Practice Set 1.1 Algebra 10th Std Maths Part 1 Answers Chapter 1 Linear Equations in Two Variables

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).

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

$$\therefore x = \frac{\boxed{21}}{\boxed{7}} \qquad \therefore x = \boxed{3}$$

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

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

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

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

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

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

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. 13 x+ y = 103 ; 2x + 14 y = 114
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

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

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

Substituting a = 2 in equation (ii), we get
2 + 5b = 22
∴ 5b = 22 – 2
∴ 5b = 20
∴ b = 205 =4
∴ (a, b) = (2, 4) is the solution of the given simultaneous equations.

ii. x + 7y = 10
∴ 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 = 5427 = 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 = -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. $\frac{1}{3}x + y = \frac{10}{3}$

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

$\therefore \quad x = 10 - 3y$ …(i)

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

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

…(ii)[Multiplying both sides by 4]

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

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

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

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

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

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

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

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

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

$\therefore \quad x - y = 4$ …(iii)

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

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

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

$\therefore \quad x + y = 10$ …(iv)

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

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

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

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

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

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

Add equations (i) and (iii).

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

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

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

$3x + 2y = 29$

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

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

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

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

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

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

CategoriesClass 10

Practice Set 1.2 Algebra 10th Std Maths Part 1 Answers Chapter 1 Linear Equations in Two Variables

10th Maths 2 Practice Set 1.2 Question 1.
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. $x - y = 4$

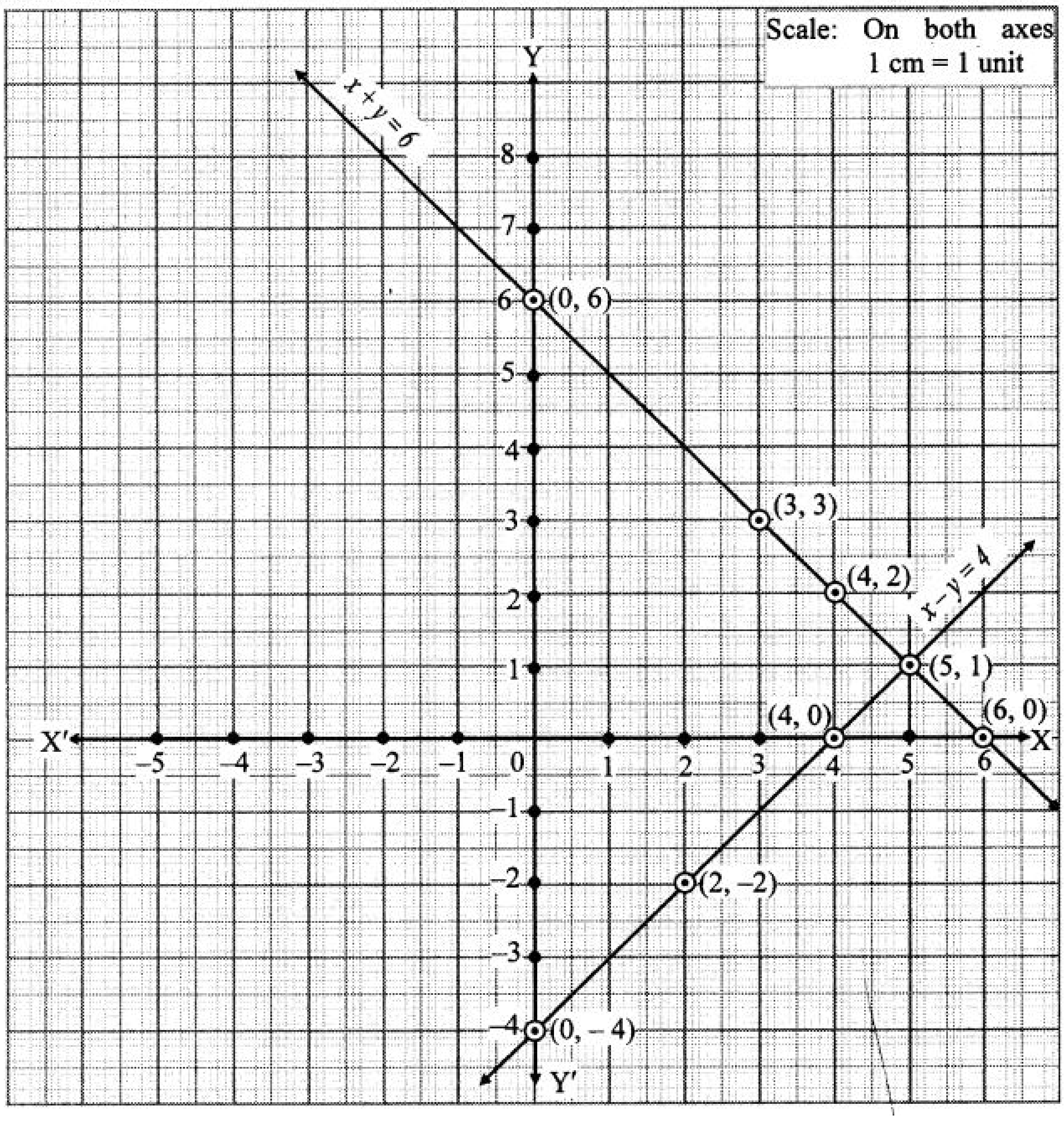
x	4	–1	0
y	0	–5	– 4
(x, y)	(4, 0)	(–1, –5)	(0, – 4)

Linear Equations In Two Variables Practice Set 1.2 Question 2.
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
$x + y = 6$
$\therefore y = 6 - x$

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

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

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



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The two lines intersect at point (5, 1).
$\therefore x = 5$ and $y = 1$ is the solution of the simultaneous equations $x + y = 6$ and $x - y = 4$.

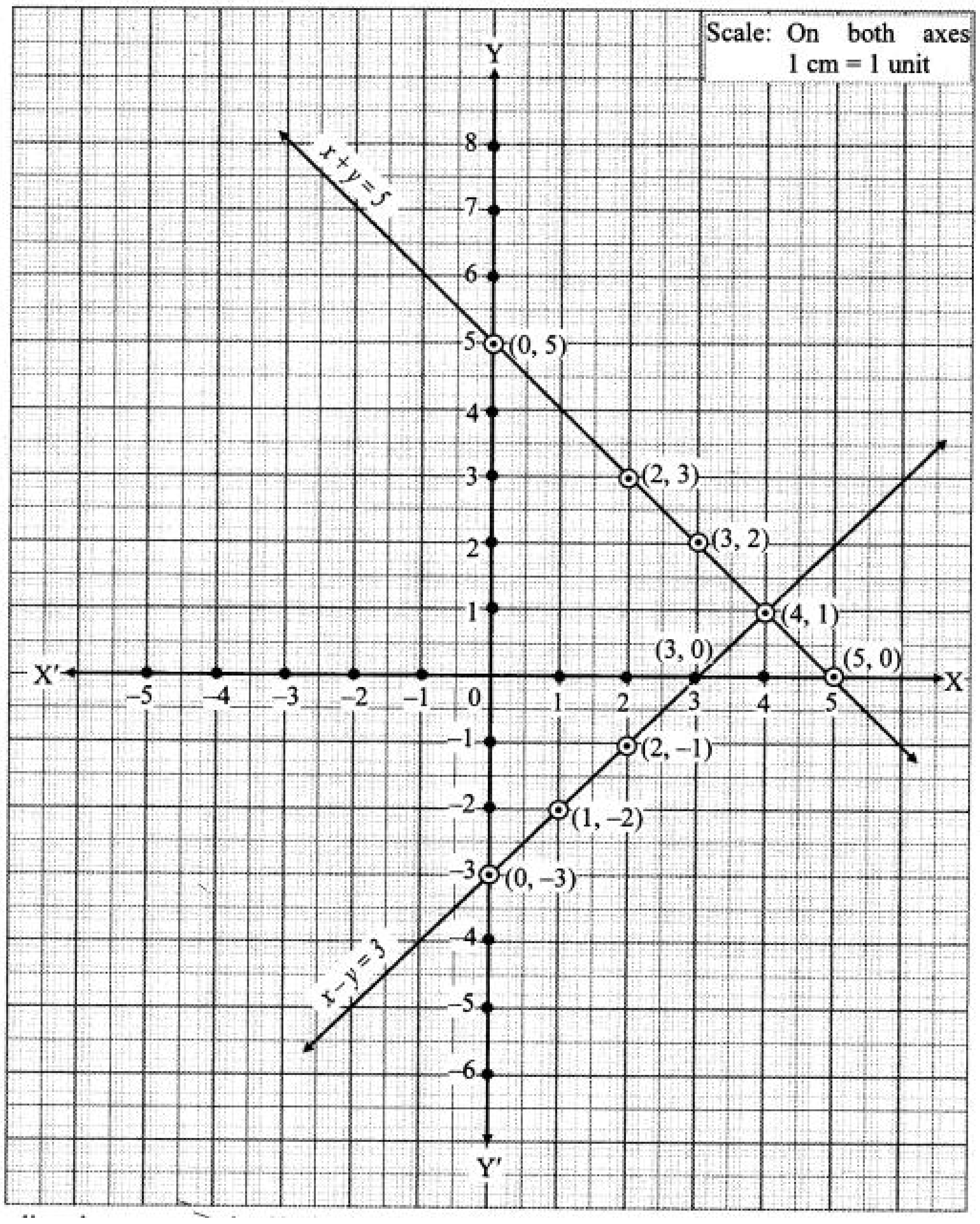
ii. The given simultaneous equations are

$x + y = 5$
$\therefore \quad y = 5 - x$

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

$x + y = 0$

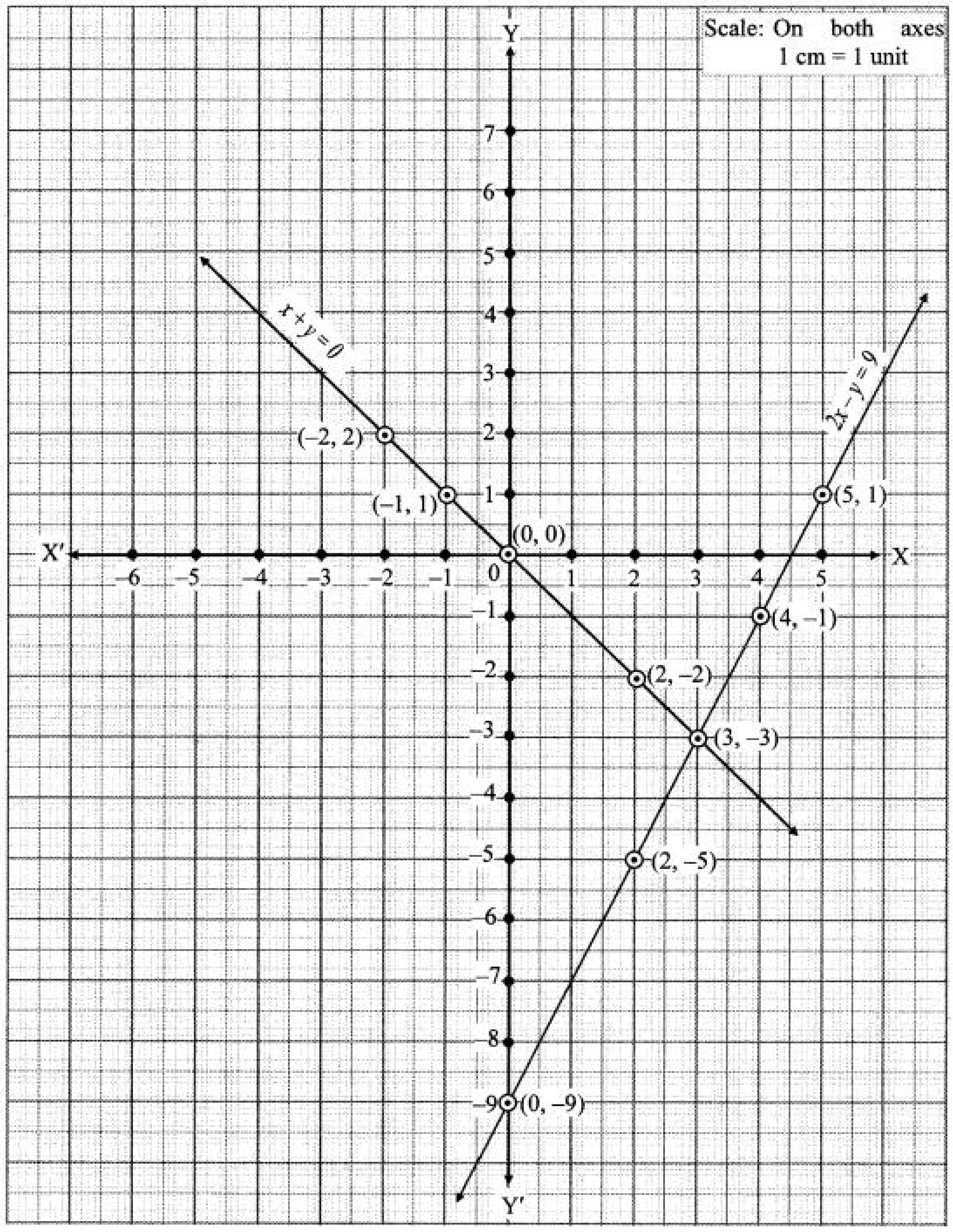
$\therefore \quad y = -x$

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.

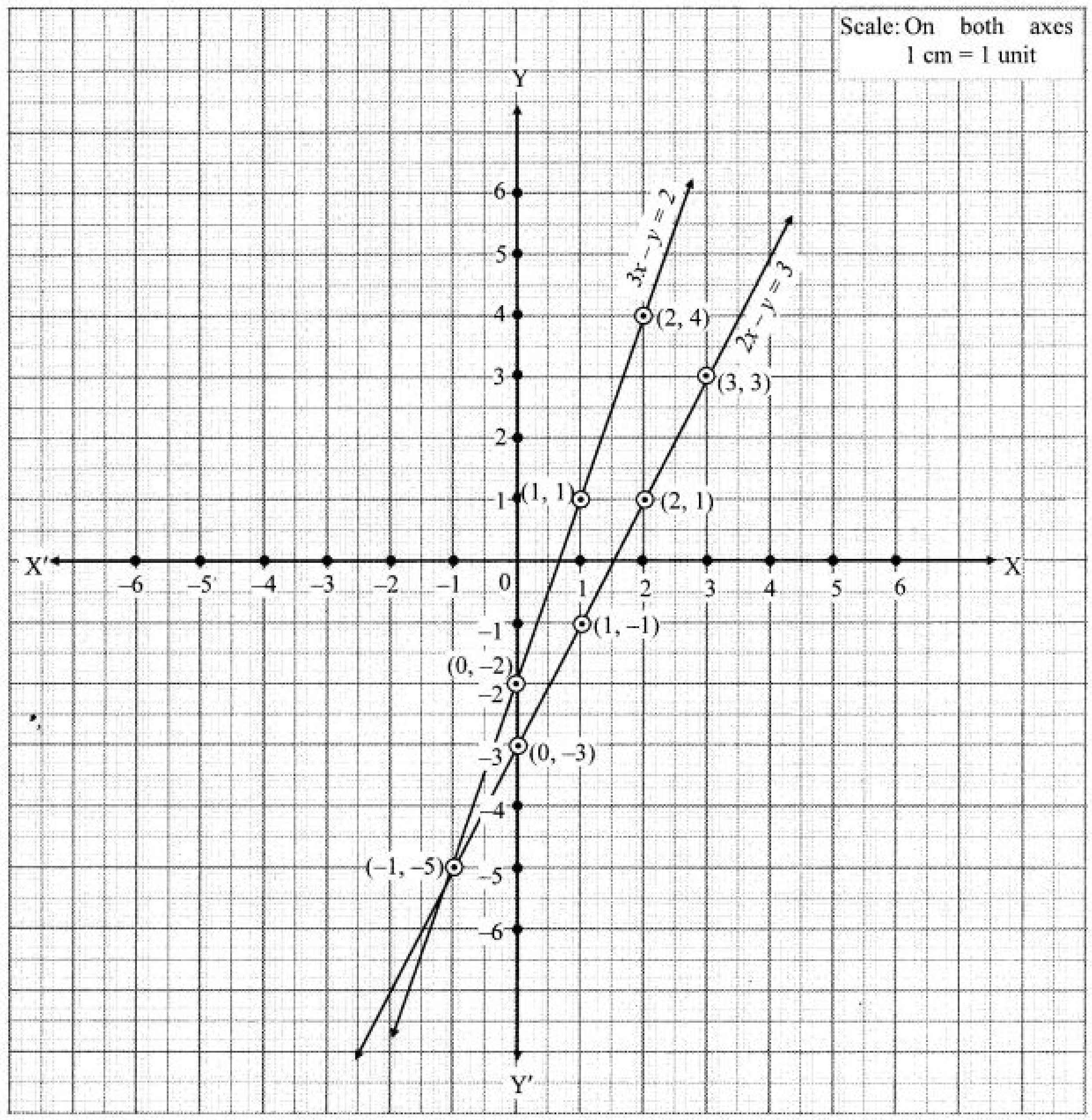
iv. The given simultaneous equations are

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

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

$3x - 4y = -7$

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

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

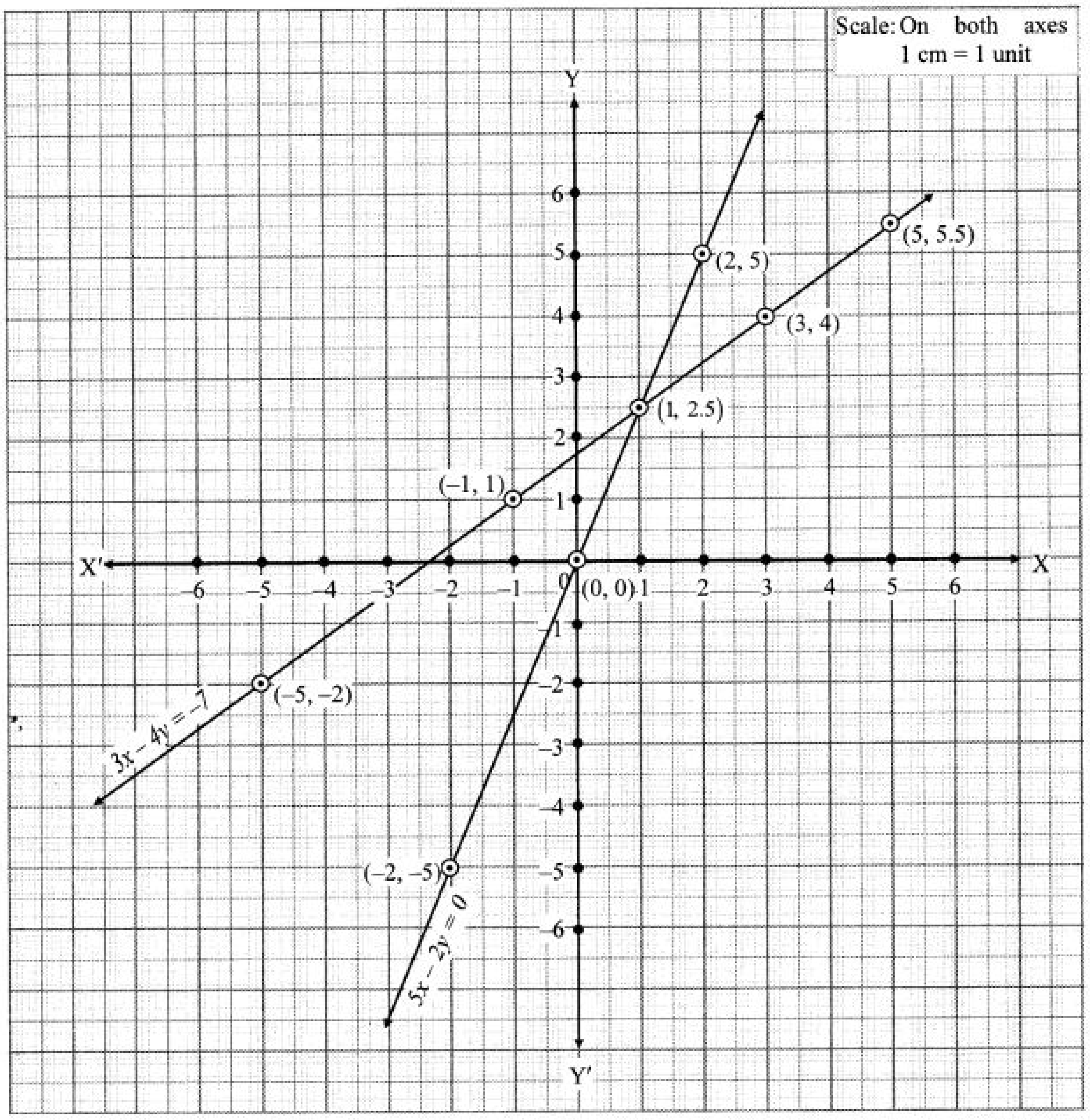
x	–1	–5	3	5
y	1	–2	4	5.5
(x, y)	(–1, 1)	(–5,–2)	(3, 4)	(5, 5.5)

$5x - 2y = 0$

$\therefore \quad 2y = 5x$

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

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

$2x - 3y = 4$

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

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

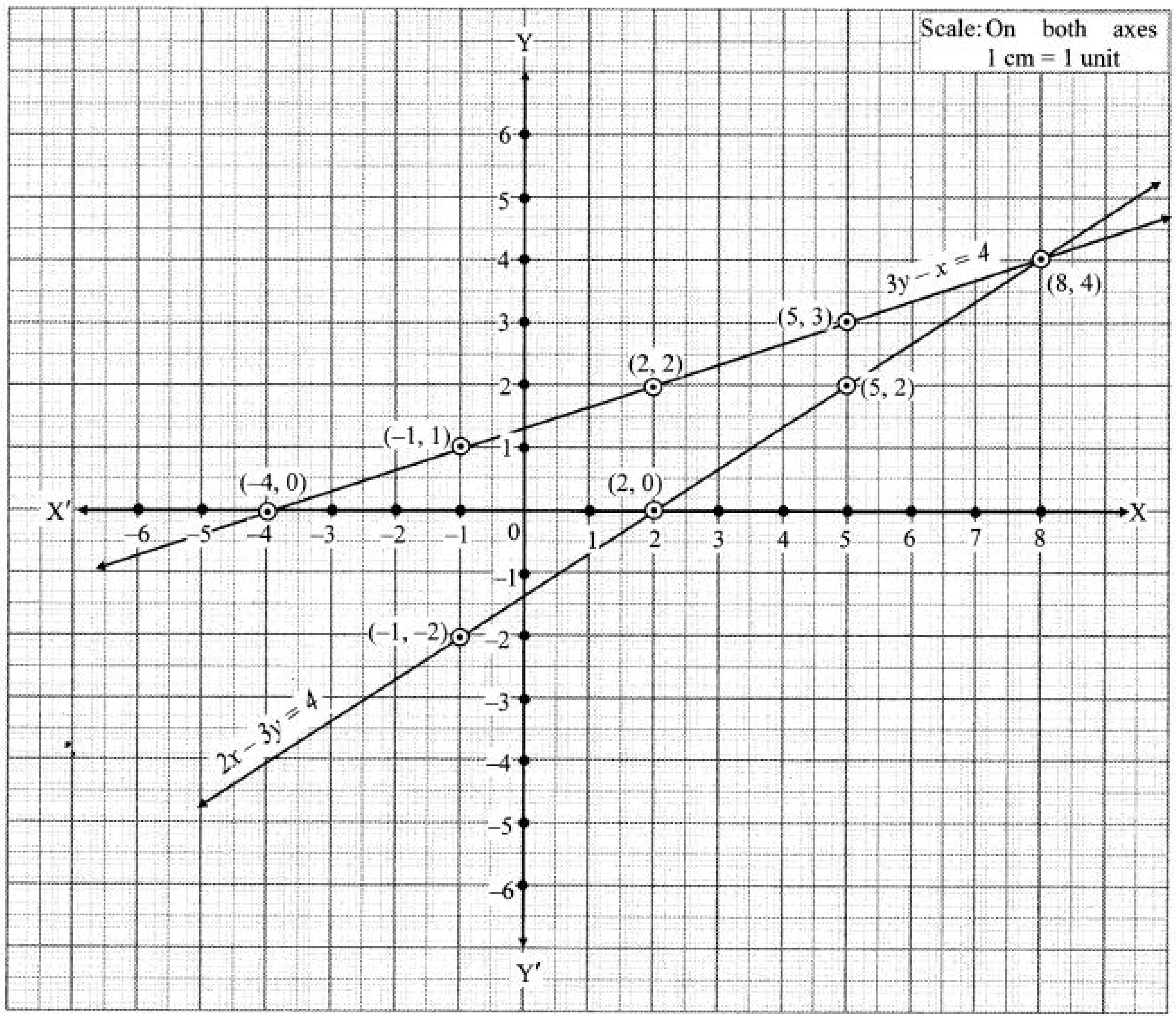
x	2	–1	5	8
y	0	–2	2	4
(x, y)	(2, 0)	(–1, –2)	(5, 2)	(8, 4)

$3y - x = 4$

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

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

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.

10th Math Part 2 Practice Set 1.2 Question 1.

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)

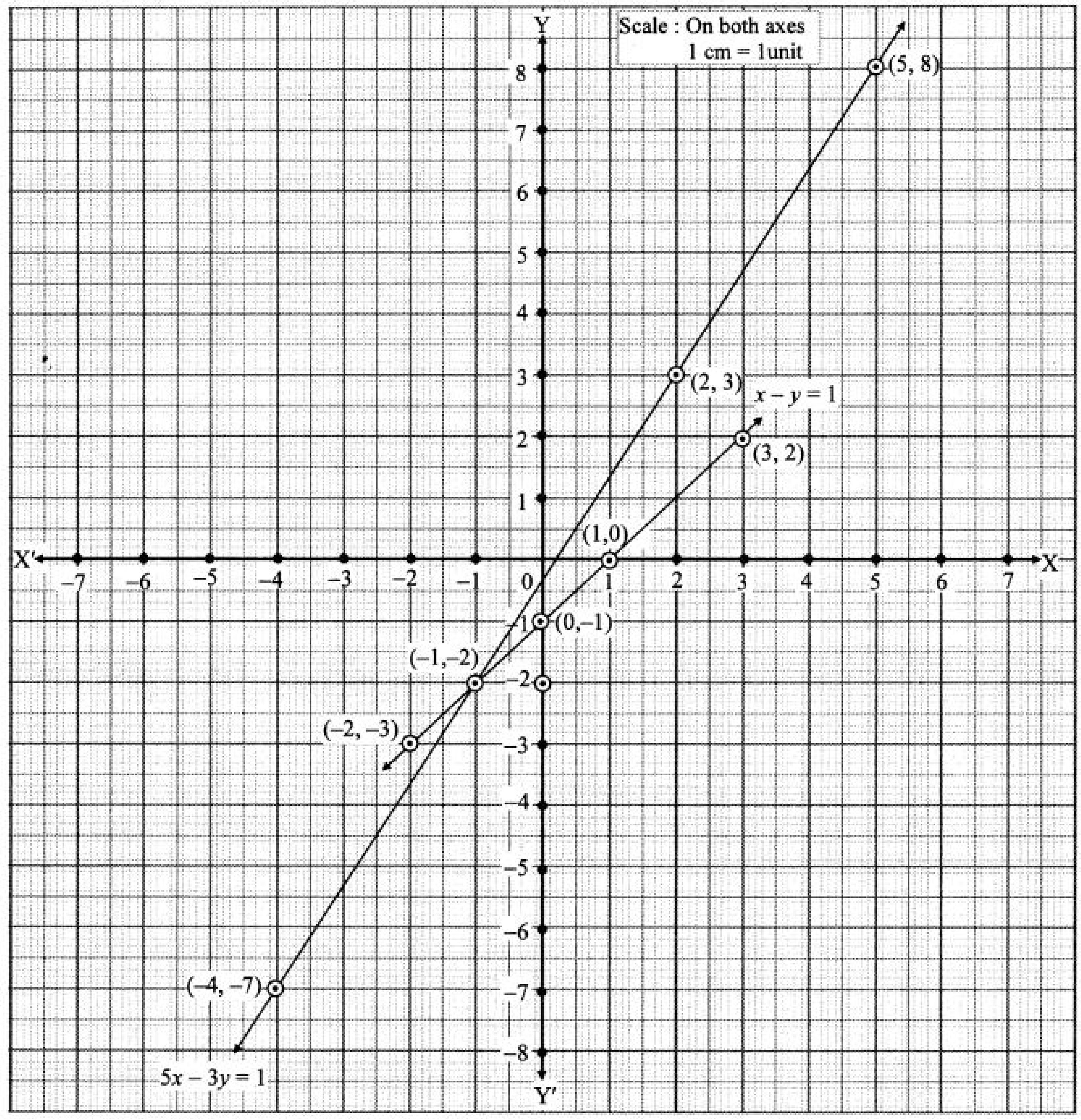
Solution:

$x - y = 1$

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.

Mathematics Part 1 Standard 9 Practice Set 1.2 Answer Question 1.
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

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

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

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.

1.2 Maths Class 10 Question 2.
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.

Linear Equations ¡n Two Variables Class 10 Maths Question 3.
To solve simultaneous equations x + 2y = 4; 3x + 6y = 12 graphically, following are the ordered pairs.

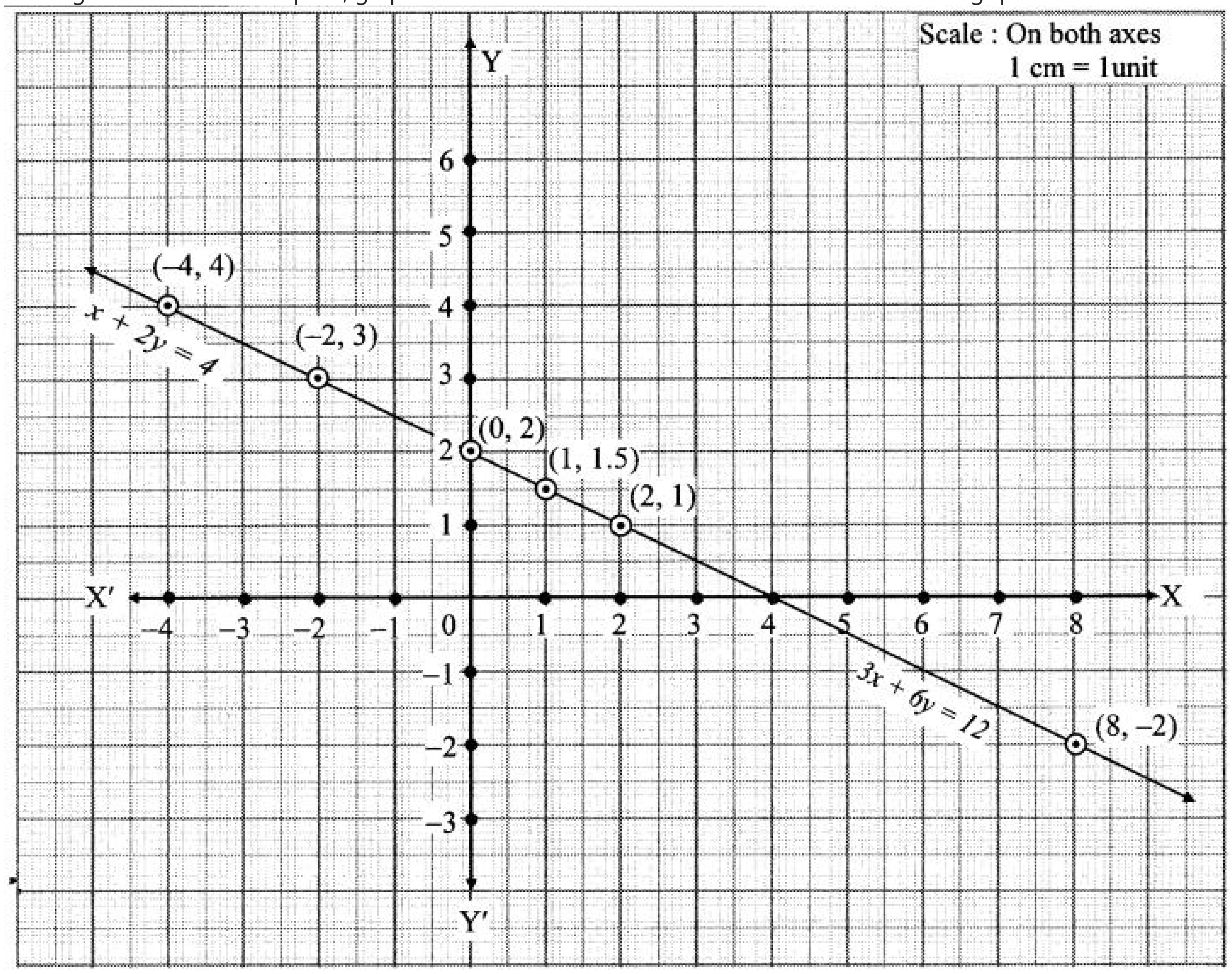
$x + 2y = 4$

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.

Class 10 Maths Part 1 Practice Set 1.2 Question 4.
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. $x - 2y = 4$

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

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

$2x - 4y = 12$

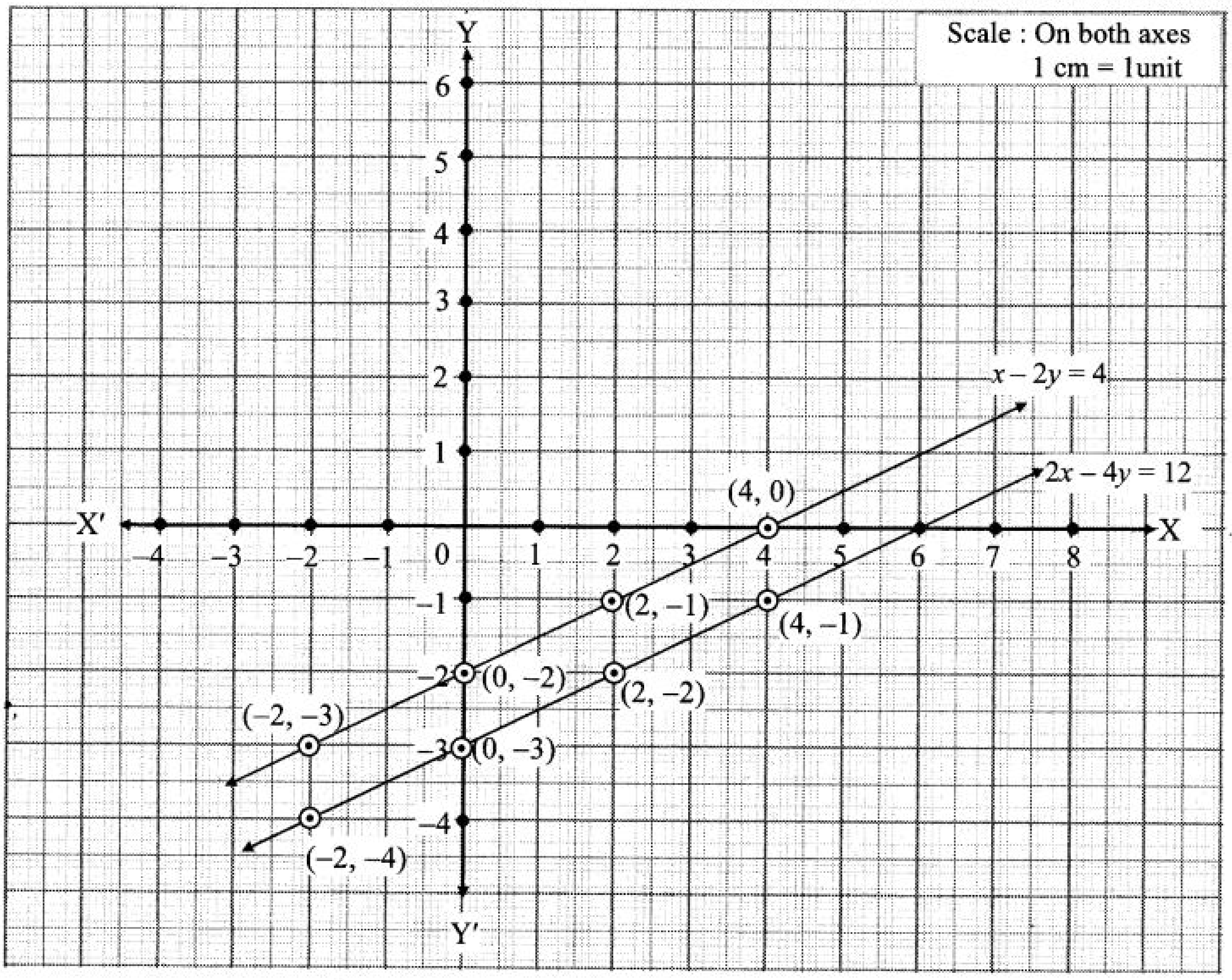
$\therefore \quad x - 2y = 6$ …[Dividing both sides by 2]

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

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

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 Algebra 10th Std Maths Part 1 Answers Chapter 1 Linear Equations in Two Variables

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

$= -4 - 14$

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

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

$= 0 - (-21)$

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

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
$$x = \frac{D_x}{D} \text{ and } y = \frac{D_y}{D}$$
$$\therefore \quad x = \frac{50}{25} \text{ and } y = \frac{-25}{25}$$
$$\therefore \quad x = 2 \text{ and } y = -1$$
$\therefore$ (x, y) = (2, -1) is the solution of the given simultaneous equations.

ii. The given simultaneous equations are
$4x + 3y - 4 = 0$
$\therefore$ $4x + 3y = 4$ ...(i)
$6x = 8 - 5y$
$\therefore$ $6x + 5y = 8$ ...(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
$$x = \frac{D_x}{D} \text{ and } y = \frac{D_y}{D}$$
$$\therefore \quad x = \frac{-4}{2} \text{ and } y = \frac{8}{2}$$
$$\therefore \quad x = -2 \text{ and } y = 4$$
$\therefore$ (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

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

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

$\therefore \quad x = 3$ 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

$$m = \frac{D_m}{D} \text{ and } n = \frac{D_n}{D}$$
$$\therefore \quad m = \frac{-30}{-5} \text{ and } n = \frac{-25}{-5}$$
$$\therefore \quad m = 6 \text{ and } n = 5$$

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

vi. The given simultaneous equations are
2x + 3y = 2 …(i)
x = $y2 = 12$
$\therefore$ 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

$$x = \frac{D_x}{D} \text{ and } y = \frac{D_y}{D}$$
$$\therefore \quad x = \frac{-5}{-8} \text{ and } y = \frac{-2}{-8}$$
$$\therefore \quad x = \frac{5}{8} \text{ and } y = \frac{1}{4}$$

$\therefore$ **$(x, y) = \left(\frac{5}{8}, \frac{1}{4}\right)$ 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

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

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

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

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

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

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

∴ By Cramer's rule, we get

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

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

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

Question 2.
Complete the following activity. (Textbook pg. no. 15)
Solution:

$3x - 2y = 3$ $\quad$ $2x + y = 16$

Find the values of determinants in the given equations

$D = \begin{vmatrix} 3 & -2 \\ 2 & 1 \end{vmatrix} = \boxed{7}$ $\quad$ $D_x = \begin{vmatrix} 3 & -2 \\ 16 & 1 \end{vmatrix} = \boxed{35}$ $\quad$ $D_y = \begin{vmatrix} 3 & 3 \\ 2 & 16 \end{vmatrix} = \boxed{42}$

Values according to Cramer's Rule

$x = \frac{D_x}{D} = \frac{\boxed{35}}{\boxed{7}} = \boxed{5}$ $\quad$ $y = \frac{D_y}{D} = \frac{\boxed{42}}{\boxed{7}} = \boxed{6}$

∴ $(x, y) = \left(\boxed{5}, \boxed{6}\right)$ is the 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 Algebra 10th Std Maths Part 1 Answers Chapter 1 Linear Equations in Two Variables

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

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

$\frac{8}{x} + \frac{5}{y} = 77$ ...(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

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

∴ $q = \frac{17}{17} = 1$

Substituting q = 1 in equation (iii), we get
2p – 3(1) = 15

∴ 2p – 3 = 15

∴ 2p = 15 + 3 = 18

∴ $p = \frac{18}{2} = 9$

∴ (p, q) = (9, 1)

Resubstituting the values of p and q, we get

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

∴ $x = \frac{1}{9}$ and $y = 1$

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

ii. The given simultaneous equations are

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

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

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

∴ Equations (i) and (ii) become

10p + 2q = 4

∴ 5p + q = 2 …(iii)

[Dividing both sides by 2]

15p – 5q = –2 …(iv)

Multiplying equation (iii) by 5, we get

25p + 5q = 10 …(v)

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

$$\begin{array}{rl} & 15p - 5q = -2 \\ + & 25p + 5q = 10 \\ \hline & 40p \quad = 8 \end{array}$$

∴ $p = \frac{8}{40} = \frac{1}{5}$

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

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

∴ 1 + q = 2

∴ q = 2 – 1 = 1

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

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

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

∴ $x = \frac{6}{2} = 3$

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 $y = 1 - 3$

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

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

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

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

iv. The given simultaneous equations are

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

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

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

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

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

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

Multiplying equation (iv) by 2, we get

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

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

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

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

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

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

$\therefore \quad 3x + y = 4$ …(vi)

and $3x - y = 2$ …(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

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

On solving

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

Replacing m, n by their original values.

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

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

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

$\frac{2}{x-y}-\frac{3}{x+y}=5$ ...(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:

$4p + q = 3$

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

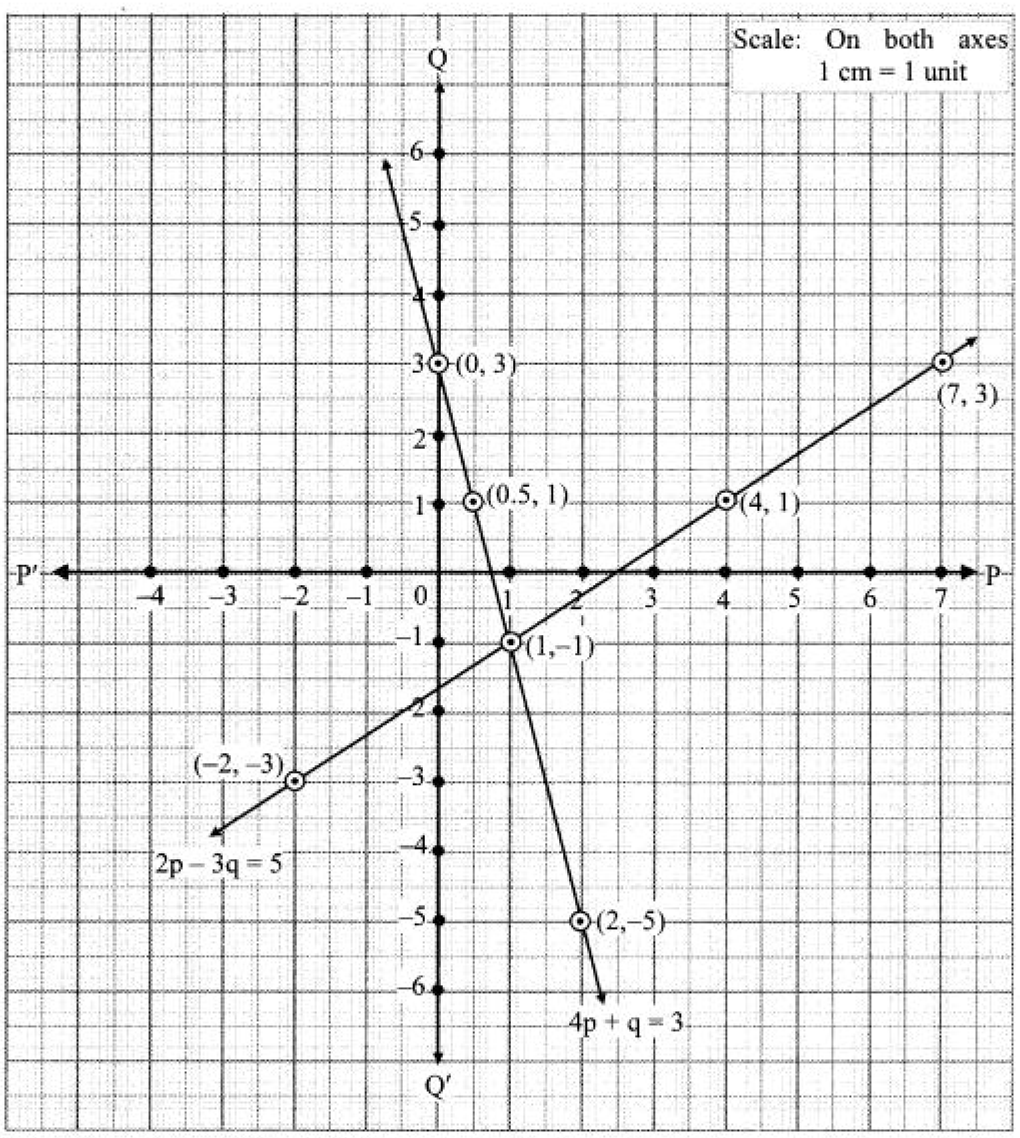
p	0	1	2	0.5
q	3	−1	−5	1
(p, q)	(0, 3)	(1, −1)	(2, −5)	(0.5, 1)

$2p - 3q = 5$

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

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

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

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

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

$x - y = 1$

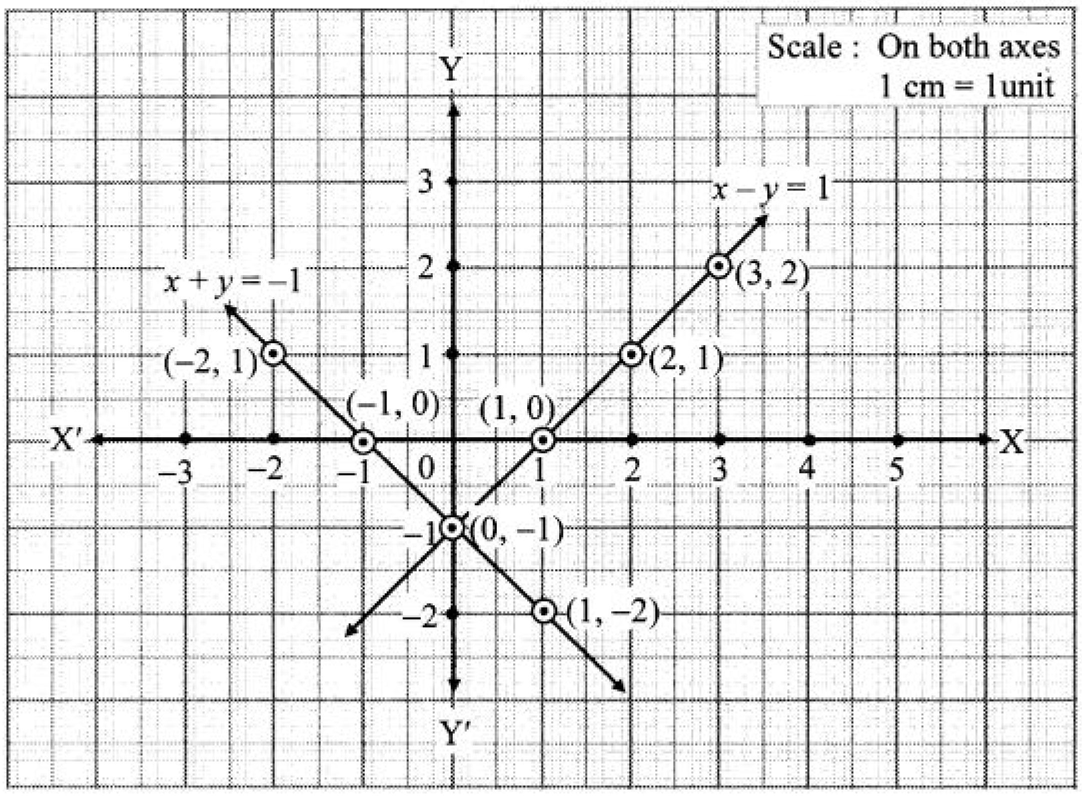
$\therefore \quad y = x - 1$

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 Algebra 10th Std Maths Part 1 Answers Chapter 1 Linear Equations in Two Variables

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

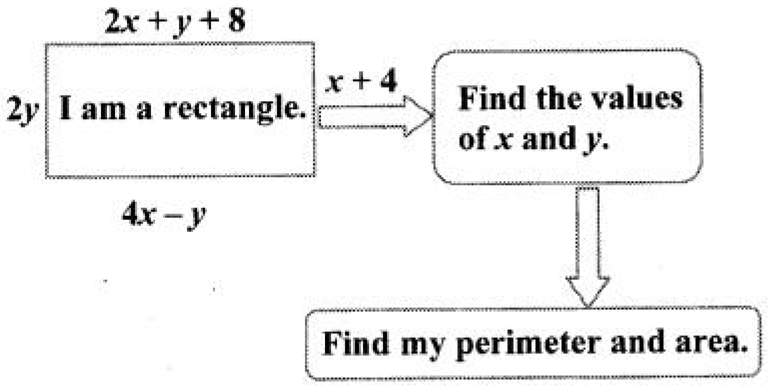
$$\begin{array}{rl} & 3x + 2y = 19 \\ + & 2x - 2y = 6 \\ \hline & 5x \quad\; = 25 \end{array}$$

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

$$\therefore \quad x = 5$$

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

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

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 × 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

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

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

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)
∴ y – 6 = 12x – 72
∴ 12x – y = 72 – 6
∴ 12x – y = 66 …(ii)
Subtracting equation (i) from (ii), we get

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

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

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

$$2(7) - y = -4$$

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

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

$$\therefore \quad y = 18$$

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

∴ **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

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

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

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,

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

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

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

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

[Dividing both sides by 10]

Multiplying equation (i) by 6, we get

6x + 6y= 11400 …(iii)

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

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

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

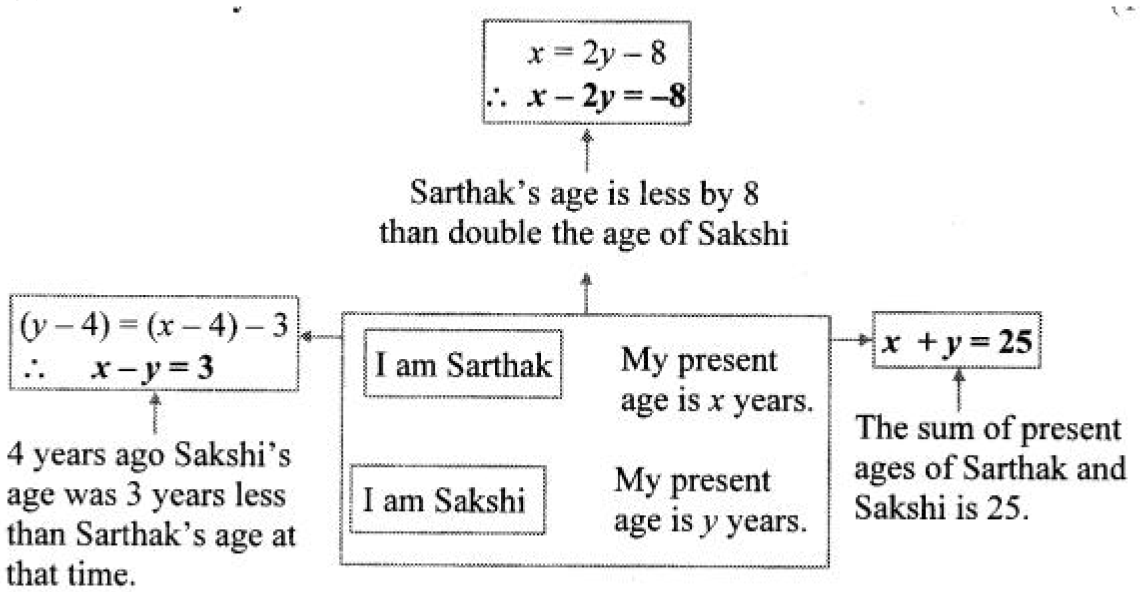
$\therefore \quad x = 150$

∴ 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:



Problem Set 1 Algebra 10th Std Maths Part 1 Answers Chapter 1 Linear Equations in Two Variables

Choose correct alternative for each of the following questions.

Question 1.
To draw graph of 4x + 5y = 19, find y when x = 1.
(a) 4
(b) 3
(c) 2
(d) -3
Answer:
(b)

Question 2.
For simultaneous equations in variables x and y, D_x = 49, Dy = – 63, D = 7 then what is x?
(a) 7
(b) -7
(c) 17
(d) -17
Answer:
(a)

Question 3.
Find the value of

$$\begin{vmatrix} 5 & 3 \\ -7 & -4 \end{vmatrix}.$$

(a) -1
(b) -41
(c) 41
(d) 1
Answer:
(d)

Question 4.
To solvex + y = 3; 3x – 2y – 4 = 0 by determinant method find D.
(a) 5
(b) 1
(c) -5
(d) -1
Answer:
(c)

Question 5.
ax + by = c and mx + n y = d and an ≠ bm then these simultaneous equations have-
(a) Only one common solution
(b) No solution
(c) Infinite number of solutions
(d) Only two solutions.
Answer:
(a)

Question 2.
Complete the following table to draw the graph of 2x – 6y = 3.
Answer:

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

Question 3.
Solve the following simultaneous equations graphically.
i. 2x + 3y = 12 ; x – y = 1
ii. x – 3y = 1 ; 3x – 2y + 4 = 0
iii. 5x – 6y + 30 = 0; 5x + 4y – 20 = 0
iv. 3x – y – 2 = 0 ; 2x + y = 8
v. 3x + y= 10 ; x – y = 2

Answer:
i. The given simultaneous equations are

$2x + 3y = 12$

$\therefore \quad 3y = 12 - 2x$

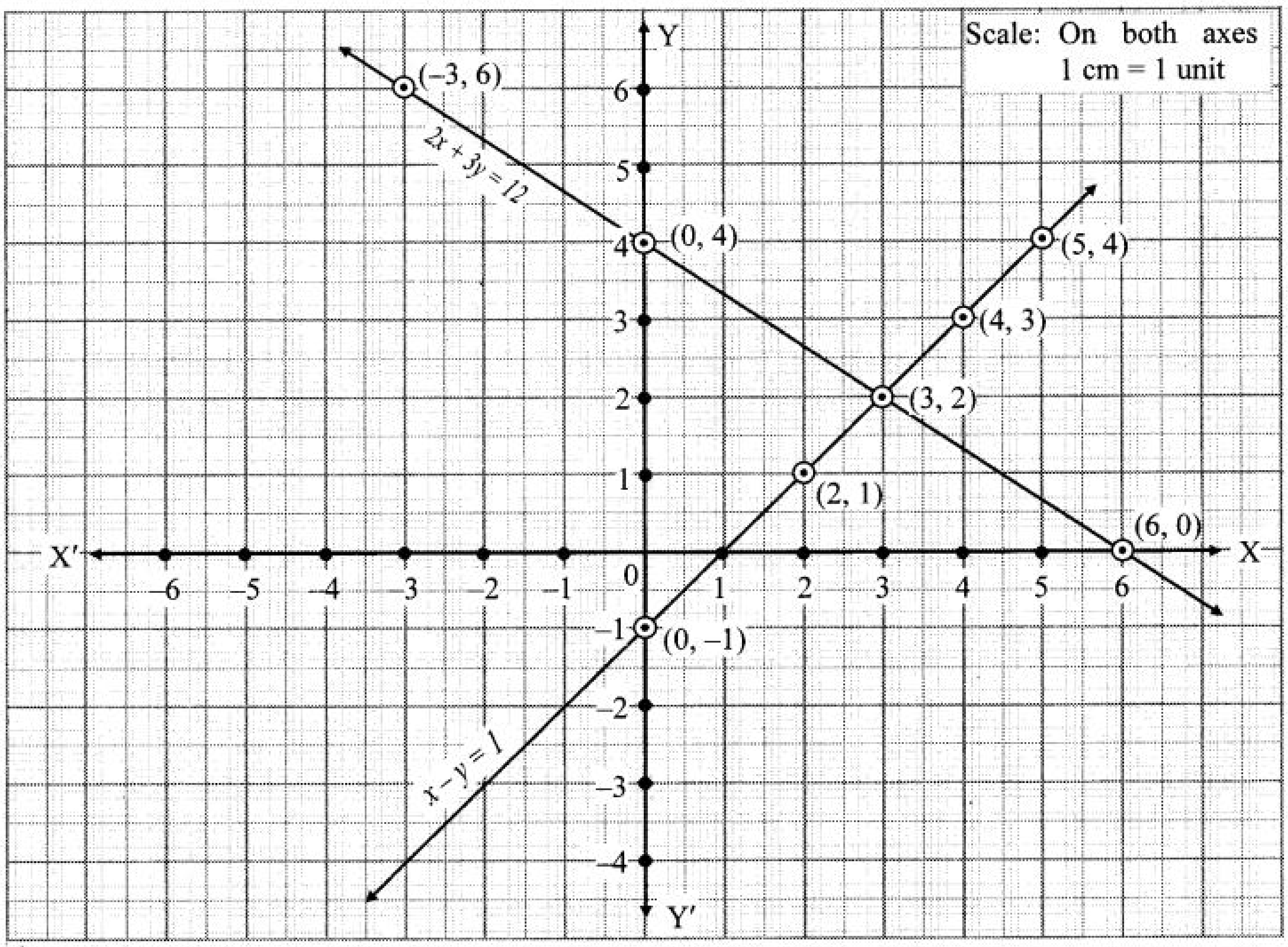
$\therefore \quad y = \frac{12 - 2x}{3}$

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

$x - y = 1$

$\therefore \quad y = x - 1$

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



The two lines interest at point (3,2).
$\therefore$ x = 3 and y = 2 is the solution of the simultaneous equations 2x + 3y = 12 and x – y = 1.

ii. The given simultaneous equations are

$x - 3y = 1$

$\therefore \quad 3y = x - 1$

$\therefore \quad y = \frac{x-1}{3}$

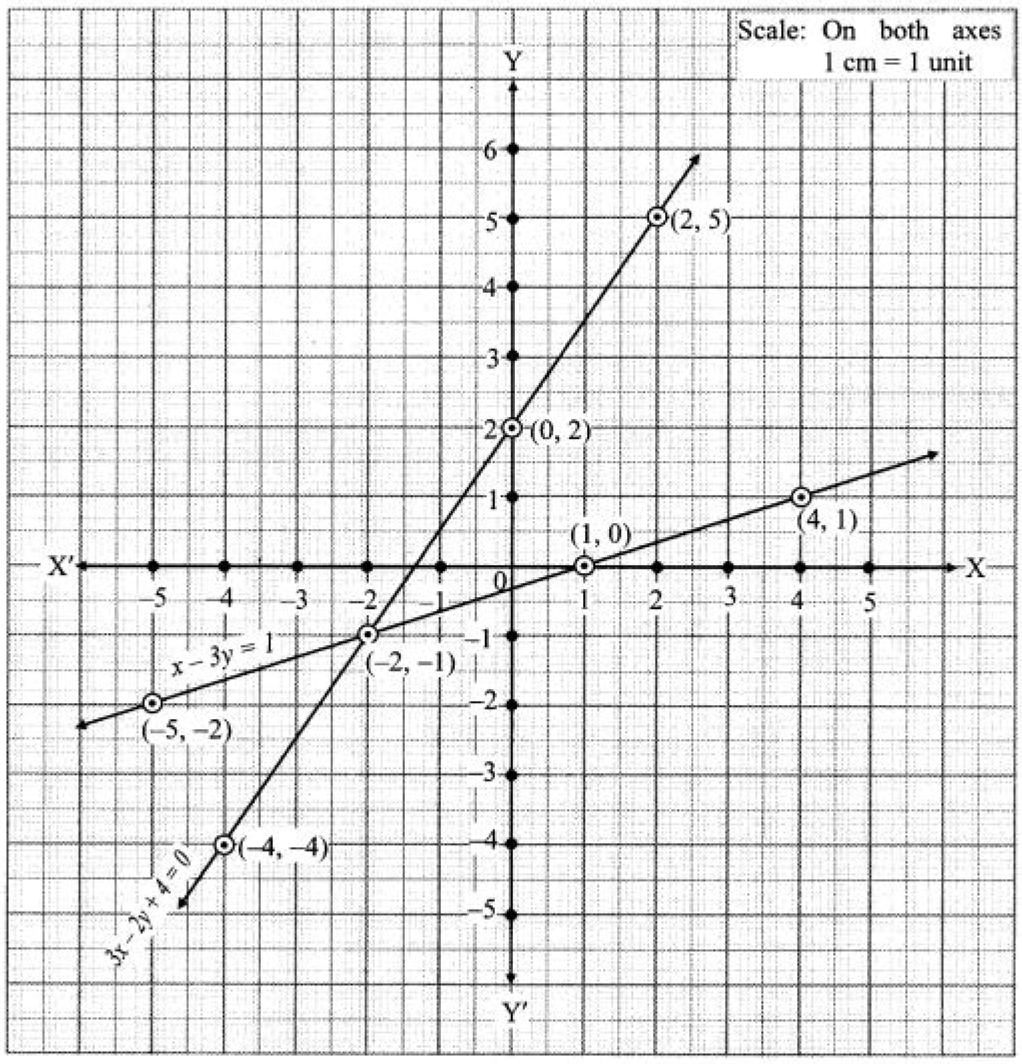
x	4	−2	−5	1
y	1	−1	−2	0
(x, y)	(4, 1)	(−2, −1)	(−5, −2)	(1, 0)

$3x - 2y + 4 = 0$

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

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

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



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

∴ x = -2 and y = -1 is the solution of the simultaneous equations x – 3y = 1 and 3x – 2p + 4 = 0.

iii. The given simultaneous equations are

$5x - 6y + 30 = 0$

$\therefore \quad 6y = 5x + 30$

$\therefore \quad y = \frac{5x+30}{6}$

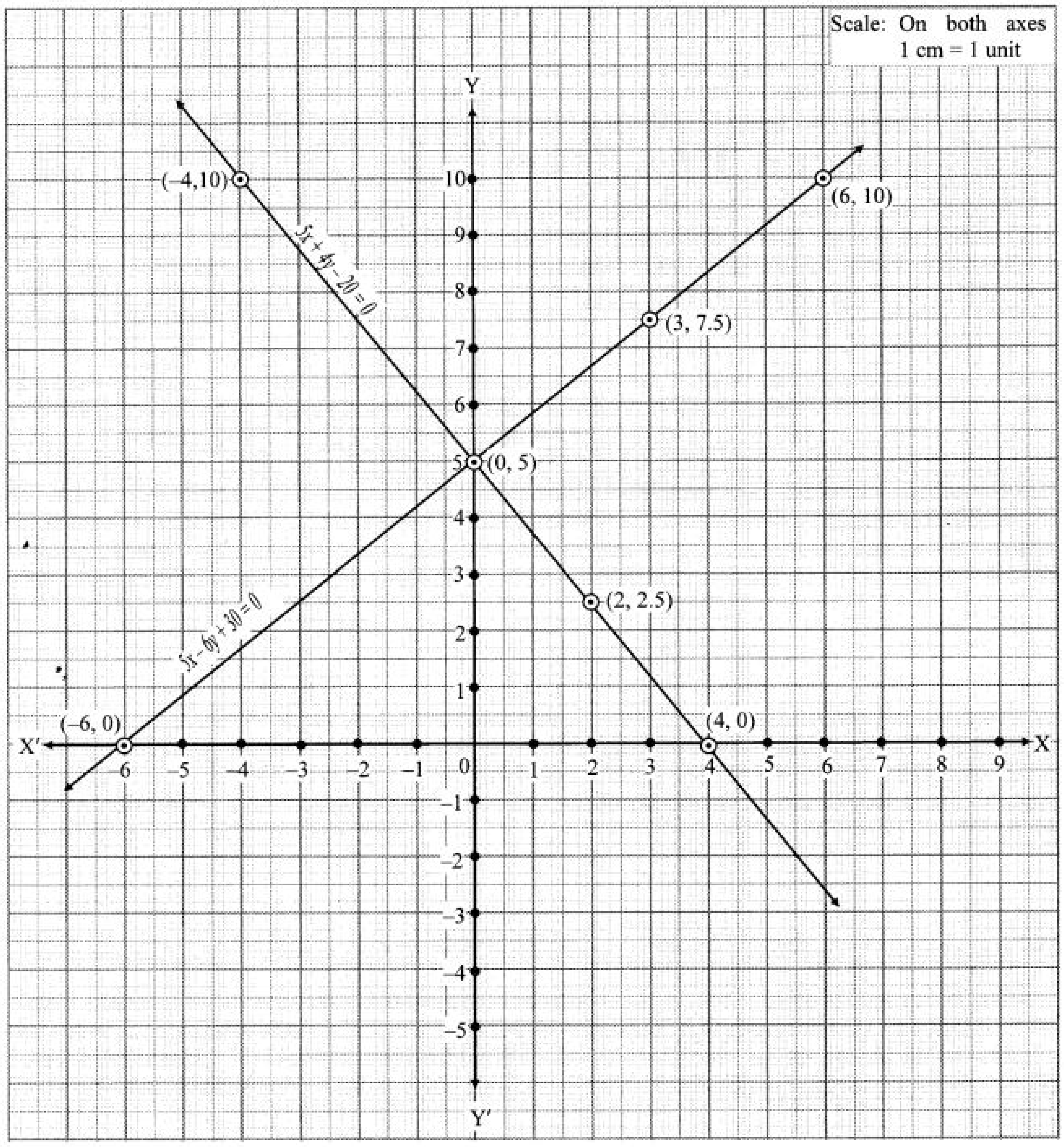
x	0	−6	6	3
y	5	0	10	7.5
(x, y)	(0, 5)	(−6, 0)	(6, 10)	(3, 7.5)

$5x + 4y - 20 = 0$

$\therefore \quad 4y = 20 - 5x$

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

x	0	4	−4	2
y	5	0	10	2.5
(x, y)	(0, 5)	(4, 0)	(−4, 10)	(2, 2.5)



The two lines intersect at point (0, 5).
∴ x = 0 and y = 5 is the solution of the simultaneous equations 5x – 6y + 30 = 0 and 5x + 4y – 20 = 0.

iv. The given simultaneous equations are

$3x - y - 2 = 0$

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

x	0	1	3	–1
y	–2	1	7	–5
(x, y)	(0, –2)	(1, 1)	(3, 7)	(–1, –5)

$2x + y = 8$

$\therefore \quad y = 8 - 2x$

x	0	4	1	3
y	8	0	6	2
(x, y)	(0, 8)	(4, 0)	(1, 6)	(3, 2)

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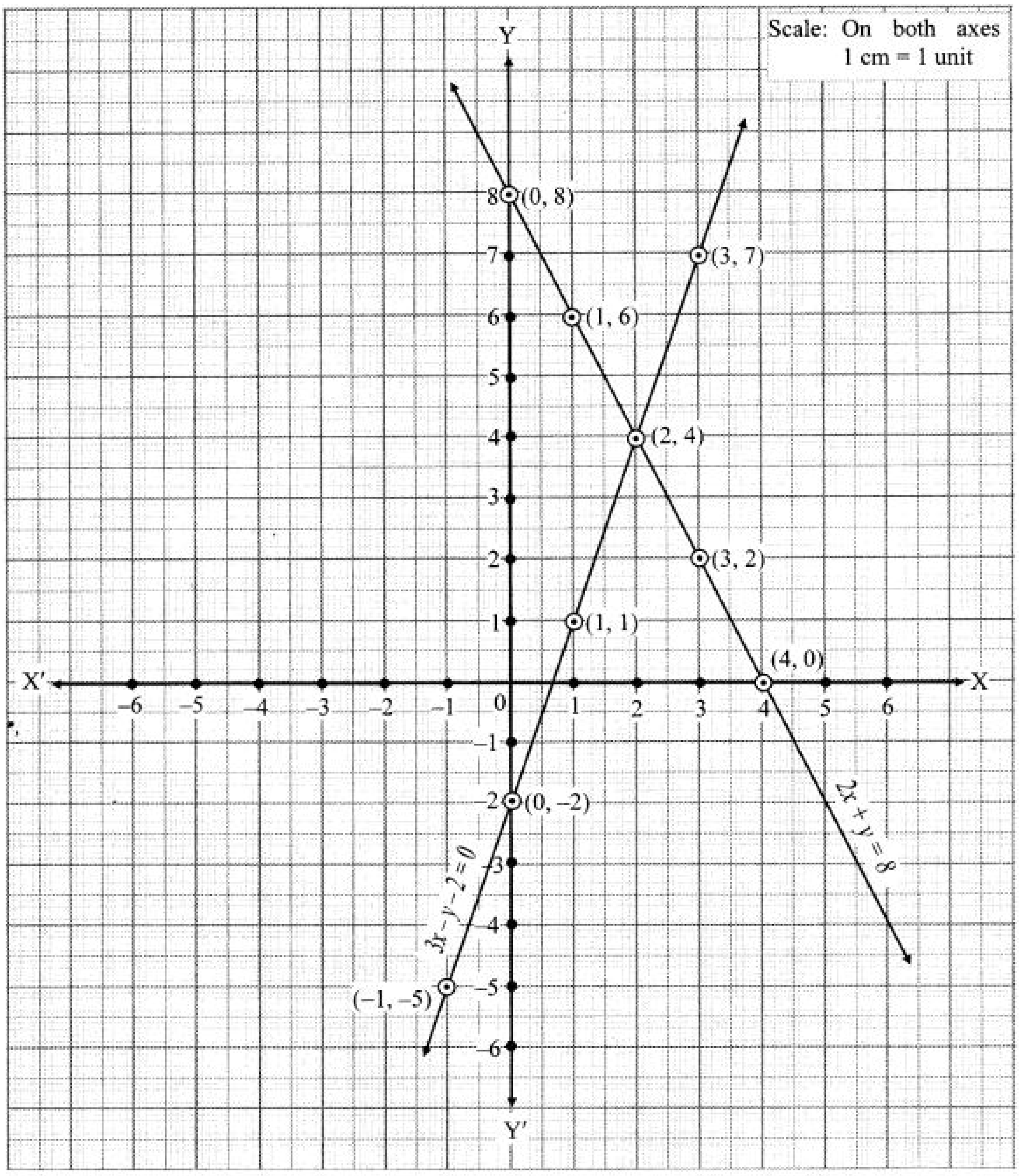


The two lines intersect at point (2, 4).
∴ x = 2 and y = 4 is the solution of the simultaneous equations 3x – y – 2 = 0 and 2x + y = 8.

v. The given simultaneous equations are

$3x + y = 10$

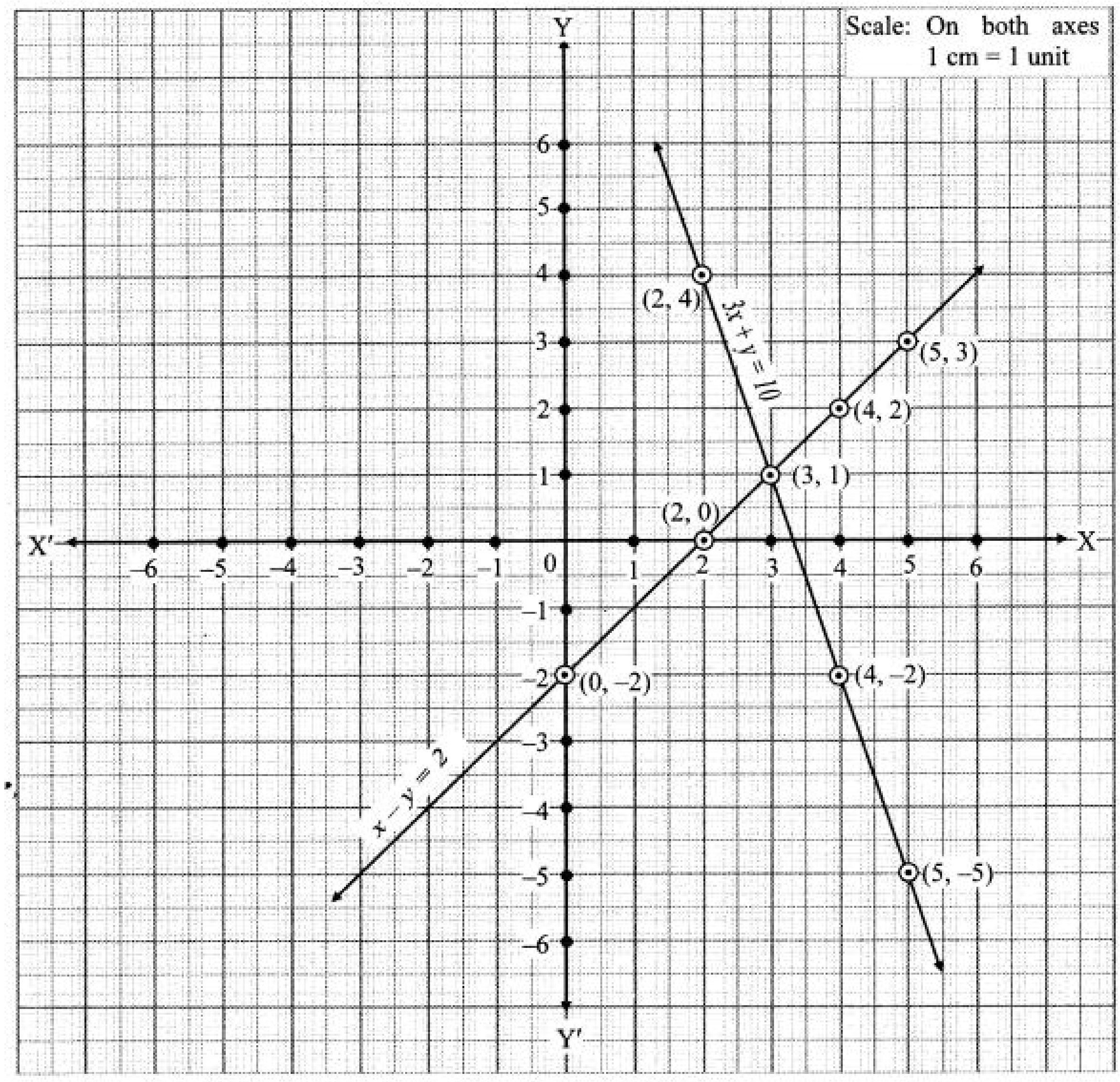
$\therefore \quad y = 10 - 3x$

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

$x - y = 2$

$\therefore \quad y = x - 2$

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



The two lines intersect at point (3, 1).
∴ x = 3 and y = 1 is the solution of the simultaneous equations 3x + y = 10 and x – y = 2.

Question 4.
Find the values of each of the following determinants.

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

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

Solution:

i. $\begin{vmatrix} 4 & 3 \\ 2 & 7 \end{vmatrix} = (4 \times 7) - (3 \times 2) = 28 - 6$

$\therefore \begin{vmatrix} \mathbf{4} & \mathbf{3} \\ \mathbf{2} & \mathbf{7} \end{vmatrix} = \mathbf{22}$

---

ii. $\begin{vmatrix} 5 & -2 \\ -3 & 1 \end{vmatrix} = (5 \times 1) - (-2 \times -3) = 5 - 6$

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

iii. $\begin{vmatrix} 3 & -1 \\ 1 & 4 \end{vmatrix} = (3 \times 4) - (-1 \times 1)$

$= 12 - (-1) = 12 + 1$

$\therefore \begin{vmatrix} \mathbf{3} & \mathbf{-1} \\ \mathbf{1} & \mathbf{4} \end{vmatrix} = \mathbf{13}$

Question 5.
Solve the following equations by Cramer's method.

i. $6x - 3y = -10$; $3x + 5y - 8 = 0$

ii. $4m - 2n = -4$; $4m + 3n = 16$

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

iv. $7x + 3y = 15$; $12y - 5x = 39$

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

Solution:

i. The given simultaneous equations are

$6x - 3y = -10$ ...(i)

$3x + 5y - 8 = 0$

$\therefore 3x + 5y = 8$ ...(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

$a_1 = 6$, $b_1 = -3$, $c_1 = 10$ and

$a_2 = 3$, $b_2 = 5$, $c_2 = 8$

$$\therefore \quad D = \begin{vmatrix} a_1 & b_1 \\ a_2 & b_2 \end{vmatrix} = \begin{vmatrix} 6 & -3 \\ 3 & 5 \end{vmatrix} = (6 \times 5) - (-3 \times 3)$$
$$= 30 - (-9)$$
$$= 30 + 9 = 39 \neq 0$$

$$D_x = \begin{vmatrix} c_1 & b_1 \\ c_2 & b_2 \end{vmatrix} = \begin{vmatrix} -10 & -3 \\ 8 & 5 \end{vmatrix} = (-10 \times 5) - (-3 \times 8)$$
$$= -50 - (-24)$$
$$= -50 + 24 = -26$$

$$D_y = \begin{vmatrix} a_1 & c_1 \\ a_2 & c_2 \end{vmatrix} = \begin{vmatrix} 6 & -10 \\ 3 & 8 \end{vmatrix} = (6 \times 8) - (-10 \times 3)$$
$$= 48 - (-30)$$
$$= 48 + 30 = 78$$

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

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

$$\therefore \quad x = \frac{-26}{39} \quad \text{and} \quad y = \frac{78}{39}$$

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

$\therefore$ **$(x, y) = \left(\frac{-2}{3}, 2\right)$ is the solution of the given simultaneous equations.**

ii. The given simultaneous equations are

$4m - 2n = -4$ ...(i)

$4m + 3n = 16$ ...(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

$a_1 = 4$, $b_1 = -2$, $c_1 = -4$ and

$a_2 = 4$, $b_2 = 3$, $c_2 = 16$

$$\therefore \quad D = \begin{vmatrix} a_1 & b_1 \\ a_2 & b_2 \end{vmatrix} = \begin{vmatrix} 4 & -2 \\ 4 & 3 \end{vmatrix} = (4 \times 3) - (-2 \times 4)$$
$$= 12 - (-8)$$
$$= 12 + 8 = 20 \neq 0$$

$$D_m = \begin{vmatrix} c_1 & b_1 \\ c_2 & b_2 \end{vmatrix} = \begin{vmatrix} -4 & -2 \\ 16 & 3 \end{vmatrix} = (-4 \times 3) - (-2 \times 16)$$
$$= -12 - (-32)$$
$$= -12 + 32 = 20$$

$$D_n = \begin{vmatrix} a_1 & c_1 \\ a_2 & c_2 \end{vmatrix} = \begin{vmatrix} 4 & -4 \\ 4 & 16 \end{vmatrix} = (4 \times 16) - (-4 \times 4)$$
$$= 64 - (-16)$$
$$= 64 + 16 = 80$$

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

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

$$\therefore \quad m = \frac{20}{20} \quad \text{and } n = \frac{80}{20}$$

$$\therefore \quad m = 1 \quad \text{and } n = 4$$

$\therefore$ $(m, n) = (1, 4)$ is the solution of the given simultaneous equations.

iii. The given simultaneous equations are

$3x - 2y = \frac{5}{2}$ ...(i)

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

$\therefore$ $x + 9y = -4$ ...(ii)

[Multiplying both sides by 3]

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

$a_1 = 3, b_1 = -2, c_1 = \frac{5}{2}$ and

$a_2 = 1, b_2 = 9, c_2 = -4$

$$\therefore \quad D = \begin{vmatrix} a_1 & b_1 \\ a_2 & b_2 \end{vmatrix} = \begin{vmatrix} 3 & -2 \\ 1 & 9 \end{vmatrix} = (3 \times 9) - (-2 \times 1)$$

$$= 27 - (-2)$$

$$= 27 + 2 = 29 \neq 0$$

$$D_x = \begin{vmatrix} c_1 & b_1 \\ c_2 & b_2 \end{vmatrix} = \begin{vmatrix} \frac{5}{2} & -2 \\ -4 & 9 \end{vmatrix} = \left(\frac{5}{2} \times 9\right) - (-2 \times -4)$$

$$= \frac{45}{2} - 8$$

$$= \frac{45 - 16}{2} = \frac{29}{2}$$

$$D_y = \begin{vmatrix} a_1 & c_1 \\ a_2 & c_2 \end{vmatrix} = \begin{vmatrix} 3 & \frac{5}{2} \\ 1 & -4 \end{vmatrix} = (3 \times -4) - \left(\frac{5}{2} \times 1\right)$$

$$= -12 - \frac{5}{2}$$

$$= \frac{-24 - 5}{2} = -\frac{29}{2}$$

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

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

$$\therefore \quad x = \frac{\frac{29}{2}}{29} \quad \text{and} \quad y = \frac{-\frac{29}{2}}{29}$$

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

$\therefore$ **$(x, y) = \left(\frac{1}{2}, -\frac{1}{2}\right)$ is the solution of the given simultaneous equations.**

iv. The given simultaneous equations are

7x + 3y = 15 ...(i)

12y – 5x = 39

i.e. -5x + 12y = 39 ...(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

$a_1 = 7$, $b_1 = 3$, $c_1 = 15$ and

$a_2 = -5$, $b_2 = 12$, $c_2 = 39$

$$\therefore \quad D = \begin{vmatrix} a_1 & b_1 \\ a_2 & b_2 \end{vmatrix} = \begin{vmatrix} 7 & 3 \\ -5 & 12 \end{vmatrix} = (7 \times 12) - (3 \times -5)$$

$$= 84 - (-15)$$

$$= 84 + 15 = 99 \neq 0$$

$$D_x = \begin{vmatrix} c_1 & b_1 \\ c_2 & b_2 \end{vmatrix} = \begin{vmatrix} 15 & 3 \\ 39 & 12 \end{vmatrix} = (15 \times 12) - (3 \times 39)$$

$$= 180 - 117 = 63$$

$$D_y = \begin{vmatrix} a_1 & c_1 \\ a_2 & c_2 \end{vmatrix} = \begin{vmatrix} 7 & 15 \\ -5 & 39 \end{vmatrix} = (7 \times 39) - (15 \times -5)$$

$$= 273 - (-75)$$

$$= 273 + 75 = 348$$

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

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

$$\therefore \quad x = \frac{63}{99} \quad \text{and} \quad y = \frac{348}{99}$$

$$\therefore \quad x = \frac{7}{11} \quad \text{and} \quad y = \frac{116}{33}$$

$\therefore$ **$(x, y) = \left(\frac{7}{11}, \frac{116}{33}\right)$ is the solution of the given simultaneous equations.**

v. The given simultaneous equations are

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

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

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

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

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

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

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

$\therefore$ 4(x + y – 8) = 2(3x – y)
$\therefore$ 4x + 4y – 32 = 6x – 2y
$\therefore$ 6x – 4x – 2y – 4y = -32
$\therefore$ 2x – 6y = -32
$\therefore$ x – 3y = -16 …(ii)[Dividing 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
$a_1 = 1$, $b_1 = -1$, $c_1 = -4$ and
$a_2 = 1$, $b_2 = -3$, $c_2 = -16$

$$\therefore \quad D=\begin{vmatrix} a_1 & b_1 \\ a_2 & b_2 \end{vmatrix}=\begin{vmatrix} 1 & -1 \\ 1 & -3 \end{vmatrix}=(1\times -3)-(-1\times 1)$$
$$=-3-(-1)$$
$$=-3+1=-2\neq 0$$

$$D_x=\begin{vmatrix} c_1 & b_1 \\ c_2 & b_2 \end{vmatrix}=\begin{vmatrix} -4 & -1 \\ -16 & -3 \end{vmatrix}=(-4\times -3)-(-1\times -16)$$
$$=12-16=-4$$

$$D_y=\begin{vmatrix} a_1 & c_1 \\ a_2 & c_2 \end{vmatrix}=\begin{vmatrix} 1 & -4 \\ 1 & -16 \end{vmatrix}=(1\times -16)-(-4\times 1)$$
$$=-16-(-4)$$
$$=-16+4=-12$$

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

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

$$\therefore \quad x=\frac{-4}{-2} \quad \text{and} \quad y=\frac{-12}{-2}$$

$$\therefore \quad x=2 \quad \text{and} \quad y=6$$

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

Question 6.
Solve the following simultaneous equations:

i. $\frac{2}{x}+\frac{2}{3y}=\frac{1}{6};\ \frac{3}{x}+\frac{2}{y}=0$

ii. $\frac{7}{2x+1}+\frac{13}{y+2}=27;$

$\frac{13}{2x+1}+\frac{7}{y+2}=33$

iii. $\frac{148}{x}+\frac{231}{y}=\frac{527}{xy};\ \frac{231}{x}+\frac{148}{y}=\frac{610}{xy}$

iv. $\frac{7x-2y}{xy}=5;\ \frac{8x+7y}{xy}=15$

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

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

Answer:
i. The given simultaneous equations are

$$\frac{2}{x} + \frac{2}{3y} = \frac{1}{6} \quad \text{...(i)}$$

$$\frac{3}{x} + \frac{2}{y} = 0 \quad \text{...(ii)}$$

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

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

$$2\text{p} + \frac{2}{3}\text{q} = \frac{1}{6}$$

$\therefore$ $6\text{p} + 2\text{q} = \frac{1}{2}$ ...(iii)

[Multiplying both sides by 3]

$3\text{p} + 2\text{q} = 0$ ...(iv)

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

$$\begin{array}{l} 6\text{p} + 2\text{q} = \frac{1}{2} \\ 3\text{p} + 2\text{q} = 0 \\ - \quad - \quad - \\ \hline 3\text{p} \qquad = \frac{1}{2} \end{array}$$

$\therefore$ $\text{p} = \frac{1}{6}$

Substituting $\text{p} = \frac{1}{6}$ in equation (iv), we get

$$3\left(\frac{1}{6}\right) + 2\text{q} = 0$$

$\therefore$ $\frac{1}{2} + 2\text{q} = 0$

$\therefore$ $2\text{q} = -\frac{1}{2}$

$\therefore$ $\text{q} = -\frac{1}{4}$

$\therefore$ $(\text{p}, \text{q}) = \left(\frac{1}{6}, -\frac{1}{4}\right)$

Resubstituting the values of p and q, we get

$\frac{1}{6} = \frac{1}{x}$ and $-\frac{1}{4} = \frac{1}{y}$

$\therefore$ $x = 6$ and $y = -4$

$\therefore$ (x, y) = (6, – 4) is the solution of the given simultaneous equations.

ii. The given simultaneous equations are

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

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

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

∴ Equations (i) and (ii) become

$7p + 13q = 27 \quad ...(iii)$

$13p + 7q = 33 \quad ...(iv)$

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

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

∴ $p + q = \frac{60}{20}$ ...[Dividing both sides by 20]

∴ $p + q = 3 \quad ...(v)$

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

$$\begin{array}{r} 7p + 13q = 27 \\ 13p + 7q = 33 \\ -\quad -\quad - \\ \hline -6p + 6q = -6 \end{array}$$

∴ $p - q = \frac{-6}{-6}$ ...[Dividing both sides by –6]

∴ $p - q = 1 \quad ...(vi)$

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

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

∴ $p = \frac{4}{2} = 2$

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

$2 + q = 3$

∴ $q = 3 - 2 = 1$

∴ $(p, q) = (2, 1)$

Resubstituting the values of p and q, we get

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

∴ $2(2x + 1) = 1$ and $y + 2 = 1$

∴ $4x + 2 = 1$ and $y = 1 - 2$

∴ $4x = 1 - 2$ and $y = -1$

∴ $4x = -1$ and $y = -1$

∴ $x = -\frac{1}{4}$ and $y = -1$

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

iii. The given simultaneous equations are

$$\frac{148}{x}+\frac{231}{y}=\frac{527}{xy}$$

$\therefore$ $148y + 231x = 527$ ...[Multiplying both sides by xy]

i.e. $231x + 148y = 527$ ...(i)

$$\frac{231}{x}+\frac{148}{y}=\frac{610}{xy}$$

$\therefore$ $231y + 148x = 610$ ...[Multiplying both sides by xy]

i.e. $148x + 231y = 610$ ...(ii)

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

$$\begin{array}{rl} & 231x + 148y = 527 \\ + & 148x + 231y = 610 \\ \hline & 379x + 379y = 1137 \end{array}$$

$\therefore$ $x + y = \frac{1137}{379}$ ...[Dividing both sides by 379]

$\therefore$ $x + y = 3$ ...(iii)

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

$$\begin{array}{l} 231x + 148y = 527 \\ 148x + 231y = 610 \\ - \quad - \qquad - \\ \hline 83x - 83y = -83 \end{array}$$

$\therefore$ $x - y = \frac{-83}{83}$ ...[Dividing both sides by 83]

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

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

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

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

Substituting $x = 1$ in equation (iii), we get

$1 + y = 3$

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

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

iv. The given simultaneous equations are

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

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

$\therefore$ $\frac{7}{y}-\frac{2}{x}=5$ ...(i)

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

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

$\therefore$ $\frac{8}{y}+\frac{7}{x}=15$ ...(ii)

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

∴ Equations (i) and (ii) become 7q – 2p = 5 ...(iii)
8q + 7p = 15 ...(iv)
Multiplying equation (iii) by 7, we get
49q – 14p = 35 ...(v)
Multiplying equation (iv) by 2, we get
16q + 14p = 30 ...(vi)
Adding equations (v) and (vi), we get

$$\begin{array}{rl} & 49q - 14p = 35 \\ + & \underline{16q + 14p = 30} \\ & 65q \qquad = 65 \end{array}$$

$\therefore \quad q = \frac{65}{65} = 1$

Substituting q = 1 in equation (iv), we get
8(1) + 7p = 15
∴ 8 + 7p = 15
∴ 7p = 15 – 8
∴ 7p = 7
∴ p = $\frac{7}{7}$ = 1
∴ (P, q) = (1,1)
Resubstituting the values of p and q, we get
1 = $\frac{1}{x}$ and 1 = $\frac{1}{y}$
∴ x = 1 and y = 1
∴ (x, y) = (1, 1) is the solution of the given simultaneous equations.

v. The given simultaneous equations are

Let $\frac{1}{3x+4y} = p$ and $\frac{1}{2x-3y} = q$

∴ Equations (i) and (ii) become

$\frac{1}{2}p + \frac{1}{5}q = \frac{1}{4}$

∴ $10p + 4q = 5$
...(iii)[Multiplying both sides by 20]

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

∴ $10p - 4q = -3$
...(iv)[Multiplying both sides by 2]

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

$$\begin{array}{rl} & 10p + 4q = 5 \\ + & \underline{10p - 4q = -3} \\ & 20p \qquad = 2 \end{array}$$

∴ $p = \frac{2}{20} = \frac{1}{10}$

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

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

∴ $1 + 4q = 5$
∴ $4q = 5 - 1$
∴ $4q = 4$
∴ $q = \frac{4}{4} = 1$
∴ $(p, q) = \left(\frac{1}{10}, 1\right)$

Resubstituting the values of p and q, we get

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

∴ 3x + 4y = 10 ...(v)
and 2x – 3y = 1 ...(vi)
Multiplying equation (v) by 3, we get
9x + 12y = 30 ...(vii)
Multiplying equation (vi) by 4, we get
8x – 12y = 4 ...(viii)
Adding equations (vii) and (viii), we get

$$\begin{array}{rl} & 9x + 12y = 30 \\ + & \underline{8x - 12y = 4} \\ & 17x \qquad = 34 \end{array}$$

∴ $x = \frac{34}{17} = 2$

Substituting x = 2 in equation (v), we get
3(2) + 4y = 10
⇒ 6 + 4y = 10
⇒ 4y = 10 – 6
⇒ y = 4/4 = 1

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

Question 7.
Solve the following word problems, 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.
Solution:
Let the digit in unit's place be x
and that in the ten's place be y.

∴ the number = $\boxed{10}\,y + x$

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

According to the first condition,
two digit number + the number obtained by interchanging the digits = 143

∴ $\boxed{10y + x} + \boxed{10x + y} = 143$

∴ $\boxed{11}\,x + \boxed{11}\,y = 143$

∴ $x + y = \boxed{13}$ …(i)[Dividing both sides by 11]

According to the second condition,
digit in unit's place = digit in the ten's place + 3

∴ $x = \boxed{y} + 3$

∴ $x - y = 3$ …(ii)

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

$$\begin{array}{rl} & x + y = 13 \\ + & x - y = 3 \\ \hline & 2x = \boxed{16} \end{array}$$

∴ $\boxed{x = 8}$

Putting this value of x in equation (i), we get
$x + y = 13$

∴ $8 + \boxed{y} = 13$

∴ $y = \boxed{5}$

The original number is $10y + x = 10(5) + 8$
$= \boxed{50} + 8 = 58$

ii. Kantabai bought 1 12 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.
Solution:
Let the rate of tea be ₹ x per kg and that of sugar be ₹ y per kg.
According to the first condition,
cost of 1 12 kg tea + cost of 5 kg sugar + fare for rickshaw = total expense

∴ $1\frac{1}{2}x + 5y + 50 = 700$

∴ $\frac{3}{2}x + 5y = 700 - 50$

∴ $\frac{3}{2}x + 5y = 650$

∴ $3x + 10y = 1300$ …(i)
[Multiplying both sides by 2]

According to the second condition,
cost of 2 kg tea + cost of 7 kg sugar = total expense
2x + 7y = 880 …(ii)
Multiplying equation (i) by 2, we get
6x + 20y = 2600 …(iii)
Multiplying equation (ii) by 3, we get
6x + 21y = 2640 …(iv)
Subtracting equation (iii) from (iv), we get

$$\begin{array}{r} 6x + 21y = 2640 \\ 6x + 20y = 2600 \\ - \quad - \quad - \\ \hline y = 40 \end{array}$$

Substituting $y = 40$ in equation (i), we get

$3x + 10(40) = 1300$

$\therefore \quad 3x + 400 = 1300$

$\therefore \quad 3x = 1300 - 400$

$\therefore \quad 3x = 900$

$\therefore \quad x = \frac{900}{3} = 300$

∴ The rate of tea is ₹ 300 per kg and that of sugar is ₹ 40 per kg.

iii. To find number of notes that Anushka had, complete the following activity.

Suppose that Anushka had $\boxed{x}$ notes of ₹ 100 and $\boxed{y}$ notes of ₹ 50 each

Anushka got ₹ 2500/- from Anand as denominations mentioned above
∴ ______ equation (i)

If Anand would have given her the amount by interchanging number of notes, Anushka would have received ₹ 500 less than the previous amount
∴ _____ equation (ii)

∴ The no. of notes (□, □)

Solution:
Anushka had x notes of ₹ 100 and y notes of ₹ 50.
According to the first condition,
$100x + 50y = 2500$
∴ $2x + y = 50$ …(i) [Dividing both sides by 50]
According to the second condition,
$100y + 50x = 2000$
∴ $2y + x = 40$ … [Dividing both sides by 50]
i.e. $x + 2y = 40$
∴ $2x + 4y = 80$ …(ii) [Multiplying both sides by 2]
Subtracting equation (i) from (ii), we get

$$\begin{array}{r} 2x + 4y = 80 \\ 2x + \ \ y = 50 \\ - \quad - \quad - \\ \hline 3y = 30 \end{array}$$

$\therefore \quad y = \frac{30}{3} = 10$

Substituting $y = 10$ in equation (i), we get

$2x + 10 = 50$

$\therefore \quad 2x = 50 - 10$

$\therefore \quad 2x = 40$

$\therefore \quad x = \frac{40}{2} = 20$

∴ Anushka had 20 notes of ₹ 100 and 10 notes of ₹ 50.

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.
Solution:
Let the present ages of Manish and Savita be x years and y years respectively.
According to the first condition,
$x + y = 31$ …(i)
3 years ago,
Manish's age = $(x – 3)$ years
Savita's age = $(y – 3)$ years
According to the second condition,
$(x – 3) = 4 (y – 3)$
∴ $x – 3 = 4y – 12$
∴ $x – 4y = -12 + 3$
∴ $x – 4y = -9$ …(ii)
Subtracting equation (ii) from (i), we get

$$\begin{array}{rl} x + y = & 31 \\ x - 4y = & -9 \\ - \quad + \qquad & + \\ \hline 5y = & 40 \end{array}$$

$\therefore \quad y = \frac{40}{5} = 8$

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

$x + 8 = 31$

∴ x = 31 – 8

∴ x = 23

The present ages of Manish and Savita are 23 years and 8 years respectively.

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.

Solution:

Let the daily wages of skilled workers be ₹ x

that of unskilled workers be ₹ y.

According to the first condition,

$\frac{x}{y} = \frac{5}{3}$

$\therefore \quad 3x = 5y$

$\therefore \quad 3x - 5y = 0 \qquad \ldots(i)$

According to the second condition,

$x + y = 720$

$\therefore \quad 5x + 5y = 3600 \qquad \ldots(ii)$

[Multiplying both sides by 5]

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

$$\begin{array}{rl} & 3x - 5y = 0 \\ + & 5x + 5y = 3600 \\ \hline & 8x \qquad = 3600 \end{array}$$

$\therefore \quad x = \frac{3600}{8} = 450$

Substituting $x = 450$ in equation (i), we get

$3(450) - 5y = 0$

$\therefore \quad 1350 = 5y$

$\therefore \quad y = \frac{1350}{5} = 270$

∴ The daily wages of skilled workers is ₹ 450 and that of unskilled workers is ₹ 270.

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 him after 3 hours. Find the speed of Hamid and Joseph.

Solution:

Let the speeds of Hamid and Joseph be x km/hr andy km/hr respectively.

Distance travelled by Hamid in 20 minutes

i.e. $\frac{1}{3}$ hrs $= \frac{1}{3} x$ km

Distance travelled by Joseph in $\frac{1}{3}$ hrs $= \frac{1}{3} y$ km

According to the first condition,

$\frac{1}{3}x + \frac{1}{3}y = 30$

$\therefore$ $x + y = 90$ ...(i)[Multiplying both sides by 3]

Distance travelled by Hamid in 3 hrs = $3x$ km

Distance travelled by Joseph in 3 hrs = $3y$ km

According to the second condition,

$3x - 3y = 30$

$\therefore$ $x - y = 10$ ...(ii)[Dividing both sides by 3]

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

$$\begin{array}{rl} & x + y = 90 \\ + & x - y = 10 \\ \hline & 2x \quad = 100 \end{array}$$

$\therefore$ $x = \frac{100}{2} = 50$

Substituting $x = 50$ in equation (i), we get

$50 + y = 90$

$\therefore$ $y = 90 - 50 = 40$

$\therefore$ The speeds of Hamid and Joseph 50 km/hr and 40 km/hr respectively.