

Pair of Linear Equations in Two Variables

EXERCISE - 3.1

1. At present : Let Aftab's age = x years
 His daughter's age = y years
 Seven years ago : Aftab's age = $(x - 7)$ years
 His daughter's age = $(y - 7)$ years
 According to the condition-I, we have $(x - 7) = 7(y - 7)$
 $\Rightarrow x - 7 = 7y - 49 \Rightarrow x - 7y + 42 = 0$ (i)
 After three years : Aftab's age = $(x + 3)$ years
 His daughter's age = $(y + 3)$ years
 According to the condition-II, we have
 $(x + 3) = 3(y + 3)$
 $\Rightarrow x + 3 = 3y + 9 \Rightarrow x - 3y - 6 = 0$ (ii)
 Hence, algebraic representation of given situation is
 $x - 7y + 42 = 0$ and $x - 3y - 6 = 0$
 Graphical representation of (i) and (ii) :
 From equation (i), we have :

$$l_1 : x - 7y + 42 = 0 \Rightarrow y = \frac{x + 42}{7}$$

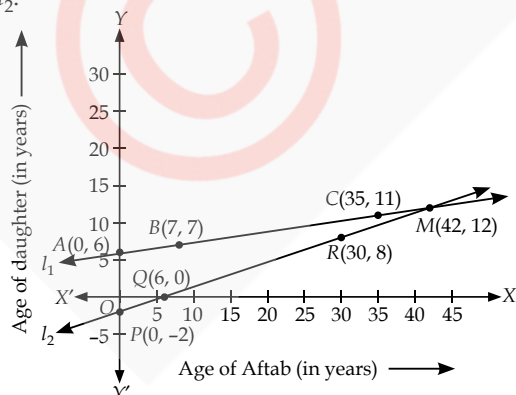
x	0	7	35
y	6	7	11

From equation (ii), we have

$$l_2 : x - 3y - 6 = 0 \Rightarrow y = \frac{x - 6}{3}$$

x	0	6	30
y	-2	0	8

Plotting the points $A(0, 6)$, $B(7, 7)$ and $C(35, 11)$ on the graph paper and joining them, we get the line l_1 .
 Similarly, plotting the points $P(0, -2)$, $Q(6, 0)$ and $R(30, 8)$ on the graph paper and joining them, we get the line l_2 .



Clearly, the lines l_1 and l_2 intersect each other at $M(42, 12)$.

2. Let the cost of a bat = ₹ x and the cost of a ball = ₹ y
 Algebraic representation :

Cost of 3 bats + Cost of 6 balls = ₹ 3900
 $\Rightarrow 3x + 6y = 3900 \Rightarrow x + 2y = 1300$ (i)

Also, cost of 1 bat + cost of 3 balls = ₹ 1300
 $\Rightarrow x + 3y = 1300$ (ii)

Thus, (i) and (ii) are the algebraic representations of the given situation.

Geometrical representation :

We have for equation (i), $l_1 : x + 2y = 1300 \Rightarrow y = \frac{1300 - x}{2}$

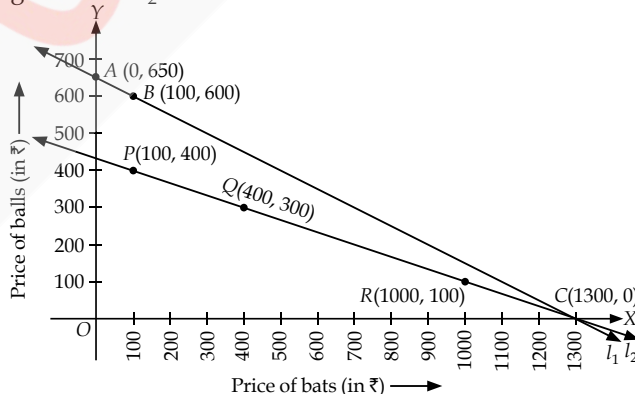
x	0	100	1300
y	650	600	0

For equation (ii), $l_2 : x + 3y = 1300 \Rightarrow y = \frac{1300 - x}{3}$

x	100	400	1000
y	400	300	100

Now, plotting the points $A(0, 650)$, $B(100, 600)$ and $C(1300, 0)$ on the graph paper and joining them, we get the line l_1 .

Similarly, plotting the points $P(100, 400)$, $Q(400, 300)$ and $R(1000, 100)$, on the graph paper and joining them, we get the line l_2 .



We also see from the graph that the straight lines representing the two equations intersect each other at $C(1300, 0)$.

3. Let the cost of 1 kg of apples = ₹ x
 And the cost of 1 kg of grapes = ₹ y

Algebraic representation :

$$2x + y = 160 \quad \dots(i)$$

$$\text{and } 4x + 2y = 300 \Rightarrow 2x + y = 150 \quad \dots(ii)$$

Geometrical representation :

We have, for equation (i), $l_1 : 2x + y = 160 \Rightarrow y = 160 - 2x$

x	50	40	30
y	60	80	100

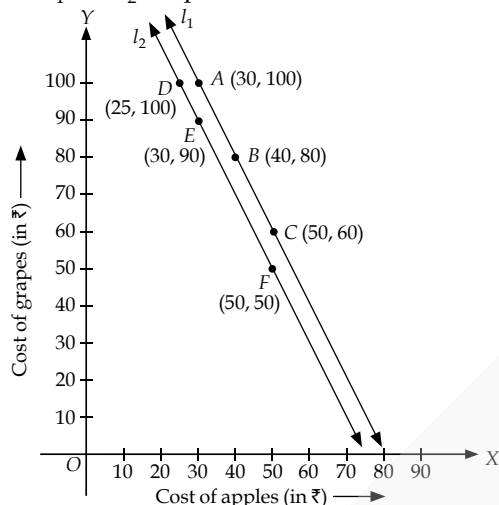
From equation (ii), we have

$$l_2 : 2x + y = 150 \Rightarrow y = 150 - 2x$$

x	50	30	25
y	50	90	100

Plotting the points $A(30, 100)$, $B(40, 80)$ and $C(50, 60)$ on the graph paper and joining them, we get the line l_1 . Similarly, plotting the points $D(25, 100)$, $E(30, 90)$ and $F(50, 50)$ on the graph paper and joining them, we get the line l_2 .

The lines l_1 and l_2 are parallel.



EXERCISE - 3.2

1. (i) Let the number of boys be x and number of girls be y .

$$\therefore x + y = 10 \quad \dots (1)$$

$$\therefore \text{Number of girls} = [\text{Number of boys}] + 4$$

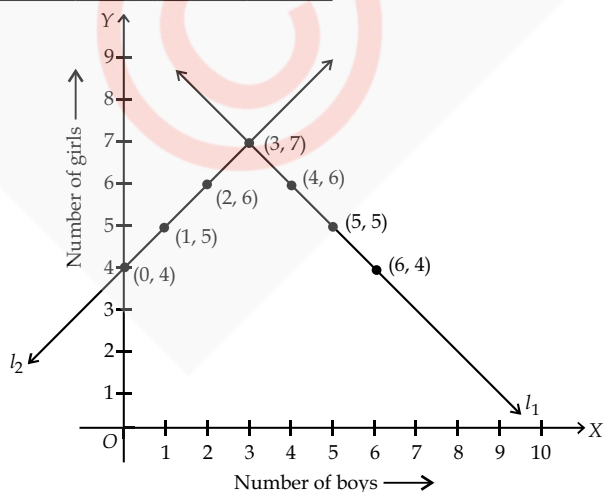
$$\therefore y = x + 4 \quad \dots (2)$$

Now, from equation (1), we have $l_1 : y = 10 - x$

x	6	4	5
y	4	6	5

And from equation (2), we have $l_2 : y = x + 4$

x	0	1	2
y	4	5	6



Since, l_1 and l_2 intersect at the point $(3, 7)$.

\therefore The solution of the given pair of linear equations is $x = 3, y = 7$

\therefore Required number of boys and girls are 3 and 7 respectively.

(ii) Let the cost of a pencil is ₹ x and cost of a pen is ₹ y . Since, cost of 5 pencils + Cost of 7 pens = ₹ 50

$$\Rightarrow 5x + 7y = 50 \quad \dots (1)$$

Also, cost of 7 pencils + cost of 5 pens = ₹ 46

$$\Rightarrow 7x + 5y = 46 \quad \dots (2)$$

Now, from equation (1), we have

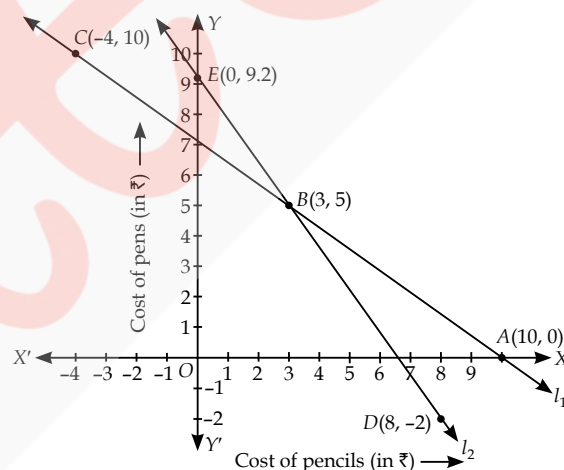
$$l_1 : y = \frac{50 - 5x}{7}$$

x	10	3	-4
y	0	5	10

And from equation (2), we have

$$l_2 : y = \frac{46 - 7x}{5}$$

x	8	3	0
y	-2	5	9.2



Since, l_1 and l_2 intersect at $B(3, 5)$.

\therefore Cost of a pencil is ₹ 3 and cost of a pen is ₹ 5.

2. Comparing the given equations with

$$a_1x + b_1y + c_1 = 0, a_2x + b_2y + c_2 = 0, \text{ we have}$$

$$(i) \text{ For, } 5x - 4y + 8 = 0, 7x + 6y - 9 = 0$$

$$a_1 = 5, b_1 = -4, c_1 = 8 \text{ and } a_2 = 7, b_2 = 6, c_2 = -9$$

$$\therefore \frac{a_1}{a_2} = \frac{5}{7}, \frac{b_1}{b_2} = \frac{-4}{6} = \frac{-2}{3} \Rightarrow \frac{a_1}{a_2} \neq \frac{b_1}{b_2}$$

So, the lines are intersecting, i.e., they intersect at a unique point.

$$(ii) \text{ For, } 9x + 3y + 12 = 0, 18x + 6y + 24 = 0, \text{ we have}$$

$$a_1 = 9, b_1 = 3, c_1 = 12 \text{ and } a_2 = 18, b_2 = 6, c_2 = 24$$

$$\therefore \frac{a_1}{a_2} = \frac{9}{18} = \frac{1}{2}, \frac{b_1}{b_2} = \frac{3}{6} = \frac{1}{2} \text{ and } \frac{c_1}{c_2} = \frac{12}{24} = \frac{1}{2}$$

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

So, the lines are coincident.

$$(iii) \text{ For, } 6x - 3y + 10 = 0, 2x - y + 9 = 0, \text{ we have}$$

$$a_1 = 6, b_1 = -3, c_1 = 10 \text{ and } a_2 = 2, b_2 = -1, c_2 = 9$$

$$\therefore \frac{a_1}{a_2} = \frac{6}{2} = 3, \frac{b_1}{b_2} = \frac{-3}{-1} = 3, \frac{c_1}{c_2} = \frac{10}{9} \Rightarrow \frac{a_1}{a_2} = \frac{b_1}{b_2} \neq \frac{c_1}{c_2}$$

So, the lines are parallel.

3. (i) For, $3x + 2y = 5$, $2x - 3y = 7$, we have

$$a_1 = 3, b_1 = 2, c_1 = -5 \text{ and } a_2 = 2, b_2 = -3, c_2 = -7$$

$$\therefore \frac{a_1}{a_2} = \frac{3}{2}, \frac{b_1}{b_2} = \frac{2}{-3} \text{ and } \frac{c_1}{c_2} = \frac{-5}{-7} = \frac{5}{7}$$

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

So, lines are intersecting *i.e.*, they intersect at a unique point.

\therefore It is consistent pair of equations.

(ii) For, $2x - 3y = 8$, $4x - 6y = 9$, we have

$$a_1 = 2, b_1 = -3, c_1 = -8 \text{ and } a_2 = 4, b_2 = -6, c_2 = -9$$

$$\therefore \frac{a_1}{a_2} = \frac{2}{4} = \frac{1}{2}, \frac{b_1}{b_2} = \frac{-3}{-6} = \frac{1}{2} \text{ and } \frac{c_1}{c_2} = \frac{-8}{-9} = \frac{8}{9}$$

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

So, lines are parallel *i.e.*, the given pair of linear equations has no solution.

\therefore It is inconsistent pair of equations.

(iii) For, $\frac{3}{2}x + \frac{5}{3}y = 7$, $9x - 10y = 14$, we have

$$a_1 = \frac{3}{2}, b_1 = \frac{5}{3}, c_1 = -7 \text{ and } a_2 = 9, b_2 = -10, c_2 = -14$$

$$\therefore \frac{a_1}{a_2} = \frac{3/2}{9} = \frac{3}{2} \times \frac{1}{9} = \frac{1}{6},$$

$$\frac{b_1}{b_2} = \frac{5/3}{-10} = \frac{5}{3} \times \frac{1}{-10} = -\frac{1}{6} \text{ and } \frac{c_1}{c_2} = \frac{-7}{-14} = \frac{1}{2}$$

$$\text{Here, } \frac{a_1}{a_2} \neq \frac{b_1}{b_2}. \text{ So lines are intersecting.}$$

So, the given pair of linear equations has a unique solution.

\therefore It is a consistent pair of equations.

(iv) For, $5x - 3y = 11$, $-10x + 6y = -22$, we have

$$a_1 = 5, b_1 = -3, c_1 = -11 \text{ and } a_2 = -10, b_2 = 6, c_2 = 22$$

$$\therefore \frac{a_1}{a_2} = \frac{5}{-10} = -\frac{1}{2}, \frac{b_1}{b_2} = \frac{-3}{6} = -\frac{1}{2} \text{ and } \frac{c_1}{c_2} = \frac{-11}{22} = -\frac{1}{2}$$

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

So, lines are coincident.

\therefore The given pair of linear equations has infinitely many solutions.

Thus, they are consistent.

(v) For, $\frac{4}{3}x + 2y = 8$, $2x + 3y = 12$, we have

$$a_1 = \frac{4}{3}, b_1 = 2, c_1 = -8 \text{ and } a_2 = 2, b_2 = 3, c_2 = -12$$

$$\therefore \frac{a_1}{a_2} = \frac{4/3}{2} = \frac{4}{3} \times \frac{1}{2} = \frac{2}{3}, \frac{b_1}{b_2} = \frac{2}{3} \text{ and } \frac{c_1}{c_2} = \frac{-8}{-12} = \frac{2}{3}$$

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

So, the lines are coincident *i.e.*, they have infinitely many solutions.

\therefore The given pair of linear equations are consistent.

4. (i) For, $x + y = 5$, $2x + 2y = 10$, we have

$$a_1 = 1, b_1 = 1, c_1 = -5 \text{ and } a_2 = 2, b_2 = 2, c_2 = -10$$

$$\therefore \frac{a_1}{a_2} = \frac{1}{2}, \frac{b_1}{b_2} = \frac{1}{2} \text{ and } \frac{c_1}{c_2} = \frac{-5}{-10} = \frac{1}{2}$$

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

So, lines are coincident.

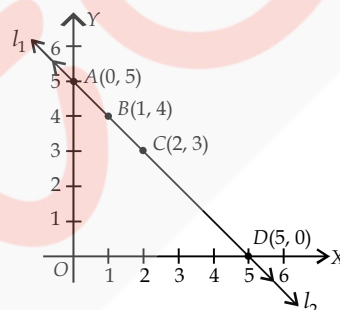
\therefore The given pair of linear equations are consistent.

$$l_1 : x + y = 5 \Rightarrow y = 5 - x$$

x	0	5	1
y	5	0	4

$$l_2 : 2x + 2y = 10 \Rightarrow x + y = 5 \Rightarrow y = 5 - x$$

x	2	0	5
y	3	5	0



From graph, it is clear that lines l_1 and l_2 are coincident.

\therefore They have infinitely many solutions.

(ii) For, $x - y = 8$, $3x - 3y = 16$

$$\therefore a_1 = 1, b_1 = -1, c_1 = -8 \text{ and } a_2 = 3, b_2 = -3, c_2 = -16$$

$$\therefore \frac{a_1}{a_2} = \frac{1}{3}, \frac{b_1}{b_2} = \frac{-1}{-3} = \frac{1}{3} \text{ and } \frac{c_1}{c_2} = \frac{-8}{-16} = \frac{1}{2} \therefore \frac{a_1}{a_2} = \frac{b_1}{b_2} \neq \frac{c_1}{c_2}$$

\therefore The pair of linear equations is inconsistent and lines are parallel.

\therefore The given system of equations has no solution.

(iii) For, $2x + y - 6 = 0$, $4x - 2y - 4 = 0$

$$a_1 = 2, b_1 = 1, c_1 = -6 \text{ and } a_2 = 4, b_2 = -2, c_2 = -4$$

$$\frac{a_1}{a_2} = \frac{2}{4} = \frac{1}{2}, \frac{b_1}{b_2} = \frac{1}{-2} = -\frac{1}{2}, \frac{c_1}{c_2} = \frac{-6}{-4} = \frac{3}{2}$$

$$\text{Here, } \frac{a_1}{a_2} \neq \frac{b_1}{b_2}$$

\therefore Lines are intersecting.

So, it is a consistent pair of linear equations.

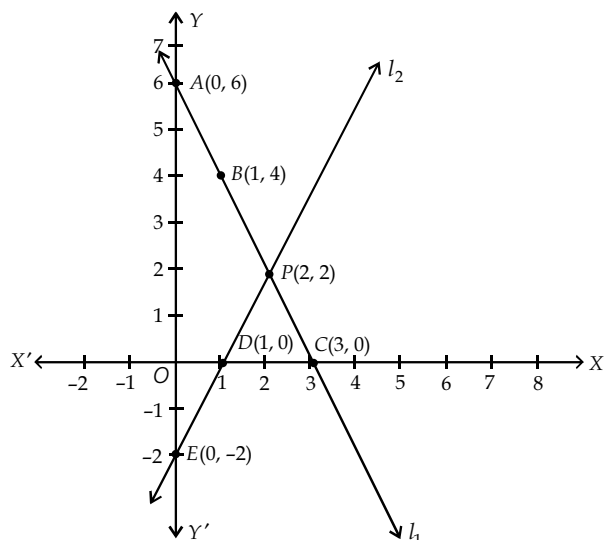
\therefore It has a unique solution.

$$l_1 : y = 6 - 2x$$

x	0	3	1
y	6	0	4

$$\text{and } l_2 : y = \frac{4x - 4}{2}$$

x	0	1	2
y	-2	0	2



$\therefore l_1$ and l_2 intersect each other at $P(2, 2)$

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

(iv) For, $2x - 2y - 2 = 0$, $4x - 4y - 5 = 0$

$\therefore a_1 = 2, b_1 = -2, c_1 = -2$ and $a_2 = 4, b_2 = -4, c_2 = -5$

$\therefore \frac{a_1}{a_2} = \frac{2}{4} = \frac{1}{2}; \frac{b_1}{b_2} = \frac{-2}{-4} = \frac{1}{2}; \frac{c_1}{c_2} = \frac{-2}{-5} = \frac{2}{5}$

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

So, the given pair of linear equations is inconsistent and lines are parallel.

Thus, the given system of equations has no solution.

5. Let the width of the garden be x m and the length of the garden be y m.

According to question, $4 + x = y$... (i)

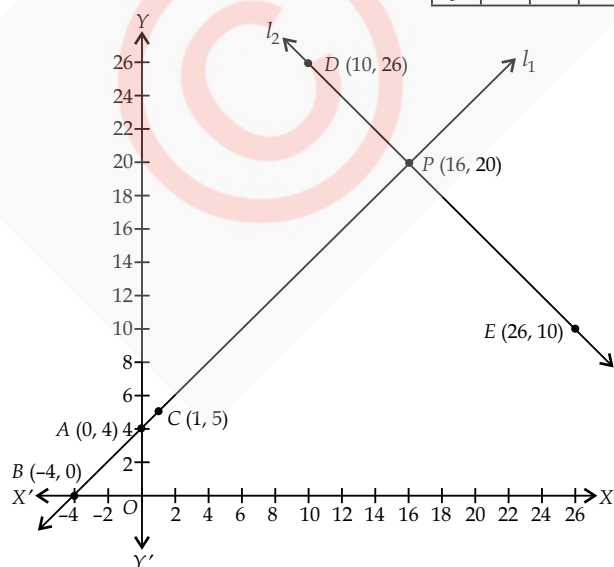
Also, $\frac{1}{2}(\text{perimeter}) = 36 \Rightarrow y + x = 36$... (ii)

From (i), $l_1 : y = x + 4$,

x	0	-4	1
y	4	0	5

From (ii), $l_2 : x + y = 36 \Rightarrow y = 36 - x$,

x	10	26	16
y	26	10	20



The lines l_1 and l_2 intersect each other at $P(16, 20)$.

$\therefore x = 16$ and $y = 20$

So, Length = 20 m and width = 16 m

6. (i) Let the pair of linear equations be $2x + 3y - 8 = 0$, where $a_1 = 2, b_1 = 3$ and $c_1 = -8$ and $a_2x + b_2y + c_2 = 0$.

For intersecting lines, we have

$$\frac{2}{a_2} \neq \frac{3}{b_2} \neq \frac{-8}{c_2}$$

\therefore We can have $a_2 = 3, b_2 = 2$ and $c_2 = -7$

\therefore The required equation will be

$$3x + 2y - 7 = 0$$

(ii) For parallel lines, we have

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

\therefore Line parallel to $2x + 3y - 8 = 0$, can be taken as $2x + 3y - 12 = 0$

(iii) For coincident lines, we have

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

\therefore Line coincident to $2x + 3y - 8 = 0$ can be taken as $2(2x + 3y - 8) = 0$

$$\Rightarrow 4x + 6y - 16 = 0$$

7. We have, $x - y + 1 = 0$... (i)

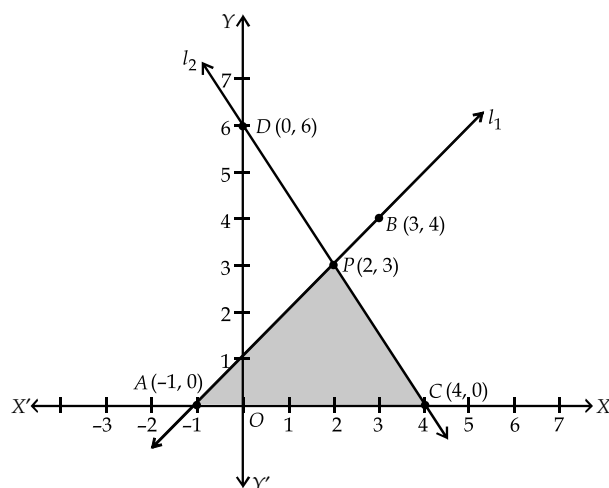
and $3x + 2y - 12 = 0$... (ii)

From (i), $l_1 : x - y + 1 = 0 \Rightarrow y = x + 1$

x	2	-1	3
y	3	0	4

From (ii), $l_2 : 3x + 2y - 12 = 0 \Rightarrow y = \frac{12 - 3x}{2}$

x	2	4	0
y	3	0	6



The lines l_1 and l_2 intersect at $P(2, 3)$. Thus, co-ordinates of the vertices of the shaded triangular region are $C(4, 0)$, $A(-1, 0)$ and $P(2, 3)$.

EXERCISE - 3.3

1. (i) We have, $x + y = 14$

and $x - y = 4$

From equation (1), we have $x = (14 - y)$

Substituting this value of x in (2), we get

$$(14 - y) - y = 4 \Rightarrow 14 - 2y = 4$$

$$\Rightarrow -2y = -10 \Rightarrow y = 5$$

Now, substituting $y = 5$ in (1), we get

$$x + 5 = 14 \Rightarrow x = 9$$

Hence, $x = 9, y = 5$ is the required solution.

(ii) We have, $s - t = 3$

$$\text{and } \frac{s}{3} + \frac{t}{2} = 6$$

From (1), we have $s = (3 + t)$

Substituting this value of s in (2), we get

$$\frac{(3+t)}{3} + \frac{t}{2} = 6 \Rightarrow 2(3+t) + 3(t) = 6 \times 6$$

$$\Rightarrow 6 + 2t + 3t = 36 \Rightarrow 5t = 30 \Rightarrow t = \frac{30}{5} = 6$$

Substituting $t = 6$ in (3) we get, $s = 3 + 6 = 9$

Thus, $s = 9, t = 6$ is the required solution.

(iii) We have, $3x - y = 3$

$$9x - 3y = 9$$

From (1), $y = (3x - 3)$

Substituting this value of y in (2), we get

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

$$\Rightarrow 9x - 9x + 9 = 9 \Rightarrow 9 = 9, \text{ which is true statement.}$$

\therefore The equations (1) and (2) have infinitely many solutions.

To find these solutions, we put $x = k$ (any real constant) in (3), we get

$$y = 3k - 3$$

$\therefore x = k, y = 3k - 3$ is the required solution, where k is any real number.

(iv) We have, $0.2x + 0.3y = 1.3$

and $0.4x + 0.5y = 2.3$

From (1), we have

$$y = \frac{1.3 - 0.2x}{0.3}$$

Substituting the value of y in (2), we get

$$0.4x + 0.5 \left[\frac{1.3 - 0.2x}{0.3} \right] = 2.3 \Rightarrow 0.4x + \left[\frac{0.65 - 0.1x}{0.3} \right] = 2.3$$

$$\Rightarrow 0.3 \times 0.4x + 0.65 - 0.1x = 0.3 \times 2.3$$

$$\Rightarrow 0.12x + 0.65 - 0.1x = 0.69$$

$$\Rightarrow 0.02x = 0.69 - 0.65 = 0.04 \Rightarrow x = \frac{0.04}{0.02} = 2$$

$$\text{From (3), } y = \frac{1.3 - 0.2(2)}{0.3} \Rightarrow y = \frac{1.3 - 0.4}{0.3} = \frac{0.9}{0.3} = 3$$

Thus, $x = 2$ and $y = 3$ is the required solution.

(v) We have, $\sqrt{2}x + \sqrt{3}y = 0$

and $\sqrt{3}x - \sqrt{8}y = 0$

From (2), we have

$$\sqrt{3}x = \sqrt{8}y \Rightarrow x = \frac{\sqrt{8}}{\sqrt{3}}y$$

Substituting the value of x in (1), we get

$$\sqrt{2} \left[\frac{\sqrt{8}}{\sqrt{3}}y \right] + \sqrt{3}y = 0$$

$$\Rightarrow \frac{\sqrt{16}}{\sqrt{3}}y + \sqrt{3}y = 0 \Rightarrow \frac{4}{\sqrt{3}}y + \sqrt{3}y = 0$$

$$\Rightarrow \left[\frac{4}{\sqrt{3}} + \sqrt{3} \right]y = 0 \Rightarrow y = 0$$

Substituting $y = 0$ in (3), we get $x = 0$

Thus, $x = 0$ and $y = 0$ is the required solution.

(vi) We have, $\frac{3x}{2} - \frac{5y}{3} = -2$... (1) and $\frac{x}{3} + \frac{y}{2} = \frac{13}{6}$... (2)

From (2), we have $\frac{x}{3} = \frac{13}{6} - \frac{y}{2}$

$$\Rightarrow x = 3 \times \left(\frac{13}{6} - \frac{y}{2} \right) \Rightarrow x = \left[\frac{13}{2} - \frac{3}{2}y \right] \quad \dots (3)$$

Substituting the value of x in (1), we get

$$\frac{3 \left[\frac{13}{2} - \frac{3}{2}y \right]}{2} - \frac{5y}{3} = -2$$

$$\Rightarrow \frac{39}{4} - \frac{9y}{4} - \frac{5y}{3} = -2 \Rightarrow \frac{117 - 27y - 20y}{12} = -2$$

$$\Rightarrow 117 - 47y = -24 \Rightarrow -47y = -24 - 117 = -141$$

$$\Rightarrow y = \frac{-141}{-47} = 3$$

Now, substituting $y = 3$ in (3), we get

$$x = \frac{13}{2} - \frac{3}{2}(3) \Rightarrow x = \frac{13}{2} - \frac{9}{2} = \frac{4}{2} = 2$$

Thus, $x = 2$ and $y = 3$ is the required solution.

2. We have, $2x + 3y = 11$... (1)

and $2x - 4y = -24$... (2)

From (1), we have

$$2x = 11 - 3y$$

$$\Rightarrow x = \left[\frac{11 - 3y}{2} \right] \quad \dots (3)$$

Substituting this value of x in (2), we get

$$2 \left[\frac{11 - 3y}{2} \right] - 4y = -24 \Rightarrow 11 - 3y - 4y = -24$$

$$\Rightarrow -7y = -24 - 11 = -35 \Rightarrow y = \frac{-35}{-7} = 5$$

Substituting $y = 5$ in (3), we get

$$x = \frac{11 - 3(5)}{2} \Rightarrow x = \frac{11 - 15}{2} \Rightarrow x = \frac{-4}{2} = -2$$

Thus, $x = -2$ and $y = 5$ is the required solution.

Also, $y = mx + 3 \Rightarrow 5 = m(-2) + 3$

$$\Rightarrow -2m = 5 - 3 \Rightarrow -2m = 2 \Rightarrow m = -1.$$

3. (i) Let the two numbers be x and y such that $x > y$.

\therefore Difference between two numbers = 26

$$\Rightarrow x - y = 26 \quad \dots (1)$$

Again, one number = 3[the other number]

$$\Rightarrow x = 3y \quad [\because x > y] \quad \dots (2)$$

Substituting $x = 3y$ in (1), we get

$$3y - y = 26 \Rightarrow 2y = 26 \Rightarrow y = \frac{26}{2} = 13$$

Now, substituting $y = 13$ in (2), we get

$$x = 3(13) \Rightarrow x = 39$$

Thus, two numbers are 39 and 13.

(ii) Let the two angles be x and y such that $x > y$.

\therefore The larger angle exceeds the smaller by 18°

$$\therefore x = y + 18^\circ \quad \dots(1)$$

Also, sum of two supplementary angles = 180°

$$\therefore x + y = 180^\circ \quad \dots(2)$$

Substituting the value of x from (1) in (2), we get

$$(18^\circ + y) + y = 180^\circ$$

$$\Rightarrow 2y = 180^\circ - 18^\circ = 162^\circ \Rightarrow y = \frac{162^\circ}{2} = 81^\circ$$

Substituting $y = 81^\circ$ in (1), we get

$$x = 18^\circ + 81^\circ = 99^\circ$$

Thus, $x = 99^\circ$ and $y = 81^\circ$ is the required solution.

(iii) Let the cost of a bat = ₹ x and the cost of a ball = ₹ y .

$$\therefore [\text{cost of 7 bats}] + [\text{cost of 6 balls}] = ₹ 3800$$

$$\Rightarrow 7x + 6y = 3800 \quad \dots(1)$$

$$\text{Again, } [\text{cost of 3 bats}] + [\text{cost of 5 balls}] = ₹ 1750$$

$$\Rightarrow 3x + 5y = 1750 \quad \dots(2)$$

From (2), we have

$$y = \left[\frac{1750 - 3x}{5} \right] \quad \dots(3)$$

Substituting this value of y in (1), we get

$$7x + 6 \left[\frac{1750 - 3x}{5} \right] = 3800$$

$$\Rightarrow 35x + 10500 - 18x = 19000$$

$$\Rightarrow 17x = 19000 - 10500 \Rightarrow x = \frac{8500}{17} = 500$$

Substituting $x = 500$ in (3), we get

$$y = \frac{1750 - 3(500)}{5} \Rightarrow y = \frac{1750 - 1500}{5} = \frac{250}{5} = 50$$

Thus, $x = 500$ and $y = 50$

\therefore Cost of a bat = ₹ 500 and cost of a ball = ₹ 50

(iv) Let fixed charges be ₹ x and charges per km be ₹ y .

$$\therefore \text{Charges for the journey of 10 km} = ₹ 105$$

$$\therefore x + 10y = 105 \quad \dots(1)$$

$$\text{and charges for the journey of 15 km} = ₹ 155$$

$$\therefore x + 15y = 155 \quad \dots(2)$$

From (1), we have

$$x = 105 - 10y \quad \dots(3)$$

Substituting the value of x in (2), we get

$$(105 - 10y) + 15y = 155$$

$$\Rightarrow 5y = 155 - 105 = 50 \Rightarrow y = 10$$

Substituting $y = 10$ in (3), we get

$$x = 105 - 10(10) \Rightarrow x = 105 - 100 = 5$$

Thus, $x = 5$ and $y = 10$

So, fixed charges = ₹ 5 and charges per km = ₹ 10.

Now, charges for 25 km = $x + 25y = 5 + 25(10)$

$$= 5 + 250 = ₹ 255$$

\therefore The charges for 25 km journey = ₹ 255

(v) Let the numerator = x and the denominator = y

$$\therefore \text{Fraction} = x/y$$

$$\text{Case I: } \frac{x+2}{y+2} = \frac{9}{11} \Rightarrow 11(x+2) = 9(y+2)$$

$$\Rightarrow 11x + 22 = 9y + 18$$

$$\Rightarrow 11x - 9y + 4 = 0 \quad \dots(1)$$

$$\text{Case II: } \frac{x+3}{y+3} = \frac{5}{6} \Rightarrow 6(x+3) = 5(y+3)$$

$$\Rightarrow 6x + 18 = 5y + 15$$

$$\Rightarrow 6x - 5y + 3 = 0 \quad \dots(2)$$

$$\text{Now, from (2), } x = \left[\frac{5y-3}{6} \right] \quad \dots(3)$$

Substituting this value of x in (1), we get

$$11 \left[\frac{5y-3}{6} \right] - 9y + 4 = 0$$

$$\Rightarrow 55y - 33 - 54y + 24 = 0 \Rightarrow y - 9 = 0 \Rightarrow y = 9$$

Now, substituting $y = 9$ in (3), we get

$$x = \frac{5(9)-3}{6} \Rightarrow x = \frac{45-3}{6} = \frac{42}{6} = 7$$

$$\therefore x = 7 \text{ and } y = 9 \Rightarrow \text{Fraction} = 7/9.$$

(vi) Let the present age of Jacob = x years and the present age of his son = y years.

\therefore 5 years hence, age of Jacob = $(x+5)$ years and age of his son = $(y+5)$ years

Given, [Age of Jacob after 5 years] = 3[Age of his son after 5 years]

$$\therefore x+5 = 3(y+5) \Rightarrow x+5 = 3y+15$$

$$\Rightarrow x - 3y - 10 = 0 \quad \dots(1)$$

5 years ago, age of Jacob = $(x-5)$ years and age of his son = $(y-5)$ years

Also, five years ago [Age of Jacob] = 7[Age of his son]

$$\therefore (x-5) = 7(y-5) \Rightarrow x-5 = 7y-35$$

$$\Rightarrow x - 7y + 30 = 0 \quad \dots(2)$$

$$\text{From (i), } x = 10 + 3y \quad \dots(3)$$

Substituting this value of x in (2), we get

$$(10+3y) - 7y + 30 = 0 \Rightarrow -4y = -40 \Rightarrow y = 10$$

Now, substituting $y = 10$ in (3), we get

$$x = 10 + 3(10) \Rightarrow x = 10 + 30 = 40$$

Thus, $x = 40$ and $y = 10$

\therefore Present age of Jacob = 40 years and present age of his son = 10 years

EXERCISE - 3.4

$$1. \quad (i) \text{ Elimination method : } x + y = 5 \quad \dots(1)$$

$$2x - 3y = 4 \quad \dots(2)$$

Multiplying (1) by 3, we get

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

$$\text{Adding (2) \& (3), we get } 5x = 19 \Rightarrow x = \frac{19}{5}$$

Now, putting $x = \frac{19}{5}$ in (1), we get

$$\frac{19}{5} + y = 5 \Rightarrow y = 5 - \frac{19}{5} = \frac{25-19}{5} = \frac{6}{5}$$

$$\text{Thus, } x = \frac{19}{5} \text{ and } y = \frac{6}{5}$$

Substitution Method :

$$\text{We have, } x + y = 5 \Rightarrow y = 5 - x \quad \dots(1)$$

$$\text{and } 2x - 3y = 4 \quad \dots(2)$$

Put $y = 5 - x$ in (2), we get

$$2x - 3(5-x) = 4 \Rightarrow 2x - 15 + 3x = 4$$

$$\Rightarrow 5x = 19 \Rightarrow x = \frac{19}{5}$$

$$\text{From (1), } y = 5 - \frac{19}{5} = \frac{25-19}{5} = \frac{6}{5}$$

$$\text{Hence, } x = \frac{19}{5} \text{ and } y = \frac{6}{5}$$

(ii) Elimination method :

$$3x + 4y = 10$$

$$2x - 2y = 2$$

Multiplying (2) by 2, we get

$$4x - 4y = 4$$

Adding (1) and (3), we get

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

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

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

$$\Rightarrow 4y = 10 - 6 = 4 \Rightarrow y = \frac{4}{4} = 1$$

Thus, $x = 2$ and $y = 1$

Substitution Method :

$$3x + 4y = 10 \Rightarrow y = \frac{10-3x}{4}$$

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

Putting $y = \frac{10-3x}{4}$ in (2), we get

$$x - \left(\frac{10-3x}{4}\right) = 1 \Rightarrow 4x - 10 + 3x = 4$$

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

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

$$y = \frac{10-3 \times 2}{4} = \frac{10-6}{4} = \frac{4}{4} = 1$$

Hence, $x = 2$ and $y = 1$

(iii) Elimination method :

$$3x - 5y - 4 = 0$$

$$9x = 2y + 7 \text{ or } 9x - 2y - 7 = 0$$

Multiplying (1) by 3, we get

$$9x - 15y - 12 = 0$$

Subtracting (2) from (3), we get

$$\therefore 13y + 5 = 0 \Rightarrow y = \frac{-5}{13}$$

Substituting the value of y in (1), we get

$$3x - 5\left(\frac{-5}{13}\right) - 4 = 0 \Rightarrow 3x + \frac{25}{13} - 4 = 0$$

$$\Rightarrow 3x = \frac{-25+52}{13} = \frac{27}{13} \Rightarrow x = \frac{27}{13} \times \frac{1}{3} = \frac{9}{13}$$

$$\text{Thus, } x = \frac{9}{13} \text{ and } y = -\frac{5}{13}$$

Substitution Method :

$$3x - 5y - 4 = 0 \Rightarrow y = \frac{3x-4}{5}$$

$$9x - 2y - 7 = 0$$

Putting $y = \frac{3x-4}{5}$ in (2), we get

$$9x - 2\left(\frac{3x-4}{5}\right) - 7 = 0 \Rightarrow 45x - 6x + 8 - 35 = 0$$

$$\Rightarrow 39x = 27 \Rightarrow x = \frac{27}{39} = \frac{9}{13}$$

Putting $x = \frac{9}{13}$ in (1), we get

$$y = \frac{3 \times \frac{9}{13} - 4}{5} = \frac{27-52}{65} = \frac{-25}{65} \Rightarrow y = \frac{-5}{13}$$

$$\text{Hence, } x = \frac{9}{13} \text{ and } y = \frac{-5}{13}$$

... (1) (iv) Elimination method :

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

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

Multiplying (2) by 2, we get

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

Adding (1) and (3), we have

$$\frac{x}{2} + 2x = 5 \Rightarrow \frac{5}{2}x = 5 \Rightarrow x = 5 \times \frac{2}{5} = 2$$

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

$$\dots (1) \quad \frac{2}{2} + \frac{2y}{3} = -1 \Rightarrow 1 + \frac{2y}{3} = -1$$

$$\dots (2) \quad \Rightarrow \frac{2y}{3} = -1 - 1 = -2 \Rightarrow y = -2 \times \frac{3}{2} = -3$$

Thus, $x = 2$ and $y = -3$

Substitution Method :

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

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

Putting $y = 3(x-3)$ in (1) from (2), we get

$$\frac{x}{2} + \frac{2}{3} \times 3(x-3) = -1 \Rightarrow \frac{x}{2} + 2x - 6 = -1$$

$$\Rightarrow \frac{5x}{2} = 5 \Rightarrow x = 5 \times \frac{2}{5} = 2$$

Putting $x = 2$ in (2), we get

$$y = 3(2-3) = 3(-1) = -3$$

Hence, $x = 2$ and $y = -3$.

2. (i) Let the numerator = x and the denominator = y

\therefore Fraction = x/y

$$\text{Case I: } \frac{x+1}{y-1} = 1 \Rightarrow x+1 = y-1$$

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

$$\text{Case II: } \frac{x}{y+1} = \frac{1}{2} \Rightarrow x = \frac{1}{2}(y+1)$$

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

Subtracting (2) from (1), we have

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

Now, putting $y = 5$ in (2), we have

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

Thus, $x = 3$ and $y = 5$.

Hence, the required fraction = $3/5$

(ii) Let the present age of Nuri = x years and the present age of Sonu = y years

For an infinite number of solutions, $\frac{a_1}{a_2} = \frac{b_1}{b_2} = \frac{c_1}{c_2}$

$$\Rightarrow \frac{2}{(a-b)} = \frac{3}{(a+b)} = \frac{-7}{-(3a+b-2)}$$

From the first two terms, we get

$$\frac{2}{a-b} = \frac{3}{a+b}$$

$$\Rightarrow 2a + 2b = 3a - 3b \Rightarrow 2a - 3a + 2b + 3b = 0$$

$$\Rightarrow -a + 5b = 0 \Rightarrow a - 5b = 0$$

From the last two terms, we get

$$\frac{3}{a+b} = \frac{7}{3a+b-2}$$

$$\Rightarrow 9a + 3b - 6 = 7a + 7b$$

$$\Rightarrow 2a - 4b = 6 \Rightarrow a - 2b - 3 = 0$$

Now, using cross-multiplication method, we have

$$\frac{a}{-5} = \frac{b}{-2} = \frac{1}{-3}$$

$$\Rightarrow \frac{a}{15-0} = \frac{b}{0+3} = \frac{1}{-2+5}$$

$$\Rightarrow \frac{a}{15} = \frac{b}{3} = \frac{1}{3} \Rightarrow a = \frac{1}{3} \times 15 = 5, b = \frac{1}{3} \times 3 = 1$$

Thus, $a = 5$ and $b = 1$.

(ii) For, $3x + y - 1 = 0$,

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

$$a_1 = 3, b_1 = 1, c_1 = -1 \text{ and } a_2 = 2k-1, b_2 = k-1, c_2 = -(2k+1)$$

For no solution

$$\frac{a_1}{a_2} = \frac{b_1}{b_2} \neq \frac{c_1}{c_2} \Rightarrow \frac{3}{2k-1} = \frac{1}{k-1} \neq \frac{-1}{-(2k+1)}$$

Taking first two terms, we get

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

$$\Rightarrow 3k-2k = -1+3 \Rightarrow k = 2.$$

3. Substitution method :

Given equations are

$$8x + 5y = 9 \quad \dots(1) \quad \text{and} \quad 3x + 2y = 4 \quad \dots(2)$$

$$\text{From (2), } y = \frac{4-3x}{2} \quad \dots(3)$$

Substituting this value of y in (1), we have

$$8x + 5\left[\frac{4-3x}{2}\right] = 9$$

$$\Rightarrow 16x + 20 - 15x = 18 \Rightarrow x = 18 - 20 = -2$$

Substituting $x = -2$ in (3), we get

$$y = \frac{4-3(-2)}{2} = \frac{4+6}{2} = \frac{10}{2} = 5$$

Thus, $x = -2$ and $y = 5$

Cross-multiplication method :

$$\text{For, } 8x + 5y - 9 = 0, 3x + 2y - 4 = 0$$

By cross-multiplication method, we have

$$\therefore \frac{x}{5} = \frac{y}{-9} = \frac{1}{8}$$

$$\Rightarrow \frac{x}{-20+18} = \frac{y}{-27+32} = \frac{1}{16-15}$$

$$\Rightarrow x = 1 \times (-2) = -2 \text{ and } y = 1 \times 5 = 5$$

Thus, $x = -2$ and $y = 5$

4. (i) Let the fixed charges = ₹ x and cost of food per day = ₹ y

For student A : Number of days = 20

\therefore Cost of food for 20 days = ₹ $20y$

According to the question, $x + 20y = 1000$

$$\Rightarrow x + 20y - 1000 = 0 \quad \dots(1)$$

For student B : Number of days = 26

\therefore Cost of food for 26 days = ₹ $26y$

According to the question : $x + 26y = 1180$

$$\Rightarrow x + 26y - 1180 = 0 \quad \dots(2)$$

Solving these by cross-multiplication, we get

$$\frac{x}{20} = \frac{y}{-1000} = \frac{1}{-23600+26000}$$

$$\Rightarrow \frac{x}{-23600+26000} = \frac{y}{-1000+1180} = \frac{1}{26-20}$$

$$\Rightarrow \frac{x}{2400} = \frac{y}{180} = \frac{1}{6}$$

$$\therefore x = \frac{1}{6} \times 2400 = 400, y = \frac{1}{6} \times 180 = 30$$

Thus, $x = 400$ and $y = 30$

\therefore Fixed charges = ₹ 400 and cost of food per day = ₹ 30

(ii) Let the numerator = x and the denominator = y

\therefore Fraction = x/y

$$\text{Condition-I : } \frac{x-1}{y} = \frac{1}{3}$$

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

$$\Rightarrow 3x - y - 3 = 0$$

$$\dots(1)$$

$$\text{Condition-II : } \frac{x}{y+8} = \frac{1}{4}$$

$$\Rightarrow 4x = y + 8$$

$$\Rightarrow 4x - y - 8 = 0$$

$$\dots(2)$$

From (1) and (2), we have

$$a_1 = 3, b_1 = -1, c_1 = -3 \text{ and } a_2 = 4, b_2 = -1, c_2 = -8$$

Using cross-multiplication method, we get

$$\frac{x}{-1} = \frac{y}{-3} = \frac{1}{-8-3}$$

$$\Rightarrow \frac{x}{8-3} = \frac{y}{-12+24} = \frac{1}{-3+4} \Rightarrow \frac{x}{5} = \frac{y}{12} = \frac{1}{1}$$

$$\therefore x = \frac{1}{1} \times 5 = 5 \text{ and } y = \frac{1}{1} \times 12 = 12$$

Thus, $x = 5$ and $y = 12 \therefore$ Fraction = $5/12$.

(iii) Let the number of correct answers = x and the number of wrong answers = y

Case-I : Marks for all correct answers = $(3 \times x) = 3x$

Marks for all wrong answers = $(1 \times y) = y$

\therefore According to the condition :

$$3x - y = 40 \quad \dots(1)$$

Case-II : Marks for all correct answers = $(4 \times x) = 4x$

Marks for all wrong answers = $(2 \times y) = 2y$

\therefore According to the condition :

$$4x - 2y = 50 \Rightarrow 2x - y = 25 \quad \dots(2)$$

From (1) and (2), we have

$$a_1 = 3, b_1 = -1, c_1 = -40 \text{ and}$$

$$a_2 = 2, b_2 = -1, c_2 = -25$$

Using cross-multiplication method, we get

$$\frac{x}{-1} = \frac{y}{-40} = \frac{1}{-25} \Rightarrow \frac{x}{-1} = \frac{y}{-40} = \frac{1}{-25} \Rightarrow \frac{x}{-1} = \frac{y}{-40} = \frac{1}{-25}$$

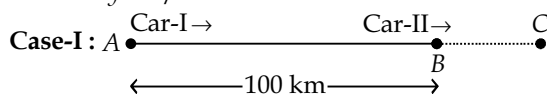
$$\Rightarrow \frac{x}{-1} = \frac{y}{-40} = \frac{1}{-25} \Rightarrow \frac{x}{-1} = \frac{y}{-40} = \frac{1}{-25}$$

$$\Rightarrow x = 15 \text{ and } y = 5$$

Now, total number of questions = [Number of correct answers] + [Number of wrong answers] = 15 + 5 = 20

Thus, required number of questions = 20.

(iv) Let the speed of car-I be x km/hr and the speed of car-II be y km/hr.



Distance travelled by car-I in 1 hour = AC

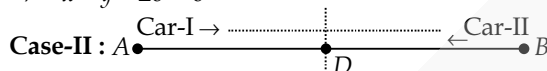
$$\Rightarrow \text{speed} \times \text{time} = 5 \times x \text{ km, } AC = 5x$$

Distance travelled by car-II, BC = $5y$

$$\text{Since } AB = AC - BC, 100 = 5x - 5y$$

$$\Rightarrow 5x - 5y - 100 = 0$$

$$\Rightarrow x - y - 20 = 0$$



Distance travelled by car-I in 1 hour = AD

$$\therefore AD = 1 \times x = x$$

Distance travelled by car-II in 1 hour = BD

$$\therefore BD = 1 \times y = y$$

$$\text{Now, } AB = AD + DB \Rightarrow 100 = x + y$$

$$\Rightarrow x + y = 100$$

From (1) and (2), we have

$$a_1 = 1, b_1 = -1, c_1 = -20 \text{ and } a_2 = 1, b_2 = 1, c_2 = -100,$$

Using cross-multiplication method, we get

$$\frac{x}{1} = \frac{y}{-20} = \frac{1}{-100} \Rightarrow \frac{x}{1} = \frac{y}{-20} = \frac{1}{-100}$$

$$\Rightarrow \frac{x}{1} = \frac{y}{-20} = \frac{1}{-100} \Rightarrow \frac{x}{1} = \frac{y}{-20} = \frac{1}{-100}$$

Thus, speed of car-I = 60 km/hr and speed of car-II = 40 km/hr.

(v) Let the length of the rectangle = x units and the breadth of the rectangle = y units

$$\therefore \text{Area of the rectangle} = x \times y = xy$$

Condition-I:

$$(\text{Length} - 5) \times (\text{Breadth} + 3) = \text{Area} - 9$$

$$\Rightarrow (x - 5)(y + 3) = xy - 9 \Rightarrow 3x - 5y - 15 = -9$$

$$\Rightarrow 3x - 5y - 6 = 0$$

Condition-II:

$$(\text{Length} + 3) \times (\text{Breadth} + 2) = \text{Area} + 67$$

$$\Rightarrow (x + 3)(y + 2) = xy + 67 \Rightarrow 2x + 3y + 6 = 67$$

$$\Rightarrow 2x + 3y - 61 = 0$$

From (1) and (2), we have $a_1 = 3, b_1 = -5, c_1 = -6$ and $a_2 = 2, b_2 = 3, c_2 = -61$

Using cross-multiplication method, we get

$$\frac{x}{-5} = \frac{y}{-6} = \frac{1}{-61} \Rightarrow \frac{x}{-5} = \frac{y}{-6} = \frac{1}{-61}$$

$$\Rightarrow \frac{x}{-5} = \frac{y}{-6} = \frac{1}{-61} \Rightarrow \frac{x}{-5} = \frac{y}{-6} = \frac{1}{-61}$$

Thus, length of the rectangle = 17 units and breadth of the rectangle = 9 units.

EXERCISE - 3.6

1. (i) Put $\frac{1}{x} = u$ and $\frac{1}{y} = v$

$$\therefore \frac{1}{2x} + \frac{1}{3y} = 2 \Rightarrow \frac{u}{2} + \frac{v}{3} = 2 \quad \dots(1)$$

$$\text{And } \frac{1}{3x} + \frac{1}{2y} = \frac{13}{6} \Rightarrow \frac{u}{3} + \frac{v}{2} = \frac{13}{6} \quad \dots(2)$$

Multiplying (1) by $\frac{1}{3}$ and (2) by $\frac{1}{2}$, we get

$$\frac{1}{3} \left[\frac{u}{2} + \frac{v}{3} = 2 \right] \Rightarrow \frac{u}{6} + \frac{v}{9} = \frac{2}{3} \quad \dots(3)$$

$$\frac{1}{2} \left[\frac{u}{3} + \frac{v}{2} = \frac{13}{6} \right] \Rightarrow \frac{u}{6} + \frac{v}{4} = \frac{13}{12} \quad \dots(4)$$

Subtracting (3) from (4), we get

$$\frac{v}{4} - \frac{v}{9} = \frac{13}{12} - \frac{2}{3} \Rightarrow \frac{9v - 4v}{36} = \frac{13 - 8}{12} \Rightarrow \frac{5}{36}v = \frac{5}{12}$$

$$\Rightarrow v = \frac{5}{12} \times \frac{36}{5} = 3$$

Substituting $v = 3$ in (3), we get

$$\frac{u}{6} + \frac{3}{9} = \frac{2}{3} \Rightarrow \frac{u}{6} = \frac{2}{3} - \frac{3}{9} = \frac{6 - 3}{9} = \frac{3}{9} \Rightarrow u = \frac{3}{9} \times 6 = 2$$

Thus, $u = 2$ and $v = 3$

$$\text{But, } u = \frac{1}{x} \Rightarrow \frac{1}{x} = 2 \Rightarrow x = \frac{1}{2}$$

$$\text{And, } v = \frac{1}{y} \Rightarrow \frac{1}{y} = 3 \Rightarrow y = \frac{1}{3}$$

$$\therefore \text{The required solution is } x = \frac{1}{2}, y = \frac{1}{3}.$$

(ii) We have $\frac{2}{\sqrt{x}} + \frac{3}{\sqrt{y}} = 2 \quad \dots(1)$

$$\frac{4}{\sqrt{x}} - \frac{9}{\sqrt{y}} = -1 \quad \dots(2)$$

Putting $\frac{1}{\sqrt{x}} = u$ and $\frac{1}{\sqrt{y}} = v$, we get

$$2u + 3v - 2 = 0 \quad \dots(3)$$

$$4u - 9v + 1 = 0 \quad \dots(4)$$

Solving (3) and (4) by cross multiplication method, we have

$$\frac{u}{3} = \frac{v}{-2} = \frac{1}{-18 - 12} \Rightarrow \frac{u}{3} = \frac{v}{-2} = \frac{1}{-30}$$

$$\Rightarrow u = \frac{1}{-30} \times (-15) = \frac{1}{2}, v = \frac{1}{-30} \times (-10) = \frac{1}{3}$$

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

$$\therefore \frac{1}{\sqrt{x}} = \frac{1}{2} \Rightarrow \frac{1}{x} = \frac{1}{4} \Rightarrow x = 4$$

$$\text{and } \frac{1}{\sqrt{y}} = \frac{1}{3} \Rightarrow \frac{1}{y} = \frac{1}{9} \Rightarrow y = 9$$

\therefore The required solution is $x = 4, y = 9$.

(iii) We have $\frac{4}{x} + 3y = 14$... (1)

$$\frac{3}{x} - 4y = 23$$
 ... (2)

Let $\frac{1}{x} = u$ in (1) and (2), we get

$$4u + 3y - 14 = 0$$
 ... (3)

$$3u - 4y - 23 = 0$$
 ... (4)

Solving (3) and (4) by cross multiplication method, we have

$$\frac{u}{\begin{array}{r} 3 \times -14 \\ -4 \times -23 \end{array}} = \frac{y}{\begin{array}{r} -14 \times 4 \\ -23 \times 3 \end{array}} = \frac{1}{\begin{array}{r} 4 \times 3 \\ 3 \times -4 \end{array}}$$

$$\Rightarrow \frac{u}{-69 - 56} = \frac{y}{-42 + 92} = \frac{1}{-16 - 9}$$

$$\Rightarrow \frac{u}{-125} = \frac{y}{50} = \frac{1}{-25}$$

$$\Rightarrow u = \frac{1}{-25} \times (-125) = 5$$

$$\text{And } y = \frac{1}{-25} \times 50 = -2$$

$$\text{Since, } u = \frac{1}{x} \therefore \frac{1}{x} = 5 \Rightarrow x = \frac{1}{5}$$

\therefore The required solution is $x = \frac{1}{5}, y = -2$.

(iv) We have, $\frac{5}{x-1} + \frac{1}{y-2} = 2$... (1)

$$\frac{6}{x-1} - \frac{3}{y-2} = 1$$
 ... (2)

Let $\frac{1}{x-1} = u$ and $\frac{1}{y-2} = v$

\therefore Equations (1) and (2) can be expressed as

$$5u + v - 2 = 0$$
 ... (3)

$$6u - 3v - 1 = 0$$
 ... (4)

Solving (3) and (4) by cross multiplication method, we have

$$\frac{u}{\begin{array}{r} 1 \times -2 \\ -3 \times -1 \end{array}} = \frac{v}{\begin{array}{r} -2 \times 5 \\ -1 \times 6 \end{array}} = \frac{1}{\begin{array}{r} 5 \times 1 \\ 6 \times -3 \end{array}}$$

$$\Rightarrow \frac{u}{-1 - 6} = \frac{v}{-12 + 5} = \frac{1}{-15 - 6} \Rightarrow \frac{u}{-7} = \frac{v}{-7} = \frac{1}{-21}$$

$$\therefore u = \frac{1}{(-21)} \times (-7) = \frac{1}{3}, v = \frac{1}{(-21)} \times (-7) = \frac{1}{3}$$

$$\text{But, } u = \frac{1}{x-1} \Rightarrow \frac{1}{x-1} = \frac{1}{3}$$

$$\Rightarrow 3 = x - 1 \Rightarrow x = 4$$

$$\text{And, } v = \frac{1}{y-2} \Rightarrow \frac{1}{y-2} = \frac{1}{3}$$

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

Thus, the required solution is $x = 4, y = 5$.

(v) We have, $\frac{7x-2y}{xy} = 5$... (1)

$$\frac{8x+7y}{xy} = 15$$
 ... (2)

From equation (1), $\frac{7x}{xy} - \frac{2y}{xy} = 5$

$$\Rightarrow \frac{7}{y} - \frac{2}{x} = 5$$
 ... (3)

From equation (2), $\frac{8x}{xy} + \frac{7y}{xy} = 15$

$$\Rightarrow \frac{8}{y} + \frac{7}{x} = 15$$
 ... (4)

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

\therefore Equations (3) and (4) can be expressed as

$$7v - 2u - 5 = 0$$
 ... (5)

$$8v + 7u - 15 = 0$$
 ... (6)

Using cross multiplication method to solve (5) and (6), we get

$$\frac{v}{\begin{array}{r} -2 \times -5 \\ 7 \times -15 \end{array}} = \frac{u}{\begin{array}{r} -5 \times 7 \\ -15 \times 8 \end{array}} = \frac{1}{\begin{array}{r} 7 \times -2 \\ 8 \times 7 \end{array}}$$

$$\Rightarrow \frac{v}{30 + 35} = \frac{u}{-40 + 105} = \frac{1}{49 + 16} \Rightarrow \frac{v}{65} = \frac{u}{65} = \frac{1}{65}$$

$$\therefore u = \frac{1}{65} \times 65 = 1, v = \frac{1}{65} \times 65 = 1$$

$$\text{Since, } u = \frac{1}{x} \Rightarrow \frac{1}{x} = 1 \Rightarrow x = 1$$

$$\text{and } v = \frac{1}{y} \Rightarrow \frac{1}{y} = 1 \Rightarrow y = 1$$

Thus, the required solution is $x = 1, y = 1$.

(vi) We have, $6x + 3y = 6xy$... (1)

$$2x + 4y = 5xy$$
 ... (2)

From (1), we get

$$\frac{6x}{xy} + \frac{3y}{xy} = \frac{6xy}{xy} \Rightarrow \frac{6}{y} + \frac{3}{x} = 6$$
 ... (3)

From (2), we get

$$\frac{2x}{xy} + \frac{4y}{xy} = \frac{5xy}{xy} \Rightarrow \frac{2}{y} + \frac{4}{x} = 5$$
 ... (4)

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

\therefore (3) and (4) can be expressed as

$$6v + 3u = 6$$
 ... (5)

$$2v + 4u = 5$$
 ... (6)

Multiplying (6) by 3, we get

$$6v + 12u = 15$$
 ... (7)

Subtracting (5) from (7), we get $9u = 9 \Rightarrow u = 1$

Substituting $p = 1$ in (5), we get $6v + 3(1) = 6$

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

$$\text{Since, } u = \frac{1}{x} \Rightarrow \frac{1}{x} = 1 \Rightarrow x = 1$$

$$\text{and } v = \frac{1}{y} \Rightarrow \frac{1}{y} = \frac{1}{2} \Rightarrow y = 2$$

Thus, the required solution is $x = 1, y = 2$.

$$\text{(vii) We have, } \frac{10}{x+y} + \frac{2}{x-y} = 4 \quad \dots(1)$$

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

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

\therefore Equations (1) and (2) can be expressed as

$$10u + 2v - 4 = 0 \quad \dots(3)$$

$$15u - 5v + 2 = 0 \quad \dots(4)$$

Solving (3) and (4) by cross-multiplication method, we get

$$\begin{array}{ccc} \frac{u}{2 \times -4 - (-5) \times 10} = \frac{v}{-4 \times 10 - 15 \times 2} = \frac{1}{10 \times -5 - 15 \times -2} \\ \Rightarrow \frac{u}{-2 - 40} = \frac{v}{-40 - 30} = \frac{1}{-50 + 30} \\ \Rightarrow \frac{u}{-42} = \frac{v}{-70} = \frac{1}{-20} \end{array}$$

$$\therefore u = \frac{1}{(-80)} \times (-16) = \frac{1}{5} \text{ and } v = \frac{1}{(-80)} \times (-80) = 1$$

$$\text{But, } u = \frac{1}{x+y} = \frac{1}{5} \Rightarrow x+y = 5 \quad \dots(5)$$

$$\text{And } v = \frac{1}{x-y} = 1 \Rightarrow x-y = 1 \quad \dots(6)$$

Adding (5) and (6), we have

$$2x = 6 \Rightarrow x = 3$$

From (5), $3 + y = 5 \Rightarrow y = 2$

Thus, the required solution is $x = 3, y = 2$.

$$\text{(viii) We have, } \frac{1}{(3x+y)} + \frac{1}{(3x-y)} = \frac{3}{4} \quad \dots(1)$$

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

$$\text{Let } \frac{1}{(3x+y)} = u \text{ and } \frac{1}{(3x-y)} = v$$

\therefore (1) and (2) can be expressed as

$$u + v = \frac{3}{4} \quad \dots(3)$$

$$\frac{u}{2} - \frac{v}{2} = -\frac{1}{8} \quad \dots(4)$$

Multiplying equation (3) by $1/2$, we get

$$\frac{u}{2} + \frac{v}{2} = \frac{3}{8} \quad \dots(5)$$

Adding (4) and (5), we get

$$\left(\frac{u}{2} + \frac{v}{2}\right) = \left(\frac{3}{8} - \frac{1}{8}\right) \Rightarrow u = \frac{2}{8} = \frac{1}{4}$$

$$\text{From (3), } \frac{1}{4} + v = \frac{3}{4} \Rightarrow v = \frac{3}{4} - \frac{1}{4} = \frac{2}{4} = \frac{1}{2}$$

$$\text{But, } u = \frac{1}{3x+y} \Rightarrow \frac{1}{3x+y} = \frac{1}{4} \Rightarrow 3x+y = 4 \quad \dots(6)$$

$$\text{And } v = \frac{1}{3x-y} \Rightarrow \frac{1}{3x-y} = \frac{1}{2} \Rightarrow 3x-y = 2 \quad \dots(7)$$

Adding (6) and (7), we get

$$6x = 6 \Rightarrow x = 1$$

Subtracting (7) from (6), we get

$$2y = 2 \Rightarrow y = 1$$

Thus, the required solution is $x = 1, y = 1$.

2. (i) Let the speed of rowing in still water = x km/hr and the speed of the water current = y km/hr.

\therefore Downstream speed = $(x + y)$ km/hr

Upstream speed = $(x - y)$ km/hr

According to the question,

$$2 = \frac{20}{x+y} \quad \left[\because \text{Time} = \frac{\text{Distance}}{\text{Speed}} \right] \Rightarrow x+y = 10 \quad \dots(1)$$

$$\text{and } 2 = \frac{4}{x-y} \Rightarrow x-y = 2 \quad \dots(2)$$

Adding (1) and (2), we get

$$2x = 12 \Rightarrow x = \frac{12}{2} = 6$$

From (1), $6 + y = 10$

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

Thus, speed of rowing in still water = 6 km/hr, speed of water current = 4 km/hr

(ii) Let the time taken to finish the task by one woman alone = x days and by one man alone = y days.

\therefore one woman's 1 day work = $1/x$

one man's 1 day work = $1/y$

Since, [2 women + 5 men] finish the task in 4 days

$$\therefore 4 \times \left[\frac{2}{x} + \frac{5}{y} \right] = 1 \Rightarrow \frac{2}{x} + \frac{5}{y} = \frac{1}{4} \quad \dots(1)$$

Again, 3 women + 6 men, finish the task in 3 days

$$\therefore 3 \times \left[\frac{3}{x} + \frac{6}{y} \right] = 1 \Rightarrow \frac{3}{x} + \frac{6}{y} = \frac{1}{3} \quad \dots(2)$$

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

\therefore Equations (1) and (2) can be expressed as

$$2u + 5v = \frac{1}{4} \Rightarrow 8u + 20v - 1 = 0$$

$$3u + 6v = \frac{1}{3} \Rightarrow 9u + 18v - 1 = 0$$

Comparing these equations with $a_1x + b_1y + c_1 = 0$ and $a_2x + b_2y + c_2 = 0$, we get

$$a_1 = 8, b_1 = 20, c_1 = -1,$$

$$a_2 = 9, b_2 = 18, c_2 = -1$$

Using cross multiplication method, we get

$$\frac{u}{\begin{array}{c} 20 \times -1 \\ 18 \times -1 \end{array}} = \frac{v}{\begin{array}{c} -1 \times 8 \\ -1 \times 9 \end{array}} = \frac{1}{\begin{array}{c} 8 \times 20 \\ 9 \times 18 \end{array}}$$

$$\Rightarrow \frac{u}{-20+18} = \frac{v}{-9+8} = \frac{1}{144-180}$$

$$\Rightarrow \frac{u}{-2} = \frac{v}{-1} = \frac{1}{-36}$$

$$\therefore u = \frac{1}{-36} \times (-2) = \frac{1}{18}, v = \frac{1}{-36} \times (-1) = \frac{1}{36}$$

$$\text{Since, } u = \frac{1}{x} \Rightarrow \frac{1}{x} = \frac{1}{18} \Rightarrow x = 18$$

$$\text{and } v = \frac{1}{y} \Rightarrow \frac{1}{y} = \frac{1}{36} \Rightarrow y = 36$$

\therefore One man can finish the work in 36 days and one woman can finish the work in 18 days.

(iii) Let the speed of the train = x km/hr and the speed of the bus = y km/hr

Case I : Total journey = 300 km

\therefore Journey travelled by train = 60 km

\therefore Journey travelled by bus = $(300 - 60)$ km = 240 km

\therefore Total time taken = 4 hours

$$\therefore \frac{60}{x} + \frac{240}{y} = 4$$

$$\Rightarrow \frac{1}{x} + \frac{4}{y} = \frac{1}{15} \quad \dots(1)$$

Case II : Distance travelled by train = 100 km

Distance travelled by bus = $(300 - 100)$ km = 200 km

Total time taken = 4 hrs 10 mins = $\left(4 + \frac{10}{60}\right)$ hrs = $\frac{25}{6}$ hrs

$$\therefore \frac{100}{x} + \frac{200}{y} = \frac{25}{6}$$

$$\Rightarrow \frac{4}{x} + \frac{8}{y} = \frac{1}{6} \quad \dots(2)$$

Multiplying (1) by 4, we get

$$\frac{4}{x} + \frac{16}{y} = \frac{4}{15} \quad \dots(3)$$

Subtracting (3) from (2), we get

$$\frac{8}{y} - \frac{16}{y} = \frac{1}{6} - \frac{4}{15} \Rightarrow \frac{-8}{y} = \frac{5-8}{30} = \frac{-3}{30}$$

$$\Rightarrow \frac{1}{y} = \frac{-3}{30} \times \frac{1}{(-8)} = \frac{1}{80} \Rightarrow y = 80$$

$$\text{From (1), } \frac{1}{x} + \frac{4}{80} = \frac{1}{15}$$

$$\Rightarrow \frac{1}{x} = \frac{1}{15} - \frac{4}{80} = \frac{1}{15} - \frac{1}{20} \Rightarrow \frac{1}{x} = \frac{4-3}{60} = \frac{1}{60}$$

$$\therefore x = 60$$

Thus, speed of the train = 60 km/hr and speed of the bus = 80 km/hr.

EXERCISE - 3.7

1. Let the age of Ani = x years

and the age of Biju = y years

Case I : $y > x$

According to 1st condition : $y - x = 3$...(1)

Now, [Age of Ani's father] = 2[Age of Ani] = $2x$ years

Also, [Age of Biju's sister] = $\frac{1}{2}$ [Age of Biju] = $\frac{1}{2}y$

According to 2nd condition : $2x - \frac{1}{2}y = 30$

$$\Rightarrow 4x - y = 60 \quad \dots(2)$$

Adding (1) and (2), we get

$$y - x + 4x - y = 63$$

$$\Rightarrow 3x = 63 \Rightarrow x = \frac{63}{3} = 21$$

Substituting the value of x in equation (1),

$$\text{we get } y - 21 = 3 \Rightarrow y = 3 + 21 = 24$$

\therefore Age of Ani = 21 years

Age of Biju = 24 years

Case II : $x > y$

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

According to the condition : $2x - \frac{1}{2}y = 30$

$$\Rightarrow 4x - y = 60 \quad \dots(2)$$

Subtracting, (1) from (2), we get

$$4x - y - x + y = 60 - 3$$

$$\Rightarrow 3x = 57 \Rightarrow x = \frac{57}{3} = 19$$

Substituting the value of x in equation (1), we get

$$19 - y = 3 \Rightarrow y = 16$$

\therefore Age of Ani = 19 years

Age of Biju = 16 years

2. Let the capital of 1st friend = ₹ x ,

and the capital of 2nd friend = ₹ y

According to the condition,

$$x + 100 = 2(y - 100)$$

$$\Rightarrow x + 100 - 2y + 200 = 0 \Rightarrow x - 2y + 300 = 0 \quad \dots(1)$$

$$\text{Also, } 6(x - 10) = y + 10 \Rightarrow 6x - y - 70 = 0 \quad \dots(2)$$

$$\text{From (1), } x = -300 + 2y \quad \dots(3)$$

Substituting the value of x in equation (2), we get

$$6[-300 + 2y] - y - 70 = 0$$

$$\Rightarrow -1870 + 11y = 0 \Rightarrow y = \frac{1870}{11} = 170$$

Now, Substituting the value of y in equation (3), we get,

$$x = -300 + 2y$$

$$= -300 + 2(170) = -300 + 340 = 40$$

Thus, 1st friend has ₹ 40 and the 2nd friend has ₹ 170.

3. Let the actual speed of the train = x km/hr

and the actual time taken = y hours

\therefore Distance = speed \times time

According to 1st condition : $(x + 10) \times (y - 2) = xy$

$$\Rightarrow xy - 2x + 10y - 20 = xy$$

$$\Rightarrow 2x - 10y + 20 = 0 \quad \dots(1)$$

According to 2nd condition : $(x - 10) \times (y + 3) = xy$

$$\Rightarrow xy + 3x - 10y - 30 = xy$$

$$\Rightarrow 3x - 10y - 30 = 0 \quad \dots(2)$$

Using cross multiplication for solving (1) and (2), we get

$$\frac{x}{-10 \times 20} = \frac{y}{20 \times 2} = \frac{1}{2 \times -10}$$

$$\Rightarrow \frac{x}{300 + 200} = \frac{y}{60 + 60} = \frac{1}{-20 + 30} \Rightarrow \frac{x}{500} = \frac{y}{120} = \frac{1}{10}$$

$$\Rightarrow x = \frac{1}{10} \times 500 = 50, y = \frac{1}{10} \times 120 = 12$$

Thus, the distance covered by the train
= $50 \times 12 \text{ km} = 600 \text{ km}$

4. Let the number of students = x

and the number of rows = y

\therefore Number of students in each row

$$= \frac{\text{Number of students}}{\text{Number of rows}} = \frac{x}{y}$$

According to 1st condition : $\left(\frac{x}{y} + 3\right) \times (y - 1) = x$

[\therefore Number of students in a row \times Number of rows
= Number of students]

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

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

Also, according to 2nd condition :

$$\left(\frac{x}{y} - 3\right) \times (y + 2) = x$$

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

$$\Rightarrow \frac{2x}{y} - 3y - 6 = 0 \quad \dots(2)$$

$$\text{Let } \frac{x}{y} = p$$

\therefore Equation (1) and (2) can be expressed as :

$$p - 3y + 3 = 0 \quad \dots(3)$$

$$\text{and } 2p - 3y - 6 = 0 \quad \dots(4)$$

Subtracting (3) from (4), we get

$$2p - 3y - 6 - p + 3y - 3 = 0$$

$$\Rightarrow p - 9 = 0 \Rightarrow p = 9$$

Substituting value of p in equation (3), we get,

$$9 - 3y + 3 = 0 \Rightarrow -3y = -12$$

$$\Rightarrow y = \frac{-12}{-3} = 4$$

$$\text{We have, } \frac{x}{y} = 9 \quad [\because p = 9]$$

$$\therefore \frac{x}{4} = 9 \Rightarrow x = 4 \times 9 = 36$$

Thus, number of students in the class, $x = 36$

5. \therefore Sum of angles of a triangle = 180°

$$\therefore \angle A + \angle B + \angle C = 180^\circ \quad \dots(1)$$

$$\therefore \angle C = 3\angle B = 2(\angle A + \angle B) \quad \dots(2)$$

From (1) and (2), we have

$$\angle A + \angle B + 2(\angle A + \angle B) = 180^\circ$$

$$\Rightarrow \angle A + \angle B + 2\angle A + 2\angle B = 180^\circ$$

$$\Rightarrow \angle A + \angle B = 60^\circ \quad \dots(3)$$

$$\text{Also, } \angle A + \angle B + 3\angle B = 180^\circ$$

$$\Rightarrow \angle A + 4\angle B = 180^\circ \quad \dots(4)$$

Subtracting (3) from (4), we get

$$\angle A + 4\angle B - \angle A - \angle B = 180^\circ - 60^\circ$$

$$\Rightarrow 3\angle B = 120^\circ \Rightarrow \angle B = \frac{120^\circ}{3} = 40^\circ$$

Substituting $\angle B = 40^\circ$ in (4) we get,

$$\angle A + 4(40^\circ) = 180^\circ$$

$$\Rightarrow \angle A = 180^\circ - 160^\circ = 20^\circ$$

$$\therefore \angle C = 3\angle B = 3 \times 40^\circ = 120^\circ$$

Thus, $\angle A = 20^\circ$, $\angle B = 40^\circ$ and $\angle C = 120^\circ$.

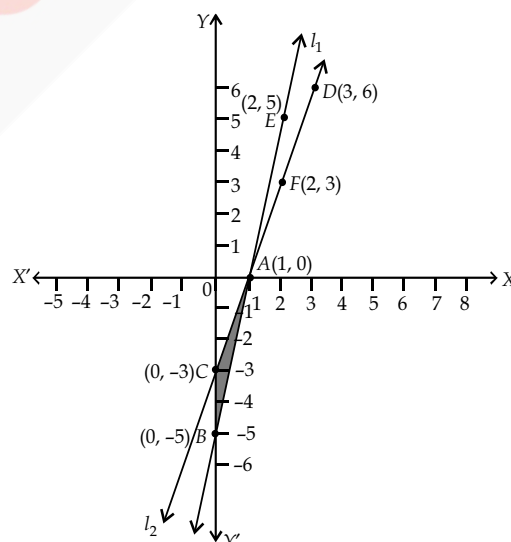
6. To draw the graph of $5x - y = 5$, we get

x	1	2	0
y	0	5	-5

and for equation $3x - y = 3$, we get

x	2	3	0
y	3	6	-3

Plotting the points (1, 0), (2, 5) and (0, -5), we get a straight line l_1 . Plotting the points (2, 3), (3, 6) and (0, -3), we get a straight line l_2 .



From the figure, obviously, the vertices of the triangle formed are A(1, 0), B(0, -5) and C(0, -3).

$$7. \text{ (i) We have, } px + qy = p - q \quad \dots(1)$$

$$qx - py = p + q \quad \dots(2)$$

Multiplying (1) by p and (2) by q , we get

$$p^2x + qpy = p^2 - pq \quad \dots(3)$$

$$q^2x - pqy = q^2 + pq \quad \dots(4)$$

Adding (3) and (4), we get

$$p^2x + q^2x = p^2 + q^2$$

$$\Rightarrow (p^2 + q^2)x = p^2 + q^2$$

$$\Rightarrow x = \frac{p^2 + q^2}{p^2 + q^2} = 1$$

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

$$p(1) + qy = p - q \Rightarrow p + qy = p - q$$

$$\Rightarrow y = -1$$

Thus, the required solution is $x = 1, y = -1$

(ii) We have, $ax + by = c \Rightarrow ax + by - c = 0$

$$bx + ay = (1 + c) \Rightarrow bx + ay - (1 + c) = 0$$

By cross multiplication, we have

$$\frac{x}{\begin{array}{cc} b & -c \\ a & -(1+c) \end{array}} = \frac{y}{\begin{array}{cc} -c & a \\ -(1+c) & b \end{array}} = \frac{1}{\begin{array}{cc} a & b \\ b & a \end{array}}$$

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

$$\therefore x = \frac{-b - bc + ac}{a^2 - b^2}, y = \frac{-bc + a + ac}{a^2 - b^2}$$

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

(iii) We have, $\frac{x}{a} - \frac{y}{b} = 0$

$$ax + by = a^2 + b^2$$

From (1), we have

$$\frac{x}{a} = \frac{y}{b} \Rightarrow y = \left(\frac{x}{a} \times b\right)$$

Substituting $y = \left(\frac{b}{a}x\right)$ in (2), we have

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

$$\Rightarrow x\left[\frac{a^2 + b^2}{a}\right] = a^2 + b^2 \Rightarrow x = \frac{a^2 + b^2}{a^2 + b^2} \times a \Rightarrow x = a$$

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

$$y = \frac{a}{a} \times b \Rightarrow y = b$$

Thus, the required solution is $x = a, y = b$.

(iv) We have,

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

$$(a + b)(x + y) = a^2 + b^2$$

From (2),

$$(a + b)x + (a + b)y = a^2 + b^2$$

Subtracting (3) from (1), we get

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

$$\Rightarrow x[a - b - a - b] = -2ab - 2b^2$$

$$\Rightarrow x(-2b) = -2b(a + b)$$

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

Substituting $x = (a + b)$ in (1), we get

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

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

$$\Rightarrow (a + b)y = -2ab \Rightarrow y = \frac{-2ab}{(a + b)}$$

Thus, the required solution is

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

...(1)

...(2)

(v) We have, $152x - 378y = -74$

...(1)

$$-378x + 152y = -604$$

...(2)

Adding (1) and (2), we have

$$-226x - 226y = -678$$

$$\Rightarrow x + y = 3$$

...(3)

Subtracting (1) from (2), we get

$$-530x + 530y = -530$$

$$\Rightarrow -x + y = -1$$

$$\Rightarrow x - y = 1$$

...(4)

Adding (3) and (4), we get

$$2x = 4 \Rightarrow x = 2$$

Subtracting (3) from (4), we get

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

...(2)

Thus, the required solution is $x = 2$ and $y = 1$

8. $\therefore ABCD$ is a cyclic quadrilateral.

...(3)

$$\therefore \angle A + \angle C = 180^\circ \text{ and } \angle B + \angle D = 180^\circ$$

$$\Rightarrow [4y + 20^\circ] + [-4x] = 180^\circ$$

$$\Rightarrow 4y - 4x + 20^\circ - 180^\circ = 0 \Rightarrow 4y - 4x - 160^\circ = 0$$

$$\Rightarrow y - x - 40^\circ = 0$$

...(1)

$$\text{And } [3y - 5^\circ] + [-7x + 5^\circ] = 180^\circ$$

$$\Rightarrow 3y - 5^\circ - 7x + 5^\circ - 180^\circ = 0$$

$$\Rightarrow 3y - 7x - 180^\circ = 0$$

...(2)

Multiplying (1) by 7, we get

$$7y - 7x - 280^\circ = 0$$

...(3)

Subtracting (3) from (2), we get

$$3y - 7x - 180^\circ - 7y + 7x + 280^\circ = 0$$

$$\Rightarrow -4y + 100^\circ = 0 \Rightarrow y = \frac{-100^\circ}{-4} = 25^\circ$$

...(1)

Now, substituting $y = 25^\circ$ in (1), we get

...(2)

$$-x = 40^\circ - 25^\circ = 15^\circ$$

$$\Rightarrow x = -15^\circ$$

...(3)

$$\therefore \angle A = 4y + 20^\circ = 4(25^\circ) + 20^\circ = 100^\circ + 20^\circ = 120^\circ$$

$$\angle B = 3y - 5^\circ = 3(25^\circ) - 5^\circ = 75^\circ - 5^\circ = 70^\circ$$

$$\angle C = -4x = -4(-15^\circ) = 60^\circ,$$

$$\angle D = -7x + 5^\circ = -7(-15^\circ) + 5^\circ = 105^\circ + 5^\circ = 110^\circ$$

Thus, $\angle A = 120^\circ, \angle B = 70^\circ, \angle C = 60^\circ, \angle D = 110^\circ$.

