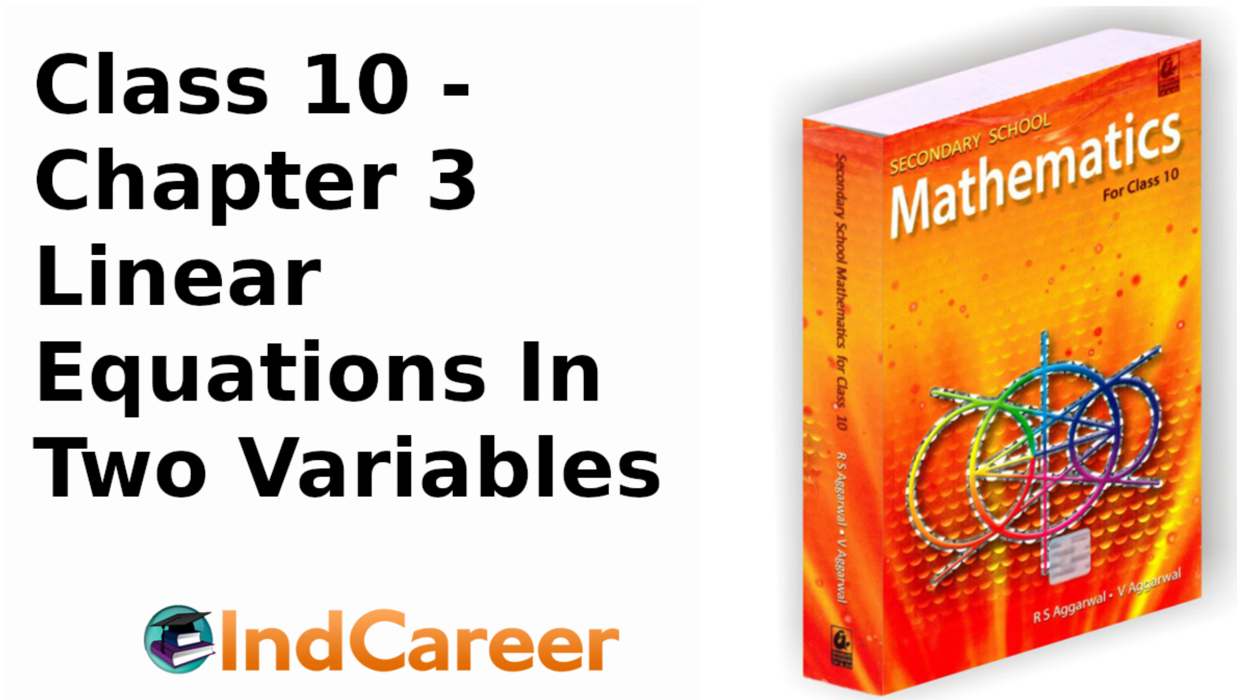
RS Aggarwal Solutions for Class 10 Maths Chapter 3–Linear Equations In Two Variables



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RS Aggarwal Solutions for Class 10 Maths Chapter 3–Linear Equations In Two Variables

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RS Aggarwal Solutions for Class 10 Maths Chapter 3–Linear Equations In Two Variables

RS Aggarwal 10th Maths Chapter 3, Class 10 Maths Chapter 3 solutions

Exercise 3A

Question 1:

On a graph paper, draw a horizontal line X'OX and a vertical line YOY' as the x-axis and the y-axis respectively.

Given equations are 2x + 3y = 2 and x - 2y = 8

Graph of 2x + 3y = 2:

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

Putting x = 1, we get y = 0

Putting x = -2, we get y = 2

Putting x = 4, we get y = -2

∴ Table for 2x + 3y = 2 is

x	1	-2	4
y	0	2	-2

Plot the points A (1, 0), B (-2, 2) and C (4, -2) on the graph paper. Join AB and AC to get the graph line BC. Extend it on both ways.

Thus, line BC is the graph of 2x + 3y = 2.

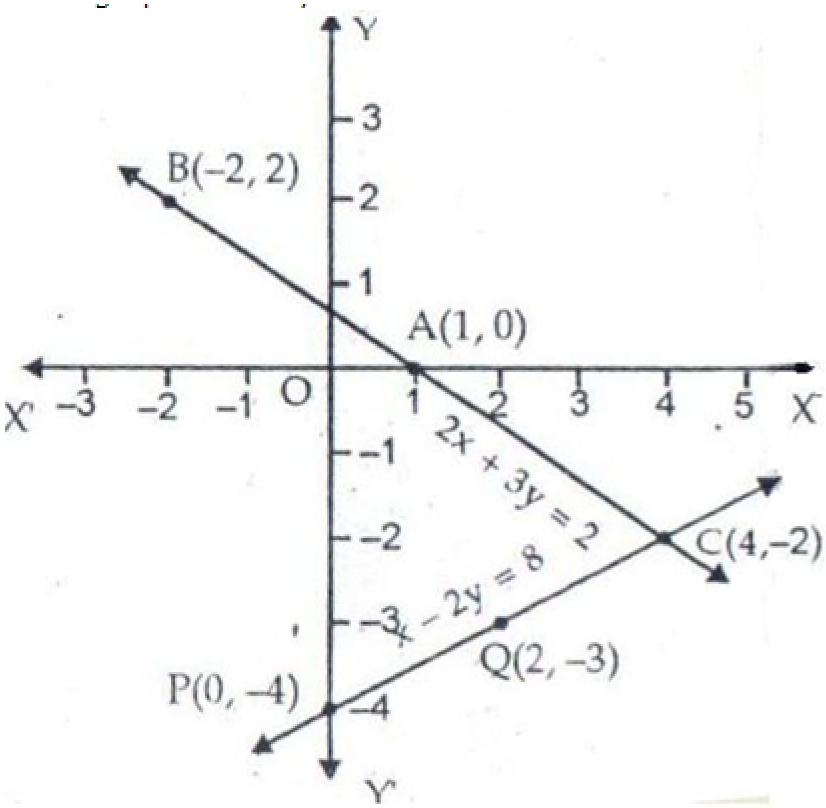
Graph of x - 2y = 8:

$y = \frac{x-8}{2}$

Putting x = 2, we get y = -3
Putting x = 4, we get y = -2
Putting x = 0, we get y = -4
Table for x - 2y = 8 is

x	2	4	0
y	-3	-2	-4

Now, on the same graph paper as above plot the points P(0, -4) and Q(2, -3). The point C(4,-2) has already been plotted. Join QC and extend it. Thus, the line PC is the graph of x - 2y = 8.



The two graph lines interest at C(4, -2)
∴ x = 4, y = -2 is the solution of given system of equations.

Question 2:

On a graph paper, draw a horizontal line X'OX and a vertical line YOY' as the x-axis and the y-axis respectively.

Given equations are 3x + 2y = 4 and 2x - 3y = 7

Graph of 3x + 2y = 4:

3x + 2y = 4

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

Thus we have the following table for 3x + 2y = 4

x	0	2	-2
y	2	-1	5

Plot the points A (0, 2), B (2, -1) and C (-2, 5) on the graph paper. Join AB and AC to get the graph line BC. Extend it on both ways.

Thus, line BC is the graph of 3x + 2y = 4.

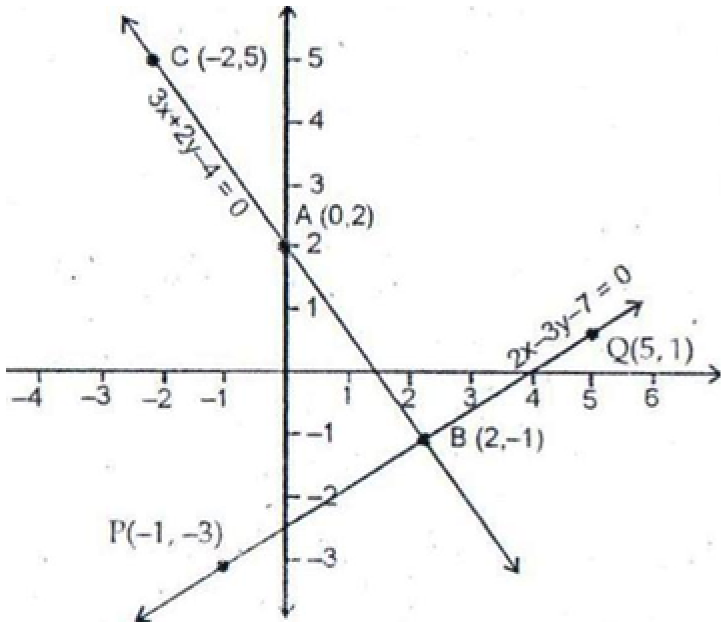
Graph of 2x - 3y = 7

$\Rightarrow y = \frac{2x-7}{3}$

thus, we have the following table for 2x - 3y = 7

x	2	-1	5
y	-1	-3	1

On the same graph paper as above plot the points P (-1, -3) and Q (5, 1). The point B (2,-1) has already been plotted. Join PB and QB and extend it. Thus, the line PQ is the graph of 2x - 3y = 7.



The two graph lines intersect at point B(2, -1)
$\therefore$ x = 2, y = -1 is the solution of the given system of equations

Question 3:

On a graph paper, draw a horizontal line X'OX and a vertical line YOY' as the x-axis and the y-axis respectively.

Given equations are x - y + 1 = 0 and 3x + 2y - 12 = 0

Graph of x - y + 1 = 0:

$x - y + 1 = 0 \Rightarrow y = x + 1$ --- (1)

Thus, we have following table for x - y + 1 = 0

x	0	-1	2
y	1	0	3

Plot the points A (0,1), B (-1, 0) and C (2, 3) on the graph paper. Join AB and AC to get the graph line BC. Extend it on both ways.

Thus, line BC is the graph of x - y + 1 = 0.

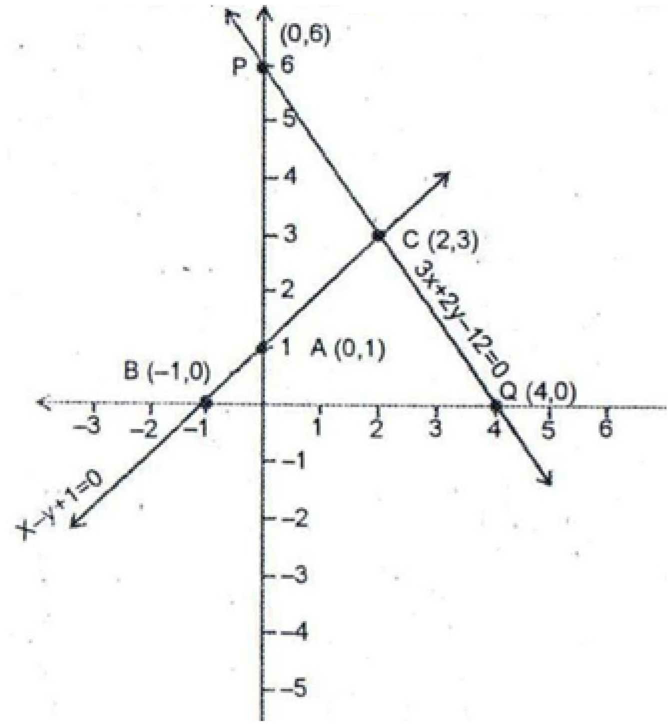
Graph of 3x + 2y - 12 = 0:

$$2y = 12 - 3x \Rightarrow y = \frac{12 - 3x}{2} \text{ --- } (2)$$

Thus, we have the following table for 3x + 2y - 12 = 0

x	0	2	4
y	6	3	0

On the same graph paper as above plot the points P (0, 6) and Q (4, 0). The point C (2, 3) has already been plotted. Join PC and QC and extend it. Thus, the line PQ is the graph of 3x + 2y - 12 = 0.



The two graph lines intersect at the point (2, 3)
$\therefore x = 2, y = 3$ is the solution of the given system of equations

Question 4:

On a graph paper, draw a horizontal line X'OX and a vertical line YOY' as the x-axis and the y-axis respectively.

Given equations are 2x + 3y = 4 and 3x - y = -5

Graph of 2x + 3y = 4:

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

Thus, we have the following table for 2x + 3y = 4

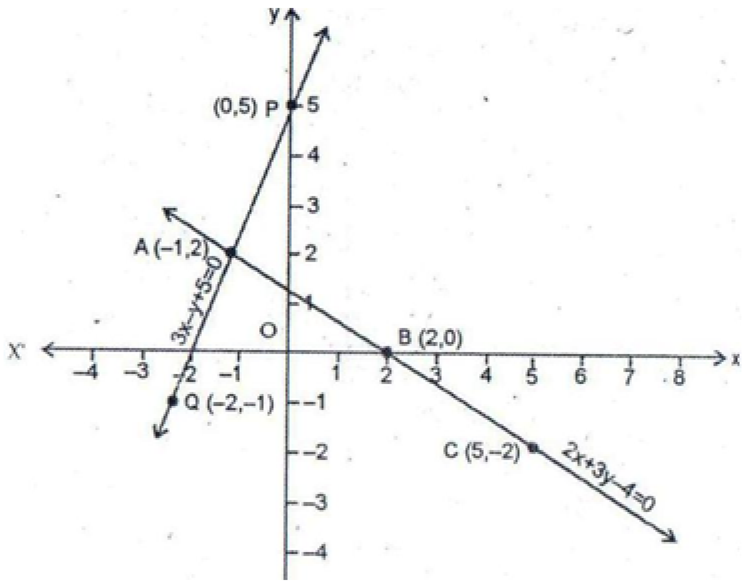
x	-1	2	5
y	2	0	-2

On the graph paper plot the point A (-1, 2), B (2, 0) and C (5, -2)
Join AB and BC to get in line AC
Thus, the line AC is the graph of the equation 2x + 3y = 4

Graph of 3x - y = -5:
y = 3x + 5
Thus, we have the following table for 3x - y = -5

x	-1	0	-2
y	2	5	-1

On the same graph paper plot the points P(0, 5) and Q (-2, -1)
The third point A (-1, 2) has been already plotted.



Join PA and QA to get the line PQ
Thus, the line PQ is the graph of the equation 3x - y = -5

The two graph lines intersect at the point A(-1, 2)
∴ x = -1, y = 2 is the solution of the given system of equations

Question 5:

On a graph paper, draw a horizontal line X'OX and a vertical line YOY' as the x-axis and the y-axis respectively.

Given equations are $2x - 3y = 1$
and $3x - 4y = 1$

Graph of 2x - 3y = 1:

$2x - 3y = 1 \Rightarrow 3y = 2x - 1$

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

Thus, we have the following table for $2x - 3y = 1$

x	-1	2	5
y	-1	1	3

On the graph paper plot the points A (-1, -1), B (2, 1) and C (5, 3)
Join AB and BC to get AC
Thus, line AC is the graph of $2x - 3y = 1$

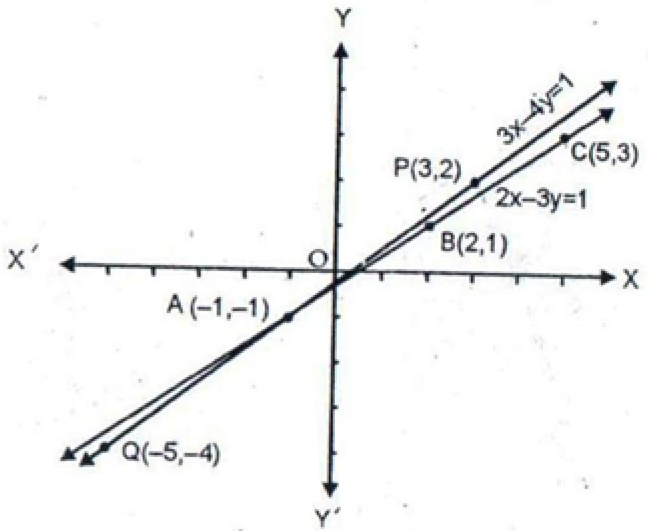
Graph of 3x - 4y = 1

$3x - 4y = 1$

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

Thus, we have the following table for $3x - 4y = 1$

x	-1	3	-5
y	-1	2	-4



On the same graph paper as above, plot the points P(3, 2) and Q(-5, -4)
The point A (-1, -1) has been already plotted.
Join PA and QA to get line PQ
Thus, line PQ is the graph of the equation 3x - 4y = 1
Thus two graph lines intersect at the point A(-1, -1)

Question 6:

On a graph paper, draw a horizontal line X'OX and a vertical line YOY' as the x-axis and the y-axis respectively.

Given equations are 4x + 3y = 5
and 2y - x= 7

Graph of 4x + 3y = 5:

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

thus , we have the following table for 4x + 3y = 5

x	-1	2	5
y	3	-1	-5

On the graph paper plot the point A(-1, 3) and B(2, -1), C(5, -5)
Joint AB and BC to get AC
Thus, line AC is the graph of 4x +3y = 5

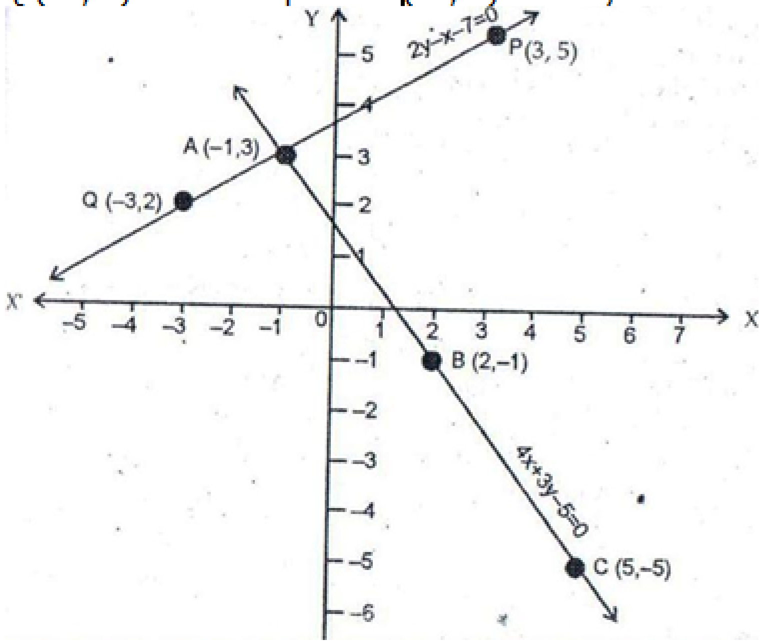
Graph of 2y - x = 7:

For graph of $2y - x = 7 \Rightarrow y = \frac{7+x}{2}$ ---(2)

Thus, we have the following table for 2y - x = 7

x	-1	3	-3
y	3	5	2

On the same graph paper as above, plot the points P (3, 5) and Q (-3, 2) and third point A (-1, 3) already has been plotted.



Join PA and QA to get line PQ
Thus, line PQ is the graph of the equation 2y - x = 7
The two graph lines intersect at point A(-1, 3)
∴ x = -1, y = 3 is the solution of the given system of equations

Question 7:

On a graph paper, draw a horizontal line X'OX and a vertical line YOY' as the x-axis and the y-axis respectively.

Given equations are x + 2y + 2 = 0
and 3x + 2y - 2 = 0

Graph of x + 2y + 2 = 0:

$x + 2y + 2 = 0 \Rightarrow y = \frac{-x-2}{2}$ ---(1)

thus, we have the following table for x + 2y + 2 = 0

x	-2	0	2
y	0	-1	-2

On the graph paper plot the points A (-2,0), B (0, -1) and C (2, -2)
Joint AB and BC to get AC
Thus, the line AC is the graph of x + 2y + 2 = 0

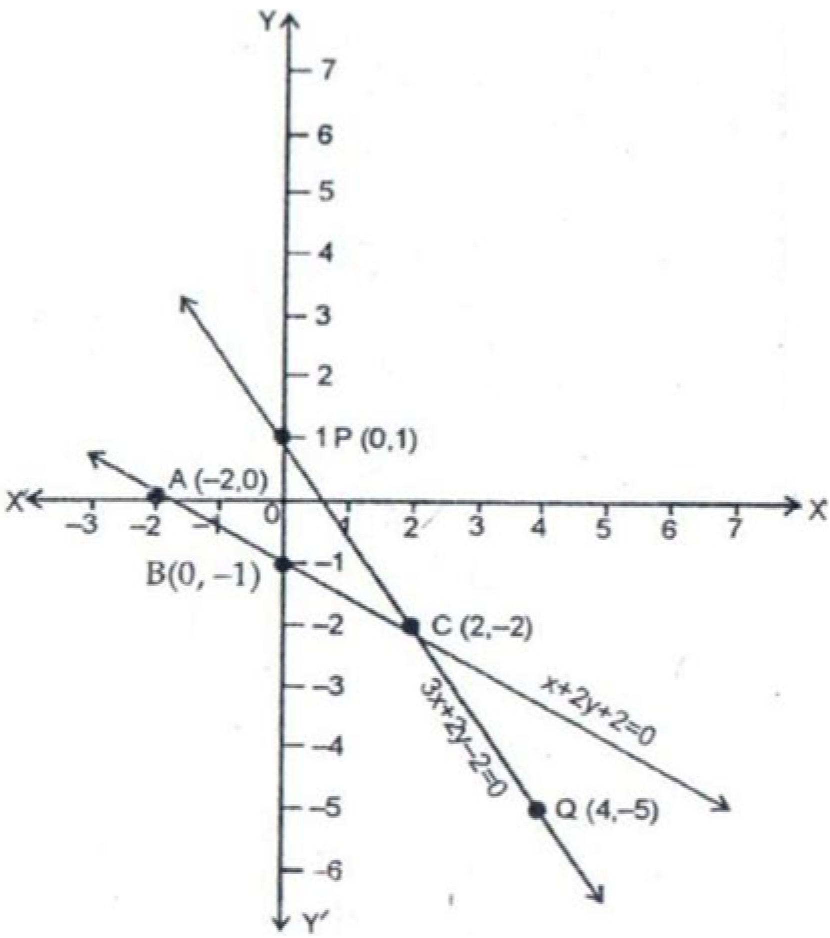
Graph of 3x + 2y - 2= 0:

Now $3x + 2y - 2 = 0 \Rightarrow y = \frac{-3x+2}{2}$ ---(2)

Thus, we have the following table for 3x + 2y - 2= 0

x	0	2	4
y	1	-2	-5

On the graph paper as above plot the points P (0, 1) and Q (4, -5) and third point C (2, -2) is already plotted.



Joint PC ad QC to get line PQ
Thus, the line PQ is the graph of the equation 3x + 2y - 2 = 0
Two graph lines intersect at the point C(2, -2)
∴ x = 2, y = -2 is the solution of the given system of equations.

Question 8:

On a graph paper, draw a horizontal line X'OX and a vertical line YOY' as the x-axis and the y-axis respectively.

Given equations are 2x + 3y = 8
and x - 2y + 3 = 0

Graph of 2x + 3y = 8:

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

Thus, we have the following table for 2x + 3y = 8

x	1	-5	7
y	2	6	-2

On the graph paper plot the points A(1, 2), B(-5, 6) and C(7, -2)
Join AB and AC to get BC
Thus the line AC is the equation of 2x + 3y = 8

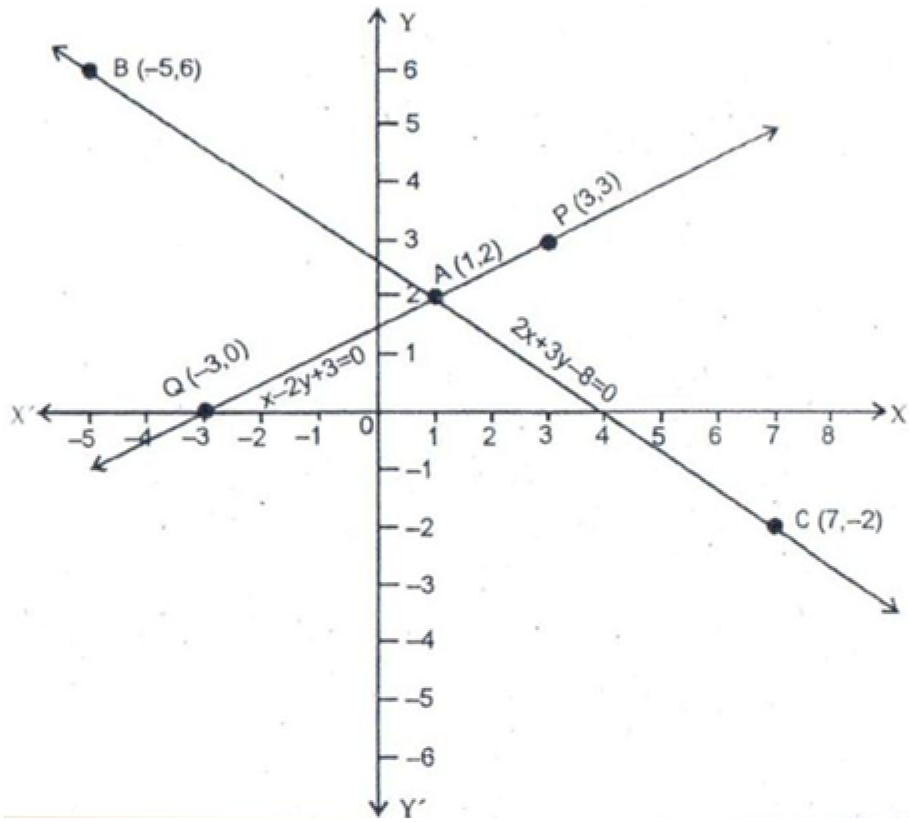
Graph of x - 2y + 3 = 0:

For graph of $x - 2y + 3 = 0 \Rightarrow y = \frac{x+3}{2}$ ---(2)

Thus, we have the following table for x - 2y + 3 = 0

x	1	3	-3
y	2	3	0

On the same graph paper as above, plot the points P(3, 3) and Q(-3, 0).
The point A(1, 2) has been already plotted.



Join PA and QA to get the line PQ
Thus, line PQ is the graph of the equation $x - 2y + 3 = 0$
The two graph lines intersect at the point A(1,2)
$\therefore$ $x = 1$, $y = 2$ is the solution of the given system of equations

Question 9:

On a graph paper, draw a horizontal line X'OX and a vertical line YOY' as the x-axis and the y-axis respectively.

Given equations are 2x - 5y + 4 = 0
and 2x + y - 8 = 0

Graph of 2x - 5y + 4 = 0:

$2x - 5y + 4 = 0 \Rightarrow y = \frac{2x+4}{5}$ ----(1)

Thus, we have the following table for 2x - 5y + 4 = 0

x	-2	3	8
y	0	2	4

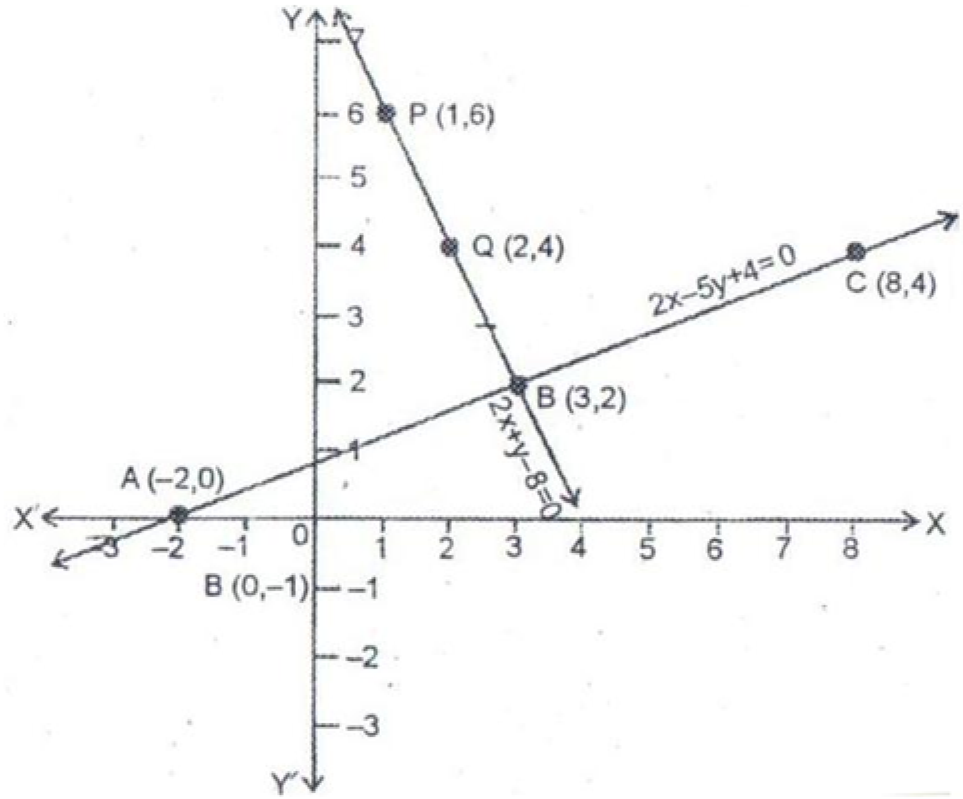
On the graph paper plot the points A(-2, 0), B(3, 2) and C(8, 4)
Joint AB and BC to get AC
Thus, line AC is the graph of the equation 2x - 5y + 4 =0

Graph of 2x + y - 8 = 0

$2x + y - 8 = 0 \Rightarrow y = -2x + 8$ ---(2)
Thus, we have the following table for 2x + y - 8 = 0

x	1	3	2
y	6	2	4

On the same graph paper as above, plot the points P (1, 6) and Q (2, 4).
The third point B (3, 2) has been already plotted.



Join PQ and QB to get to the line PB. Thus, line PB is the graph of the equation $2x + y - 8 = 0$.

The two graph lines intersect at the point B(3, 2)

$\therefore$ $x = 3$, $y = 2$ is the solution of the given system of equations

Question 10:

On a graph paper, draw a horizontal line X'OX and a vertical line YOY' as the x-axis and the y-axis respectively.

Given equations are 3x + y + 1 = 0
and 2x + y - 8 = 0

Graph of 3x + y + 1 = 0:

$3x + y + 1 = 0 \Rightarrow y = -3x - 1$ ---(1)
Thus, we have the following table for 3x + y + 1 = 0

x	0	-1	1
y	-1	2	-4

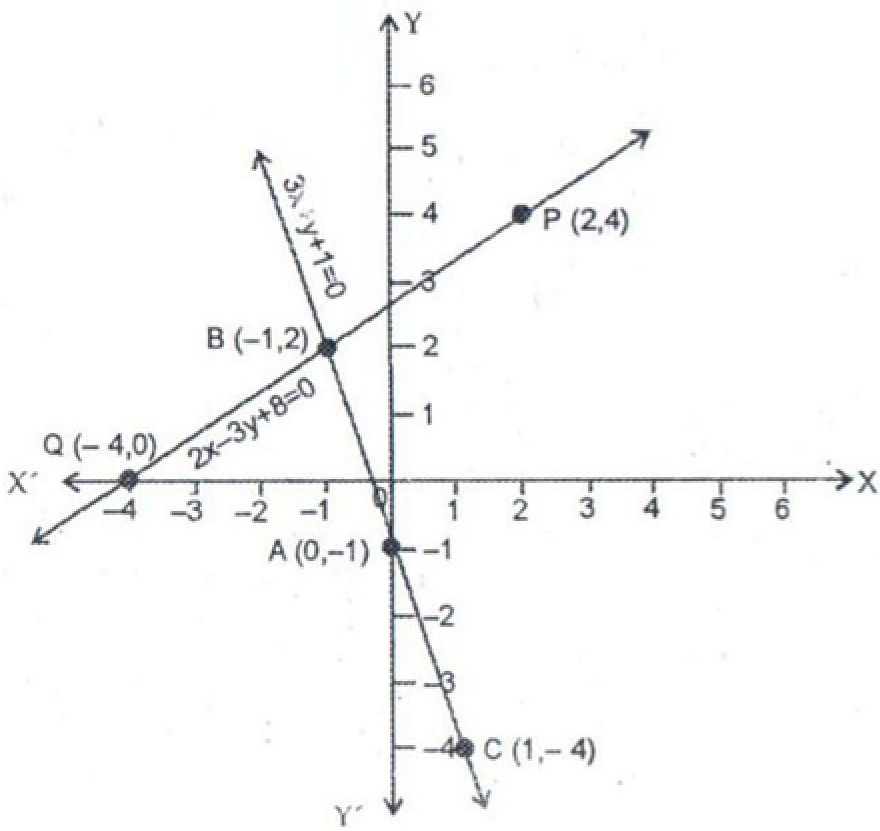
On the graph plot the points A (0, -1) and B (-1, 2) and C (1, -4)
Join AB and AC to get BC
Thus, line BC is the graph of equation 3x + y + 1 = 0

Graph of 2x - 3y + 8 = 0:

For graph of 2x - 3y + 8 = 0
$$2x - 3y + 8 = 0 \Rightarrow y = \frac{2x + 8}{3} --- (2)$$
Thus, we have the following table for equation (2)

x	-1	2	-4
y	2	4	0

On the same graph as above, plot the points P (2, 4) and Q (-4, 0).
The point B (-1, 2) has been already plotted.
Join PB and BQ to get PQ.



Thus the line PQ is graph of equation $2x - 3y + 8 = 0$
The two graph lines intersect at the point B(-1, 2)
$\therefore$ x = -1, y = 2 is the solution of the given system of equations.

Question 11:

On a graph paper, draw horizontal line X'OX and a vertical line YOY' as x-axis and y-axis respectively.

Given equations are 3x - 2y + 2 = 0
and $\frac{3}{2}x - y + 3 = 0$

Graph of 3x -2y + 2 = 0:

$3x - 2y + 2 = 0 \therefore y = \frac{3x+2}{2} --- (1)$

We have the following table for 3x - 2y + 2 = 0

x	0	2	-2
y	1	4	-2

Plot the points A (0,1), B (2, 4) and C (-2, -2) on the graph paper.
Join AB and AC to get the graph of line BC.
Extend it on both sides.
Therefore, BC is the graph of line 3x - 2y + 2 = 0

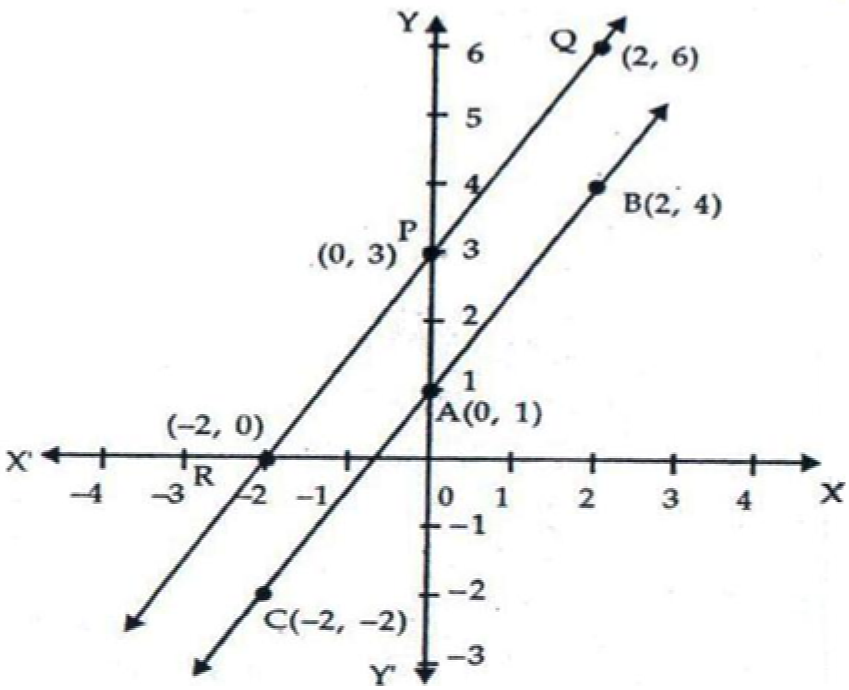
Graph of $\frac{3}{2}x - y + 3 = 0$:

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

Thus, we have the following table for $\frac{3}{2}x - y + 3 = 0$

x	0	2	-2
y	3	6	0

On the same graph paper, plot the points P (0, 3), Q (2, 6) and R (-2, 0)
Join PQ and PR to get the line QR.
Extend it on both sides
Thus, line QR is the graph of equation $\frac{3}{2}x - y + 3$



It is clear from the graph that the two lines are parallel and do not intersect even when produced.
∴ Given equations are inconsistent and has no solution.

The coordinates of the points where these, lines meet y - axis are A (0, 1) and B (0, 3) respectively.

Question 12:

On a graph paper, draw horizontal line X'OX and a vertical line YOY' as x-axis and y-axis respectively

Given equations are $3x + y - 5 = 0$
and $2x - y - 5 = 0$

Graph of $3x + y - 5 = 0$:

For the graph of $3x + y - 5 = 0$ or $y = -3x + 5$ ---(1)
We have the following table for $3x + y - 5 = 0$

x	0	1	2
y	5	2	-1

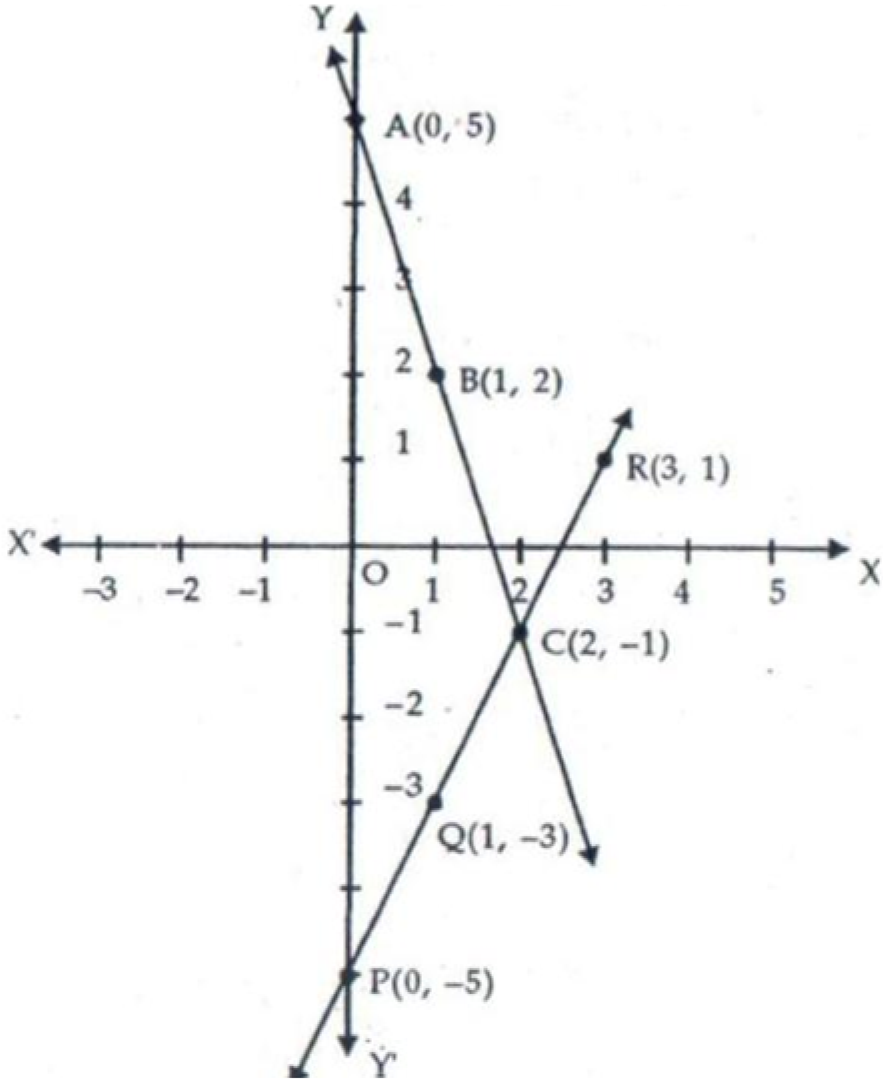
Plot the points A (0, 5), B (1, 2) and C (2, -1).
Join AB and BC to get AC
The line AC is the graph of the equation $3x + y - 5 = 0$

Graph of $2x - y - 5 = 0$:

For the graph of $2x - y - 5 = 0$ or $y = 2x - 5$ ---(2)
We have the following table for $2x - y - 5 = 0$

x	0	1	3
y	-5	-3	1

On the same graph paper, plot the points P(0, -5), Q(1, -3) and R(3,1)



Join PQ and QR to get PR
The line PR is the graph of 2x - y - 5 = 0
The lines (1) and (2) intersect y-axis at (0, 5) and (0, -5) respectively.

Question 13:

On a graph paper, draw horizontal line X'OX and a vertical line YOY' as x-axis and y-axis respectively.

Graph of 3x + 5y = 15:

For the graph of 3x + 5y = 15 or $y = \frac{-3x+15}{5}$

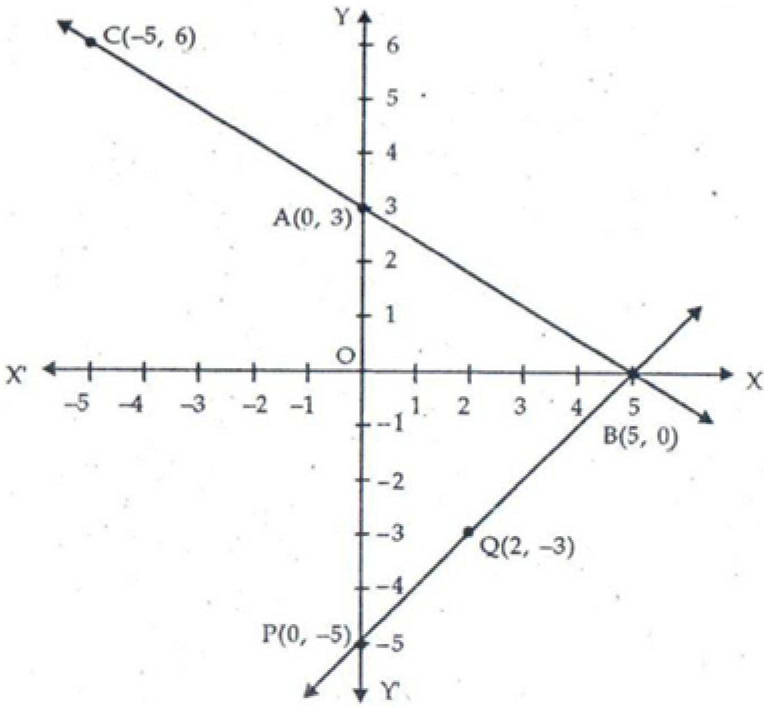
We have the following table for 3x + 5y = 15

x	0	5	-5
y	3	0	6

Plot the points A (0, 3), B (5, 0) and C (-5, 6).
Join AB and AC to get BC.
Extend it on both ways.
The line BC is the graph of the equation 3x + 5y = 15

Graph of x - y = 5:
$x - y = 5 \Rightarrow y = x - 5$
We have the following table x - y = 5

x	0	5	2
y	-5	0	-3



On the same graph paper, plot the points P(0, -5) and Q(2, -3).
The point B (5, 0) has already been plotted.
Join PQ and QB to get PB
The line PB is the graph of the equation x - y = 5

It is clear from the graph that the given system of equations is consistent.

The lines 3x + 5y = 15 and x - y = 5 meet the y-axis at A (0, 3) and P(0, -5) respectively.

Question 14:

On a graph paper, draw horizontal line X'OX and a vertical line YOY' as x-axis and y-axis respectively.

Graph of x + 2y = 5:

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

thus, we have the following table for x + 2y = 5.

x	1	3	5
y	2	1	0

On the graph paper, plot the points A (1, 2), B (3, 1) and C (5, 0)
Join AB and BC to get AC
Thus, line AC is the graph of the equation x + 2y = 5

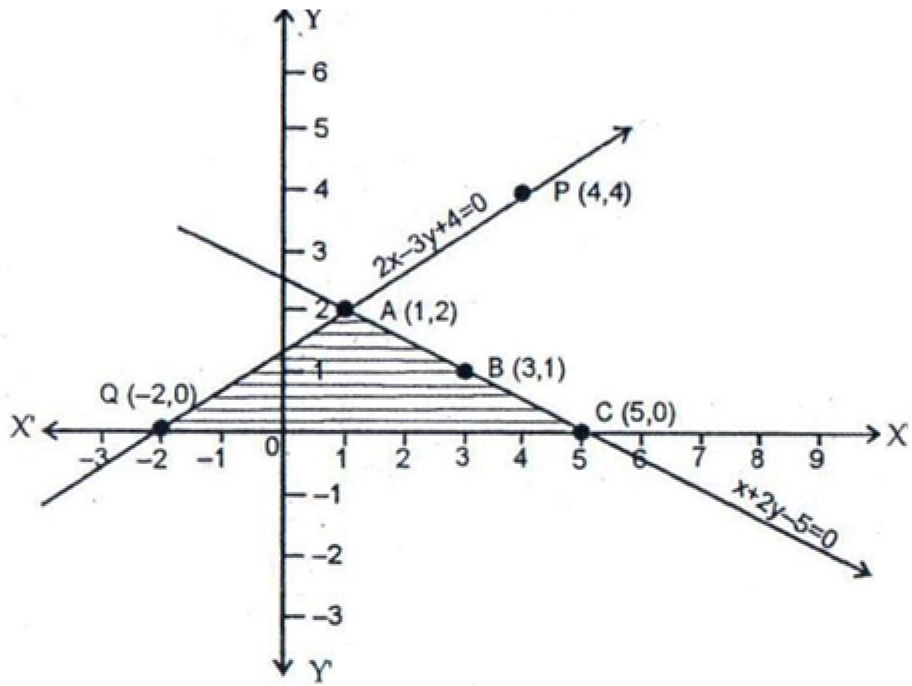
Graph of 2x - 3y = -4:

For graph of 2x - 3y = -4

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

Thus, we have the following table for 2x - 3y = -4

x	1	-2	4
y	2	0	4



On the same graph paper, plot the points P (4,4) and Q (-2, 0).
The point A (1, 2) has been already plotted.
Join PA and QA to get PQ
The line PQ is the graph of the equation 2x - 3y = -4

The two graph lines intersect at point A (1, 2)
∴ x = 1, y = 2 is the solution of the given system of equations
The region bounded by these lines and x-axis has been shaded.

On extending the graph lines on both sides, we find that these graph lines intersect the x-axis at points Q (-2, 0) and C (5, 0)

Question 15:

On a graph paper, draw horizontal line X'OX and a vertical line YOY' as x-axis and y-axis respectively.

Graph of 4x - 5y + 16 = 0:

$4x - 5y + 16 = 0 \Rightarrow \frac{4x+16}{5} = y$ or $y = \frac{4x+16}{5}$

Thus, we have the following table for 4x - 5y + 16 = 0

x	1	-4	6
y	4	0	8

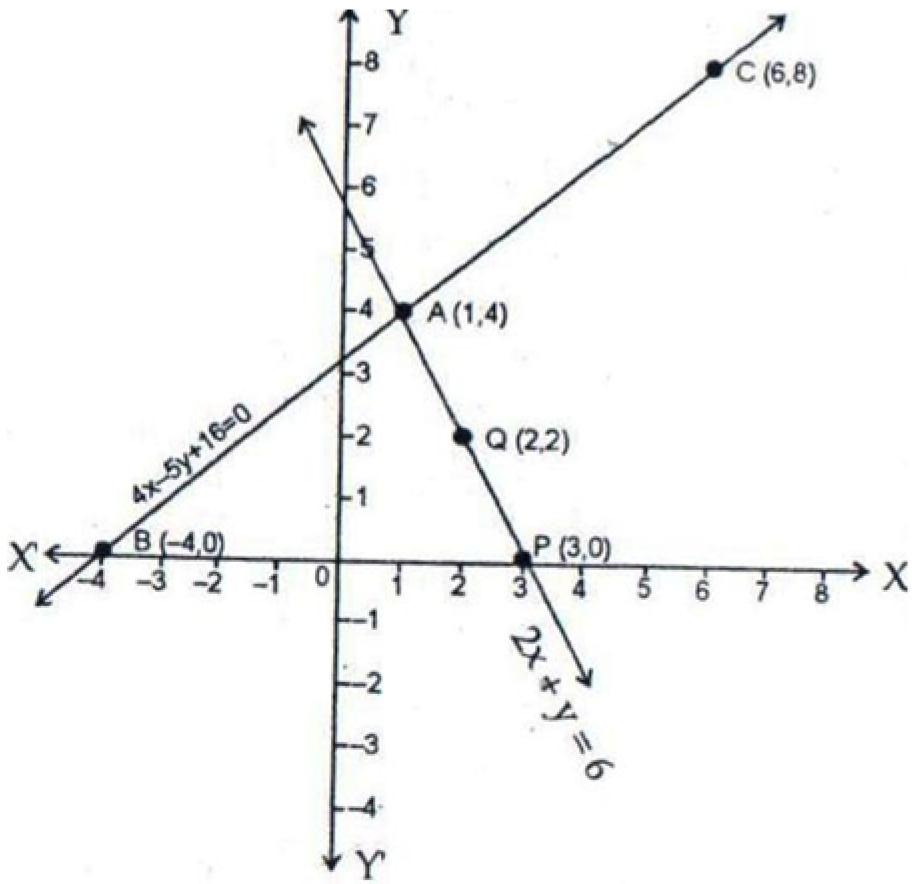
On the graph paper plot the points A (1, 4), B (-4, 0) and C (6, 8)
Joint AB and AC to get BC
Thus, BC is the graph of the equation 4x - 5y + 16 = 0

Graph of 2x + y - 6 = 0:

$2x + y - 6 = 0 \Rightarrow y = -2x + 6$

Thus, we have the following table for 2x + y - 6 = 0

x	1	3	2
y	4	0	2



On the same graph as above, plot the points P (3, 0), Q (2, 2).
The third point A (1, 4) has been already plotted.
Join PQ and QA to get PA.
Thus, line PA is the graph of the equations $2x + y - 6 = 0$
The two graph lines intersect at A(1, 4)

$\therefore$ $x = 1$, $y = 4$ is the solution of the given system of equations
Clearly, the given equations are represented by the graph lines BC and PA respectively.

The vertices of ΔBAP formed by these lines and the x-axis are B(-4, 0), A(1, 4) and P(3, 0)

Question 16:

On a graph paper, draw horizontal line X'OX and a vertical line YOY' as x-axis and y-axis respectively.

Graph of 2x - 3y - 17 = 0:

2x - 3y - 17 = 0, -3y = 17 - 2x

$$\Rightarrow \quad y = \frac{-17+2x}{3} \quad \text{or} \quad y = \frac{2x-17}{3} \quad ---(1)$$

Thus, we have the following table for 2x - 3y - 17 = 0

x	1	4	7
y	-5	-3	-1

On the graph paper plot the points A (1, -5), B (4, -3) and C (7, -1).

Join AB and BC to get AC

Thus, line AC is the graph of the equation 2x - 3y - 17 = 0

Graph of 4x + y - 13 = 0:

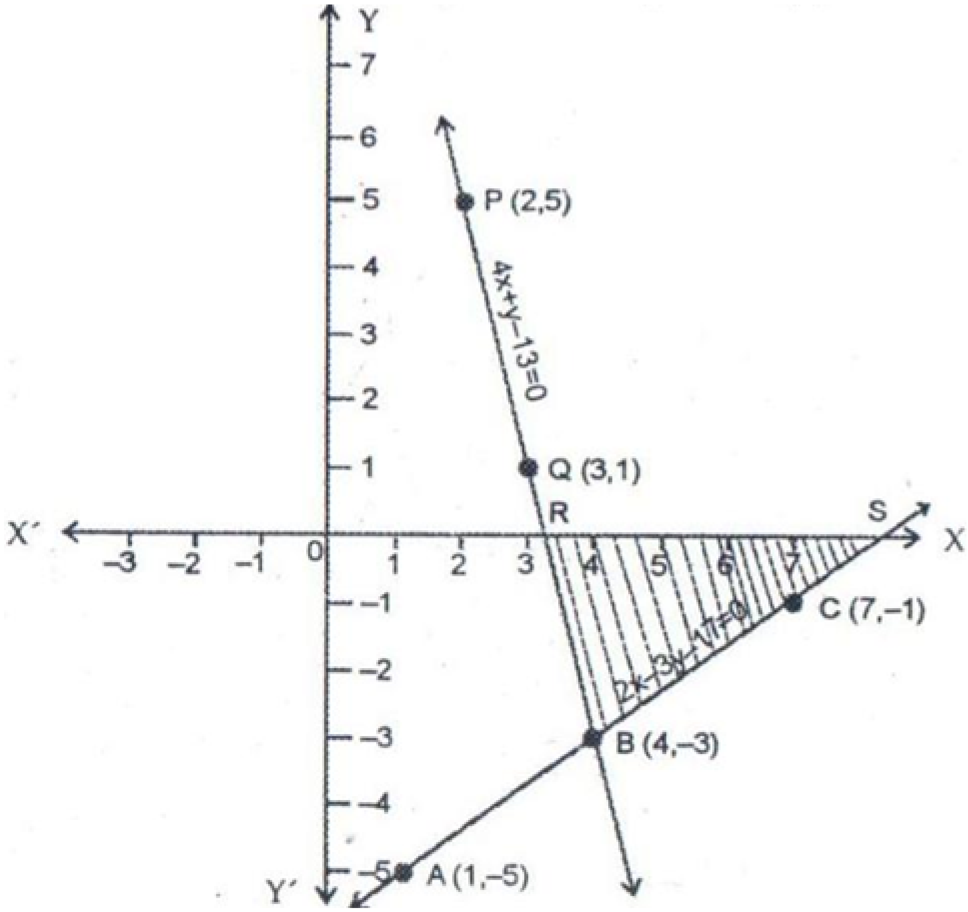
4x + y - 13 = 0 ⇒ y = -4x + 13 ---(2)

Thus, we have the following table for 4x + y - 13 = 0

x	4	2	3
y	-3	5	1

On the same graph paper as above, plot the points P (2, 5) and Q (3, 1)

The point B (4, -3) has been already plotted.



Joint PQ and QB to get PB.
Thus, line PB is the graph of equation 4x + y - 13 = 0
The two graph lines intersect at the point B (4, -3)
x = 4, y = -3 is the solution of the given system of equations

These graph lines intersect the x-axis at R and S
The region bounded by these lines and the x-axis has been shaded

Question 17:

On a graph paper, draw horizontal line X'OX and a vertical line YOY' as x-axis and y-axis respectively.

Graph of 4x - y = 4:

$4x - y = 4 \Rightarrow y = 4x - 4$

Thus, we have the following table for 4x - y = 4

x	0	1	2
y	-4	0	4

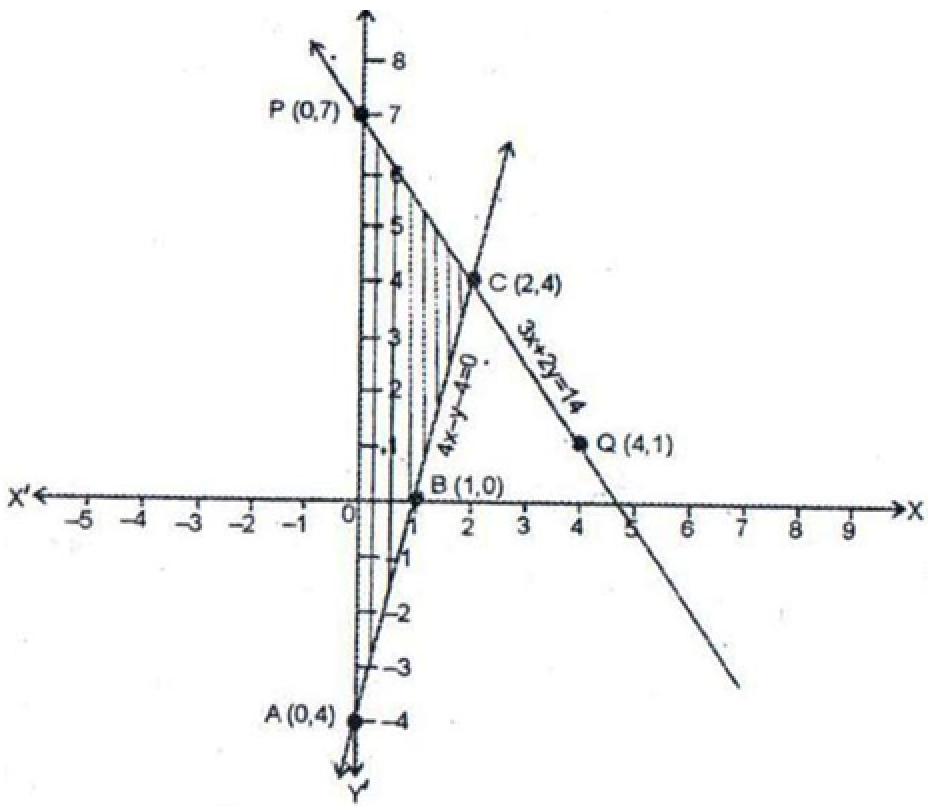
On the graph paper plot the points A (0, -4), B (1, 0) and C (2,4)
Joint AB and BC to get AC
Thus, line AC is the graph of the equation 4x - y = 4
For graph of 3x + 2y = 14

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

Thus, we have the following table for 3x + 2y = 14

x	0	2	4
y	7	4	1

On the same graph paper as above, plot the points P (0, 7) and Q (4, 1).
Third point C (2, 4) has already been plotted.
Join PC and CQ to get PQ.



Thus, line PQ is the graph of the equation $3x + 2y = 14$
The two graph lines intersect at point C(2, 4)

$\therefore$ $x = 2$, $y = 4$ is the solution of the given system of equations
The region bounded by these lines and the y-axis has been shown by shaded area.

Question 18:

On a graph paper, draw horizontal line X'OX and a vertical line YOY' as x-axis and y-axis respectively.

The given system of equations is $2x - y = 1$, $x - y = -1$

Graph of 2x - y = 1:

$2x - y = 1 \Rightarrow y = 2x - 1$ ---(1)
Putting $x = 1$, we get $y = 2 - 1 = 1$
Putting $x = 2$, we get $y = 2 \times 2 - 1 = 3$
Putting $x = 0$, we get $y = 0 - 1 = -1$
$\therefore$ table for equations (1) is

x	1	2	0
y	1	3	-1

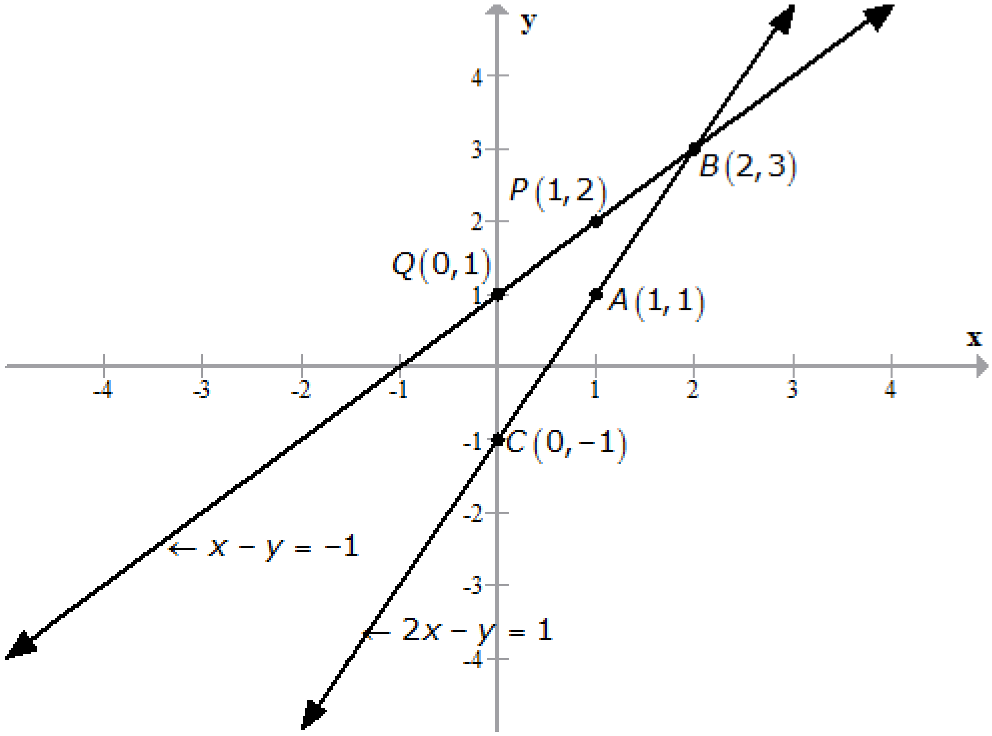
Plot the points A (1, 1), B(2, 3), C(0, -1).
Join AB and AC to get BC.
BC is the graph of the equation $2x - y = 1$

Graph of $x - y = -1$**:**

$x - y = -1 \Rightarrow y = x + 1$ ---(2)
Putting $x = 1$, we get $y = 1 + 1 = 2$
Putting $x = 2$, we get $y = 2 + 1 = 3$
Putting $x = 0$, we get $y = 0 + 1 = 1$
Table for equations (2) is

x	1	2	0
y	2	3	1

Plot the points P (1, 2) and Q (0, 1)
The point B (2, 3) has been already plotted.



Join PB and PQ to get BQ.
The line BQ is the graph of x - y = -1

The graph of lines BC and BQ intersect at B (2, 3). Solution of the given system of equations is x = 2, y = 3.
The region bounded by the lines and y-axis has been shaded.

Question 19:

On a graph paper, draw horizontal line X'OX and a vertical line YOY' as x-axis and y-axis respectively.

The given system of equations is 2x - 5y + 4 = 0, 2x + y - 8 = 0

Graph of 2x - 5y + 4 = 0:

$2x - 5y + 4 = 0 \Rightarrow y = \frac{2x+4}{5}$ --(1)

Thus, we have the following table for equation (1)

x	3	-2	8
y	2	0	4

On the graph paper plot the points A (3, 2), B (-2, 0) and C (8, 4)
Join AB and AC to get BC
Thus, line BC is the graph of the equation 2x - 5y + 4 = 0

Graph of 2x + y - 8 = 0:

$2x + y - 8 = 0 \Rightarrow y = -2x + 8$ ---(2)

Then, we have following table for equation (2)

x	3	1	2
y	2	6	4

On the same graph paper plot the points P (1, 6) and Q (2, 4)
The third point A (3, 2) has been already plotted.
Join PA.
Thus, line PA is the graph of 2x + y - 8 = 0

On extending the graph lines on both sides, we find that these graph lines intersect the y-axis at the point R(0, 8) and S(0, 0.8)

Question 20:

On a graph paper, draw horizontal line X'OX and a vertical line YOY' as x-axis and y-axis respectively.

The given system of equations is
$4x - 5y - 20 = 0, 3x + 5y - 15 = 0$

Graph of $4x - 5y - 20 = 0$:

$4x - 5y - 20 = 0 \Rightarrow y = \frac{4x-20}{5} ---(1)$

Thus, we have the following table for equation (1)

x	0	5	10
y	-4	0	4

On the graph paper plot the points A(0, -4), B(5, 0) and C(10, 4)
Joint AB and BC to get AC
Thus, line AC is the graph of equation $4x - 5y - 20 = 0$

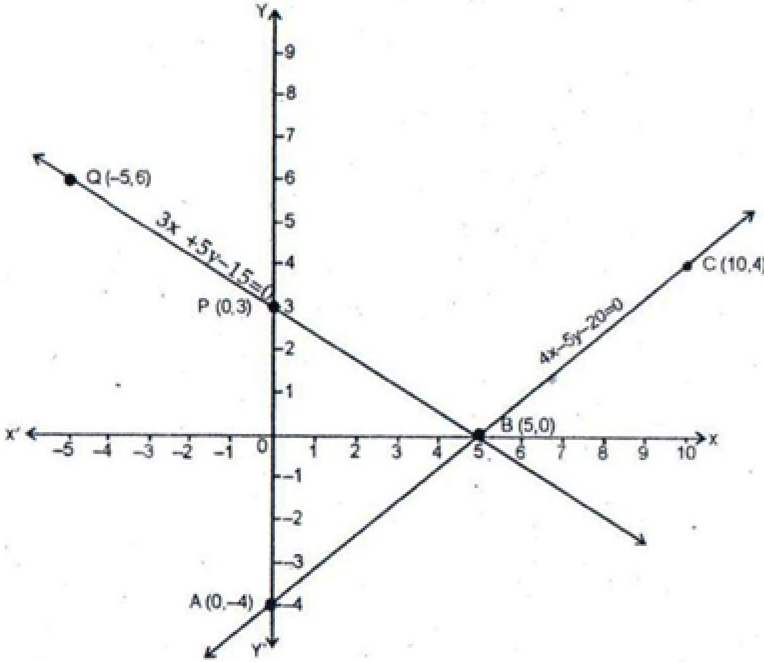
Graph of $3x + 5y - 15 = 0$:

$3x + 5y - 15 = 0 \Rightarrow y = \frac{-3x+15}{5} ---(2)$

Thus, we have the following table for equation (2)

x	5	0	-5
y	0	3	6

On the same graph paper plot the points P (0, 3) and Q (-5, 6).
The third point B (5, 0) has been already plotted in the graph.



Joint PQ and PB to get the line QB
Thus, line QB is the graph of equation 3x + 5y - 15 = 0
The two graph lines intersect at B(5, 0)
∴ x = 5, y = 0 is the solution of the given system of equations

Clearly, the vertices of ΔPBA formed by these lines and the y-axis are A (0, -4), B (5, 0) and P (0, 3)

Question 21:

On a graph paper, draw horizontal line X'OX and a vertical line YOY' as x-axis and y-axis respectively.

The given system of equations is
$4x - 3y + 4 = 0$, $4x + 3y - 20 = 0$

Graph of 4x - 3y + 4 = 0:

$4x - 3y + 4 = 0 \Rightarrow y = \frac{4x+4}{3}$ ----(1)

Thus, we have the following table for equation (1)

x	-1	2	5
y	0	4	8

On the graph paper plot the points A (-1, 0), B (2, 4) and C (5, 8)
Join AB and BC to get AC
Thus, line AC is the graph of $4x - 3y + 4 = 0$

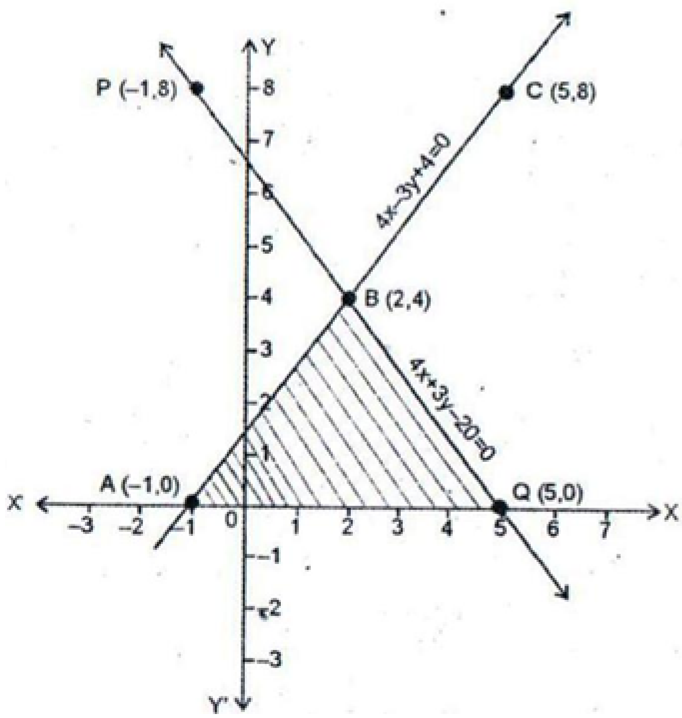
Graph of 4x + 3y - 20 = 0

$4x + 3y = 20 \Rightarrow y = \frac{-4x+20}{3}$ ---(2)

Thus, we have the table for following table for equation (2)

x	2	-1	5
y	4	8	0

On the same graph paper as above, plot the points P (-1, 8), Q (5, 0).
The third point B (2, 4) has been already plotted.



Joint PB and QB to get the line PQ
Thus, line PQ is the graph of the equation 4x + 3y - 20 = 0
The two graph lines intersect at B (2, 4)
∴ x = 2, y = 4 is the solution of the given system of equations

Clearly, the vertices of ΔABQ formed by these lines and the x-axis are A (-1, 0), B (2, 4) and Q (5, 0)

Consider the triangle ΔABQ:
height of the triangle = 4 units and base(AQ)= 6 units

Area of triangle ΔABQ:

$$\text{Area} = \left(\frac{1}{2}\times \text{Base}\times \text{height}\right)\text{sq.units} = \left(\frac{1}{2}\times 4\times 6\right)\text{sq.units}$$

Area of ΔABQ = 12 sq. units

Question 22:

On a graph paper, draw horizontal line X'OX and a vertical line YOY' as x-axis and y-axis respectively.

The given system of equations is
$x - y + 1 = 0,\ 3x + 2y - 12 = 0$

Graph of $x - y + 1 = 0$:

$x - y + 1 = 0 \Rightarrow y = x + 1$ ---(1)
Thus, we have the following table for equation (1)

x	-1	1	2
y	0	2	3

On the graph paper plot the points A(-1, 0), B(1, 2) and C(2, 3)
Joint AB and BC to get AC
Thus, line AC is the graph of the equation $x - y + 1 = 0$

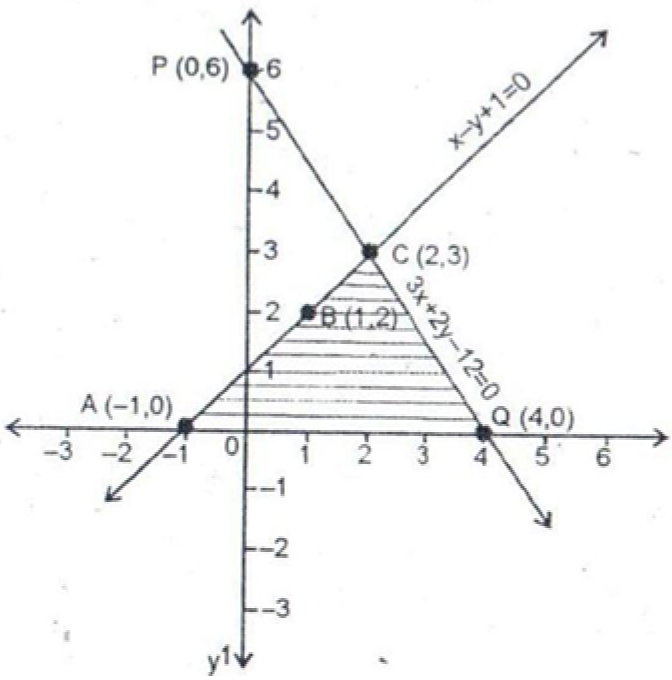
Graph of $3x + 2y - 12 = 0$:

$3x + 2y - 12 = 0 \Rightarrow y = \frac{-3x + 12}{2}$ ----(2)

Thus, we have the following table for equation (2)

x	0	2	4
y	6	3	0

On the same graph paper plot points P (0, 6) and Q (4, 0)
The third point C (2, 3) has been already plotted.
Join PC and CQ to get PQ.



Thus, line PQ is the graph of the equation 3x + 2y - 12 = 0
The two graph lines intersect at C (2, 3)
∴ x = 2, y = 3 is the solution of the given system of equations

Clearly, the vertices of ΔACQ formed by these lines and the x-axis are A (-1, 0), C (2, 3) and Q (4, 0)

Consider the triangle ΔACQ:
height of the triangle = 3 units and base(AQ)= 5 units

Area of triangle ΔACQ:

$$\text{Area of } \Delta ACQ = \left(\frac{1}{2}\times \text{Base}\times \text{Height}\right)$$
$$= \left(\frac{1}{2}\times 3\times 5\right)\text{sq.units} = 7.5 \text{ sq.units}$$

Question 23:

On a graph paper, draw horizontal line X'OX and a vertical line YOY' as x-axis and y-axis respectively.

The given system of equations is
$5x - y = 7, x - y + 1 = 0$

Graph of $5x - y = 7$:

$5x - y - 7 = 0 \Rightarrow y = 5x - 7$ ---(1)
Thus, we have the following table for equation (1)

x	0	1	2
y	-7	-2	3

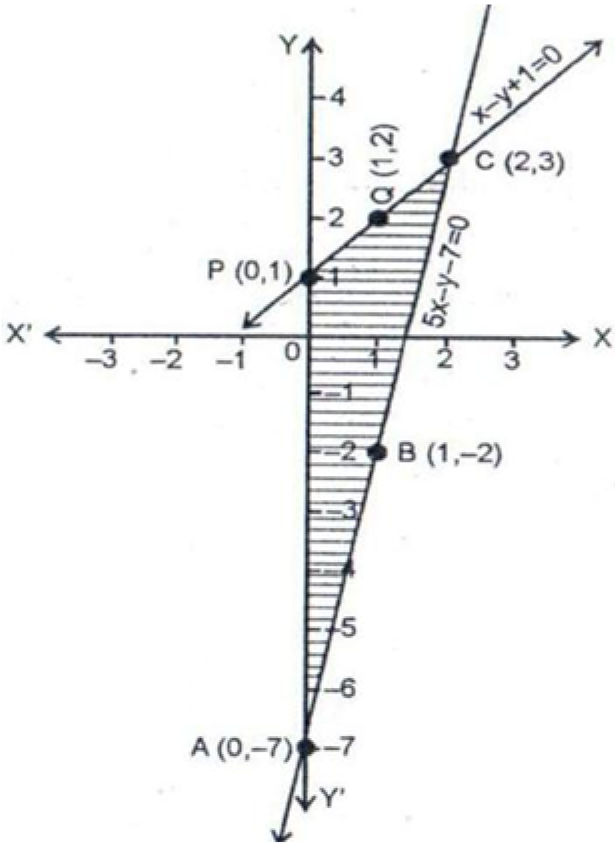
On the graph paper plot the points A (0, -7), B (1, -2) and C (2, 3)
Join AB and BC to get AC
Thus, AC line is the graph of $5x - y = 7$

Graph of $x - y + 1 = 0$:

$x - y + 1 = 0 \Rightarrow y = x + 1$ ---(2)
thus, we have the table for following equation (2)

x	0	1	2
y	1	2	3

On the same graph paper plot the points P (0, 1) and Q (1, 2).
The other point C (2, 3) has been already plotted.
Join PA.



These lines cut the y-axis at (0, -7) (0, 1) intersecting at (2, 3)
∴ x = 2, y = 3 is the solution of the given system of equations

Clearly, the vertices of ΔAPC formed by these lines and the y-axis are A (0, -7), P (0, 1) and C (2, 3)

Consider the triangle ΔAPC:
height of the triangle = 2 units and base(AP) = 8 units

Area of triangle ΔAPC:

$$\text{Area of } \Delta APC = \left(\frac{1}{2}\times \text{Base}\times \text{Height}\right)$$
$$= \left(\frac{1}{2}\times 8\times 2\right)\text{sq.units} = 8 \text{ sq.units}$$

Question 24:

On a graph paper, draw horizontal line X'OX and a vertical line YOY' as x-axis and y-axis respectively.

The given system of equations is
x - 2y = 2, 4x - 2y = 5

Graph of x - 2y = 2:

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

Thus, we have following table for equation (1)

x	0	2	1
y	-1	0	-0.5

On graph paper plot the points A (0, -1), B (2, 0) and C (1, -0.5)
Join AC and BC to get AB
Thus line, AB is the graph of equation x - 2y = 2

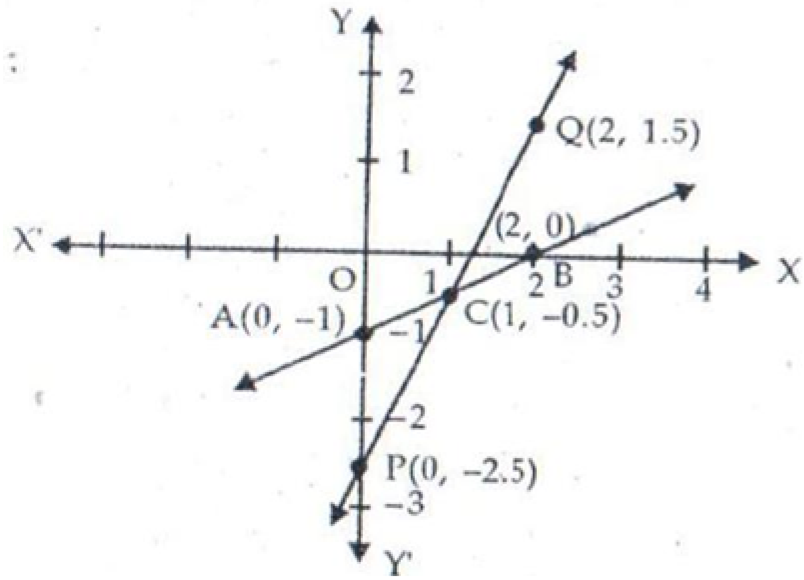
Graph of 4x - 2y = 5:

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

Thus, we have following table for equation (2)

x	0	1	2
y	-2.5	-0.5	1.5

On graph paper plot the points P (0, -2.5) and Q (2, 1.5).
The point C (1, -0.5) has already been plotted



Join PC and CQ to get PQ
Then line PQ is the graph of equation 4x - 2y = 5

Thus, we find that two graph lines intersect at (1, -0.5)
Hence, the given system of equations is consistent.

Question 25:

On a graph paper, draw horizontal line X'OX and a vertical line YOY' as x-axis and y-axis respectively.

The given system of equations is
$2x + 3y = 4$, $4x + 6y = 12$

Graph of 2x + 3y = 4:

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

Thus, we have the following table for the equation (1)

x	2	-1	-4
y	0	2	4

On the graph paper plot the points A (2, 0) and B (-1, 2) and C (-4, 4)
Join AB and BC to get AC
Thus, line AC is the graph of the equation 2x + 3y = 4

Graph of 4x + 6y = 12:

$4x + 6y = 12 \Rightarrow y = \dfrac{-4x + 12}{6} \; --- (2)$

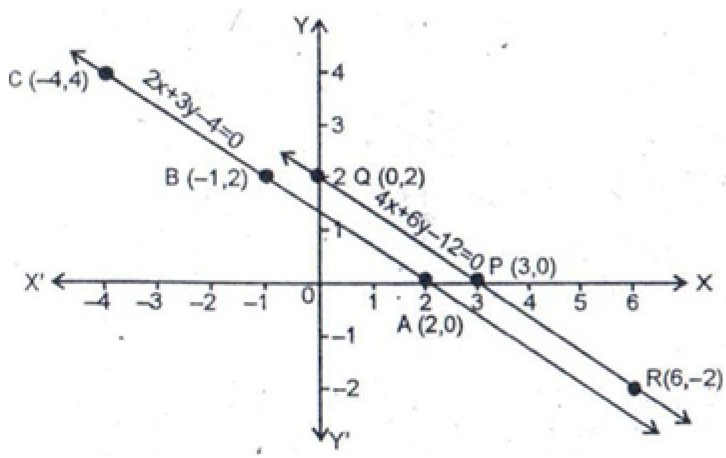
Thus, we have following table for equation (2)

x	3	0	6
y	0	2	-2

On the same graph plot the points P (3, 0) and Q (0, 2) and R (6,-2)

Join PQ and PR to get QR

Thus, line QR is the graph of the equation 4x + 6y = 12



It is clear from the graph that two graph lines are parallel and do not intersect when produced

Hence, the given system of equation is inconsistent

Question 26:

On a graph paper, draw horizontal line X'OX and a vertical line YOY' as x-axis and y-axis respectively.

The given system of equations is
2y -x = 9, 4y - 2x = 20

Graph of 2y -x = 9:

$2y - x = 9 \Rightarrow y = \frac{x+9}{2} - - - (1)$

Thus, we have following table for equation (1)

x	1	-1	-3
y	5	4	3

On the graph plot the points A(1, 5), B(-1, 4), C(-3, 3)
Join AB and BC to get AC
Thus line AC is the graph of the equation 2y -x = 9

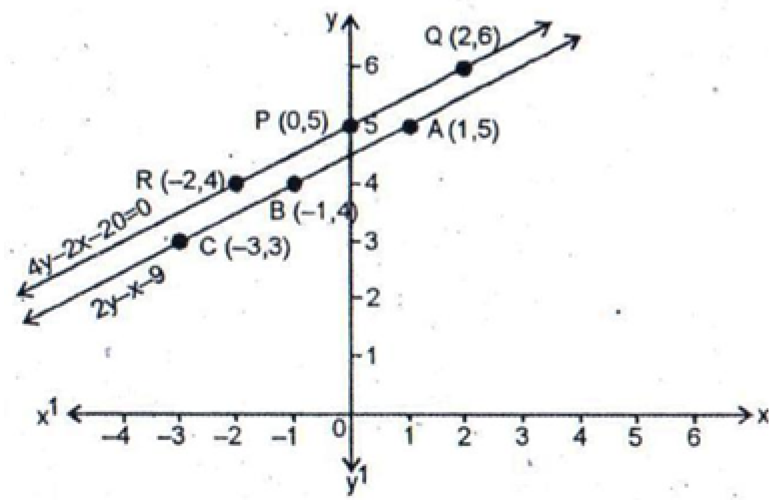
Graph of 4y - 2x = 20:

$4y - 2x = 20 \Rightarrow y = \frac{2x+20}{4} - - - (2)$

Thus, we have following table for equation (2)

x	0	2	-2
y	5	6	4

On the graph plot the points P(0, 5), Q(2, 6) and R(-2, 4)
Join PQ and PR to get QR
Thus, line QR is the graph of the equation 4y - 2x = 20



It is clear from the graph that two graph lines are parallel and do not intersect even when produced.
Hence, the given system of equation is inconsistent.

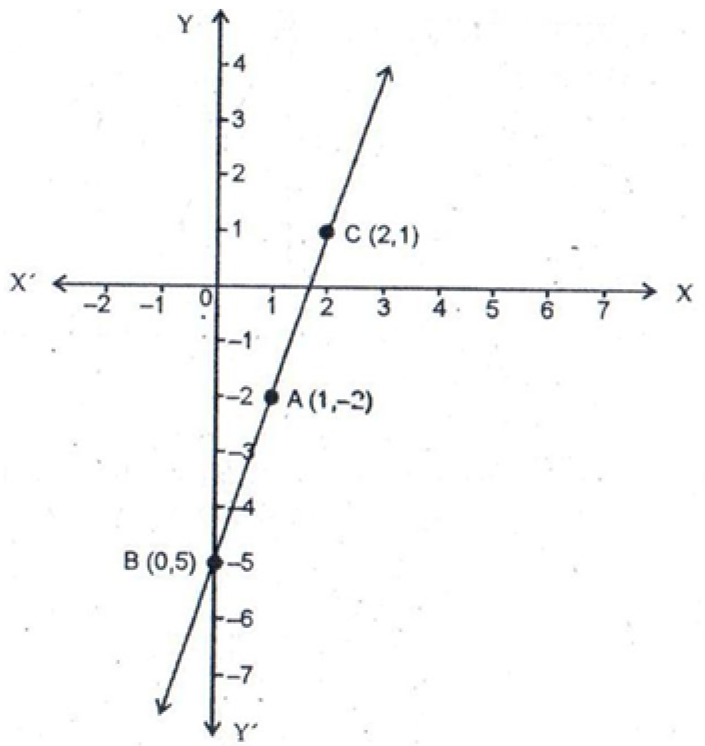
Question 27:

On a graph paper, draw horizontal line X'OX and a vertical line YOY' as x-axis and y-axis respectively.

The given system of equations is
3x - y = 5, 6x - 2y = 10

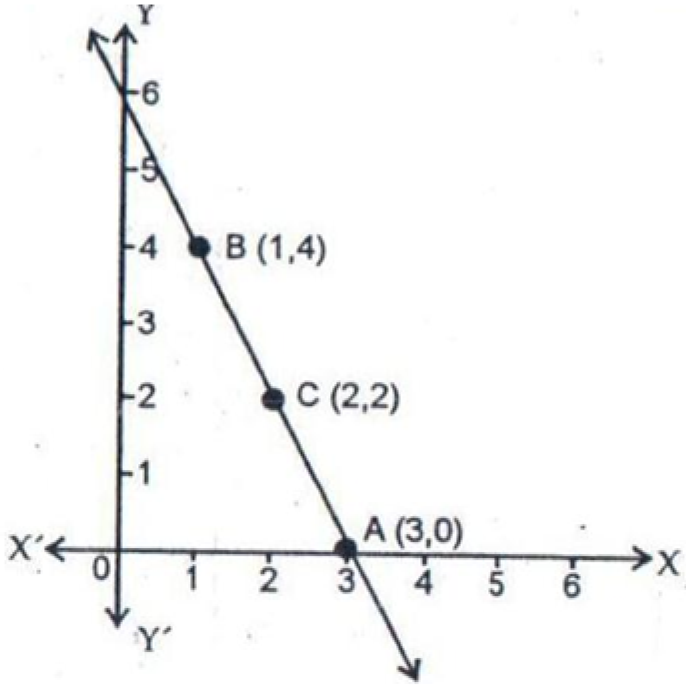
Graph of 3x - y = 5:

3x - y = 5 ⇒ y = 3x - 5 ---(1)



From the graph, it is clear that these two lines coincide.
Both equations represent same graph.
Hence, these lines have infinitely many solutions.

Question 28:



Thus, we find that the two line graphs coincide.
Hence the given system of equations has infinitely many solutions.

Exercise 3B

Question 1:

The given equations are
$x + y = 8$ ---(1)
$2x - 3y = 1$ ---(2)

Multiplying (1) by 3 and (2) by 1, we get
$3x + 3y = 24$ ---(3)
$2x - 3y = 1$ ---(4)
Adding (3) and (4), we get
$5x = 25 \Rightarrow x = \frac{25}{5} \Rightarrow x = 5$
Substituting $x = 5$ in (1), we get
$5 + y = 8 \Rightarrow y = 8 - 5 = 3$
$\therefore x = 5$ and $y = 3$

Question 2:

The given equations are
$x - y = 3$ ---(1)
$3x - 2y = 10$ ---(2)

Multiplying (1) by 2 and (2) by 1, we get
$2x - 2y = 6$ -(3)
$3x - 2y = 10$ ---(4)
Subtracting (3) from (4), we get $x = 4$
Substituting $x= 4$ in (1) we get
$4 - y = 3 \Rightarrow y = 4 - 3 = 1$
$\therefore x = 4, y = 1$

Question 3:

The given equations are
$x + y = 3$ ---(1)
$4x - 3y = 26$ ---(2)
By Multiplying (1) by 3 and (2) by 1, we get
$3x + 3y = 9$ ---(3)
$4x - 3y = 26$ ----(4)
Adding (3) and (4), we get
$7x = 35 \Rightarrow x = 5$
Substituting $x = 5$ in (1), we get
$x + y = 3$
$5 + y = 3 \Rightarrow y = 3 - 5 = -2$
$\therefore x = 5, y = -2$

Question 4:

The given equations are
$2x + 3y = 0$ ---(1)
$3x + 4y = 5$ ---(2)
Multiplying (1) by 4 and (2) by 3, we get
$8x + 12y = 0$ ---(3)
$9x + 12y = 15$ ---(4)
Subtracting (3) from (4), we get
$x = 15$

Substituting $x = 15$ in (1), we get
$2 \times 15 + 3y = 0 \Rightarrow 3y = 0 - 30$
$3y = -30$ or $y = -10$
$\therefore x = 15, y = -10$

Question 5:

The given equations are
$2x - 3y = 13$ ---(1)
$7x - 2y = 20$ ---(2)
Multiplying (1) by 2 and (2) by 3, we get
$4x - 6y = 26$ ---(3)
$21x - 6y = 60$ ---(4)

Subtracting (3) from (4), we get
$17x = 34 \Rightarrow x = 2$
Substituting $x = 2$ in (1), we get
$2 \times 2 - 3y = 13 \Rightarrow 4 - 3y = 13$
$-3y = 13 - 4 \Rightarrow -3y = 9$
$y = -3$
$\therefore$ Solution is $x = 2, y = -3$

Question 6:

The given equations are
$3x - 5y - 19 = 0$---(1)
$-7x + 3y + 1 = 0$ ---(2)
Multiplying (1) by 3 and (2) by 5, we get
$9x - 15y = 57$ ---(3)
$-35x + 15y = -5$ ---(4)

Adding (3) and (4), we get
$-26x = 52 \Rightarrow x = -2$

Substituting $x = -2$ in (1), we get
$3 \times (-2) - 5y = 19 \Rightarrow -6 - 5y = 19$
$-5y = 19 + 6 \Rightarrow -5y = 25$
$y = -5$
$\therefore$ solution is $x = -2, y = -5$

Question 7:

The given equations are
$4x - 3y = 8$ ---(1)
$6x - y = \frac{29}{3}$ ---(2)

Multiplying (1) by 1 and (2) by 3
$4x - 3y = 8$ ---(3)
$18x - 3y = 29$ ---(4)
Subtracting (3) from (4), we get
$14x = 21 \Rightarrow x = \frac{21}{14} = \frac{3}{2}$

Substituting $x = \frac{3}{2}$ in (1), we get

$4 \times \frac{3}{2} - 3y = 8 \Rightarrow 6 - 3y = 8$
$-3y = 2$
$y = \frac{-2}{3}$

$\therefore$ Solution is $x = \frac{3}{2}$ and $y = \frac{-2}{3}$

Question 8:

The given equations are

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

$5x = 2y + 7$ ----(2)

Multiplying (1) by 2 and (2) by $\frac{3}{4}$

$4x - \frac{3y}{2} = 6$ ----(3)

$\frac{15}{4}x - \frac{3}{2}y = \frac{21}{4}$ ---(4)

Subtracting (3) from (4), we get

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

$-x = -3 \Rightarrow x = 3$

Substituting x = 3 in (1), we get

$2 \times 3 - \frac{3y}{4} = 3$

$-\frac{3y}{4} = 3 - 6$

$-\frac{3y}{4} = -3 \Rightarrow y = \frac{-3 \times 4}{-3} = 4$

$\therefore$ solution is x = 3 and y = 4

Question 9:

The given equations are
$11x + 15y + 23 = 0$ ---(1)
$7x - 2y - 20 = 0$ ---(2)
Multiplying (1) by 2 and (2) by 15
$22x + 30y = -46$ ---(3)
$105x - 30y = 300$ ---(4)
Adding (3) and (4), we get
$127x = 254 \Rightarrow x = \frac{254}{127} = 2$
Substituting x = 2 in (1), we get
$11 \times 2 + 15y = -23$
$15y = -23 - 22 \Rightarrow 15y = -45$
$y = -3$
$\therefore$ solution is $x = 2$, $y = -3$

Question 10:

The given equations are
$2x - 5y + 8 = 0$ ---(1)
$x - 4y + 7 = 0$ ---(2)
Multiplying (1) by 4 and (2) by 5
$8x - 20y = -32$----(3)
$5x - 20y = -35$ ---(4)
Subtracting (3) from (4), we get
$-3x = -3 \Rightarrow x = 1$
Substituting x = 1 in (1), we get
$2 \times 1 - 5y = -8$
$-5y = -8 - 2 \Rightarrow -5y = -10$
$\therefore$ $y = 2$
$\therefore$ solution is $x = 1$, $y = 2$

Question 11:

Question 12:

The given equations are

$2x + 5y = \frac{8}{3}$ ----(1)

$3x - 2y = \frac{5}{6}$ ----(2)

Multiplying (1) by 2 and (2) by 5

$4x + 10y = \frac{16}{3}$ ---(3)

$15x - 10y = \frac{25}{6}$ ---(4)

Adding (3) and (4), we get

$19x = \frac{57}{6} \Rightarrow x = \frac{57}{6 \times 19} = \frac{1}{2}$

Substituting $x = \frac{1}{2}$ in (3), we get

$4 \times \frac{1}{2} + 10y = \frac{16}{3}$

$10y = \frac{16}{3} - 2 \Rightarrow 10y = \frac{10}{3}$

$y = \frac{10}{3 \times 10} = \frac{1}{3}$

$\therefore$ Solution is $x = \frac{1}{2}, y = \frac{1}{3}$

Question 13:

Question 14:

The given equations are:
$7(y + 3) - 2(x + 2) = 14$
$4(y - 2) + 3(x - 3) = 2$

$7(y + 3) - 2(x + 2) = 14$
$\Rightarrow 7y + 21 - 2x - 4 = 14$
$\Rightarrow \quad 7y - 2x = 14 + 4 - 21$
$\Rightarrow \quad -2x + 7y = -3$ ---(1)

$4(y - 2) + 3(x - 3) = 2$
$\Rightarrow \quad 4y - 8 + 3x - 9 = 2$
$\Rightarrow \quad 4y + 3x = 2 + 8 + 9$
$\Rightarrow \quad 3x + 4y = 19$ ---(2)

Multiplying (1) by 4 and (2) by 7, we get
$-8x + 28y = -12$ ---(3)
$21x + 28y = 133$ ---(4)
Subtracting (3) and (4), we get
$29x = 145$
$x = 5$

Substituting $x = 5$ in (1), we get
$-2 \times 5 + 7y = -3$

$7y = -3 + 10$
$7y = 7 \Rightarrow y = 1$
$\therefore$ Solution is $x = 5, y = 1$

Question 15:

The given equations are:
$6x + 5y = 7x + 2y + 1 = 2(x + 6y - 1)$

Therefore, we have
$6x + 5y = 2(x + 6y - 1)$
$6x + 5y = 2x + 12y - 2$
$6x - 2x + 5y - 12y = -2$
$4x - 7y = -2$ ----(1)

$7x + 3y + 1 = 2(x + 6y - 1)$
$7x + 3y + 1 = 2x + 12y - 2$
$7x - 2x + 3y - 12y = -2 - 1$
$5x - 9y = -3$ ---(2)

Multiplying (1) by 9 and (2) by 7, we get
$36x - 63y = -18$ ---(3)
$35x - 63y = -21$ ---(4)
Subtracting (4) from (3), we get
$x = 3$
Substituting $x = 3$ in (1), we get
$4 \times 3 - 7y = -2 \Rightarrow -7y = -2 - 12$
$-7y = -14$
$y = 2$

$\therefore$ solution is $x = 3$, $y = 2$

Question 16:

The given equations are:

$$\frac{x+y-8}{2} = \frac{x+2y-14}{3} = \frac{3x+y-12}{11}$$

Therefore we have,

$$\frac{x+y-8}{2} = \frac{3x+y-12}{11}$$

By cross multiplication, we get

$11x + 11y - 88 = 6x + 2y - 24$

$11x - 6x + 11y - 2y = -24 + 88$

$5x + 9y = 64$ ---(1)

$$\frac{x+2y-14}{3} = \frac{3x+y-12}{11}$$

By cross multiplication, we get

$11x + 22y - 154 = 9x + 3y - 36$

$11x - 9x + 22y - 3y = -36 + 154$

$2x + 19y = 118$ ---(2)

By Multiplying (1) by 19 and (2) by 9

$95x + 171y = 1216$ ---(3)

$18x + 171y = 1062$ ---(4)

Subtracting (4) from (3), we get

$77x = 154 \Rightarrow x = 2$

Substituting $x = 2$ in (1), we get

$5 \times 2 + 9y = 64 \Rightarrow 9y - 54$

$y = 6$

$\therefore$ solution is $x = 2, y = 6$

Question 17:

The given equations are:
$.8x + .3y = 3.8$ ---(1)
$.4x - .5y = 0.6$ ---(2)

Multiplying each one of the equation by 10, we get
$8x + 3y = 38$ ---(3)
$4x - 5y = 6$ ---(4)
Multiplying (3) by 5 and (4) by 3, we get
$40x + 15y = 190$ ---(5)
$12x - 15y = 18$ ---(6)
Adding (5) and (6), we get

$$52x = 208 \Rightarrow x = \frac{208}{52} = 4$$

Substituting $x = 4$ in (3), we get

$$8 \times 4 + 3y = 38 \Rightarrow 3y = 38 - 32$$

$$3y = 6 \Rightarrow y = \frac{6}{3} = 2$$

Hence, the solution is $x = 4$, $y = 2$

Question 18:

The given equations are:
$.05x + .2y = .07$ ---(1)
$.3x - .1y = .03$ ---(2)

Multiplying (1) by 100 and (2) by 100
$5x + 20y = 7$ ---(3)
$30x - 10y = 3$ ---(4)
Multiplying (3) by 10 and (4) by 20, we get
$50x + 200y = 70$ ---(5)
$600x - 200y = 60$ ---(6)
Adding (5) and (6), we get
$650x = 130 \Rightarrow x = \frac{130}{650} = \frac{1}{5} = .2$
Substituting x= 2 in (3) we get
$5 \times (.2) + 20y = 7$
$1 + 20y = 7$
$20y = 7 - 1 \Rightarrow 20y = 6,\ y = \frac{6}{20} = \frac{3}{10}$
$y = .3$
$\therefore$ solution is $x = .2$ and $y = .3$

Question 19:

$mx - ny = m^2 + n^2$ ---(1)

x + y = 2m ---(2)

Multiplying (1) by 1 and (2) by n

$$mx - ny = m^2 + n^2 \quad ---(3)$$
$$nx + ny = 2mn \quad ---(4)$$

Adding (3) and (4), we get

$$mx + nx = m^2 + n^2 + 2mn$$
$$x(m+n) = (m+n)^2$$
$$x = \frac{(m+n)^2}{m+n} = m + n$$

Putting x = m + n in (1), we get

$$m(m+n) - ny = m^2 + n^2$$
$$m^2 + mn - ny = m^2 + n^2$$
$$-ny = m^2 + n^2 - m^2 - mn$$
$$-ny = n^2 - nm$$
$$-y = \frac{n(n-m)}{n}$$
$$-y = (n-m)$$
$$y = (m-n)$$

$\therefore$ solution is x = (m + n), y = (m - n)

Question 20:

$\frac{bx}{a} - \frac{ay}{b} + a + b = 0$

By taking L.C.M, we get

$\frac{b^2x - a^2y + a^2b + b^2a}{ab} = 0$

$b^2x - a^2y = -a^2b - b^2a \; --- (1)$

$bx - ay = -2ab \qquad --- (2)$

Multiplying (1) by 1 and (2) by a

$b^2x - a^2y = -a^2b - b^2a \; --- (3)$

$abx - a^2y = -2a^2b \qquad --- (4)$

Subtracting (3) from (4)

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

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

$\therefore \quad x = \frac{-ab(a-b)}{b(a-b)}$

$x = -a$

Putting x = -a, in (1), we get

$b^2(-a) - a^2y = -a^2b - b^2a$

$-ab^2 - a^2y = -a^2b - b^2a$

$-a^2y = -a^2b - b^2a + ab^2$

$-a^2y = -a^2b \Rightarrow y = \frac{-a^2b}{-a^2} = b$

$\therefore$ solution is x = -a, y = b

Question 21:

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

$\frac{bx+ay}{ab}=2$

$bx+ay=2ab---(1)$

$ax-by=\left(a^2-b^2\right)---(2)$

Multiplying (1) by b and (2) by a

$b^2x+bay=2ab^2---(3)$

$a^2x-bay=a\left(a^2-b^2\right)--(4)$

Adding (3) and (4), we get

$b^2x+a^2x=2ab^2+a\left(a^2-b^2\right)$

$x\left(b^2+a^2\right)=2ab^2+a^3-ab^2$

$x\left(b^2+a^2\right)=ab^2+a^3$

$x\left(b^2+a^2\right)=a\left(b^2+a^2\right)$

$$x=\frac{a\left(b^2+a^2\right)}{\left(b^2+a^2\right)}=a$$

Putting x= a in (1), we get

$b\times a+ay=2ab$

$ay=2ab-ab\Rightarrow ay=ab \text{ or } y=b$

$\therefore$ solution is x = a, y = b

Question 22:

$\frac{bx}{a}+\frac{ay}{b}=a^2+b^2$

Taking L.C.M, we get

$$\frac{b^2x + a^2y}{ab} = a^2 + b^2$$

$$b^2x + a^2y = ab\left(a^2 + b^2\right) --- (1)$$

$$x + y = 2ab \qquad --- (2)$$

Multiplying (1) by 1 and (2) by

$$b^2x + a^2y = a^3b + ab^3 --- (3)$$

$$a^2x + a^2y = 2a^3b \qquad --- (4)$$

Subtracting (4) from (3), we get

$$b^2x - a^2x = a^3b + ab^3 - 2a^3b$$

$$x\left(b^2 - a^2\right) = ab^3 - a^3b$$

$$x\left(b^2 - a^2\right) = ab\left(b^2 - a^2\right)$$

$$x = \frac{ab\left(b^2 - a^2\right)}{\left(b^2 - a^2\right)} = ab$$

Substituting x = ab in (3), we get

$$b^2 \times ab + a^2y = a^3b + ab^3$$

$$b^3a + a^2y = a^3b + ab^3$$

$$a^2y = a^3b + ab^3 - b^3a$$

$$a^2y = a^3b \Rightarrow y = \frac{a^3b}{a^2} = ab$$

Therefore solution is x = ab, y = ab

Question 23:

6(ax + by) = 3a + 2b

6ax + 6by = 3a + 2b —(1)

6(bx – ay) = 3b – 2a

6bx – 6ay = 3b- 2a —(2)

6ax + 6by = 3a + 2b —(1)

6bx – 6ay = 3b – 2a —(2)

Multiplying (1) by a and (2) by b

$$6a^2x + 6aby = 3a^2 + 2ab \quad ---(3)$$
$$6b^2x - 6aby = 3b^2 - 2ab \quad ---(4)$$

Adding (3) and (4), we get

$$6a^2x + 6b^2x = 3a^2 + 3b^2$$
$$6(a^2 + b^2)x = 3(a^2 + b^2)$$
$$x = \frac{3(a^2 + b^2)}{6(a^2 + b^2)} = \frac{3}{6} = \frac{1}{2}$$

Substituting in (1), we get

$$6a \times \frac{1}{2} + 6by = 3a + 2b$$
$$3a + 6by = 3a + 2b$$
$$6by = 3a + 2b - 3a$$
$$6by = 2b$$
$$y = \frac{2b}{6b} = \frac{1}{3}$$

Hence, the solution is

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

Question 24:

$2(ax - by) + (a + 4b) = 0$
$2ax - 2by = -(a + 4b) \quad ---(1)$
$2bx + 2ay = -(b - 4a) \quad ---(2)$
Multiplying (1) by a and (2) by b
$2a^2x - 2aby = -a(a + 4b) --- (3)$
$2b^2x + 2aby = -b(b - 4a) --- (4)$
Adding (3) and (4), we get
$2a^2x + 2b^2x = -a(a + 4b) - b(b - 4a)$
$2(a^2 + b^2)x = -a^2 - 4ab - b^2 + 4ab$
$2(a^2 + b^2) = -(a^2 + b^2)$
$x = -\frac{a^2 + b^2}{2(a^2 + b^2)} = -\frac{1}{2}$
Putting $x = \frac{-1}{2}$ in (1), we get
$2a \times \frac{-1}{2} - 2by = -(a + 4b)$
$-a - 2by = -a - 4b$
$-2by = -a - 4b + a$
$-2by = -4b \Rightarrow y = \frac{-4b}{-2b} = 2$
$\therefore$ solution is $x = -\frac{1}{2}, y = 2$

Question 25:

The given equations are

71x + 37y = 253 —(1)

37x + 71y = 287 —(2)

Adding (1) and (2)

108x + 108y = 540

108(x + y) = 540

$\therefore\ x + y = \frac{540}{108} = 5$

—-(3)

Subtracting (2) from (1)

34x – 34y = 253 – 287 = -34

34(x – y) = -34

$\therefore\ x - y = -\frac{34}{34} = -1$

—(4)

Adding (3) and (4)

2x = 5 – 1= 4

⇒ x = 2

Subtracting (4) from (3)

2y = 5 + 1 = 6

⇒ y = 3

Hence solution is x = 2, y = 3

Question 26:

37x + 43y = 123 —-(1)

43x + 37y = 117 —-(2)

Adding (1) and (2)

80x + 80y = 240

80(x + y) = 240

x + y =

$\frac{240}{80} = 3$

—-(3)

Subtracting (1) from (2),

6x – 6y = -6

6(x – y) = -6

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

—-(4)

Adding (3) and (4)

2x = 3 – 1 = 2

⇒ x = 1

Subtracting (4) from (3),

2y = 3 + 1 = 4

⇒ y = 2

Hence solution is x = 1, y = 2

Question 27:

217x + 131y = 913 —(1)

131x + 217y = 827 —(2)

Adding (1) and (2), we get

348x + 348y = 1740

348(x + y) = 1740

x + y = 5 —-(3)

Subtracting (2) from (1), we get

86x – 86y = 86

86(x – y) = 86

x – y = 1 —(4)

Adding (3) and (4), we get

2x = 6

x = 3

putting x = 3 in (3), we get

3 + y = 5

y = 5 – 3 = 2

Hence solution is x = 3, y = 2

Question 28:

41x – 17y = 99 —(1)

17x – 41y = 75 —(2)

Adding (1) and (2), we get

58x – 58y = 174

58(x – y) = 174

x – y = 3 —(3)

subtracting (2) from (1), we get

24x + 24y = 24

24(x + y) = 24

x + y = 1 —(4)

Adding (3) and (4), we get

2x = 4 x = 2

Putting x = 2 in (3), we get

2 – y = 3

-y = 3 – 2 y = -1

Hence solution is x =2, y = -1

Exercise 3C

Question 1:

x + 2y + 1 = 0 —(1)

2x – 3y – 12 = 0 —(2)

By cross multiplication, we have

$$\therefore \frac{x}{[2\times(-12)-1\times(-3)]}=\frac{y}{[1\times 2-1\times(-12)]}=\frac{1}{[1\times(-3)-2\times 2]}$$

$$\Rightarrow \frac{x}{(-24+3)}=\frac{y}{[2+12]}=\frac{1}{(-3-4)}$$

$$\Rightarrow \frac{x}{-21}=\frac{1}{-7},\ \frac{y}{14}=\frac{1}{-7}$$

$$\Rightarrow x=\frac{-21}{-7}=3,\ y=\frac{14}{-7}=-2$$

Hence, x = 3 and y = -2 is the solution

Question 2:

2x + 5y – 1 = 0 —(1)

2x + 3y – 3 = 0 —(2)

By cross multiplication we have

$$\therefore \frac{x}{5\times(-3)-3\times(-1)}=\frac{y}{(-1)\times 2-(-3)\times 2}=\frac{1}{2\times 3-2\times 5}$$

$$\Rightarrow \frac{x}{-15+3}=\frac{y}{-2+6}=\frac{1}{6-10}$$

$$\Rightarrow \frac{x}{-12}=\frac{y}{4}=\frac{1}{-4}$$

$$\Rightarrow \frac{x}{-12}=\frac{1}{-4}\Rightarrow x=\frac{-12}{-4}=3$$

$$\Rightarrow \frac{y}{4}=\frac{1}{-4}\Rightarrow y=\frac{4}{-4}=-1$$

Hence the solution is x = 3, y = -1

Question 3:

3x – 2y + 3 = 0

4x + 3y – 47 = 0

By cross multiplication we have

$$\therefore \frac{x}{[(-2)\times(-47)-(3\times3)]}=\frac{y}{[(3\times4)-(-47)\times3]}=\frac{1}{[3\times3-(-2)\times4]}$$

$$\Rightarrow \quad \frac{x}{(94-9)}=\frac{y}{(12+141)}=\frac{1}{(9+8)}$$

$$\Rightarrow \quad \frac{x}{85}=\frac{y}{153}=\frac{1}{17}$$

$$\Rightarrow \quad \frac{x}{85}=\frac{1}{17},\ \frac{y}{153}=\frac{1}{17}$$

$$17x=85,\ 17y=153$$

$$\Rightarrow \quad x=\frac{85}{17},\ y=\frac{153}{17}$$

Hence the solution is x = 5, y = 9

Question 4:

6x – 5y – 16 = 0

7x – 13y + 10 = 0

By cross multiplication we have

$$\therefore \frac{x}{[(-5)\times10-(-16)\times(-13)]}=\frac{y}{[(-16\times7)-10\times6]}=\frac{1}{[6\times(-13)-(-5)\times7]}$$

$$\Rightarrow \quad \frac{x}{-50-208}=\frac{y}{[-112-60]}=\frac{1}{-78+35}$$

$$\Rightarrow \quad \frac{x}{-258}=\frac{y}{-172}=\frac{1}{-43}$$

$$\Rightarrow \quad \frac{x}{-258}=\frac{1}{-43},\ \frac{y}{-172}=\frac{1}{-43}$$

$$x=\frac{-258}{-43}=6,\ y=\frac{-172}{-43}=4$$

Hence the solution is x = 6, y = 4

Question 5:

3x + 2y + 25 = 0

2x + y + 10 = 0

By cross multiplication, we have

$$\therefore \frac{x}{[2\times 10-25\times 1]}=\frac{y}{(25\times 2-10\times 3)}=\frac{1}{3\times 1-2\times 2}$$

$$\Rightarrow \frac{x}{20-25}=\frac{y}{50-30}=\frac{1}{3-4}$$

$$\Rightarrow \frac{x}{-5}=\frac{y}{20}=\frac{1}{-1}$$

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

Hence the solution is x = 5, y = -20

Question 6:

2x + y – 35 = 0

3x + 4y – 65 = 0

By cross multiplication, we have

$$\therefore \frac{x}{[(1\times(-65))-4\times(-35)]}=\frac{y}{[(-35)\times 3-(-65)\times 2]}=\frac{1}{(2\times 4-3\times 1)}$$

$$\Rightarrow \frac{x}{(-65+140)}=\frac{y}{(-105+130)}=\frac{1}{8-3}$$

$$\Rightarrow \frac{x}{75}=\frac{y}{25}=\frac{1}{5}$$

$$\therefore \frac{x}{75}=\frac{1}{5}, \frac{y}{25}=\frac{1}{5}$$

$$\therefore x=\frac{75}{5}, y=\frac{25}{5}$$

$\therefore$ x = 15, y = 5 is the solution

Question 7:

7x – 2y – 3 = 0

By cross multiplication, we have

$$\therefore \frac{x}{\left[(-2)(-8)-\left(\frac{-3}{2}\right)\times(-3)\right]}=\frac{y}{\left[(-3\times 11)-(-8\times 7)\right]}$$

$$=\frac{1}{\left[7\times\left(\frac{-3}{2}\right)-11\times(-2)\right]}$$

$$\Rightarrow \quad \frac{x}{16-\frac{9}{2}}=\frac{y}{-33+56}=\frac{1}{\frac{-21}{2}+22}$$

$$\Rightarrow \quad \frac{x}{\left(\frac{23}{2}\right)}=\frac{y}{23}=\frac{1}{\frac{23}{2}}$$

$$\Rightarrow \quad \frac{x}{\left(\frac{23}{2}\right)}=\frac{1}{\frac{23}{2}},\ \frac{y}{23}=\frac{1}{\frac{23}{2}}$$

Hence x = 1, y = 2 is the solution

Question 8:

$$\frac{x}{6}+\frac{y}{15}-4=0$$

$$\frac{x}{3}-\frac{y}{12}-\frac{19}{4}=0$$

$$\therefore \frac{x}{\left[\frac{1}{15}\times\left(-\frac{19}{4}\right)-\left(-\frac{1}{12}\right)(-4)\right]}=\frac{y}{(-4)\left(\frac{1}{3}\right)-\left(\frac{1}{6}\right)\left(-\frac{19}{4}\right)}$$

$$=\frac{1}{\frac{1}{6}\times\left(-\frac{1}{12}\right)-\frac{1}{3}\times\frac{1}{15}}$$

or $$\frac{x}{-\frac{19}{60}-\frac{1}{3}}=\frac{y}{-\frac{4}{3}+\frac{19}{24}}=\frac{1}{-\frac{1}{72}-\frac{1}{45}}$$

or $$\frac{x}{-\frac{39}{60}}=\frac{y}{-\frac{13}{24}}=\frac{1}{-\frac{13}{360}}$$

$$\therefore x=-\frac{39}{60}\times\left(-\frac{360}{13}\right),\ y=\frac{-13}{24}\times\left(\frac{-360}{13}\right)$$

x = 18, y = 15 is the solution

Question 9:

ax + by – (a – b) = 0

bx – ay – (a + b) = 0

By cross multiplication, we have

$$\therefore \frac{x}{\left[b\times(-(a+b))-(-a)\times(-(a-b))\right]}=\frac{y}{\left[b\times(-(a-b))-a\times(-(a+b))\right]}$$

$$=\frac{1}{-a^2-b^2}$$

$$\therefore \frac{x}{(-ba-b^2-a^2+ab)}=\frac{y}{(-ba+b^2+a^2+ab)}=\frac{1}{-a^2-b^2}$$

$$\Rightarrow \quad \frac{x}{-b^2-a^2}=\frac{y}{b^2+a^2}=\frac{1}{-a^2-b^2}$$

$$\Rightarrow \quad \frac{x}{-b^2-a^2}=\frac{1}{-(a^2+b^2)},\ \frac{y}{b^2+a^2}=\frac{1}{-(a^2+b^2)}$$

$$\therefore \quad x=\frac{-(b^2+a^2)}{-(a^2+b^2)},\ y=\frac{(b^2+a^2)}{-(a^2+b^2)}$$

$\therefore$ the solution is x = 1, y = -1

Question 10:

2ax + 3by – (a + 2b) = 0

3ax + 2by – (2a + b) = 0

By cross multiplication, we have

$$\therefore \frac{x}{\left[3b\times\left(-(2a+b)\right)-2b\times\left(-(a+2b)\right)\right]}=\frac{y}{-(a+2b)\times 3a-2a\times\left(-(2a+b)\right)}$$
$$=\frac{1}{2a\times 2b-3a\times 3b}$$
$$\therefore \frac{x}{\left[-6ab-3b^2+2ab+4b^2\right]}=\frac{y}{-3a^2-6ab+4a^2+2ab}=\frac{1}{4ab-9ab}$$
$$\Rightarrow \frac{x}{b^2-4ab}=\frac{y}{a^2-4ab}=\frac{1}{-5ab}$$
$$\Rightarrow \frac{x}{-b(4a-b)}=\frac{y}{-a(4b-a)}=\frac{1}{-5ab}$$
$$\Rightarrow \frac{x}{-b(4a-b)}=\frac{1}{-5ab},\ \frac{y}{-a(4b-a)}=\frac{1}{-5ab}$$
$$x=\frac{-b(4a-b)}{-5ab},\ y=\frac{-a(4b-a)}{-5ab}$$

$x=\frac{(4a-b)}{5a},\ y=\frac{(4b-a)}{5b}$ is the solution

Question 11:

$$\frac{x}{a}-\frac{y}{b}=0$$
$$ax+by-\left(a^2+b^2\right)=0$$

By cross multiplication, we have

$$\therefore \frac{x}{\left[\left(-\frac{1}{b}\right)\times\left(-\left(a^2+b^2\right)\right)-0\right]} = \frac{y}{\left[0-\frac{1}{a}\times\left(-\left(a^2+b^2\right)\right)\right]} = \frac{1}{\frac{b}{a}+\frac{a}{b}}$$

$$\Rightarrow \frac{x}{\frac{a^2}{b}+\frac{b^2}{b}} = \frac{y}{\frac{a^2}{a}+\frac{b^2}{a}} = \frac{1}{\frac{b^2+a^2}{ab}}$$

$$\Rightarrow \frac{x}{\left[\frac{\left(a^2+b^2\right)}{b}\right]} = \frac{y}{\left[\left(\frac{a^2+b^2}{a}\right)\right]} = \frac{1}{\left[\frac{\left(b^2+a^2\right)}{ab}\right]}$$

$$\frac{x}{\left(\frac{a^2+b^2}{b}\right)} = \frac{1}{\frac{\left(b^2+a^2\right)}{ab}} \text{ and } \frac{y}{\left(\frac{a^2+b^2}{a}\right)} = \frac{1}{\left(\frac{b^2+a^2}{ab}\right)}$$

$$x = \frac{\left(a^2+b^2\right)}{b}\times\frac{ab}{\left(a^2+b^2\right)}, y = \frac{\left(a^2+b^2\right)}{a}\times\frac{ab}{\left(a^2+b^2\right)}$$

$\therefore$ The solution is $x = a$, $y = b$

Question 12:

$$\frac{x}{a}+\frac{y}{b}-2=0$$

$$ax-by-\left(a^2-b^2\right)=0$$

By cross multiplication, we have

$$\therefore \frac{x}{\left[\frac{1}{b}\left\{-\left(a^2-b^2\right)\right\}-(-2)(-b)\right]}=\frac{y}{\left[(-2a)-\frac{1}{a}\times\left\{-\left(a^2-b^2\right)\right\}\right]}=\frac{1}{-\frac{b}{a}-\frac{a}{b}}$$

$$\Rightarrow \frac{x}{\frac{-a^2}{b}+b-2b}=\frac{y}{\left[-2a+a-\frac{b^2}{a}\right]}=\frac{1}{\frac{-b^2-a^2}{ab}}$$

$$\Rightarrow \frac{x}{\frac{-a^2-b^2}{b}}=\frac{y}{\frac{-a^2-b^2}{a}}=\frac{1}{\frac{-b^2-a^2}{ab}}$$

$$\Rightarrow \frac{x}{\frac{-a^2-b^2}{b}}=\frac{1}{\frac{-b^2-a^2}{ab}},\quad \frac{y}{\frac{-a^2-b^2}{a}}=\frac{1}{\frac{-b^2-a^2}{ab}}$$

$$\therefore\ x=\frac{-\left(a^2+b^2\right)}{b}\times\frac{ab}{-\left(b^2+a^2\right)}=a$$

$$y=\frac{-\left(a^2+b^2\right)}{a}\times\frac{ab}{-\left(b^2+a^2\right)}=b$$

$\therefore$ the solution is $x = a,\ y = b$

Question 13:

$$\frac{x}{a}+\frac{y}{b}-(a+b)=0$$

$$\frac{x}{a^2}+\frac{y}{b^2}-2=0$$

By cross multiplication we have

$$\therefore \frac{x}{\left[(-2)\times\frac{1}{b}-\frac{1}{b^2}\times(-(a+b))\right]}=\frac{y}{\left[\frac{1}{a^2}\times(-(a+b))-\frac{1}{a}\times(-2)\right]}=\frac{1}{\frac{1}{ab^2}-\frac{1}{a^2b}}$$

$$\Rightarrow \frac{x}{\frac{-2}{b}+\frac{a}{b^2}+\frac{b}{b^2}}=\frac{y}{\frac{-1}{a}-\frac{b}{a^2}+\frac{2}{a}}=\frac{1}{\frac{a-b}{a^2b^2}}$$

$$\Rightarrow \frac{x}{\frac{-2b+a+b}{b^2}}=\frac{y}{\frac{-a-b+2a}{a^2}}=\frac{1}{\frac{a-b}{a^2b^2}}$$

$$\Rightarrow \frac{x}{\frac{a-b}{b^2}}=\frac{y}{\frac{a-b}{a^2}}=\frac{1}{\frac{a-b}{a^2b^2}}$$

$$\therefore \quad x=\frac{(a-b)}{b^2}\times\frac{a^2b^2}{(a-b)}=a^2$$

$$y=\frac{(a-b)}{a^2}\times\frac{a^2b^2}{(a-b)}=b^2$$

The solution is $x=a^2,\ y=b^2$

Question 14:

$$\frac{1}{x}+\frac{1}{y}-7=0$$
$$\frac{2}{x}+\frac{3}{y}-17=0$$

Taking

$\frac{1}{x}=u$ and $\frac{1}{y}=v$

$u + v – 7 = 0$

2u + 3v – 17 = 0

By cross multiplication, we have

$$\therefore \frac{u}{[1\times(-17)-3\times(-7)]}=\frac{v}{[(-7)\times 2-1\times(-17)]}=\frac{1}{3-2}$$

$$\Rightarrow \frac{u}{-17+21}=\frac{v}{-14+17}=\frac{1}{1}$$

$$\Rightarrow \quad \frac{u}{4}=\frac{v}{3}=\frac{1}{1}$$

$$\Rightarrow \quad \frac{u}{4}=1, \frac{v}{3}=1$$

$$\Rightarrow \quad u=4, v=3$$

$$\Rightarrow \frac{1}{x}=4, \frac{1}{y}=3$$

Hence the solution is

$$x=\frac{1}{4}, y=\frac{1}{3}$$

Question 15:

Let

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

in the equation

5u – 2v + 1 = 0

15u + 7v – 10 = 0

$$\therefore \frac{u}{[-2\times(-10)-1\times7]} = \frac{v}{1\times15-(-10)\times5} = \frac{1}{35+30}$$

$$\Rightarrow \quad \frac{u}{20-7} = \frac{v}{15+50} = \frac{1}{65}$$

$$\Rightarrow \quad \frac{u}{13} = \frac{v}{65} = \frac{1}{65}$$

$$\Rightarrow \quad \frac{u}{13} = \frac{1}{65}, \frac{v}{65} = \frac{1}{65}$$

$$\Rightarrow u = \frac{13}{65}, \quad v = \frac{65}{65}$$

$$\therefore u = \frac{1}{5}, v = 1$$

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

$x+y=5, x-y=1$

By cross multiplication, we have

$$\frac{x}{[1\times(-1)-(-5)\times(-1)]} = \frac{y}{[(-5)\times1-(-1)\times1]} = \frac{1}{[1\times(-1)-1\times1]}$$

$$\Rightarrow \frac{x}{(-1-5)} = \frac{y}{-5+1} = \frac{1}{-1-1}$$

$$\Rightarrow \quad \frac{x}{-6} = \frac{y}{-4} = \frac{1}{-2}$$

$$\Rightarrow \frac{x}{-6} = \frac{1}{-2}, \frac{y}{-4} = \frac{1}{-2}$$

$$\therefore x = \frac{-6}{-2} = 3 \qquad , y = \frac{-4}{-2} = 2$$

$\therefore$ the solution is $x = 3, y = 2$

Question 16:

The given equations are

$$\frac{ax}{b}-\frac{by}{a}-(a+b)=0$$

$$ax-by-2ab=0$$

By cross multiplication, we have

$$\therefore \frac{x}{\left(-\frac{b}{a}\right)\times(-2ab)-(-b)\times(-(a+b))}=\frac{y}{-(a+b)\times a-(-2ab)\times\frac{a}{b}}$$

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

$$\Rightarrow \frac{x}{2b^2-b(a+b)}=\frac{y}{-a(a+b)+2a^2}=\frac{1}{-a+b}$$

$$\text{or } \frac{x}{2b^2-ab-b^2}=\frac{y}{-a^2-ab+2a^2}=\frac{1}{-a+b}$$

$$\Rightarrow \frac{x}{b^2-ab}=\frac{y}{a^2-ab}=\frac{1}{-(a-b)}$$

$$\Rightarrow \frac{x}{-b(a-b)}=\frac{y}{a(a-b)}=\frac{1}{-(a-b)}$$

$$\therefore \frac{x}{-b(a-b)}=\frac{1}{-(a-b)} \text{ and } \frac{y}{a(a-b)}=\frac{1}{-(a-b)}$$

$$\therefore x=\frac{-b(a-b)}{-(a-b)} \text{ and } y=\frac{a(a-b)}{-(a-b)}$$

$$\Rightarrow x=b, \quad \text{and} \quad y=-a$$

$\therefore$ the solution is $x = b$, $y = -a$

Exercise 3D

Question 1:

$3x + 5y - 12 = 0, 5x + 3y - 4 = 0$

$a_1 = 3 \quad b_1 = 5 \quad c_1 = -12$

$a_2 = 5 \quad b_2 = 3 \quad c_2 = -4$

Thus, $\frac{a_1}{a_2} \neq \frac{b_1}{b_2} \qquad \left(\frac{3}{5} \neq \frac{5}{3}\right)$

Hence, the given system of equations has a unique solution

The given equations are

$3x + 5y = 12$ ---(1)

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

Multiplying (1) by 3 and (2) by 5, we get

$9x + 15y = 36$ ---(3)

$25x + 15y = 20$ ---(4)

Subtracting (3) from (4), we get

$16x = -16 \Rightarrow x = \frac{-16}{16} = -1$

Putting x = -1, in (3), we get

$9 \times (-1) + 15y = 36$

$-9 + 15y = 36$

$15y = 36 + 9 \Rightarrow y = \frac{45}{15} = 3$

$\therefore$ the solution is x = -1, y = 3

Question 2:

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

$$\Rightarrow \frac{2x+3y}{6}=3$$

$$2x+3y-18=0 \quad ---(1)$$

$$x-2y-2=0 \quad ---(2)$$

$a_1=2, b_1=3, c_1=-18$

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

Thus, $\frac{a_1}{a_2} \neq \frac{b_1}{b_2} \Rightarrow \frac{2}{1} \neq \frac{3}{-2}$

Hence, the given system of equations has unique solution

The given equations are

$2x + 3y = 18$ ---(1)

$x - 2y = 2$ ---(2)

Multiplying (1) by 2 and (2) by 3

$4x + 6y = 36$ ---(3)

$3x - 6y = 6$ ---(4)

Adding (3) and (4) we get

$7x = 42 \Rightarrow x = 6$

Putting $x = 6$ in (1), we get

$2 \times 6 + 3y = 18 \Rightarrow 3y = 18 - 12$

$3y = 6$

$y = \frac{6}{3} = 2$

$\therefore$ solution is $x = 6$, $y = 2$

Question 3:

3x – 5y – 7 = 0

6x – 10y – 3 = 0

$$a_1 = 3, b_1 = -5, c_1 = -7$$
$$a_2 = 6, b_2 = -10, c_2 = -3$$
$$\therefore \frac{a_1}{a_2} = \frac{3}{6} = \frac{1}{2}, \frac{b_1}{b_2} = \frac{-5}{-10} = \frac{1}{2}, \frac{c_1}{c_2} = \frac{-7}{-3} = \frac{7}{3}$$
$$\text{Thus, } \frac{a_1}{a_2} = \frac{b_1}{b_2} \neq \frac{c_1}{c_2}$$

Hence the given system of equations is inconsistent

Question 4:

2x – 3y – 5 = 0, 6x – 9y – 15 = 0

These equations are of the form

$$a_1x + b_1y + c_1 = 0, \quad a_2x + b_2y + c_2 = 0$$
$$\text{where, } a_1 = 2, b_1 = -3, c_1 = -5,$$
$$a_2 = 6, b_2 = -9, c_2 = -15$$
$$\therefore \frac{a_1}{a_2} = \frac{2}{6} = \frac{1}{3}, \frac{b_1}{b_2} = \frac{-3}{-9} = \frac{1}{3} \text{ and } \frac{c_1}{c_2} = \frac{-5}{-15} = \frac{1}{3}$$
$$\text{Thus, } \frac{a_1}{a_2} = \frac{b_1}{b_2} = \frac{c_1}{c_2}$$

Hence the given system of equations has infinitely many solutions

Question 5:

kx + 2y – 5 = 0

3x – 4y – 10 = 0

These equations are of the form

$$a_1x + b_1y + c_1 = 0, \quad a_2x + b_2y + c_2 = 0$$
where $a_1 = k, b_1 = 2, c_1 = -5$
$a_2 = 3, b_2 = -4, c_2 = -10$
for a unique solution, we must have
$$\frac{a_1}{a_2} \neq \frac{b_1}{b_2} \text{ or } \frac{k}{3} \neq \frac{2}{-4} \Rightarrow k \neq \frac{-3}{2}$$

This happens when

k≠−32

Thus, for all real value of k other that , the given system equations will have a unique solution

(ii) For no solution we must have

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

$$\text{Now, } \frac{a_1}{a_2} = \frac{b_1}{b_2} \neq \frac{c_1}{c_2}$$
$$\frac{k}{3} = \frac{2}{-4} \neq \frac{-5}{-10}$$
$$\Rightarrow \frac{k}{3} = \frac{2}{-4} \text{ and } \frac{k}{3} \neq \frac{1}{2}$$
$$k = \frac{-3}{2}, k \neq \frac{3}{2}$$

Hence, the given system of equations has no solution if k=−32

Question 6:

x + 2y – 5 = 0

3x + ky + 15 = 0

These equations are of the form of

$$a_1x + b_1y + c_1 = 0, \quad a_2x + b_2y + c_2 = 0$$

where $a_1 = 1, b_1 = 2, c_1 = -5$

$a_2 = 3, b_2 = k, c_2 = 15$

for a unique solution, we must have

$$\frac{a_1}{a_2} \neq \frac{b_1}{b_2} \text{ i.e., } \frac{1}{3} \neq \frac{2}{k} \Rightarrow k \neq 6$$

Thus for all real value of k other than 6, the given system of equation will have unique solution

(ii) For no solution we must have

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

$$\frac{1}{3} = \frac{2}{k} \neq \frac{-5}{15}$$

$$\frac{1}{3} = \frac{2}{k} \text{ and } \frac{2}{k} \neq \frac{-5}{15}$$

Therefore k = 6

Hence the given system will have no solution when k = 6.

Question 7:

x + 2y – 3 = 0, 5x + ky + 7 = 0

These equations are of the form

$$a_1x + b_1y + c_1 = 0, \quad a_2x + b_2y + c_2 = 0$$

where, $a_1 = 1, b_1 = 2, c_1 = -3$ and $a_2 = 5, b_2 = k, c_2 = 7$

(i) For a unique solution we must have

$$\frac{a_1}{a_2} \neq \frac{b_1}{b_2} \text{ i.e., } \frac{1}{5} \neq \frac{2}{k}$$
$$k \neq 10$$

Thus, for all real value of k other than 10

The given system of equation will have a unique solution.

(ii) For no solution we must have

$$\frac{a_1}{a_2} = \frac{b_1}{b_2} \neq \frac{c_1}{c_2}$$
$$\frac{1}{5} = \frac{2}{k} \neq \frac{-3}{7} \Rightarrow \frac{1}{5} = \frac{2}{k} \text{ or } \frac{2}{k} \neq \frac{-3}{7}$$
$$k = 10 \text{ or } k \neq \frac{-14}{3}$$

Hence the given system of equations has no solution if

$$k = 10, k \neq -\frac{14}{3}$$

For infinite number of solutions we must have

$$\frac{a_1}{a_2} = \frac{b_1}{b_2} = \frac{c_1}{c_2}$$
$$\frac{1}{5} = \frac{5}{k} = \frac{-3}{7}$$

This is never possible since

$$\frac{1}{5} \neq \frac{-3}{7}$$

There is no value of k for which system of equations has infinitely many solutions

Question 8:

8x + 5y – 9 = 0

kx + 10y – 15 = 0

These equations are of the form

$$a_1x + b_1y + c_1 = 0,\ a_2x + b_2y + c_2 = 0$$
where, $a_1 = 8,\ b_1 = 5,\ c_1 = -9$ and
$$a_2 = k,\ b_2 = 10,\ c_2 = -15$$
For no solution, we must have $\frac{a_1}{a_2} = \frac{b_1}{b_2} \neq \frac{c_1}{c_2}$

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

$\Rightarrow \frac{8}{k} = \frac{5}{10} \neq \frac{-9}{-15}$

$\Rightarrow \frac{8}{k} = \frac{1}{2} \neq \frac{3}{5}$

$\Rightarrow \frac{8}{k} = \frac{1}{2}$ and $\frac{8}{k} \neq \frac{3}{5}$

$\Rightarrow k = 16$ and $k \neq \frac{40}{3}$

Clearly, k = 16 also satisfies the condition

$k \neq \frac{40}{3}$

Hence, the given system will have no solution when k = 16.

Question 9:

kx + 3y – 3 = 0 —-(1)

12x + ky – 6 = 0 —(2)

$a_1 = k, b_1 = 3, c_1 = -3$
$a_2 = 12, b_2 = k, c_2 = -6$

These equations are of the form

$a_1x + b_1y + c_1 = 0,\ a_2x + b_2y + c_2 = 0$

for no solution, we must have $\frac{a_1}{a_2} = \frac{b_1}{b_2} \neq \frac{c_1}{c_2}$

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

$\Rightarrow \quad \frac{k}{12} = \frac{3}{k} \neq \frac{-3}{-6}$

$\Rightarrow \quad \frac{k}{12} = \frac{3}{k}$ and $\frac{3}{k} \neq \frac{1}{2}$

$k^2 = 36$ and $k \neq 6$

Hence, $k = -6$

Hence, the given system will have no solution when k = -6

Question 10:

3x + y – 1 = 0

(2k – 1)x + (k – 1)y – (2k + 1) = 0

These equations are of the form

$$a_1x + b_1y + c_1 = 0,\ a_2x + b_2y + c_2 = 0$$

where, $a_1 = 3,\ b_1 = 1,\ c_1 = -1$

$a_2 = (2k - 1),\ b_2 = (k - 1),\ c_2 = -(2k + 1)$

For no solution, we must have $\frac{a_1}{a_2} = \frac{b_1}{b_2} \neq \frac{c_1}{c_2}$

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

$$\frac{3}{2k-1} = \frac{1}{k-1} \neq \frac{-1}{-(2k+1)}$$

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

$$3k - 3 = 2k - 1 \text{ and } (2k+1) \neq (k-1)$$

$$k = 2 \text{ and } k \neq -2$$

Thus,

$\frac{a_1}{a_2} = \frac{b_1}{b_2} \neq \frac{c_1}{c_2}$ hold when $k = 2$

Hence the given equation has no solution when k = 2

Question 11:

$(3k + 1)x + 3y – 2 = 0$

$(k^2 + 1)x + (k – 2)y – 5 = 0$

these equations are of the form

$a_1x + b_1y + c_1 = 0,\ a_2x + b_2y + c_2 = 0$

$a_1 = (3k+1),\ b_1 = 3,\ c_1 = -2$ and

$a_2 = (k^2+1),\ b_2 = (k-2),\ c_2 = -5$

for no solution, we must have $\frac{a_1}{a_2} = \frac{b_1}{b_2} \neq \frac{c_1}{c_2}$

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

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

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

$(3k+1)(k-2) = 3(k^2+1)$ and $2(k-2) \neq 15$

$\Rightarrow 3k^2 + k - 6k - 2 = 3k^2 + 3$ and $2k - 4 \neq 15$

$\Rightarrow k = -1$ and $k \neq \frac{19}{2}$

Thus, k = -1 also satisfy the condition

$k \neq \frac{19}{2}$

Hence, the given system will have no solution when k = -1

Question 12:

The given equations are

3x – y – 5 = 0 —(1)

6x – 2y + k = 0—(2)

Here, $a_1 = 3, b_1 = -1, c_1 = -5$
$a_2 = 6, b_2 = -2, c_2 = k$

$$\therefore \frac{a_1}{a_2} = \frac{3}{6} = \frac{1}{2}, \frac{b_1}{b_2} = \frac{-1}{-2} = \frac{1}{2}, \frac{c_1}{c_2} = \frac{-5}{k}$$

Equations (1) and (2) have no solution, if

$$\frac{-5}{k} \neq \frac{1}{2} \text{ or } k \neq -10$$

Question 13:

kx + 2y – 5 = 0

3x + y – 1 = 0

These equations are of the form

$a_1x + b_1y + c_1 = 0, \ a_2x + b_2y + c_2 = 0$
Where, $a_1 = k, b_1 = 2, c_1 = -5$
$a_2 = 3, b_2 = 1, c_2 = -1$

For unique solution, we must have $\frac{a_1}{a_2} \neq \frac{b_1}{b_2}$

Now, $\frac{a_1}{a_2} \neq \frac{b_1}{b_2}$ i.e., $\frac{k}{3} \neq \frac{2}{1}$
$k \neq 6$

Thus, for all real values of k other than 6, the given system of equations will have a unique solution

Question 14:

x – 2y – 3 = 0

3x + ky – 1 = 0

These equations are of the form of

$$a_1x + b_1y + c_1 = 0,\ a_2x + b_2y + c_2 = 0$$

where, $a_1 = 1, b_1 = -2, c_1 = -3$

$a_2 = 3, b_2 = k, \quad c_2 = -1$

for unique solution

Thus, $\frac{a_1}{a_2} \neq \frac{b_1}{b_2}$

Now, $\frac{1}{3} \neq \frac{-2}{k},\ k \neq -6$

Thus, for all real value of k other than -6, the given system of equations will have a unique solution

Question 15:

kx + 3y – (k – 3) = 0

12x + ky – k = 0

These equations are of the form

$$a_1x + b_1y + c_1 = 0,\ a_2x + b_2y + c_2 = 0$$

where $a_1 = k, b_1 = 3, c_1 = -(k - 3)$

$a_2 = 12, b_2 = k, c_2 - k$

For unique solution, we have

$$\frac{a_1}{a_2} \neq \frac{b_1}{b_2}$$

$$\frac{k}{12} \neq \frac{3}{k}$$

$\Rightarrow k^2 \neq 36 \Rightarrow k \neq \pm 6$

Thus, for all real value of k other than , the given system of equations will have a unique solution

Question 16:

4x – 5y – k = 0, 2x – 3y – 12 = 0

These equations are of the form

$$a_1x + b_1x + c_1 = 0, \ a_2x + b_2y + c_2 = 0$$

where, $a_1 = 4, b_1 = -5, c_1 = -k$

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

For unique solution, we must have

$$\frac{a_1}{a_2} \neq \frac{b_1}{b_2}$$

$$\frac{4}{2} \neq \frac{-5}{-3}$$

$$2 \neq \frac{5}{3} \Rightarrow 6 \neq 5$$

Thus, for all real value of k the given system of equations will have a unique solution

Question 17:

2x + 3y – 7 = 0

(k – 1)x + (k + 2)y – 3k = 0

These are of the form

$$a_1x + b_1y + c_1 = 0, \quad a_2x + b_2y + c_2 = 0$$

where, $a_1 = 2, b_1 = 3, c_1 = -7$

$a_2 = (k-1), b_2 = (k+2), c_2 = -3k$

For infinitely many solutions, we must have

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

This hold only when

$$\frac{2}{k-1} = \frac{3}{k+2} = \frac{-7}{-3k}$$
$$\frac{2}{k-1} = \frac{3}{k+2} = \frac{7}{3k}$$

Now the following cases arises

Case : I

$$\frac{2}{k-1} = \frac{3}{k+2}$$
$$\Rightarrow 2(k+2) = 3(k-1) \Rightarrow 2k + 4 = 3k - 3$$
$$\Rightarrow \quad k = 7$$

Case: II

$$\frac{3}{k+2} = \frac{7}{3k}$$
$$\Rightarrow 7(k+2) = 9k \Rightarrow 7k + 14 = 9k$$
$$\Rightarrow \quad k = 7$$

Case III

$$\frac{2}{k-1} = \frac{7}{3k}$$
$$\Rightarrow 7k - 7 = 6k$$
$$\Rightarrow k = 7$$

For k = 7, there are infinitely many solutions of the given system of equations

Question 18:

2x + (k – 2)y – k = 0

6x + (2k – 1)y – (2k + 5) = 0

These are of the form

$$a_1x + b_1y + c_1 = 0,\ a_2x + b_2y + c_2 = 0$$
$$\text{where } a_1 = 2,\ b_1 = (k-2),\ c_1 = -k$$
$$a_2 = 6,\ b_2 = (2k-1),\ c_2 = -(2k+5)$$

For infinite number of solutions, we have

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

This hold only when

$$\frac{2}{6} = \frac{k-2}{2k-1} = \frac{-k}{-(2k+5)}$$
$$\frac{1}{3} = \frac{k-2}{2k-1} = \frac{k}{2k+5}$$

Case (1)

$$\frac{1}{3} = \frac{k-2}{2k-1}\ [\text{taking I and II}]$$
$$\Rightarrow 2k - 1 = 3k - 6 \Rightarrow k = 5$$

Case (2)

$$\frac{k-2}{2k-1} = \frac{k}{2k+5} \quad [\text{Taking II and III}]$$
$$(k-2)(2k+5) = k(2k-1)$$
$$\Rightarrow 2k^2 + 5k - 4k - 10 = 2k^2 - k$$
$$\Rightarrow \quad k + k = 10 \Rightarrow 2k = 10$$
$$k = \frac{10}{2} = 5 \; [\text{taking I and III}]$$

Case (3)

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

Thus, for k = 5 there are infinitely many solutions

Question 19:

kx + 3y – (2k +1) = 0

2(k + 1)x + 9y – (7k + 1) = 0

These are of the form

$$a_1x + b_1y + c_1 = 0, \; a_2x + b_2y + c_2 = 0$$
$$\text{where, } a_1 = k, \; b_1 = 3, \; c_1 = -(2k+1)$$
$$a_2 = 2(k+1), \; b_2 = 9, \; c_2 = -(7k+1)$$

For infinitely many solutions, we must have

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

This hold only when

$$\frac{k}{2(k+1)} = \frac{3}{9} = \frac{-(2k+1)}{-(7k+1)}$$
$$\Rightarrow \frac{k}{2(k+1)} = \frac{1}{3} = \frac{2k+1}{7k+1}$$

Now, the following cases arise

Case – (1)

$$\frac{k}{2(k+1)} = \frac{1}{3} \text{[Taking I and II]}$$
$$\Rightarrow 2(k+1) = 3k \Rightarrow 2k+2 = 3k$$
$$\Rightarrow \quad k = 2$$

Case (2)

$$\frac{1}{3} = \frac{2k+1}{7k+1} \text{[taking II and III]}$$
$$7k+1 = 6k+3 \Rightarrow 7k-6k = 3-1$$
$$k = 2$$

Case (3)

$$\frac{k}{2(k+1)} = \frac{2k+1}{7k+1} \text{[taking I and III]}$$
$$k(7k+1) = 2(2k+1)(k+1)$$
$$\Rightarrow 7k^2 + k = 2(2k^2 + 2k + k + 1)$$
$$7k^2 + k = 2(2k^2 + 3k + 1)$$
$$7k^2 + k = 4k^2 + 6k + 2$$
$$7k^2 - 4k^2 + k - 6k - 2 = 0$$
$$3k^2 - 5k - 2 = 0$$
$$3k^2 - (6k - 1k) - 2 = 0$$
$$3k(k-2) + 1(k-2) = 0$$
$$(k-2)(3k+1) = 0$$
$$k = 2 \text{ or } k = \frac{-1}{3}$$

Thus, k = 2, is the common value for which there are infinitely many solutions

Question 20:

5x + 2y – 2k = 0

2(k +1)x + ky – (3k + 4) = 0

These are of the form

$$a_1x + b_1y + c_1 = 0,\ a_2x + b_2y + c_2 = 0$$

where, $a_1 = 5,\ b_1 = 2,\ c_1 = -2k$

$$a_2 = 2(k+1),\ b_2 = k,\ c_2 = -(3k+4)$$

For infinitely many solutions, we must have

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

These hold only when

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

$$\Rightarrow \frac{5}{2(k+1)} = \frac{2}{k} = \frac{2k}{(3k+4)}$$

Case I

$$\frac{5}{2(k+1)} = \frac{2}{k} \quad [\because \text{taking I and II}]$$

$$\Rightarrow 5k = 4(k+1) \Rightarrow 5k = 4k + 4$$

$$k = 4$$

Case (2)

$$\frac{2}{k} = \frac{2k}{(3k+4)} \quad [\therefore \text{taking II and III}]$$

$$2(3k+4) = 2k^2 \Rightarrow 6k + 8 = 2k^2$$

$$\Rightarrow 2k^2 - 6k - 8 = 0$$

$$2(k^2 - 3k - 4) = 0$$

$$k^2 - 3k - 4 = 0$$

$$k^2 - 4k + k - 4 = 0$$

$$k(k-4) + 1(k-4) = 0$$

$$(k-4)(k+1) = 0$$

$$(k-4) = 0 \text{ or } k + 1 = 0$$

$$k = 4 \text{ or } k = -1$$

Case (3)

$$\frac{5}{2(k+1)} = \frac{2k}{(3k+4)} \quad [\text{taking I and III}]$$

$$\Rightarrow 15k + 20 = 4k^2 = 4k$$

$$\Rightarrow 4k^2 + 4k - 15k - 20 = 0$$

$$4k^2 - 11k - 20 = 0$$

$$4k^2 - 16k + 5k - 20 = 0$$

$$4k(k-4) + 5(k-4) = 0$$

$$(k-4)(4k+5) = 0 \Rightarrow k = 4 \text{ or } k = \frac{-5}{4}$$

Thus, k = 4 is a common value for which there are infinitely by many solutions.

Question 21:

x + (k + 1)y – 5 = 0

(k + 1)x + 9y – (8k – 1) = 0

These are of the form

$$a_1x + b_1y + c_1 = 0,\ a_2x + b_2y + c_2 = 0$$

where $a_1 = 1, b_1 = (k+1),\ c_1 = -5$

$$a_2 = (k+1),\ b_2 = 9,\ c_2 = -(8k-1)$$

For infinitely many solutions, we must have

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

$$\frac{1}{(k+1)} = \frac{(k+1)}{9} = \frac{-5}{-(8k-1)}$$

$$\Rightarrow \frac{1}{(k+1)} = \frac{(k+1)}{9} = \frac{5}{(8k-1)}$$

Case I : $\frac{1}{(k+1)} = \frac{(k+1)}{9}$ [Taking I and II]

$$\Rightarrow (k+1)^2 = 9 \Rightarrow (k+1) = \pm 3$$

$$k+1 = 3 \text{ or } k+1 = -3$$

$$k = 2 \text{ or } k = -4$$

Case II : $\frac{k+1}{9} = \frac{5}{8k-1}$ [Taking II and III]

$$\Rightarrow (k+1)(8k-1) = 45$$

$$\Rightarrow 8k^2 + 7k - 46 = 0$$

$$8k^2 + 23k - 16k - 46 = 0$$

$$\Rightarrow k(8k+23) - 23(8k+23) = 0$$

$$\Rightarrow (k-23)(8k+23) = 0$$

$$\Rightarrow k = \frac{-23}{8} \text{ or } k = 2$$

Case III : $\frac{1}{(k+1)} = \frac{5}{(8k-1)}$ [Taking I and III]

$$8k - 1 = 5(k+1)$$

$$3k = 6 \Rightarrow k = 2$$

Thus, $k = 2$ is the common value for which there are inifnitely many solutions

Question 22:

(k – 1)x – y – 5 = 0

(k + 1)x + (1 – k)y – (3k + 1) = 0

These are of the form

$$a_1x + b_1y + c_1 = 0,\ \ a_2x + b_2y + c_2 = 0$$

where, $a_1 = (k - 1),\ b_1 = -1,\ c_1 = -5$

$$a_2 = (k + 1),\ b_2 = (1 - k),\ c_2 = -(3k + 1)$$

For infinitely many solution, we must now

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

$$\frac{k-1}{k+1} = \frac{-1}{-(k-1)} = \frac{-5}{-(3k+1)}$$

$$\frac{k-1}{k+1} = \frac{1}{(k-1)} = \frac{5}{(3k+1)}$$

Case I : $\frac{k-1}{k+1} = \frac{1}{(k-1)}$ [Taking I and II]

$(k-1)^2 = k+1$

$\Rightarrow k^2 + 1 - 2k = k + 1$

$\Rightarrow k^2 + 1 - 1 - 2k - k = 0$

$\Rightarrow \quad k^2 = 3k \Rightarrow k = 3$

case II : $\frac{1}{(k-1)} = \frac{5}{(3k+1)}$ [TakingII and III]

$(3k+1) = 5(k-1) \Rightarrow 3k + 1 = 5k - 5$

$-2k = -6 \Rightarrow k = 3$

Case III : $\frac{k-1}{k+1} = \frac{5}{(3k+1)}$ [Taking I and III]

$(k-1)(3k+1) = 5(k+1)$

$3k^2 + k - 3k - 1 = 5k + 5$

$3k^2 - 2k - 5k - 1 - 5 = 0$

$3k^2 - 7k - 6 = 0$

$3k^2 - 9k + 2k - 6 = 0$

$3k(k-3) + 2(k-3) = 0$

$(3k+2)(k-3) = 0$

$(3k+2) = 0$ or $(k-3) = 0$

$3k = -2$ or $k = 3$

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

k = 3 is common value for which the number of solutions is infinitely many

Question 23:

(a – 1)x + 3y – 2 = 0

6x + (1 – 2b)y – 6 = 0

These equations are of the form

$$a_1x + b_1y + c_1 = 0,\ a_2x + b_2y + c_2 = 0$$
$$\text{where, } a_1 = (a-1),\ b_1 = 3,\ c_1 = -2$$
$$a_2 = 6,\ b_2 = (1-2b),\ c_2 = -6$$

For infinite many solutions, we must have

$$\frac{a_1}{a_2} = \frac{b_1}{b_2} = \frac{c_1}{c_2}$$
$$\frac{(a-1)}{6} = \frac{3}{(1-2b)} = \frac{-2}{-6}$$
$$\Rightarrow \frac{a-1}{6} = \frac{3}{(1-2b)} = \frac{1}{3}$$
$$\Rightarrow \frac{a-1}{6} = \frac{3}{(1-2b)} = \frac{1}{3}$$
$$\Rightarrow \frac{a-1}{6} = \frac{1}{3} \text{ and } \frac{3}{(1-2b)} = \frac{1}{3}$$
$$\Rightarrow 3a - 3 = 6 \text{ and } 9 = 1 - 2b$$
$$\Rightarrow 3a = 6 + 3 \text{ and } 2b = 1 - 9$$
$$3a = 9 \Rightarrow a = \frac{9}{3} = 3 \text{ and } 2b = -8$$
$$b = \frac{-8}{2} = -4$$

Hence a = 3 and b = -4

Question 24:

(2a – 1)x + 3y – 5 = 0

3x + (b – 1)y – 2 = 0

These equations are of the form

$$a_1x + b_1y + c_1 = 0,\ a_2x + b_2y + c_2 = 0$$
$$\text{where, } a_1 = (2a-1), b_1 = 3,\ c_1 = -5$$
$$a_2 = 3,\ b_2 = (b-1),\ c_2 = -2$$

These holds only when

Question 25:

2x – 3y – 7 = 0

(a + b)x + (a + b – 3)y – (4a + b) = 0

These equation are of the form

$$a_1x + b_1y + c_1 = 0,\ a_2x + b_2y + c_2 = 0$$
$$\text{where, } a_1 = 2,\ b_1 = -3,\ c_1 = -7$$
$$a_2 = (a+b), b_2 = -(a+b-3), c_2 = -(4a+b)$$

For infinite number of solution

$$\frac{a_1}{a_2} = \frac{b_1}{b_2} = \frac{c_1}{c_2}$$
$$\frac{2}{a+b} = \frac{-3}{-(a+b-3)} = \frac{-7}{-(4a+b)}$$
$$\frac{2}{a+b} = \frac{3}{(a+b-3)} = \frac{7}{(4a+b)}$$
$$\Rightarrow \frac{2}{a+b} = \frac{7}{(4a+b)} \text{ or } \frac{3}{(a+b-3)} = \frac{7}{(4a+b)}$$
$$8a+2b = 7a+7b \text{ and } 12a+3b = 7a+7b-21$$
$$a-5b = 0 \quad ---(1)$$
$$5a-4b = -21---(2)$$

Putting a = 5b in (2), we get

$$5 \times 5b - 4b = -21$$
$$25b - 4b = -21$$
$$21b = -21$$
$$b = \frac{-21}{21} = -1$$

Putting b = -1 in (1), we get

$$a - 5 \times -1 = 0$$
$$a + 5 = 0$$
$$a = -5$$

Thus, a = -5, b = -1

Question 27:

The given equations are

2x + 3y = 7 —-(1)

a(x + y) – b(x – y) = 3a + b – 2 —(2)

Equation (2) is

ax + ay – bx + by = 3a + b – 2

(a – b)x + (a + b)y = 3a + b -2

Comparing with the equations

$$a_1x + b_1y + c_1 = 0,\ a_2x + b_2y + c_2 = 0$$
$$\therefore\ a_1 = 2,\ b_1 = 3,\ c_1 = 7$$
$$a_2 = (a-b),\ b_2 = (a+b),\ c_2 = 3a + b = 2$$

There are infinitely many solution

$$\text{If}\quad \frac{a_1}{a_2} = \frac{b_1}{b_2} = \frac{c_1}{c_2}$$
$$\text{or}\quad \frac{2}{a-b} = \frac{3}{a+b} = \frac{7}{3a+b-2}$$
$$\therefore\ \frac{2}{a-b} = \frac{3}{a+b}\ \text{and}\ \frac{3}{a+b} = \frac{7}{3a+b-2}$$

2a + 2b = 3a – 3b and 3(3a + b – 2) = 7(a + b)

-a = -5b and 9a + 3b – 6 = 7a + 7b

a = 5b and 9a – 7a + 3b – 7b = 6

or 2a – 4b = 6

or a – 2b = 3

thus equation in a, b are

a = 5b —(3)

a – 2b = 3 —(4)

putting a = 5b in (4)

5b – 2b = 3 or 3b = 3 Þ b = 1

Putting b = 1 in (3)

a = 5 and b = 1

Question 28:

We have 5x – 3y = 0 —(1)

2x + ky = 0 —(2)

Comparing the equation with

$$a_1x + b_1y + c_1 = 0, \quad a_2x + b_2y + c_2 = 0$$
$$a_1 = 5, b_1 = -3, a_2 = 2, b_2 = k$$

These equations have a non – zero solution if

$$\frac{5}{2} = \frac{-3}{k} \Rightarrow 5k = -6$$
$$\frac{a_1}{a_2} = \frac{b_1}{b_2} \quad k = \frac{-6}{5}$$

Exercise 3E

Question 1:

Let the cost of 1 chair be Rs x and the cost of one table be Rs. y

The cost of 5 chairs and 4 tables = Rs(5x + 4y) = Rs. 2800

5x + 4y = 2800 —(1)

The cost of 4 chairs and 3 tables = Rs(4x + 3y) = Rs. 2170

4x + 3y = 2170 —(2)

Multiplying (1) by 3 and (2) by 4, we get

15x + 12y = 8400 —(3)

16x + 12y = 8680 —(4)

Subtracting (3) and (4), we get

x = 280

Putting value of x in (1), we get

5 × 280 + 4y = 2800

or 1400 + 4y = 2800

or 4y = 1400

y=14004=350

Thus, cost of 1 chair = Rs. 280 and cost of 1 table = Rs. 350

Question 2:

Let the cost of a pen and a pencil be Rs x and Rs y respectively

Cost of 37 pens and 53 pencils = Rs(37x + 53y) = Rs 820

37x + 53y = 820 —(1)

Cost of 53 pens and 37 pencils = Rs(53x + 37y) = Rs 980

53x + 37y = 980 —(2)

Adding (1) and (2), we get

90x + 90y = 1800

x + y = 20 —(3)

y = 20 – x

Putting value of y in (1), we get

37x + 53(20 – x) = 820

37x + 1060 – 53x = 820

16x = 240

x=24016=15

From (3), y = 20 – x = 20 – 15 = 5

x = 15, y = 5

Thus, cost of a pen = Rs 15 and cost of pencil = Rs 5

Question 3:

Let the number of 20 P and 25 P coins be x and y respectively

Total number of coins x + y = 50

i.e., x + y = 50 —(1)

$$\text{Value of these coins} = \text{Rs}\left(\frac{x}{5}+\frac{y}{4}\right) = \text{Rs } 11.50 = \text{Rs } 11\frac{1}{2}$$

$$\therefore \quad \frac{x}{5}+\frac{y}{4}=\frac{23}{2}$$

$$\Rightarrow \quad 4x+5y=230 \;---(2)$$

Multiplying (1) by 5 and (2) by 1, we get

5x + 5y = 250 —(3)

4x + 5y = 230 —(4)

Subtracting (4) from (3), we get

x = 20

Putting x = 20 in (1),

y = 50 – x

= 50 – 20

= 30

Hence, number of 20 P coins = 20 and number of 25 P coins = 30

Question 4:

Let the two numbers be x and y respectively.

Given:

x + y = 137 —(1)

x – y = 43 —(2)

Adding (1) and (2), we get

2x = 180

y=1802=90

Putting x = 90 in (1), we get

90 + y = 137

y = 137 – 90

= 47

Hence, the two numbers are 90 and 47.

Question 5:

Let the first and second number be x and y respectively.

According to the question:

2x + 3y = 92 —(1)

4x – 7y = 2 —(2)

Multiplying (1) by 7 and (2) by 3, we get

14 x+ 21y = 644 —(3)

12x – 21y = 6 —(4)

Adding (3) and (4), we get

26x=650x=65026=25[/latex]

Putting x = 25 in (1), we get

$2 \times 25 + 3y = 92$

$50 + 3y = 92$

$3y = 92 – 50$

$y=423=14$

$y = 14$

Question 6:

Let the first and second numbers be x and y respectively.

According to the question:

$3x + y = 142$ —(1)

$4x – y = 138$ —(2)

Adding (1) and (2), we get

$7x=280x=2807=40$

Putting x = 40 in (1), we get

$3 \times 40 + y = 142$

$y = 142 – 120$

$y = 22$

Hence, the first and second numbers are 40 and 22.

Question 7:

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

According to the question:

$2x – 45 = y$

$2x – y = 45$ —(1)

and

2y – x = 21

-x + 2y = 21 —(2)

Multiplying (1) by 2 and (2) by 1

4x – 2y = 90 —(3)

-x + 2y = 21 —(4)

Adding (3) and (4), we get

3x = 111

x=1113=37

Putting x = 37 in (1), we get

2 × 37 – y = 45

74 – y = 45

y = 29

Hence, the greater and the smaller numbers are 37 and 29.

Question 8:

Let the larger number be x and smaller be y respectively.

We know,

Dividend = Divisor × Quotient + Remainder

3x = y × 4 + 8

3x – 4y = 8 —(1)

And

5y = x × 3 + 5

-3x + 5y = 5 —(2)

Adding (1) and (2), we get

y = 13

putting y = 13 in (1)

$$\text{Value of these coins} = \text{Rs}\left(\frac{x}{5}+\frac{y}{4}\right) = \text{Rs } 11.50 = \text{Rs } 11\frac{1}{2}$$

$$\therefore \quad \frac{x}{5}+\frac{y}{4}=\frac{23}{2}$$

$$\Rightarrow \; 4x+5y=230 ---(2)$$

Hence, the larger and smaller numbers are 20 and 13 respectively.

Question 9:

Let the required numbers be x and y respectively.

Then,

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

$$\frac{x-4}{y-4}=\frac{5}{11} \Rightarrow 11x-44=5y-20 \Rightarrow 11x-5y=24$$

Therefore,

2x – y = -2 —(1)

11x – 5y = 24 —(2)

Multiplying (1) by 5 and (2) by 1

10x – 5y = -10 —(3)

11x – 5y = 24 —(4)

Subtracting (3) and (4) we get

x = 34

putting x = 34 in (1), we get

2 × 34 – y = -2

68 – y = -2

-y = -2 – 68

y = 70

Hence, the required numbers are 34 and 70.

Question 10:

Let the numbers be x and y respectively.

According to the question:

$x^2 - y^2 = 448 --- (2)$

x – y = 14 —(1)

From (1), we get

x = 14 + y —(3)

putting x = 14 + y in (2), we get

$$(14+y)^2 - y^2 = 448$$
$$196 + y^2 + 28y - y^2 = 448$$
$$196 + 28y = 448$$
$$28y = 448 - 196$$
$$y = \frac{252}{28} = 9$$

Putting y = 9 in (1), we get

x – 9 = 14

x = 14 + 9 = 23

Hence the required numbers are 23 and 9

Question 11:

Let the ten's digit be x and units digit be y respectively.

Then,

x + y = 12 —(1)

Let the ten's digit of required number be x and its unit's digit be y respectively

Required number = 10x + y

10x + y = 7(x + y)

10x + y = 7x + 7y

3x – 6y = 0 —(1)

Number found on reversing the digits = 10y + x

(10x + y) – 27 = 10y + x

10x – x + y – 10y = 27

9x – 9y = 27

(x – y) = 27

x – y = 3 —(2)

Multiplying (1) by 1 and (2) by 6

3x – 6y = 0 —(3)

6x – 6y = 18 —(4)

Subtracting (3) from (4), we get

3x=18x=183=6

Putting x = 6 in (1), we get

3 × 6 – 6y = 0

18 – 6y = 0

−6y=−18y=−18−6=3

Number = 10x + y

= 10 × 6 + 3

= 60 + 3

= 63

Hence the number is 63.

Question 12:

Let the ten's digit and unit's digits of required number be x and y respectively.

Required number = 10x + y

Number obtained on reversing digits = 10y + x

According to the question:

10y + x × (10x + y) = 18

10y + x – 10x – y = 18

9y – 9x = 18

y – x = 2 —-(2)

Adding (1) and (2), we get

2y=14y=142=7

Putting y = 7 in (1), we get

x + 7 = 12

x = 5

Number = 10x + y

= 10 × 5 + 7

= 50 + 7

= 57

Hence, the number is 57.

Question 13:

Let the ten's digit and unit's digits of required number be x and y respectively.

Then,

x + y = 15 —(1)

Required number = 10x + y

Number obtained by interchanging the digits = 10y + x

10y + x × (10x + y) = 9

10y + x – 10x – y = 9

9y – 9x = 9

$$9(y-x)=9$$
$$\Rightarrow y-x=\frac{9}{9}$$
$$\Rightarrow y-x=1$$
$$-x+y=1 \quad ---(2)$$

Add (1) and (2), we get

2y=16y=162=8

Putting y = 8 in (1), we get

x + 8 = 15

x = 15 – 8 = 7

Required number = 10x + y

= 10 × 7 + 8

= 70 + 8

= 78

Hence the required number is 78.

Question 14:

Let the ten's and unit's of required number be x and y respectively.

Then, required number =10x + y

According to the given question:

10x + y = 4(x + y) + 3

10x + y = 4x + 4y + 3

6x – 3y = 3

2x – y = 1 —(1)

And

10x + y + 18 = 10y + x

9x – 9y = -18

$$9(x-y)=-18$$
$$\Rightarrow (x-y)=\frac{-18}{9}$$

x – y = -2 —(2)

Subtracting (2) from (1), we get

x = 3

Putting x = 3 in (1), we get

2 × 3 – y = 1

$y = 6 - 1 = 5$

$x = 3, y = 5$

Required number = $10x + y$

$= 10 \times 3 + 5$

$= 30 + 5$

$= 35$

Hence, required number is 35.

Question 15:

Let the ten's digit and unit's digit of required number be x and y respectively.

We know,

Dividend = (divisor × quotient) + remainder

According to the given questiion:

$10x + y = 6 \times (x + y) + 0$

$10x - 6x + y - 6y = 0$

$4x - 5y = 0$ —(1)

Number obtained by reversing the digits is $10y + x$

$10x + y - 9 = 10y + x$

$9x - 9y = 9$

$9(x - y) = 9$

$(x - y) = 1$ —(2)

Multiplying (1) by 1 and (2) by 5, we get

$4x - 5y = 0$ —(3)

$5x - 5y = 5$ —(4)

Subtracting (3) from (4), we get

x = 5

Putting x = 5 in (1), we get

$$4 \times 5 - 5y = 0$$
$$\Rightarrow -5y = -20$$
$$\Rightarrow y = \frac{-20}{-5} = 4$$

x =5 and y = 4

Hence, required number is 54.

Question 16:

Let the ten's and unit's digits of the required number be x and y respectively.

Then, xy = 35

Required number = 10x + y

Also,

(10x + y) + 18 = 10y + x

9x – 9y = -18

9(y – x) = 18 —(1)

y – x = 2

Now,

$$(y+x)^2-(y-x)^2=4xy$$

$$\Rightarrow y+x=\sqrt{(y-x)^2+4xy}$$
$$=\sqrt{4+4\times 35}$$
$$=\sqrt{144}$$
$$=12$$

$$y + x = 12 \text{ ---}(2)$$

Adding (1) and (2),

2y = 12 + 2 = 14

y = 7

Putting y = 7 in (1),

7 – x = 2

x = 5

Hence, the required number = 5 × 10 + 7

= 57

Question 17:

Let the ten's and units digit of the required number be x and y respectively.

Then, xy = 14

Required number = 10x + y

Number obtained on reversing the digits = 10y + x

Also,

(10x + y) + 45 = 10y + x

9(y – x) = 45

y – x = 5 —(1)

Now,

$$(y+x)^2-(y-x)^2=4xy$$

$$\Rightarrow (y+x)=\sqrt{(y-x)^2+4xy}$$
$$=\sqrt{25+4\times 14}$$
$$=\sqrt{81}$$

y + x = 9 —(2) (digits cannot be negative, hence -9 is not possible)

On adding (1) and (2), we get

2y = 14

y = 7

Putting y = 7 in (2), we get

7 + x = 9

x = (9 – 7) = 2

x = 2 and y = 7

Hence, the required number is = 2 × 10 + 7

= 27

Question 18:

Let the ten's and unit's digits of the required number be x and y respectively.

Then, xy = 18

Required number = 10x + y

Number obtained on reversing its digits = 10y + x

(10x + y) – 63 = (10y + x)

9x – 9y = 63

x – y = 7 —(1)

Now,

$$(x+y)^2 - (x-y)^2 = 4xy$$

$$\Rightarrow (x+y) = \sqrt{(x-y)^2 + 4xy}$$

$$x + y = \sqrt{(7)^2 + 4 \times 18} = \sqrt{49 + 72} = \sqrt{121}$$

$$x + y = 11 \; --- (2)$$

Adding (1) and (2), we get

$$2x = 18 \Rightarrow x = \frac{18}{2} = 9$$

Putting x = 9 in (1), we get

9 – y = 7

y = 9 – 7

y = 2

x = 9, y = 2

Hence, the required number = 9 × 10 + 2

= 92.

Question 19:

Let the ten’s digit be x and the unit digit be y respectively.

Then, required number = 10x + y

According to the given question:

10x + y = 4(x + y)

6x – 3y = 0

2x – y = 0 —(1)

And

10x + y = 2xy —(2)

Putting y = 2x from (1) in (2), we get

$10x + 2x = 4x^2 \Rightarrow 12x - 4x^2 = 0 \Rightarrow 4x(3 - x) = 0 \Rightarrow x = 3$

Putting x = 3 in (1), we get

2 × 3 – y = 0

y = 6

Hence, the required number = 3 × 10 + 6

= 36.

Question 20:

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

According to the question:

x + y = 8 —(1)

And

$$\because \frac{x+3}{y+3} = \frac{3}{4}$$
$$\Rightarrow 4x + 12 = 3y + 9$$
$$\Rightarrow 4x - 3y = -3 - - - (2)$$

Multiplying (1) be 3 and (2) by 1

3x + 3y = 24 —(3)

4x – 3y = -3 —(4)

Add (3) and (4), we get

7x=21x=217=3

Putting x = 3 in (1), we get

3 + y= 8

y = 8 – 3

y = 5

x = 3, y = 5

Hence, the fraction is xy=35

Question 21:

Let numerator and denominator be x and y respectively.

Sum of numerator and denominator = x + y

3 less than 2 times y = 2y – 3

x + y =2y – 3

or x – y = -3 —(1)

When 1 is decreased from numerator and denominator, the fraction becomes:

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

2(x – 1) = y – 1

or 2x – 2 = y – 1

or 2x – y = 1 —(2)

Subtracting (1) from (2), we get

x = 1 + 3 = 4

Putting x = 4 in (1), we get

y = x + 3

= 4 + 3

= 7

the fraction is xy=47

Question 22:

Let the numerator and denominator be x and y respectively.

Then the fraction is xy

$$\therefore \frac{x-1}{y+2}=\frac{1}{2} \Rightarrow 2x-2=y+2 \Rightarrow 2x-y=4 ---(1)$$
$$\text{and} \therefore \frac{x-7}{y-2}=\frac{1}{3} \Rightarrow 3x-21=y-2 \Rightarrow 3x-y=19 --(2)$$

Subtracting (1) from (2), we get

x = 15

Putting x = 15 in (1), we get

2 × 15 – y = 4

30 – y = 4

y = 26

x = 15 and y = 26

Hence the given fraction is 1526

Question 23:

Let the numerator and denominator be x and y respectively.

Then the fraction is xy.

According to the given question:

y = x + 11

y – x = 11 —(1)

and

$$\frac{x+8}{y+8} = \frac{3}{4} \Rightarrow 4x + 32 = 3y + 24 \Rightarrow 4x - 3y = -8$$

-3y + 4x = -8 —(2)

Multiplying (1) by 4 and (2) by 1

4y – 4x = 44 —(3)

-3y + 4x = -8 —(4)

Adding (3) and (4), we get

y = 36

Putting y = 36 in (1), we get

y – x = 11

36 – x = 11

x = 25

x = 25, y = 36

Hence the fraction is 2536

Question 24:

Let the numerator and denominator be x and y respectively.

Then the fraction is xy.

$\therefore \frac{x+2}{y} = \frac{1}{2} \Rightarrow 2x + 4 = y \Rightarrow 2x - y = -4 - - - (1)$

and $\frac{x}{y-1} = \frac{1}{3} \Rightarrow 3x = y - 1 \Rightarrow 3x - y = -1 - - (2)$

Subtracting (1) from (2), we get

x = 3

Putting x = 3 in (1), we get

2 × 3 – 4

-y = -4 -6

y = 10

x = 3 and y = 10

Hence the fraction is 310

Question 25:

Let the fraction be xy.

When 2 is added to both the numerator and the denominator, the fraction becomes:

$\frac{x+2}{y+2} = \frac{1}{3}$ or $3x + 6 = y + 2$

3x – y = -4 —(1)

When 3 is added both to the numerator and the denominator, the fractions becomes:

$\frac{x+3}{y+3} = \frac{2}{5}$ or $5x + 15 = 2y + 6$

5x – 2y = -9 —-(2)

Multiplying (1) by 2 and (2) by 1, we get

6x – 2y = -8 —(3)

5x – 2y = -9 —(4)

Subtracting (4) from (3), we get

x = 1

Putting x = 1 in (1),

3 × 1 – y = 4

y = 7

Required fraction is 17

Question 26:

Let the two numbers be x and y respectively.

According to the given question:

x + y = 16 —(1)

And

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

—(2)

From (2),

$$\frac{x+y}{xy} = \frac{1}{3} \quad \text{or} \quad \frac{16}{xy} = \frac{1}{3} \quad [x + y = 16]$$

xy = 48

We know,

$$(x-y)^2 = (x+y)^2 - 4xy$$
$$= 16^2 - 4\times 48 = 256 - 192 = 64$$
$$\therefore \quad x - y = 8 --- (3)$$

Adding (1) and (3), we get

2x = 24

x = 12

Putting x = 12 in (1),

y = 16 – x

= 16 – 12

= 4

The required numbers are 12 and 4.

Question 27:

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

Then,

Two years ago:

(x – 2) = 5(y – 2)

x – 2 = 5y – 10

x – 5y = -8 —(1)

Two years later:

(x + 2) = 3(y + 2) + 8

x + 2 = 3y + 6 + 8

x – 3y = 12 —(2)

Subtracting (2) from (1), we get

$-2y = -20$

$y = 10$

Putting $y = 10$ in (1), we get

$x – 5 \times 10 = -8$

$x – 50 = -8$

$x = 42$

Hence the present ages of the man and the son are 42 years and 10 respectively.

Question 28:

Let the present ages of A and B be x and y respectively.

Five years ago:

$(x – 5) = 3(y – 5)$

$x – 5 = 3y – 15$

$x – 3y = -10$ —(1)

Ten years later:

$(x + 10) = 2(y + 10)$

$x + 10 = 2y + 20$

$x – 2y = 10$ —(2)

Subtracting (2) from (1), we get

$y = 20$

Putting $y = 20$ in (1), we get

$x – 3y = -10$

$x – 3 \times 20 = -10$

x = -10 + 60 = 50

x = 50, y = 20

Hence, present ages of A and B are 50 years and 20 years respectively.

Question 29:

Let the present ages of woman and daughter be x and y respectively.

Then,

Their present ages:

x = 3y + 3

x – 3y = 3 —(1)

Three years later:

(x + 3) = 2(y + 3) + 10

x + 3 = 2y + 6 + 10

x – 2y = 13 —(2)

Subtracting (2) from (1), we get

y = 10

Putting y = 10 in (1), we get

x – 3 × 10 = 3

x = 33

x = 33, y = 10

Hence, present ages of woman and daughter are 33 and 10 years.

Question 30:

Let the present ages of the mother and her son be x and y respectively.

According to the given question:

x + 2y = 70 —(1)

and

2x + y = 95 —(2)

Multiplying (1) by 1 and (2) by 2, we get

x + 2y = 70 —(3)

4x + 2y = 190 —(4)

Subtracting (3) from (4), we get

3x=120y=1203=40

Putting x = 40 in (1), we get

40 + 2y = 70

2y = 30

y = 15

x = 40, y = 15

Hence, the ages of the mother and the son are 40 years and 15 years respectively.

Question 31:

Let the present age of the man and the sum of the ages of the two sons be x and y respectively.

We are given x = 3y —(1)

After 5 years the age of man = x + 5

And age of each son is increased by 5 years

Age of two sons after 5 years = y + 5 + 5 = y + 10

Now,

x + 5 = 2(y + 10)

or x + 5 = 2y + 10

x – 2y = 15 —(2)

Putting x = 3y in (2)

3y – 2y = 15

y = 15

Putting y = 15 in (1),

x = 3 × 15 = 45

Age of the man = 45 years.

Question 32:

Let the present age of the man and his son be x and y respectively.

Ten years later:

(x + 10) = 2(y + 10)

x + 10 = 2y + 20

x – 2y = 10 —(1)

Ten years ago:

(x – 10) = 4(y – 10)

x – 10 = 4y – 40

x – 4y = – 30 —(2)

Subtracting (1) from (2), we get

-2y = -40

y = 20 years

Putting y = 20 in (1), we get

x – 2 × 20 = 10

x = 50

x = 50 years, y = 20 years

Hence, present ages of the man and his son are 50 years and 20 years respectively.

Question 33:

Let the monthly income of A and B be Rs. 5x and Rs. 4x respectively and let their expenditures be Rs. 7y and Rs. 5y respectively.

Then,

5x – 7y = 3000 —(1)

4x – 5y = 3000 —(2)

Multiplying (1) by 5 and (2) by 7 we get

25x – 35y = 15000 —(3)

28x – 35y = 21000 —(4)

Subtracting (3) from (4), we get

3x = 6000

x = 2000

Putting x = 2000 in (1), we get

5 × 2000 – 7y = 3000

-7y = 3000 – 10000

y=−7000−7=1000

x = 2000, y = 1000

Income of A = 5x = 5 × 2000 = Rs. 10000

Income of B = 4x = 4 × 2000 = Rs. 8000

Question 34:

Let Rs. x and Rs. y be the CP of a chair and table respectively

If profit is 25%, then SP of chair =

$$Rs\ \frac{100+25}{100}\times x = Rs\frac{125}{100}x$$

If profit is 10%, then SP of the table =

$$Rs\ \frac{100+10}{100}\times y = Rs.\frac{110}{100}y$$

SP of a chair and table = Rs. 760

$$\therefore \frac{125}{100}x+\frac{110}{100}y = 760$$
$$\Rightarrow \frac{25}{20}x+\frac{22}{20}y = 760$$
$$\Rightarrow 25x+22y = 15200 ---(1)$$

Further , If profit is 10%, then SP of a chair =

$$Rs\ \frac{100+10}{100}\times x =$$

Rs110100x

If profit is 25%, then SP of a table =

$$Rs\ \frac{100+25}{100}\times y =$$

Rs125100y

SP of a chair and table = Rs. 767.50

$$\therefore \frac{110}{100}x+\frac{125}{100}y = 767.50$$
$$\Rightarrow \frac{22}{20}x+\frac{25}{20}y = 767.50$$
$$\Rightarrow 22x+25y = 15350 ---(2)$$

Adding (1) and (2),

$$47(x+y) = 30550$$
$$\therefore \quad x+y = \frac{30550}{47} = 650 \;---(3)$$

Subtracting (2) from (1)

$$3(x-y) = 15200-15350$$
$$3(x-y) = -150$$
$$x-y = -50 \;---(4)$$

Adding (3) and (4),

$$2x = 640-50$$
$$2x = 600$$
$$\therefore x = \frac{600}{2} = 300$$

Subtracting (4) from (3)

$$2y = 650+50$$
$$2y = 700$$
$$\therefore y = \frac{700}{2} = 350$$

Hence, CP of a chair is Rs 300 and CP of table is Rs 350.

Question 35:

Let the CP of TV and fridge be Rs x and Rs y respectively.

5% gain on TV = $Rs \frac{5}{100} x = Rs \frac{x}{20}$

10% of gain on fridge = $Rs \frac{10}{100} y = Rs \frac{2y}{20}$

Gain on TV and Fridge = $Rs \left(\frac{x}{20} + \frac{2y}{20} \right) = Rs.3250$

$\Rightarrow \frac{x}{20} + \frac{2y}{20} = 3250 \quad \text{or} \quad x + 2y = 65000 --- (1)$

Further,

10% gain on TV = $Rs \frac{10}{100} x = \frac{2x}{20}$

5% loss on fridge = $Rs \frac{5}{100} y = \frac{y}{20}$

Total gain = $Rs \left(\frac{2x}{20} - \frac{y}{20} \right) = Rs1500$

2x – y = 30000 —(2)

Multiplying (2) by 2 and (1) by 1, we get

4x – 2y = 60000 —(3)

x + 2y = 65000 —(4)

Adding (3) and (4), we get

5x = 125000

x = 25000

Putting x = 25000 in (1), we get

25000 + 2y = 65000

2y = 40000

y = 20000

The cost of TV = Rs. 25000 and cost of fridge = Rs. 20000

Question 36:

Let the amounts invested at 12% and 10% be Rs x and Rs y respectively.

Then,

First case:

S.I. on Rs x at 12% p.a. for 1 year = $\frac{x \times 12 \times 1}{100} = \frac{3x}{25}$

S.I. on Rs y at 10% p.a. for 1 year = $\frac{y \times 10 \times 1}{100} = \frac{y}{10}$

Total S.I. = Rs. 1145

$$\Rightarrow \frac{3x}{25} + \frac{y}{10} = 1145$$
$$\Rightarrow \frac{6x + 5y}{50} = 1145$$
$$\Rightarrow 6x + 5y = 57250 \quad ---(1)$$

Second case:

S.I. of Rs x at 10% p.a. for 1 year = $Rs\left(\frac{x \times 10 \times 1}{100}\right) = Rs\frac{x}{10}$

S.I. of Rs y at 12% p.a. for 1 year = $Rs\left(\frac{y \times 12 \times 1}{100}\right) = Rs\frac{3}{25}y$

Total S.I. = Rs(1145 - 90) = 1055

$\Rightarrow \frac{x}{10} + \frac{3}{25}y = 1055$

$\Rightarrow \frac{5x + 6y}{50} = 1055$

$\Rightarrow 5x + 6y = 52750 - - - (2)$

Multiplying (1) by 6 and (2) by 5, we get

36x + 30y = 343500 —(3)

25x + 30y = 263750 —(4)

Subtracting (4) from (3), we get

11x=79750x=7975011=7250

Putting x = 7250 in (1), we get

6 × 7250 + 5y = 57250

43500 + 5y = 57250

5y = 13750

y = 2750

x = 7250, y = 2750

Hence, amount invested at 12% = Rs 7250

And amount invested at 10% = Rs 2750

Question 37:

Let the number of student in class room A and B be x and y respectively.

When 10 students are transferred from A to B:

$x – 10 = y + 10$

$x – y = 20$ —(1)

When 20 students are transferred from B to A:

$2(y – 20) = x + 20$

$2y – 40 = x + 20$

$-x + 2y = 60$ —(2)

Adding (1) and (2), we get

$y = 80$

Putting $y = 80$ in (1), we get

$x – 80 = 20$

$x = 100$

Hence, number of students of A and B are 100 and 80 respectively.

Question 38:

Let P and Q be the cars starting from A and B respectively and let their speeds be x km/hr and y km/hr respectively.

Case- I

When the cars P and Q move in the same direction.

Distance covered by the car P in 7 hours = 7x km

Distance covered by the car Q in 7 hours = 7y km

Let the cars meet at point M.

$AM = 7x$ km and $BM = 7y$ km

$AM – BM = AB$

$7x – 7y = 70$

$7(x – y) = 70$

$x – y = 10$ —-(1)

Case II

When the cars P and Q move in opposite directions.

Distance covered by P in 1 hour = x km

Distance covered by Q in 1 hour = y km

In this case let the cars meet at a point N.

$AN = x$ km and $BN = y$ km

$AN + BN = AB$

$x + y = 70$ —(2)

Adding (1) and (2), we get

$2x = 80$

$x = 40$

Putting $x = 40$ in (1), we get

40 – y = 10

y = (40 – 10) = 30

x = 40, y = 30

Hence, the speeds of these cars are 40 km/ hr and 30 km/ hr respectively.

Question 39:

Let the original speed be x km/h and time taken be y hours

Then, length of journey = xy km

Case I:

Speed = (x + 5)km/h and time taken = (y – 3)hour

Distance covered = (x + 5)(y – 3)km

(x + 5) (y – 3) = xy

xy + 5y -3x -15 = xy

5y – 3x = 15 —(1)

Case II:

Speed (x – 4)km/hr and time taken = (y + 3)hours

Distance covered = (x – 4)(y + 3) km

(x – 4)(y + 3) = xy

xy -4y + 3x -12 = xy

3x – 4y = 12 —(2)

Multiplying (1) by 4 and (2) by 5, we get

20y × 12x = 60 —(3)

-20y + 15x = 60 —(4)

Adding (3) and (4), we get

3x = 120

or x = 40

Putting x = 40 in (1), we get

5y – 3 × 40 = 15

5y = 135

y = 27

Hence, length of the journey is (40 × 27) km = 1080 km

Question 40:

Let the speed of train and car be x km/hr and y km/hr respectively.

Then,

$$\frac{250}{x}+\frac{120}{y}=4$$

$$\Rightarrow \frac{125}{x}+\frac{60}{y}=2$$

when, $\frac{1}{x}=u$ and $\frac{1}{y}=v$

$$\Rightarrow 125u+60v=2 \quad ---(1)$$

and,

$$\frac{130}{x}+\frac{240}{y}=4+\frac{18}{60}=4+\frac{3}{10}=\frac{43}{10}$$

$$\Rightarrow \frac{1300}{x}+\frac{2400}{y}=43$$

$$\Rightarrow 1300u+2400v=43---(2)$$

Multiplying (1) by 40 and (2) by 1, we get

5000u + 2400v = 80 —(3)

1300u + 2400v = 43 —(4)

subtracting (4) from (3), we get

3700u=37u=1100

Putting u=1100 in (1), we get

$$125\times\frac{1}{100}+60v=2\Rightarrow 6000v=200-125\Rightarrow v=\frac{1}{80}$$

$$\therefore\ u=\frac{1}{100}\Rightarrow\frac{1}{x}=\frac{1}{100}\Rightarrow x=100$$

$$v=\frac{1}{80}\Rightarrow\frac{1}{y}=\frac{1}{80}\Rightarrow y=80$$

Hence, speeds of the train and the car are 100km/hr and 80 km/hr respectively.

Question 41:

Let the speed of the boat in still water be x km/hr and speed of the stream be y km/hr.

Then,

Speed upstream = (x – y)km/hr

Speed downstream = (x + y) km/hr

Time taken to cover 12 km upstream = 12x−yhrs

Time taken to cover 40 km downstream = 40x+yhrs

Total time taken = 8hrs

$$\therefore\ \frac{12}{x-y}+\frac{40}{x+y}=8$$

Again, time taken to cover 16 km upstream = 16x−y

Time taken to taken to cover 32 km downstream = 32x+y

Total time taken = 8hrs

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

Putting

$$\frac{1}{(x-y)} = u \text{ and } \frac{1}{(x+y)} = v, \text{ we get}$$

12u + 40v = 8

3u + 10v = 2 —(1)

and

16u + 32v = 8

2u + 4v = 1 —(2)

Multiplying (1) by 4 and (2) by 10, we get

12u + 40v = 8 —(3)

20u + 40v = 10 —(4)

Subtracting (3) from (4), we get

8u=2u=14

Putting u=14 in (3), we get

$$3 \times \frac{1}{4} + 10v = 2 \Rightarrow 10v = \frac{5}{4} \Rightarrow v = \frac{1}{8}$$

$$u = \frac{1}{4} \Rightarrow \frac{1}{x-y} = \frac{1}{4} \Rightarrow x - y = 4 - - - (5)$$

$$v = \frac{1}{8} \Rightarrow \frac{1}{x+y} = \frac{1}{8} \Rightarrow x + y = 8 - - - (6)$$

On adding (5) and (6), we get

2x = 12

x = 6

Putting x = 6 in (6) we get

6 + y = 8

y = 8 – 6 = 2

x = 6, y = 2

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

Question 42:

Let the fixed charges of taxi per day be Rs x and charges for travelling for 1km be Rs y.

For travelling 110 km, he pays

Rs x + Rs 110y = Rs 1130

x + 110y = 1130 —(1)

For travelling 200 km, he pays

Rs x + Rs 200y = Rs 1850

x + 200y = 1850 —(2)

Subtracting (1) from (2), we get

$90y=1850-1130=720y=72090=8$

Putting y = 8 in (1),

x + 110 × 8 = 1130

x = 1130 – 880 = 250

Hence, fixed charges = Rs 250

And charges for travelling 1 km = Rs 8

Question 43:

Let the fixed hostel charges be Rs x and food charges per day be Rs y respectively.

For student A:

Student takes food for 25days and he has to pay: Rs 3500

Rs x + Rs 25y = Rs 3500

$x + 25y = 3500$ —(1)

For student B:

Student takes food for 28days and he has to pay: Rs 3800

Rs x + Rs 28y = Rs 3800

or $x + 28y = 3800$ —(2)

Subtracting (1) from (2), we get

$3y = 3800 – 3500$

$3y= 300$

$y = 100$

Putting $y = 100$ in (1),

$x + 25 \times 100 = 3500$

or $x = 3500 – 2500$

or $x = 1000$

Thus, fixed charges for hostel = Rs 1000 and

Charges for food per day = Rs 100

Question 44:

Let the length = x meters and breadth = y meters

Then,

$x = y + 3$

$x – y = 3$ —-(1)

Also,

(x + 3)(y – 2) = xy

3y – 2x = 6 —-(2)

Multiplying (1) by 2 and (2) by 1

-2y + 2x = 6 —(3)

3y – 2x = 6 —(4)

Adding (3) and (4), we get

y = 12

Putting y = 12 in (1), we get

x – 12 = 3

x = 15

x = 15, y = 12

Hence length = 15 metres and breadth = 12 metres

Question 45:

Let the length of a rectangle be x meters and breadth be y meters.

Then, area = xy sq.m

Now,

xy – (x – 5)(y + 3) = 8

xy × [xy × 5y + 3x -15] = 8

xy × xy + 5y × 3x + 15 = 8

3x – 5y = 7 —(1)

And

(x + 3)(y + 2) – xy = 74

xy + 3y +2x + 6 × xy = 74

2x + 3y = 68 —(2)

Multiplying (1) by 3 and (2) by 5, we get

9x – 15y = 21 —(3)

10x + 15y = 340 —(4)

Adding (3) and (4), we get

$$19x = 361 \Rightarrow x = \frac{361}{19} = 19$$

Putting x = 19 in (3) we get

$$9 \times 19 - 15y = 21 \Rightarrow 171 - 15y = 21 \Rightarrow y = \frac{150}{15} = 10$$

x = 19 meters, y = 10 meters

Hence, length = 19m and breadth = 10m

Question 46:

Let man's 1 day's work be 1x and 1 boy's day's work be 1y

Also let 1x=u and 1y=v

$$\text{Then, } \frac{2}{x} + \frac{5}{y} = \frac{1}{4} \Rightarrow 2u + 5v = \frac{1}{4} \quad ---(1)$$
$$\text{and } \quad \frac{3}{x} + \frac{6}{y} = \frac{1}{3} \Rightarrow 3u + 6v = \frac{1}{3} \quad ---(2)$$

Multiplying (1) by 6 and (2) by 5 we get

$$12u + 30v = \frac{6}{4} \quad ---(3)$$

$$15u + 30v = \frac{5}{3} ---(4)$$

Subtracting (3) from (4), we get

$$3u = \frac{5}{3} - \frac{6}{4}$$
$$\Rightarrow 3u = \frac{20-18}{12}$$
$$\Rightarrow 3u = \frac{2}{12}$$
$$\Rightarrow 3u = \frac{1}{6}$$
$$\Rightarrow u = \frac{1}{18}$$

Putting u=118 in (1), we get

$$2 \times \frac{1}{18} + 5v = \frac{1}{4} \Rightarrow \frac{1}{9} + 5v = \frac{1}{4} \Rightarrow 5v = \frac{1}{4} - \frac{1}{9}$$
$$\Rightarrow 5v = \frac{5}{36} \Rightarrow v = \frac{1}{36}$$
$$\text{Now } u = \frac{1}{18} \Rightarrow x = \frac{1}{u} = 18$$
$$\text{and } v = \frac{1}{36} \Rightarrow y = \frac{1}{v} = 36$$

x = 18, y = 36

The man will finish the work in 18 days and the boy will finish the work in 36 days when they work alone.

Question 47:

$\angle A + \angle B + \angle C = 180^\circ$

x + 3x + y = 180

4x + y = 180 —(1)

Also,

3y – 5x = 30

-5x + 3y = 30 —(2)

Multiplying (1) by 3 and (2) by 1, we get

12x + 3y = 540 —(3)

-5x + 3y = 30 —(4)

Subtracting (4) from (3), we get

17x = 510

x = 30

Putting x = 30 in (1), we get

4 × 30 + y = 180

y = 60

Hence ∠A = 30∘, ∠B = 3 × 30∘ = 90∘, ∠C = 60∘

Therefore, the triangle is right angled.

Question 48:

In a cyclic quadrilateral ABCD:

∠A = (x + y + 10)°,

∠B = (y + 20)°,

∠C = (x + y – 30)°,

∠D = (x + y)°

We have, ∠A + ∠C = 180° and ∠B + ∠D = 180°

$[\because ABCD \text{ is a quadrilateral}]$

Now,

$\angle A + \angle C = (x + y + 10)° + (x + y – 30)° = 180°$

$2x + 2y – 20° = 180°$

$x + y – 10° = 90°$

$x + y = 100$ —(1)

Also,

$\angle B + \angle D = (y + 20)° +(x + y)° = 180°$

$x + 2y + 20° = 180°$

$x + 2y = 160°$ —(2)

Subtracting (1) from (2), we get

$y = 160 – 100 = 60$

Putting $y = 60$ in (1), we get

$x = 100 – y$

$x = 100 – 60$

$x = 40$

Therefore,

$$\angle A = (x+y+10)° = (60+40+10)° = (100+10)° = 110°$$
$$\angle B = (y+20)° = (60+20)° = 80°$$
$$\angle C = (x+y-30)° = (60+40-30)° = (100-30)° = 70°$$
$$\angle D = (x+y)° = (60+40)° = 100°$$

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He was born on January 2, 1946 in a village of Delhi. He graduated from Kirori Mal College, University of Delhi. After completing his M.Sc. in Mathematics in 1969, he joined N.A.S. College, Meerut, as a lecturer. In 1976, he was awarded a fellowship for 3 years and joined the University of Delhi for his Ph.D. Thereafter, he was promoted as a reader in N.A.S. College, Meerut. In 1999, he joined M.M.H. College, Ghaziabad, as a reader and took voluntary retirement in 2003. He has authored more than 75 titles ranging from Nursery to M. Sc. He has also written books for competitive examinations right from the clerical grade to the I.A.S. level.

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