve the equations by eliminating 'y'.

Fill suitably the boxes below.

Multiplying equation (ii) by 2, we get

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

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

Add equations (i) and (iii).

$$\begin{array}{l} 3x + 2y = 29 \\ \boxed{10x} - \boxed{2y} = \boxed{36} \\ \hline \boxed{13x} \quad = \boxed{65} \end{array}$$

$\therefore \quad x = \frac{65}{13} = \boxed{5}$

Substituting $x = 5$ in equation (i).

$3x + 2y = 29$

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

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

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

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

$\therefore \quad y = \frac{14}{2} = \boxed{7}$

$\therefore \quad (x, y) = (\boxed{5}, \boxed{7})$ **is the solution.**

Practice Set 1.2

Complete the following table to draw graph of the equations.

i. x + y = 3

ii. x – y = 4

Answer:

i. x + y = 3

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

ii. x – y = 4

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

Solve the following simultaneous equations graphically.

i. x + y = 6 ; x – y = 4

ii. x + y = 5 ; x – y = 3

iii. x + y = 0 ; 2x – y = 9

iv. 3x – y = 2 ; 2x – y = 3

v. 3x – 4y = -7 ; 5x – 2y = 0

vi. 2x – 3y = 4 ; 3y – x = 4

Solution:

i. The given simultaneous equations are

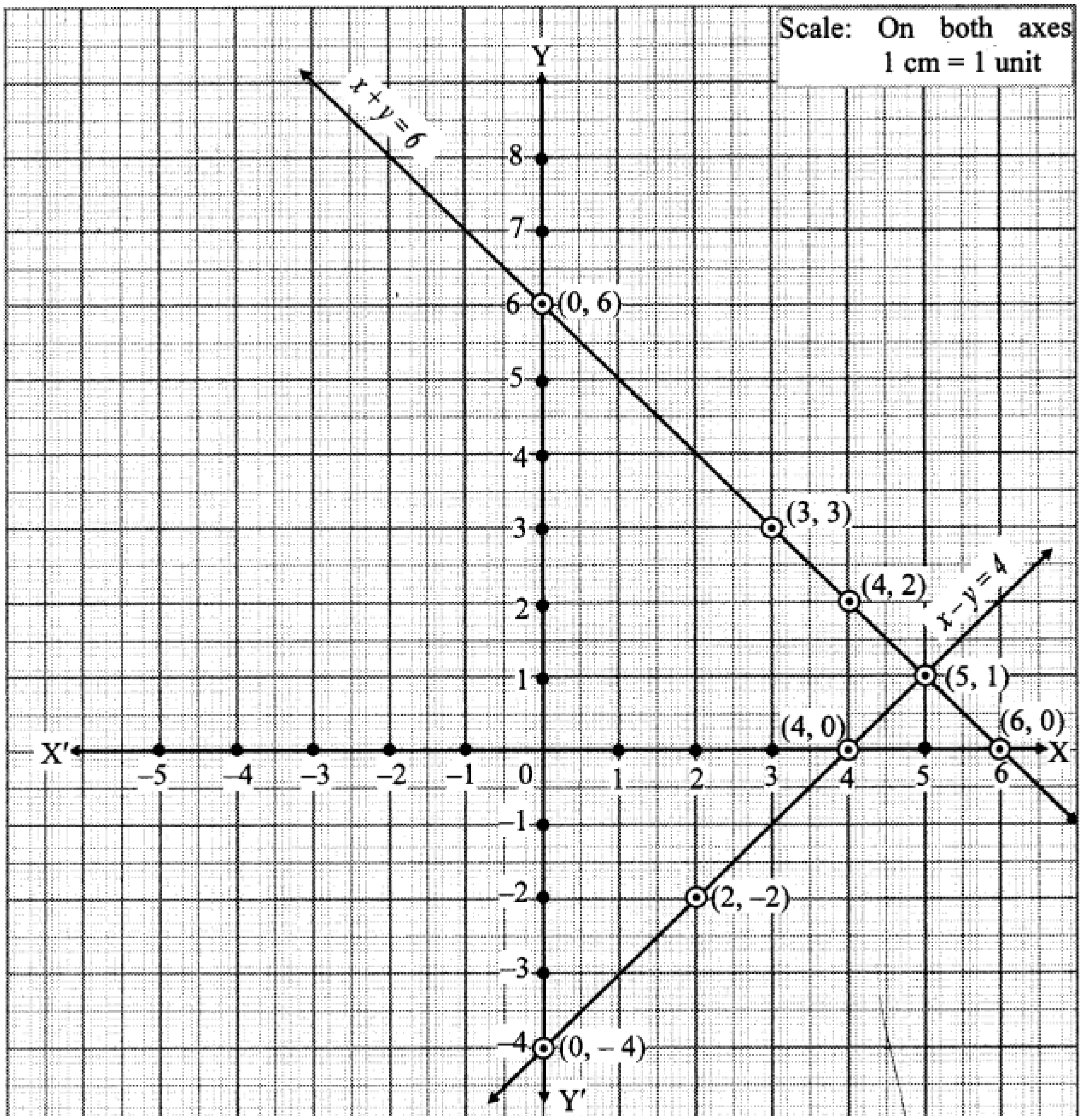
x + y = 6 x – y = 4

∴ y = 6 – x

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

∴ y = x – 4

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



The two lines intersect at point (5, 1).

∴ x = 5 and y = 1 is the solution of the simultaneous equations x + y = 6 and x – y = 4.

ii. The given simultaneous equations are

$x + y = 5$

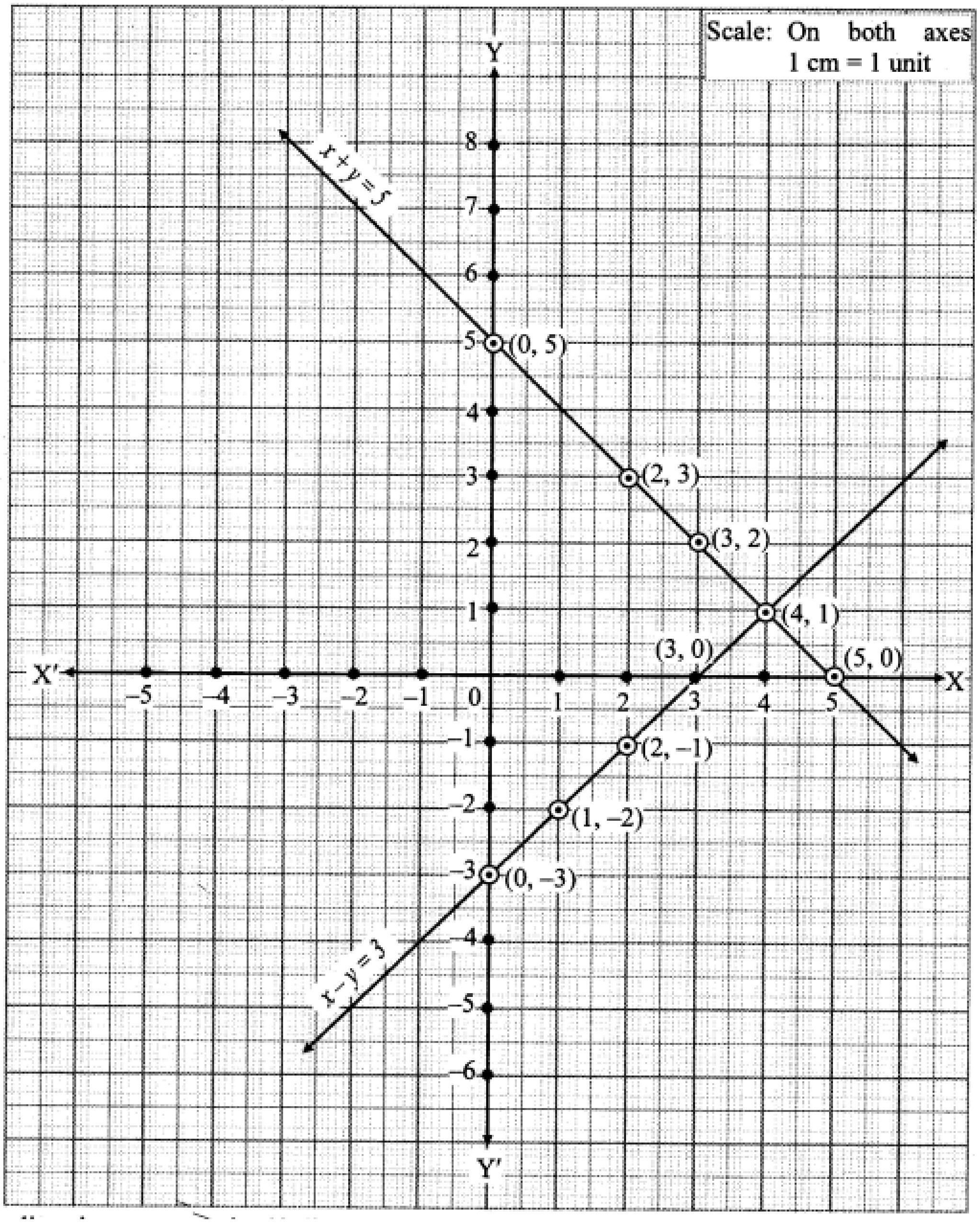
$\therefore \quad y = 5 - x$

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

$x - y = 3$

$\therefore \quad y = x - 3$

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



The two lines intersect at point (4, 1).

∴ x = 4 and y = 1 is the solution of the simultaneous equations x+y = 5 and x – y = 3.

iii. The given simultaneous equations are

$x + y = 0$

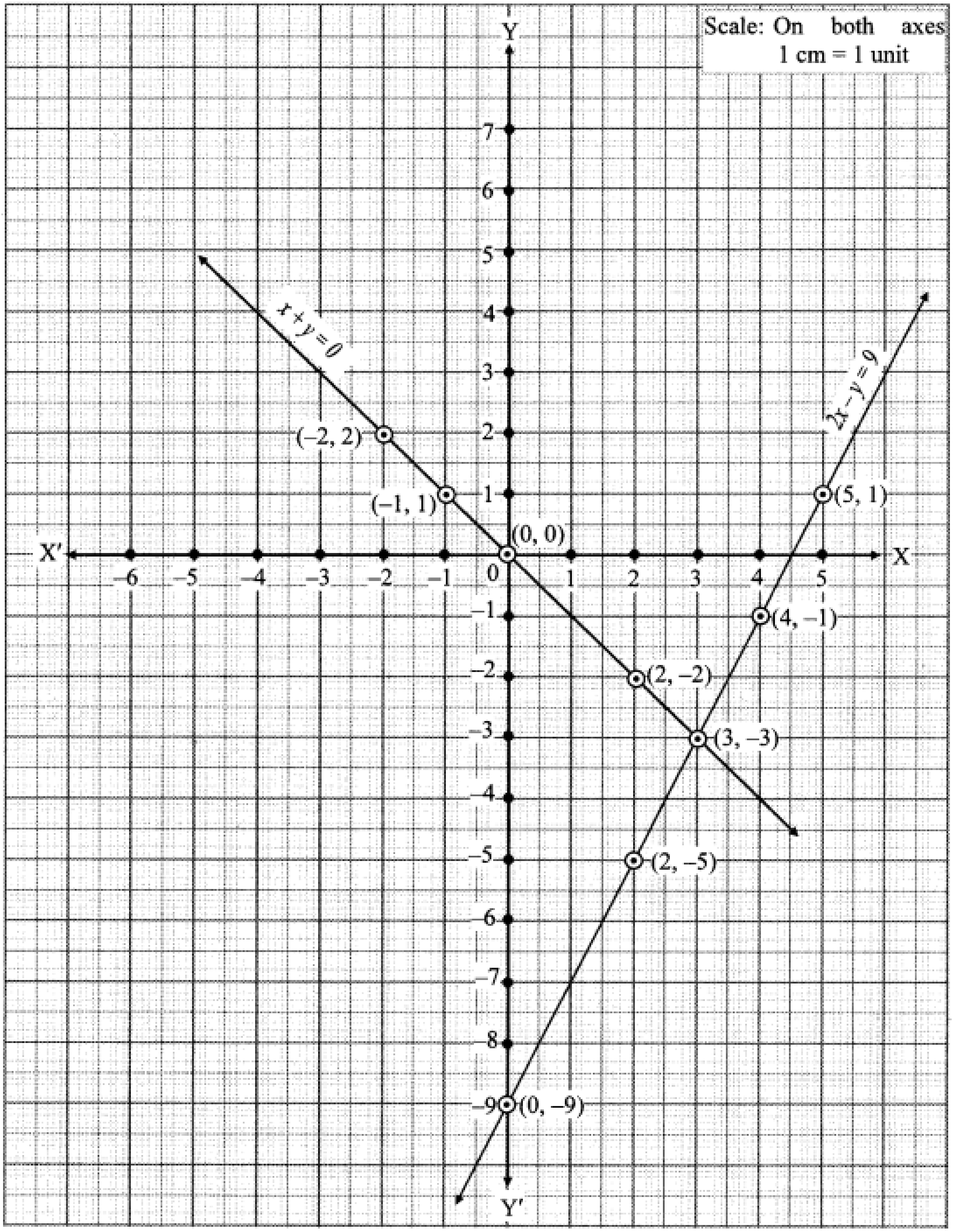
$\therefore \quad y = -x$

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

$2x - y = 9$

$\therefore \quad y = 2x - 9$

x	0	2	5	4
y	-9	-5	1	-1
(x, y)	$(0, -9)$	$(2, -5)$	$(5, 1)$	$(4, -1)$



The two lines intersect at point (3, -3).

∴ $x = 3$ and $y = -3$ is the solution of the simultaneous equations $x + y = 0$ and $2x - y = 9$.

iv. The given simultaneous equations are

$3x - y = 2$

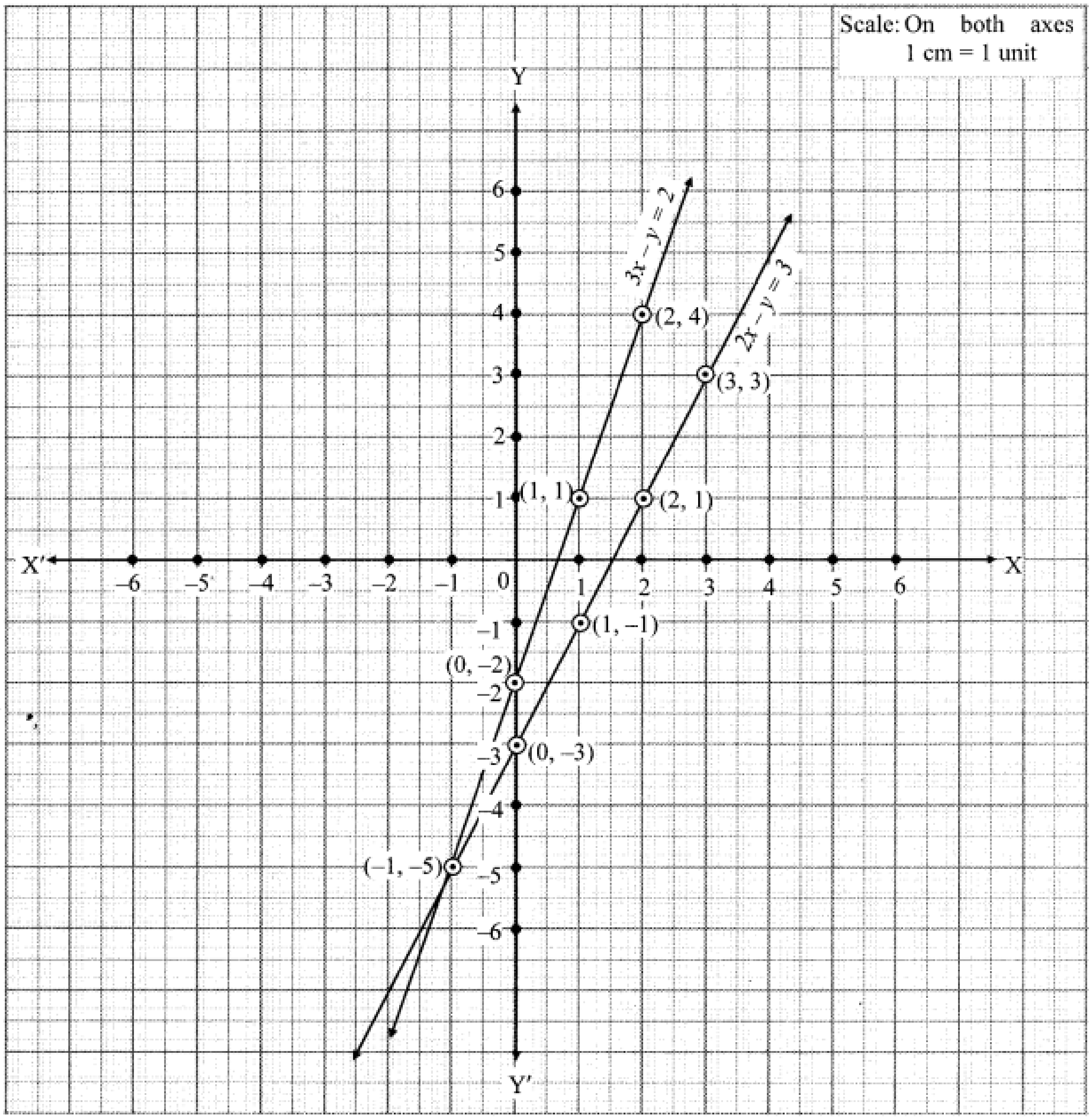
$\therefore \quad y = 3x - 2$

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

$2x - y = 3$

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

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



The two lines intersect at point (-1, -5).

∴ $x = -1$ and $y = -5$ is the solution of the simultaneous equations $3x - y = 2$ and $2x - y = 3$.

v. The given simultaneous equations are

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$3x - 4y = -7$

$\therefore \quad 4y = 3x + 7$

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

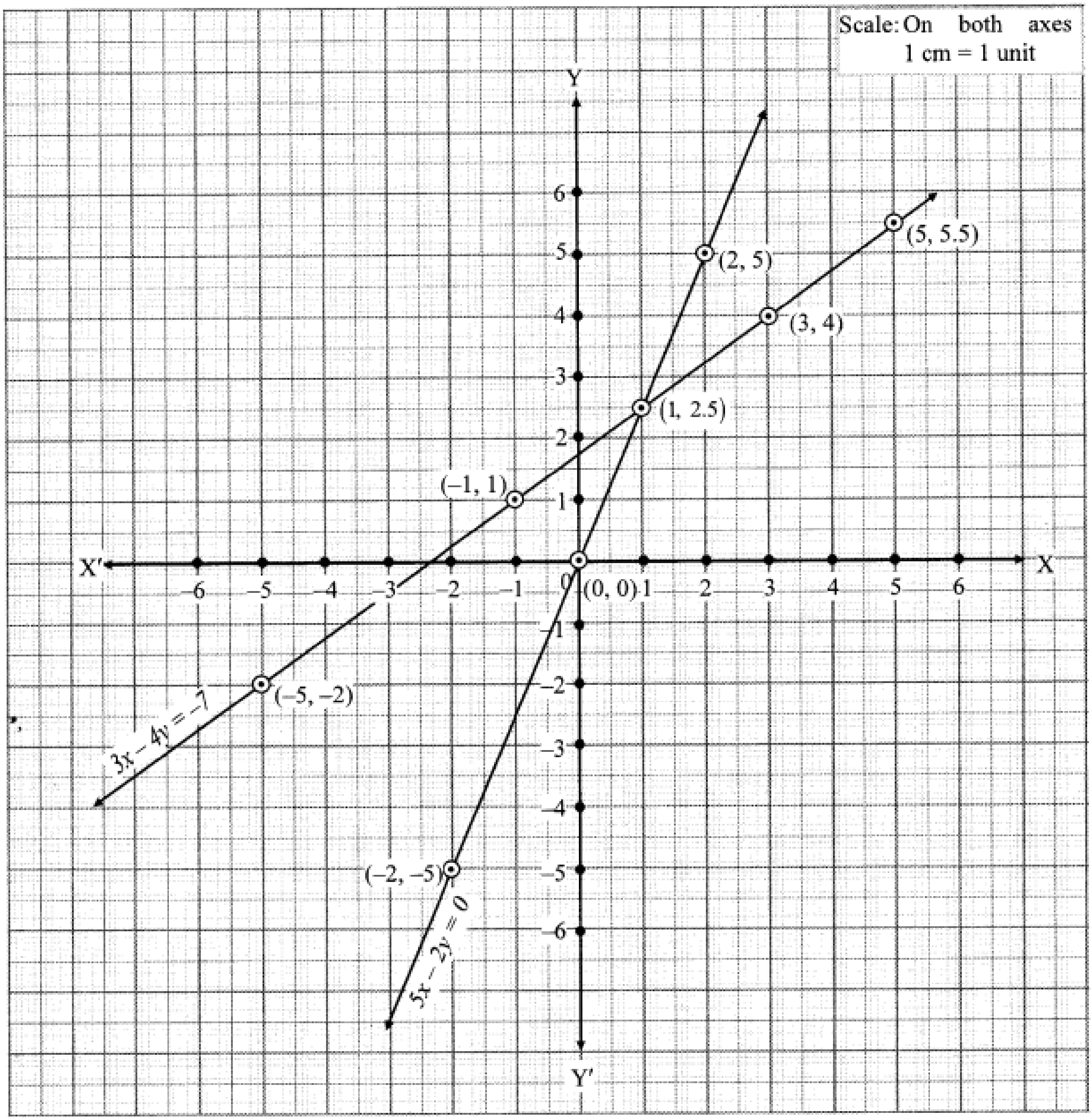
x	–1	–5	3	5
y	1	–2	4	5.5
(x, y)	(–1, 1)	(–5,–2)	(3, 4)	(5, 5.5)

$5x - 2y = 0$

$\therefore \quad 2y = 5x$

$\therefore \quad y = \frac{5}{2}x$

x	0	2	–2	1
y	0	5	–5	2.5
(x, y)	(0, 0)	(2, 5)	(–2, –5)	(1, 2.5)



The two lines intersect at point (1, 2.5).

∴ x = 1 and y = 2.5 is the solution of the simultaneous equations 3x – 4y = -7 and 5x – 2y = 0.

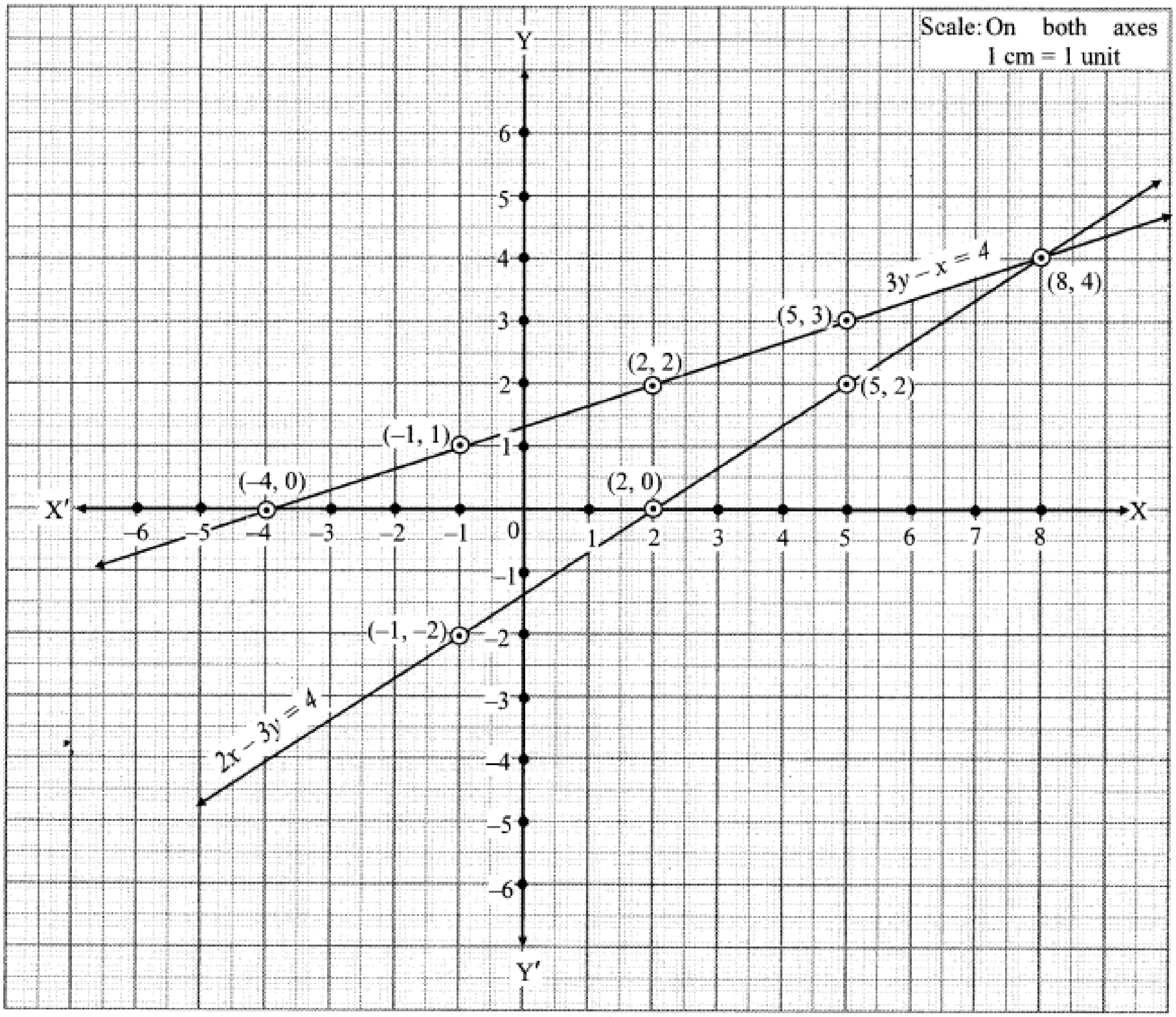
vi. The given simultaneous equations are

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

x	2	–1	5	8
y	0	–2	2	4
(x, y)	(2, 0)	(–1,–2)	(5, 2)	(8, 4)

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

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



The two lines intersect at point (8, 4).

∴ x = 8 and y = 4 is the solution of the simultaneous equations 2x – 3y = 4 and 3y – x = 4.

Solve the following simultaneous equations by graphical method. Complete the following tables to get ordered pairs.

$x - y = 1$

x	0		3	
y		0		–3
(x, y)				

$5x - 3y = 1$

x	2			–4
y		8	–2	
(x, y)				

i. Plot the above ordered pairs on the same co-ordinate plane.

ii. Draw graphs of the equations.

iii. Note the co-ordinates of the point of intersection of the two graphs. Write solution of these equations. (Textbook pg. no. 8)

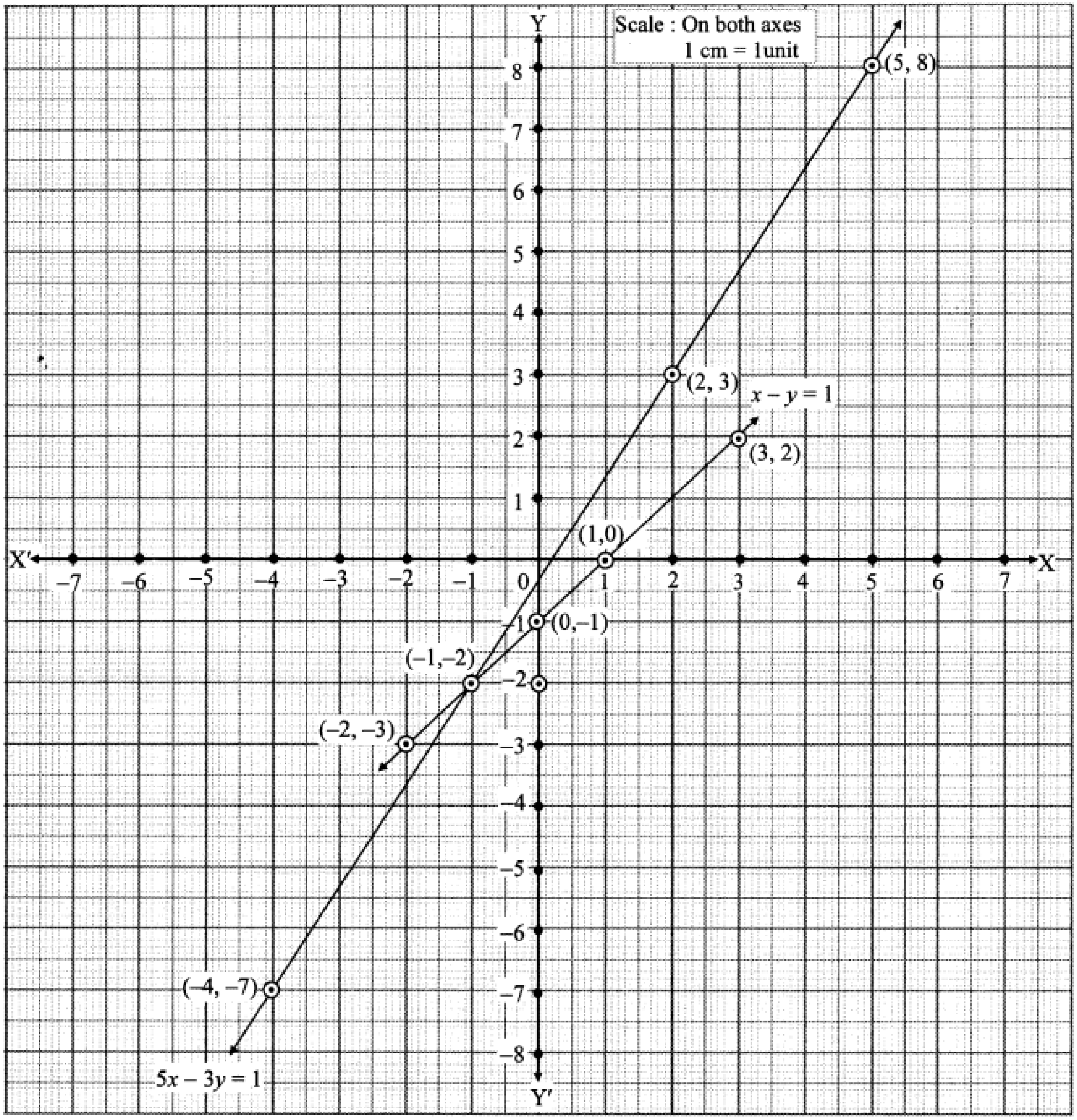
Solution:

$x - y = 1$

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)



The two lines intersect at point (-1, -2).

∴ (x , y) = (-1, -2) is the solution of the given simultaneous equations.

Solve the above equations by method of elimination. Check your solution with the solution obtained by graphical method. (Textbook pg. no. 8)

Solution:

The given simultaneous equations are

x – y = 1 …(i)

5x – 3y = 1 …(ii)

Multiplying equation (i) by 3, we get

3x – 3y = 3 …(iii)

Subtracting equation (iii) from (ii), we get

$$\begin{array}{rcrcl} 5x & - & 3y & = & 1 \\ 3x & - & 3y & = & 3 \\ - & + & & & - \\ \hline 2x & & & = & -2 \end{array}$$

$$\therefore \quad x = \frac{-2}{2} = -1$$

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

-1 -y= 1

∴ -y = 1 + 1

∴ -y = 2

∴ y = -2

∴ (x,y) = (-1, -2) is the solution of the given simultaneous equations.

∴ The solution obtained by elimination method and by graphical method is the same.

The following table contains the values of x and y co-ordinates for ordered pairs to draw the graph of 5x – 3y = 1.

x	0	$\frac{1}{5}$	1	-2
y	$-\frac{1}{3}$	0	$\frac{4}{3}$	$-\frac{11}{3}$
(x, y)	$\left(0, -\frac{1}{3}\right)$	$\left(\frac{1}{5}, 0\right)$	$\left(1, \frac{4}{3}\right)$	$\left(-2, -\frac{11}{3}\right)$

i. Is it easy to plot these points?

ii. Which precaution is to be taken to find ordered pairs so that plotting of points becomes easy? (Textbook pg. no. 8)

Solution:

i. No

Here, $-\frac{1}{3} = -0.33\ldots$, $\frac{4}{3} = 1.33\ldots$, $-\frac{11}{3} = -3.66\ldots$

The above numbers are non-terminating and recurring decimals.

∴ It is not easy to plot the given points.

ii. While finding ordered pairs, numbers should be selected in such a way that the co-ordinates obtained will be integers.

To solve simultaneous equations x + 2y = 4; 3x + 6y = 12 graphically, following are the ordered pairs.

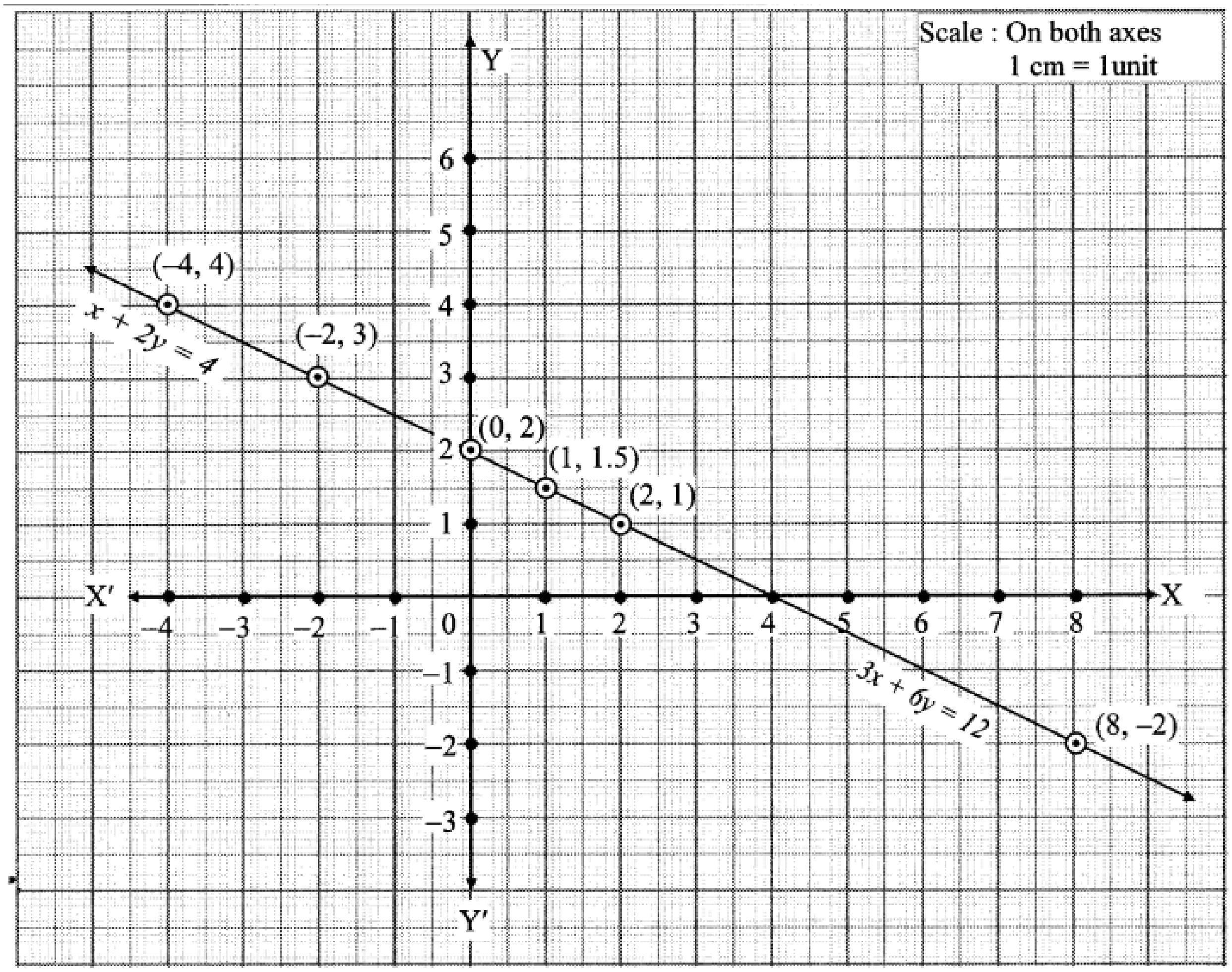
$x + 2y = 4$

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

$3x + 6y = 12$

x	-4	1	8
y	4	1.5	-2
(x, y)	$(-4, 4)$	$(1, 1.5)$	$(8, -2)$

Plotting the above ordered pairs, graph is drawn. Observe it and find answers of the following questions.



i. Are the graphs of both the equations different or same?

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

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

iv. What conclusion can you draw when two equations are given but the graph is only one line? (Textbook pg. no. 9)

Solution:

i. The graphs of both the equations are same.

ii. The solutions of the given equations are (-2, 3), (0, 2), (1, 1.5), etc.

∴ Infinite solutions are possible.

iii. Ratio of coefficients of x = 13

Ratio of coefficients of y = 26 = 13

Ratio of constant terms = 412 = 13

∴ Ratios of coefficients of x = ratio of coefficients of y = ratio of the constant terms

iv. When two equations are given but the graph is only one line, the equations will have infinite solutions.

Draw graphs of x- 2y = 4, 2x – 4y = 12 on the same co-ordinate plane. Observe it. Think of the relation between the coefficients of x, coefficients ofy and the constant terms and draw the inference. (Textbook pg. no. 10)

Solution:

i. $x - 2y = 4$

$\therefore \quad 2y = x - 4$

$\therefore \quad y = \dfrac{x-4}{2}$

$2x - 4y = 12$

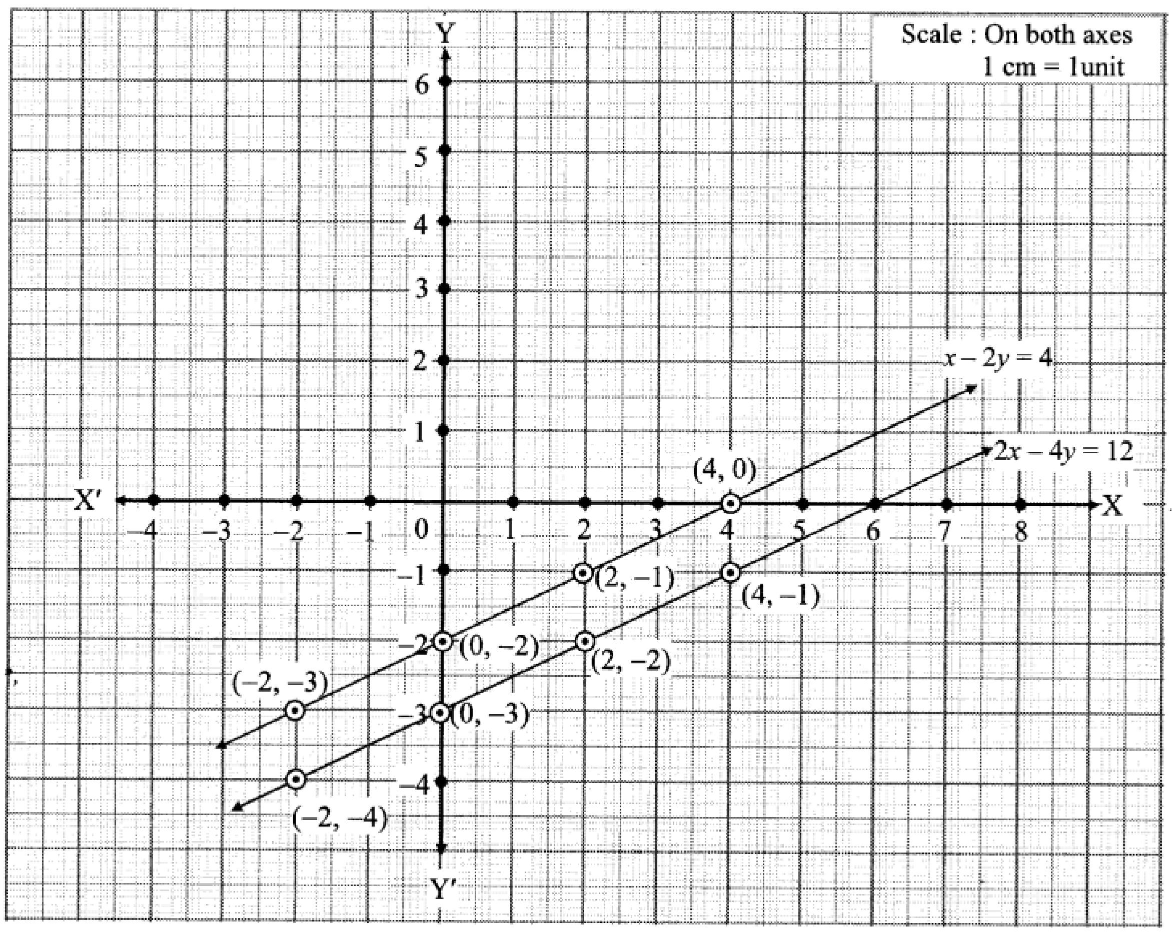
$\therefore \quad x - 2y = 6$ …[Dividing both sides by 2]

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

$\therefore \quad y = \dfrac{x-6}{2}$

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

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



ii. Ratio of coefficients of x =12

Ratio of coefficients of y = −2−4 = 12

Ratio of constant terms = 412 = 13

∴ Ratio of coefficients of x = ratio of coefficients of y ratio of constant terms

iii. If ratio of coefficients of x = ratio of coefficients of y ≠ ratio of constant terms, then the graphs of the two equations will be parallel to each other.

Condition of consistency in Equations:

Sr. No.	Simultaneous Equations	$\frac{a_1}{a_2}$	$\frac{b_1}{b_2}$	$\frac{c_1}{c_2}$	Comparison of ratios	Graphical interpretation	Algebraic interpretation
1.	$x+y=3; x-y=1$	$\frac{1}{1}$	$\frac{1}{-1}$	$\frac{3}{1}$	$\frac{a_1}{a_2} \neq \frac{b_1}{b_2}$	Intersecting lines	Unique solution (OR) Only one common solution
2.	$2x-y=-1; 2x-y=4$	$\frac{2}{2}$	$\frac{-1}{-1}$	$\frac{-1}{4}$	$\frac{a_1}{a_2} = \frac{b_1}{b_2} \neq \frac{c_1}{c_2}$	Parallel lines	No solution
3.	$x-y=-2; 2x-2y=-4$	$\frac{1}{2}$	$\frac{-1}{-2}$	$\frac{-2}{-4}$	$\frac{a_1}{a_2} = \frac{b_1}{b_2} = \frac{c_1}{c_2}$	Coincident lines	Infinitely many solutions

Practice Set 1.3

Question 1.

Fill in the blanks with correct number.

Solution:

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

$$= \boxed{15} - 8$$

$$= \boxed{7}$$

Question 2.

Find the values of following determinants.

i. $\begin{vmatrix} -1 & 7 \\ 2 & 4 \end{vmatrix}$ ii. $\begin{vmatrix} 5 & 3 \\ -7 & 0 \end{vmatrix}$

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

Solution:

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

$= -4 - 14$

$\therefore$ $\begin{vmatrix} \mathbf{-1} & \mathbf{7} \\ \mathbf{2} & \mathbf{4} \end{vmatrix} \mathbf{= -18}$

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

$= 0 - (-21)$

$\therefore$ $\begin{vmatrix} \mathbf{5} & \mathbf{3} \\ \mathbf{-7} & \mathbf{0} \end{vmatrix} \mathbf{= 21}$

iii. $\begin{vmatrix} \frac{7}{3} & \frac{5}{3} \\ \frac{3}{2} & \frac{1}{2} \end{vmatrix} = \left(\frac{7}{3} \times \frac{1}{2}\right) - \left(\frac{5}{3} \times \frac{3}{2}\right)$

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

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

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

$\therefore \begin{vmatrix} \frac{7}{3} & \frac{5}{3} \\ \frac{3}{2} & \frac{1}{2} \end{vmatrix} = \frac{-4}{3}$

Question 3.

Solve the following simultaneous equations using Cramer's rule.

i. 3x – 4y = 10 ; 4x + 3y = 5

ii. 4x + 3y – 4 = 0 ; 6x = 8 – 5y

iii. x + 2y = -1 ; 2x – 3y = 12

iv. 6x – 4y = -12 ; 8x – 3y = -2

v. 4m + 6n = 54 ; 3m + 2n = 28

vi. 2x + 3y = 2 ; x – y2 = 12

Solution:

i. The given simultaneous equations are 3x – 4y = 10 …(i)

4x + 3y = 5 …(ii)

Equations (i) and (ii) are in ax + by = c form.

Comparing the given equations with

$a_1x + b_1y = c_1$ and $a_2x + b_2y = c_2$, we get

$a_1 = 3$, $b_1 = -4$, $c_1 = 10$ and

$a_2 = 4$, $b_2 = 3$, $c_2 = 5$

$$\therefore \quad D = \begin{vmatrix} a_1 & b_1 \\ a_2 & b_2 \end{vmatrix} = \begin{vmatrix} 3 & -4 \\ 4 & 3 \end{vmatrix} = (3 \times 3) - (-4 \times 4)$$

$$= 9 - (-16)$$

$$= 9 + 16 = 25 \neq 0$$

$$D_x = \begin{vmatrix} c_1 & b_1 \\ c_2 & b_2 \end{vmatrix} = \begin{vmatrix} 10 & -4 \\ 5 & 3 \end{vmatrix} = (10 \times 3) - (-4 \times 5)$$

$$= 30 - (-20)$$

$$= 30 + 20 = 50$$

$$D_y = \begin{vmatrix} a_1 & c_1 \\ a_2 & c_2 \end{vmatrix} = \begin{vmatrix} 3 & 10 \\ 4 & 5 \end{vmatrix} = (3 \times 5) - (10 \times 4)$$

$$= 15 - 40 = -25$$

$\therefore$ By Cramer's rule, we get

$$x = \frac{D_x}{D} \text{ and } y = \frac{D_y}{D}$$

$$\therefore \quad x = \frac{50}{25} \text{ and } y = \frac{-25}{25}$$

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

∴ (x, y) = (2, -1) is the solution of the given simultaneous equations.

ii. The given simultaneous equations are

$4x + 3y – 4 = 0$

∴ $4x + 3y = 4$ …(i)

$6x = 8 – 5y$

∴ $6x + 5y = 8$ …(ii)

Equations (i) and (ii) are in $ax + by = c$ form.

Comparing the given equations with

$a_1x + b_1y = c_1$ and $a_2x + b_2y = c_2$, we get

$a_1 = 4$, $b_1 = 3$, $c_1 = 4$ and

$a_2 = 6$, $b_2 = 5$, $c_2 = 8$

$$\therefore \quad D = \begin{vmatrix} a_1 & b_1 \\ a_2 & b_2 \end{vmatrix} = \begin{vmatrix} 4 & 3 \\ 6 & 5 \end{vmatrix} = (4 \times 5) - (3 \times 6)$$

$$= 20 - 18 = 2 \neq 0$$

$$D_x = \begin{vmatrix} c_1 & b_1 \\ c_2 & b_2 \end{vmatrix} = \begin{vmatrix} 4 & 3 \\ 8 & 5 \end{vmatrix} = (4 \times 5) - (3 \times 8)$$

$$= 20 - 24 = -4$$

$$D_y = \begin{vmatrix} a_1 & c_1 \\ a_2 & c_2 \end{vmatrix} = \begin{vmatrix} 4 & 4 \\ 6 & 8 \end{vmatrix} = (4 \times 8) - (4 \times 6)$$

$$= 32 - 24 = 8$$

$\therefore$ By Cramer's rule, we get

$$x = \frac{D_x}{D} \text{ and } y = \frac{D_y}{D}$$

$$\therefore \quad x = \frac{-4}{2} \text{ and } y = \frac{8}{2}$$

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

∴ (x, y) = (-2, 4) is the solution of the given simultaneous equations.

iii. The given simultaneous equations are

$x + 2y = -1$ …(i)

$2x - 3y = 12$ …(ii)

Equations (i) and (ii) are in $ax + by = c$ form.

Comparing the given equations with

$a_1x + b_1y = C_1$ and $a_2x + b_2y = c_2$, we get

$a_1 = 1$, $b_1 = 2$, $c_1 = -1$ and

$a_2 = 2$, $b_2 = -3$, $c_2 = 12$

$$\therefore \quad D = \begin{vmatrix} a_1 & b_1 \\ a_2 & b_2 \end{vmatrix} = \begin{vmatrix} 1 & 2 \\ 2 & -3 \end{vmatrix} = (1 \times -3) - (2 \times 2)$$

$$= -3 - 4 = -7 \neq 0$$

$$D_x = \begin{vmatrix} c_1 & b_1 \\ c_2 & b_2 \end{vmatrix} = \begin{vmatrix} -1 & 2 \\ 12 & -3 \end{vmatrix} = (-1 \times -3) - (2 \times 12)$$

$$= 3 - 24 = -21$$

$$D_y = \begin{vmatrix} a_1 & c_1 \\ a_2 & c_2 \end{vmatrix} = \begin{vmatrix} 1 & -1 \\ 2 & 12 \end{vmatrix} = (1 \times 12) - (-1 \times 2)$$

$$= 12 - (-2) = 12 + 2 = 14$$

$\therefore$ By Cramer's rule, we get

$$x = \frac{D_x}{D} \text{ and } y = \frac{D_y}{D}$$

$$\therefore \quad x = \frac{-21}{-7} \text{ and } y = \frac{14}{-7}$$

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

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

iv. The given simultaneous equations are

$6x - 4y = -12$

$\therefore$ $3x - 2y = -6$ …(i) [Dividing both sides by 2]

$8x - 3y = -2$ …(ii)

Equations (i) and (ii) are in $ax + by = c$ form.

Comparing the given equations with

$a_1x + b_1y = c_1$ and $a_2x + b_2y = c_2$, we get

$a_1 = 3$, $b_1 = -2$, $c_1 = -6$ and

$a_2 = 8$, $b_2 = -3$, $c_2 = -2$

$\therefore \quad D = \begin{vmatrix} a_1 & b_1 \\ a_2 & b_2 \end{vmatrix} = \begin{vmatrix} 3 & -2 \\ 8 & -3 \end{vmatrix} = (3 \times -3) - (-2 \times 8)$

$= -9 - (-16)$

$= -9 + 16 = 7 \neq 0$

$D_x = \begin{vmatrix} c_1 & b_1 \\ c_2 & b_2 \end{vmatrix} = \begin{vmatrix} -6 & -2 \\ -2 & -3 \end{vmatrix} = (-6 \times -3) - (-2 \times -2)$

$= 18 - 4 = 14$

$D_y = \begin{vmatrix} a_1 & c_1 \\ a_2 & c_2 \end{vmatrix} = \begin{vmatrix} 3 & -6 \\ 8 & -2 \end{vmatrix} = (3 \times -2) - (-6 \times 8)$

$= -6 - (-48)$

$= -6 + 48 = 42$

$\therefore$ By Cramer's rule, we get

$x = \frac{D_x}{D}$ and $y = \frac{D_y}{D}$

$\therefore \quad x = \frac{14}{7}$ and $y = \frac{42}{7}$

$\therefore \quad x = 2$ and $y = 6$

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

v. The given simultaneous equations are

4m + 6n = 54

2m + 3n = 27 …(i) [Dividing both sides by 2]

3m + 2n = 28 …(ii)

Equations (i) and (ii) are in am + bn = c form.

Comparing the given equations with

$a_1m + b_1n = c_1$ and $a_2m + b_2n = c_2$, we get

$a_1 = 2$, $b_1 = 3$, $c_1 = 27$ and

$a_2 = 3$, $b_2 = 2$, $c_2 = 28$

$$\therefore \quad D = \begin{vmatrix} a_1 & b_1 \\ a_2 & b_2 \end{vmatrix} = \begin{vmatrix} 2 & 3 \\ 3 & 2 \end{vmatrix} = (2 \times 2) - (3 \times 3)$$

$$= 4 - 9 = -5 \neq 0$$

$$D_m = \begin{vmatrix} c_1 & b_1 \\ c_2 & b_2 \end{vmatrix} = \begin{vmatrix} 27 & 3 \\ 28 & 2 \end{vmatrix} = (27 \times 2) - (3 \times 28)$$

$$= 54 - 84 = -30$$

$$D_n = \begin{vmatrix} a_1 & c_1 \\ a_2 & c_2 \end{vmatrix} = \begin{vmatrix} 2 & 27 \\ 3 & 28 \end{vmatrix} = (2 \times 28) - (27 \times 3)$$

$$= 56 - 81 = -25$$

$\therefore$ By Cramer's rule, we get

$$m = \frac{D_m}{D} \text{ and } n = \frac{D_n}{D}$$

$$\therefore \quad m = \frac{-30}{-5} \text{ and } n = \frac{-25}{-5}$$

$$\therefore \quad m = 6 \text{ and } n = 5$$

∴ (m, n) = (6, 5) is the solution of the given simultaneous equations.

vi. The given simultaneous equations are

2x + 3y = 2 …(i)

x = y2 = 12

∴ 2x – y = 1 …(ii) [Multiplying both sides by 2]

Equations (i) and (ii) are in ax + by = c form.

Comparing the given equations with

$a_1x + b_1y = c_1$ and $a_2x + b_2y = c_2$, we get

$a_1 = 2$, $b_1 = 3$, $c_1 = 2$ and

$a_2 = 2$, $b_2 = -1$, $c_2 = 1$

$\therefore \quad D = \begin{vmatrix} a_1 & b_1 \\ a_2 & b_2 \end{vmatrix} = \begin{vmatrix} 2 & 3 \\ 2 & -1 \end{vmatrix} = (2 \times -1) - (3 \times 2)$

$= -2 - 6 = -8 \neq 0$

$D_x = \begin{vmatrix} c_1 & b_1 \\ c_2 & b_2 \end{vmatrix} = \begin{vmatrix} 2 & 3 \\ 1 & -1 \end{vmatrix} = (2 \times -1) - (3 \times 1)$

$= -2 - 3 = -5$

$D_y = \begin{vmatrix} a_1 & c_1 \\ a_2 & c_2 \end{vmatrix} = \begin{vmatrix} 2 & 2 \\ 2 & 1 \end{vmatrix} = (2 \times 1) - (2 \times 2)$

$= 2 - 4 = -2$

$\therefore$ By Cramer's rule, we get

$x = \frac{D_x}{D}$ and $y = \frac{D_y}{D}$

$\therefore \quad x = \frac{-5}{-8}$ and $y = \frac{-2}{-8}$

$\therefore \quad x = \frac{5}{8}$ and $y = \frac{1}{4}$

$\therefore$ **$(x, y) = \left(\frac{5}{8}, \frac{1}{4}\right)$ is the solution of the given simultaneous equations.**

Question 1.

To solve the simultaneous equations by determinant method, fill in the blanks,

y + 2x – 19 = 0; 2x – 3y + 3 = 0 (Textbookpg.no. 14)

Solution:

Write the given equations in the form

ax + by = c.

2x + y = 19

2x – 3y = -3

$$D = \begin{vmatrix} \boxed{2} & \boxed{1} \\ 2 & -3 \end{vmatrix} = \left[\boxed{2} \times (-3)\right] - \left[2 \times \left(\boxed{1}\right)\right]$$

$$= \boxed{-6} - \boxed{2} = \boxed{-8}$$

$$D_x = \begin{vmatrix} 19 & \boxed{1} \\ \boxed{-3} & -3 \end{vmatrix} = \left[19 \times \left(\boxed{-3}\right)\right] - \left[\left(\boxed{-3}\right) \times \left(\boxed{1}\right)\right]$$

$$= \boxed{-57} - \boxed{-3} = \boxed{-54}$$

$$D_y = \begin{vmatrix} \boxed{2} & 19 \\ 2 & \boxed{-3} \end{vmatrix} = \left[\left(\boxed{2}\right) \times \left(\boxed{-3}\right)\right] - \left[\left(\boxed{2}\right) \times \left(\boxed{19}\right)\right]$$

$$= \boxed{-6} - \boxed{38} = \boxed{-44}$$

$\therefore$ By Cramer's rule, we get

$$x = \frac{D_x}{D} \text{ and } y = \frac{D_y}{D}$$

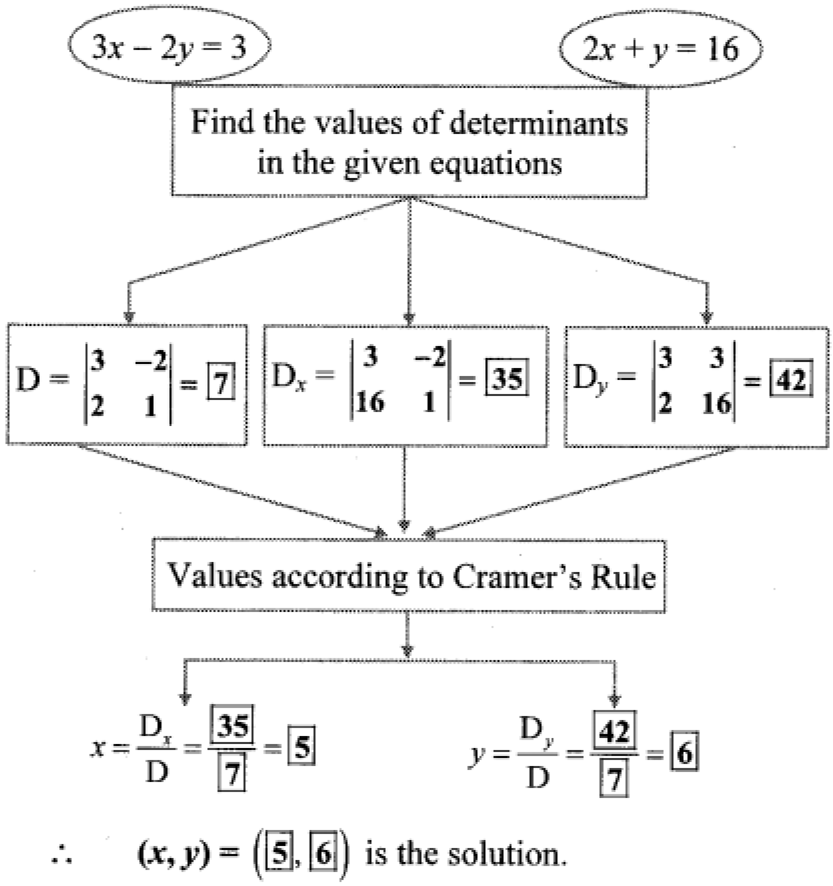
$$\therefore \quad x = \frac{\boxed{-54}}{\boxed{-8}} = \frac{\boxed{27}}{\boxed{4}} \text{ and } y = \frac{\boxed{-44}}{\boxed{-8}} = \frac{\boxed{11}}{\boxed{2}}$$

$\therefore$ $(x, y) = \left(\frac{\boxed{27}}{\boxed{4}}, \frac{\boxed{11}}{\boxed{2}}\right)$ **is the solution of the given simultaneous equations.**

Question 2.

Complete the following activity. (Textbook pg. no. 15)

Solution:



Question 3.

What is the nature of solution if D = 0? (Textbook pg. no. 16)

Solution:

If D = 0, i.e. $a_1b_2 – b_1a_2 = 0$, then the two simultaneous equations do not have a unique solution.

Examples:

i. $2x – 4y = 8$ and $x – 2y = 4$

Here, $a_1b_2 – b_1a_2 = (2)(-2) – (-4)(1)$

$= -4 + 4 = 0$

Graphically, we can check that these two lines coincide and hence will have infinite solutions.

ii. $2x - y = -1$ and $2x - y = -4$

Here, $a_1 b_2 - b_1 a_2 = (2)(-1) - (-1)(2)$

$= -2 + 2 = 0$

Graphically, we can check that these two lines are parallel and hence they do not have a solution.

Question 4.

What can you say about lines if common solution is not possible? (Textbook pg. no. 16)

Answer:

If the common solution is not possible, then the lines will either coincide or will be parallel to each other.

Practice Set 1.4

Question 1.

Solve the following simultaneous equations.

i. $\frac{2}{x} - \frac{3}{y} = 15$; $\frac{8}{x} + \frac{5}{y} = 77$

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

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

iv. $\frac{1}{3x+y} + \frac{1}{3x-y} = \frac{3}{4}$;

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

Solution:

i. The given simultaneous equations are

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

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

Let $\frac{1}{x} = p$ and $\frac{1}{y} = q$

∴ Equations (i) and (ii) become

2p – 3q = 15 …(iii)

8p + 5q = 77 …(iv)

Multiplying equation (iii) by 4, we get

8p – 12q = 60 …(v)

Subtracting equation (v) from (iv), we get

$$\begin{array}{r} 8p + 5q = 77 \\ 8p - 12q = 60 \\ - \quad + \qquad - \\ \hline 17q = 17 \end{array}$$

$\therefore \quad q = \frac{17}{17} = 1$

Substituting q = 1 in equation (iii), we get

$2p - 3(1) = 15$

$\therefore \quad 2p - 3 = 15$

$\therefore \quad 2p = 15 + 3 = 18$

$\therefore \quad p = \frac{18}{2} = 9$

$\therefore \quad (p, q) = (9, 1)$

Resubstituting the values of p and q, we get

$9 = \frac{1}{x}$ and $1 = \frac{1}{y}$

$\therefore \quad x = \frac{1}{9}$ and $y = 1$

$\therefore$ **$(x, y) = \left(\frac{1}{9}, 1\right)$ is the solution of the given simultaneous equations.**

ii. The given simultaneous equations are

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

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

Let $\frac{1}{x+y}=\text{p}$ and $\frac{1}{x-y}=\text{q}$

∴ Equations (i) and (ii) become

$10\text{p}+2\text{q}=4$

∴ $5\text{p}+\text{q}=2$ …(iii)

[Dividing both sides by 2]

$15\text{p}-5\text{q}=-2$ …(iv)

Multiplying equation (iii) by 5, we get

$25\text{p}+5\text{q}=10$ …(v)

Adding equations (iv) and (v), we get

$$\begin{array}{r} 15\text{p}-5\text{q}=-2 \\ +\ 25\text{p}+5\text{q}=10 \\ \hline 40\text{p} \qquad =8 \end{array}$$

∴ $\text{p}=\frac{8}{40}=\frac{1}{5}$

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

$$5\left(\frac{1}{5}\right)+\text{q}=2$$

∴ $1+\text{q}=2$

∴ $\text{q}=2-1=1$

∴ $(\text{p}, \text{q})=\left(\frac{1}{5}, 1\right)$

Resubstituting the values of p and q, we get

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

∴ $x+y=5$ …(vi)

and $x-y=1$ …(vii)

Adding equations (vi) and (vii), we get

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

$$\therefore \quad x = \frac{6}{2} = 3$$

Substituting x = 3 in equation (vi), we get

3 + y = 5

∴ y = 5 – 3 = 2

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

iii. The given simultaneous equations are

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

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

Let $\frac{1}{x-2} = p$ and $\frac{1}{y+3} = q$

∴ Equations (i) and (ii) become

27p + 31q = 85 …(iii)

31p + 27q = 89 …(iv)

Adding equations (iii) and (iv), we get

$$\begin{array}{r} 27p + 31q = 85 \\ +\ 31p + 27q = 89 \\ \hline 58p + 58q = 174 \end{array}$$

$\therefore \quad p + q = \frac{174}{58}$ ...[Dividing both sides by 58]

$\therefore \quad p + q = 3$ ...(v)

Subtracting equation (iv) from (iii), we get

$$\begin{array}{r} 27p + 31q = 85 \\ 31p + 27q = 89 \\ -\quad -\quad\ - \\ \hline -4p + 4q = -4 \end{array}$$

$\therefore \quad p - q = \frac{-4}{-4}$ ...[Dividing both sides by –4]

$\therefore \quad p - q = 1$ ...(vi)

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

$$\begin{array}{r} p + q = 3 \\ +\ p - q = 1 \\ \hline 2p \quad = 4 \end{array}$$

$\therefore \quad p = \frac{4}{2} = 2$

Substituting p = 2 in equation (v), we get

$2 + q = 3$

$\therefore \quad q = 3 - 2 = 1$

$\therefore \quad (p, q) = (2, 1)$

Resubstituting the values of p and q, we get

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

$\therefore \quad 2(x - 2) = 1$ and $y + 3 = 1$

$\therefore \quad 2x - 4 = 1$ and $y = 1 - 3$

$\therefore \quad 2x = 1 + 4 \quad$ and $\quad y = -2$

$\therefore \quad 2x = 5 \quad$ and $\quad y = -2$

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

$\therefore \quad (x, y) = \left(\frac{5}{2}, -2\right)$ **is the solution of the given simultaneous equations.**

iv. The given simultaneous equations are

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

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

Let $\frac{1}{3x+y} = p$ and $\frac{1}{3x-y} = q$

$\therefore$ Equations (i) and (ii) become

$$p + q = \frac{3}{4} \quad \ldots(iii)$$

$$\frac{1}{2}p - \frac{1}{2}q = -\frac{1}{8} \quad \ldots(iv)$$

Multiplying equation (iv) by 2, we get

$$p - q = -\frac{1}{4} \quad \ldots(v)$$

Adding equations (iii) and (v), we get

$$\begin{array}{rl} p + q &= \frac{3}{4} \\ + \quad p - q &= -\frac{1}{4} \\ \hline 2p &= \frac{2}{4} \end{array}$$

$\therefore \quad p = \frac{1}{4}$

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

$$\frac{1}{4} + q = \frac{3}{4}$$

$\therefore \quad q = \frac{3}{4} - \frac{1}{4} = \frac{2}{4} = \frac{1}{2}$

$\therefore \quad (p, q) = \left(\frac{1}{4}, \frac{1}{2}\right)$

Resubstituting the values of p and q, we get

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

$\therefore \quad 3x + y = 4 \quad \ldots(vi)$

and $3x - y = 2 \quad \ldots(vii)$

Adding equations (vi) and (vii), we get

$$\begin{array}{rl} & 3x + y = 4 \\ + & \underline{3x - y = 2} \\ & 6x \quad\; = 6 \end{array}$$

$\therefore \quad x = \frac{6}{6} = 1$

Substituting x = 1 in equation (vi), we get

3(1) + y = 4

∴ 3 + y = 4

∴ y = 4 – 3 = 1

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

Question 1.

Complete the following table. (Textbook pg. no. 16)

Solution:

Equation	No. of variables	Whether linear or not
$\frac{3}{x}-\frac{4}{y}=8$	2	Not linear
$\frac{6}{x-1}+\frac{3}{y-2}=0$	$\boxed{2}$	$\boxed{\text{Not linear}}$
$\frac{7}{2x+1}+\frac{13}{y+2}=0$	$\boxed{2}$	$\boxed{\text{Not linear}}$
$\frac{14}{x+y}+\frac{3}{x-y}=5$	$\boxed{2}$	$\boxed{\text{Not linear}}$

Question 2.

In the above table the equations are not linear. Can you convert the equations into linear equations? (Textbook pg. no. 17)

Answer:

Yes, the above given simultaneous equations can be converted to a pair of linear equations by making suitable substitutions.

Steps for solving equations reducible to a pair of linear equations.

- Step 1: Select suitable variables other than those which are in the equations.
- Step 2: Replace the given variables with new variables such that the given equations become linear equations in two variables.
- Step 3: Solve the new simultaneous equations and find the values of the new variables.
- Step 4: By resubstituting the value(s) of the new variables, find the replaced variables which are to be determined.

Question 3.

To solve given equations fill the below boxes suitably. (Text book pg.no. 19)

Answer:

$$\frac{5}{x-1}+\frac{1}{y-2}=2;\ \frac{6}{x-1}-\frac{3}{y-2}=1$$

Replacing $\left(\frac{1}{x-1}\right)$ by m, $\left(\frac{1}{y-2}\right)$ by n

New equations

$\boxed{5m + n = 2}$ $\boxed{6m - 3n = 1}$

On solving

$m = \boxed{\frac{1}{3}}$, $n = \boxed{\frac{1}{3}}$

Replacing m, n by their original values.

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

On solving

$\therefore x-1=3,\ y-2=3$

$\therefore x=\boxed{4},\ y=\boxed{5}$

$\therefore$ $\boxed{(x, y)=(4, 5)}$ is the solution of the given simultaneous equations.

Question 4.

The examples on textbook pg. no. 17 and 18 obtained by transformation are solved by elimination method. If you solve these equations by graphical method and by Cramer's rule will you get the same answers? Solve and check it. (Textbook pg. no. 18)

i. $\frac{4}{x}+\frac{5}{y}=7;\ \frac{3}{x}+\frac{4}{y}=5$

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

Solution:

ii. The given simultaneous equations are

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

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

Let $\frac{1}{x-y} = p$ and $\frac{1}{x+y} = q$

$\therefore$ Equations (i) and (ii) become

$4p + q = 3$ ...(iii)

$2p - 3q = 5$ ...(iv)

Graphical method:

$4p + q = 3$

$\therefore$ $q = 3 - 4p$

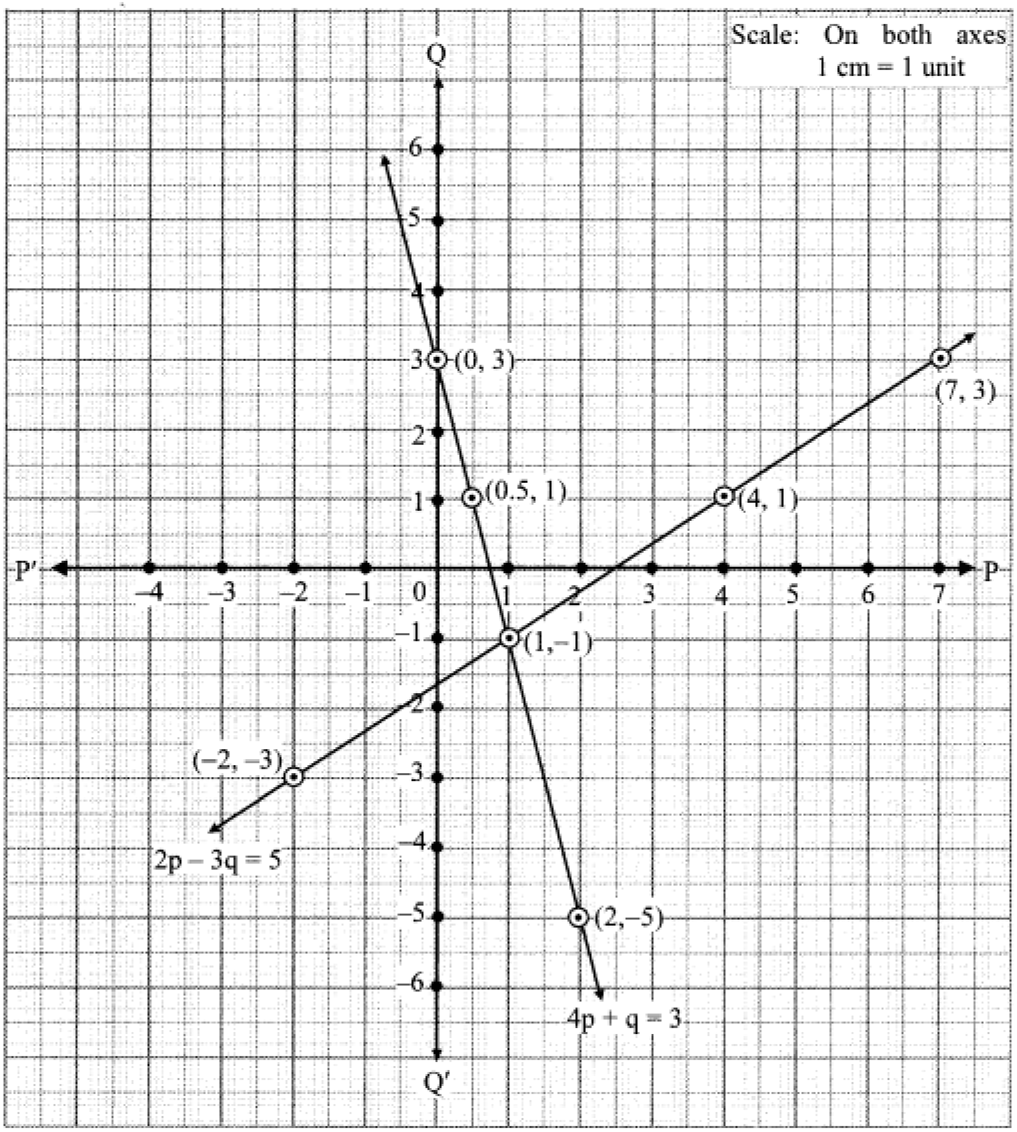
p	0	1	2	0.5
q	3	−1	−5	1
(p, q)	(0, 3)	(1, −1)	(2, −5)	(0.5, 1)

$2p - 3q = 5$

$\therefore$ $3q = 2p - 5$

$\therefore$ $q = \frac{2p-5}{3}$

p	1	4	7	−2
q	−1	1	3	−3
(p, q)	(1, −1)	(4, 1)	(7, 3)	(−2, −3)



The two lines intersect at point (1,-1).

∴ p = 1 and q = -1 is the solution of the simultaneous equations 4p + q = 3 and 2p – 3q = 5.

Re substituting the values of p and q, we get

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

$\therefore \quad x - y = 1$ and $x + y = -1$

$x - y = 1$

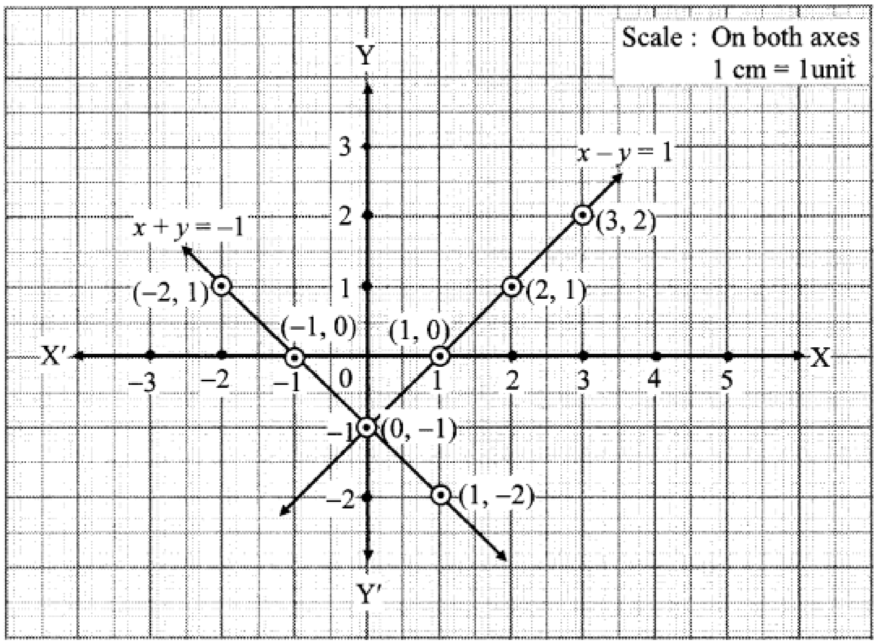
$\therefore \quad y = x - 1$

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

$x + y = -1$

$\therefore \quad y = -1 - x$

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



The two lines intersect at point (0, -1).

∴ x = 0 and y = -1 is the solution of the simultaneous equations x – y = 1 and x + y = -1.

∴ (x, y) = (0, -1) is the solution of the given simultaneous equations.

Practice Set 1.5

Question 1.

Two numbers differ by 3. The sum of twice the smaller number and thrice the greater number is 19. Find the numbers.

Solution:

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

According to the first condition, x – y = 3 …(i)

According to the second condition,

3x + 2y = 19 …(ii)

Multiplying equation (i) by 2, we get

2x – 2y = 6 …(iii)

Adding equations (ii) and (iii), we get

$$\begin{array}{rl} & 3x + 2y = 19 \\ + & 2x - 2y = 6 \\ \hline & 5x \qquad = 25 \end{array}$$

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

$$\therefore \quad x = 5$$

Substituting x = 5 in equation (i), we get

5 – y = 3

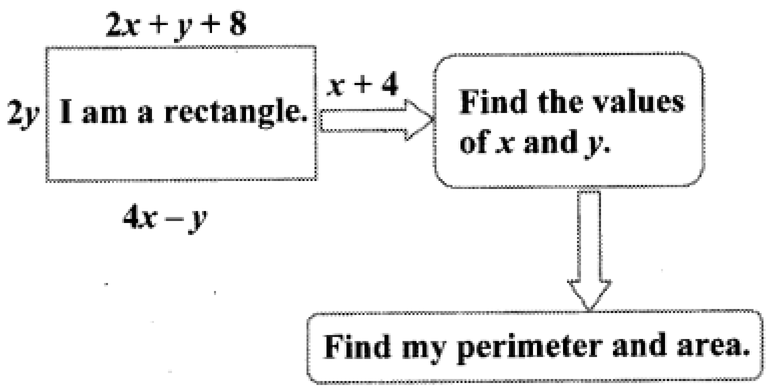
∴ 5 – 3 = y

∴ y = 2

∴ The required numbers are 5 and 2.

Question 2.

Complete the following.



Solution:

Opposite sides of a rectangle are equal.

∴ 2x + y + 8 = 4x – y

∴ 8 = 4x – 2x – y – y

∴ 2x – 2y = 8

∴ x – y = 4 …(i)[Dividingboth sides by 2]

Also, x + 4= 2y

∴ x – 2y = -4 …(ii)

Subtracting equation (ii) from (i), we get

$$\begin{array}{rcl} x - \ \ y &=& 4 \\ x - 2y &=& -4 \\ - \quad + & & + \\ \hline y &=& 8 \end{array}$$

Substituting y = 8 in equation (i), we get

x – 8 = 4

∴ x = 4 + 8

∴ x = 12

Now, length of rectangle = $4x – y$

$= 4(12) – 8$

$= 48 – 8$

∴ Length of rectangle = 40

Breadth of rectangle = $2y = 2(8) = 16$

Perimeter of rectangle = 2(length + breadth)

$= 2(40 + 16)$

$= 2(56)$

∴ Perimeter of rectangle =112 units

Area of rectangle = length × breadth

$= 40 \times 16$

∴ Area of rectangle = 640 sq. units

∴ $x = 12$ and $y = 8$, Perimeter of rectangle is 112 units and area of rectangle is 640 sq. units.

Question 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.

Solution:

Let the present ages of father and son be x years and y years respectively.

According to the first condition,

$x + 2y = 70$ …(i)

According to the second condition,

$2x + y = 95$ …(ii)

Multiplying equation (i) by 2, we get

2x + 4y = 140 …(iii)

Subtracting equation (ii) from (iii), we get

$$\begin{array}{r} 2x + 4y = 140 \\ 2x + y \;=\; 95 \\ - \quad - \qquad - \\ \hline 3y = \;\; 45 \end{array}$$

$$\therefore \quad y = \frac{45}{3} = 15$$

Substituting y = 15 in equation (i), we get

x + 2(15) = 7O

⇒ x + 30 = 70

⇒ x = 70 – 30

∴ x = 40

∴ The present ages of father and son are 40 years and 15 years respectively.

Question 4.

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

Solution:

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

∴ Fraction = xy

According to the first condition,

y = 2x + 4

∴ 2x – y = -4 …(i)

According to the second condition,

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

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

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

$\therefore$ $12x - y = 66$ …(ii)

Subtracting equation (i) from (ii), we get

$$\begin{array}{rcl} 12x - y &=& 66 \\ 2x - y &=& -4 \\ - \quad + & & + \\ \hline 10x \quad &=& 70 \end{array}$$

$\therefore \quad x = \frac{70}{10} = 7$

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

$2(7) - y = -4$

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

$\therefore \quad 14 + 4 = y$

$\therefore \quad y = 18$

$\therefore \quad \text{Fraction} = \frac{x}{y} = \frac{7}{18}$

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

Question 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 weights 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.

Solution:

Let the weights of box of type A be x kg and that of box of type B be y kg.

1 ton = 1000 kg

∴ 10 tons = 10000 kg

According to the first condition,

150x + 100y = 10000

∴ 3x + 2y = 200 …(i) [Dividing both sides by 50]

According to the second condition,

260x + 40y = 10000

∴ 13x + 2y = 500 …(ii) [Dividing both sides by 20]

Subtracting equation (i) from (ii), we get

$$\begin{array}{r} 13x + 2y = 500 \\ 3x + 2y = 200 \\ - \quad\; - \quad\; - \\ \hline 10x \qquad = 300 \end{array}$$

$\therefore \quad x = \frac{300}{10} = 30$

Substituting $x = 30$ in equation (i), we get

$3(30) + 2y = 200$

$\therefore \quad 90 + 2y = 200$

$\therefore \quad 2y = 200 - 90$

$\therefore \quad 2y = 110$

$\therefore \quad y = \frac{110}{2}$

$\therefore \quad y = 55$

∴ The weights of box of type A is 30 kg and that of box of type B is 55 kg.

Question 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.

Solution:

Let the distance Vishal travelled by bus be x km and by aeroplane be y km.

According to the first condition,

x + y = 1900 …(i)

Time = Distance Speed

∴ Time required to cover x km by bus = x60 hr

Time required to cover y km by aeroplane

= y700 hr

According to the second condition,

$$\frac{x}{60} + \frac{y}{700} = 5$$

$$\therefore \quad \frac{700x + 60y}{60 \times 700} = 5$$

$$\therefore \quad 700x + 60y = 5 \times 60 \times 700$$

$$\therefore \quad 70x + 6y = 21000 \qquad \ldots\text{(ii)}$$

[Dividing both sides by 10]

Multiplying equation (i) by 6, we get

6x + 6y= 11400 …(iii)

Subtracting equation (iii) from (ii), we get

$$\begin{array}{rl} 70x + 6y &= 21000 \\ 6x + 6y &= 11400 \\ - \quad - & \quad - \\ \hline 64x \qquad &= 9600 \end{array}$$

$$\therefore \quad x = \frac{9600}{64}$$

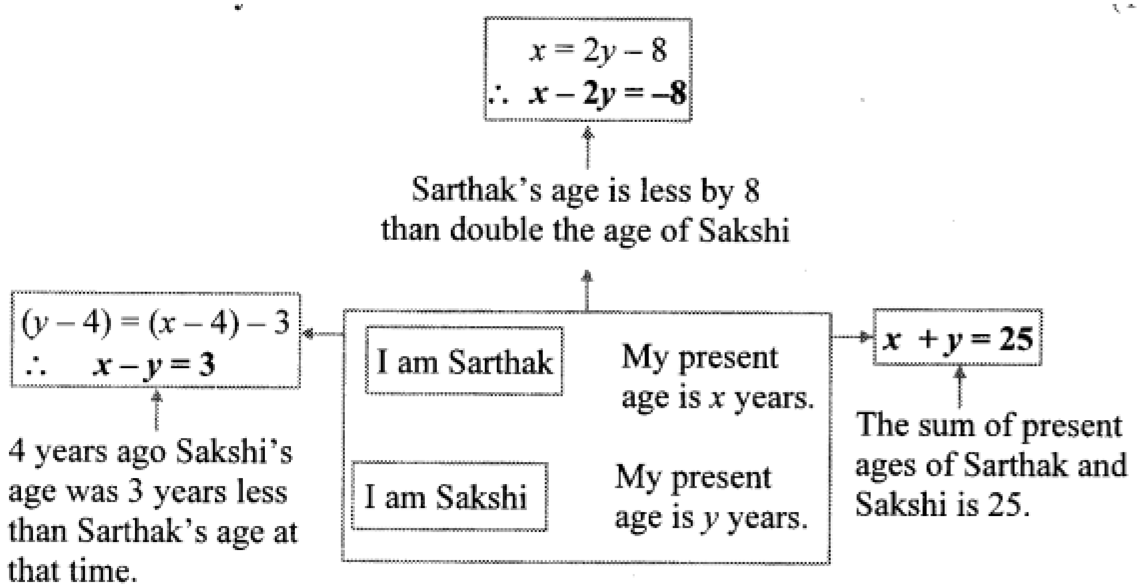
$$\therefore \quad x = 150$$

∴ The distance Vishal travelled by bus is 150 km.

Question 1.

There are some instructions given below. Frame the equations from the information and write them in the blank boxes shown by arrows. (Textbook pg. no. 20)

Answer:



Maharashtra Board Solutions Class 10 Maths (Part 1)

About About Maharashtra State Board (MSBSHSE)

The Maharashtra State Board of Secondary and Higher Secondary Education or MSBSHSE (Marathi: महाराष्ट्र राज्य माध्यमिक आणि उच्च माध्यमिक शिक्षण मंडळ), is an **autonomous and statutory body established in 1965**. The board was amended in the year 1977 under the provisions of the Maharashtra Act No. 41 of 1965.

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The Maharashtra government established the Maharashtra State Bureau of Textbook Production and Curriculum Research, also commonly referred to as Ebalbharati, in 1967 to take up the responsibility of providing quality textbooks to students from all classes studying under the Maharashtra State Board. MSBHSE prepares and updates the curriculum to provide holistic development for students. It is designed to tackle the difficulty in understanding the concepts with simple language with simple illustrations. Every year around 10 lakh students are enrolled in schools that are affiliated with the Maharashtra State Board.

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The Maharashtra State Board of Secondary & Higher Secondary Education, conducts the HSC and SSC Examinations in the state of Maharashtra through its nine Divisional Boards located at Pune, Mumbai, Aurangabad, Nasik, Kolhapur, Amravati, Latur, Nagpur and Ratnagiri.

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