EXERCISE 3.3

Question 1:

Solve the following pairs of linear equations by the elimination method:

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

(ii) $3x + 4y = 10$ and $2x - 2y = 2$

(iii) $3x - 5y - 4 = 0$ and $9x = 2y + 7$

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

Solution:

(i) By Elimination Method:

Fquations are $x + y = 5$

and $2x - 3y = 4$

Multiply equation (i) by 2 and subtract equation (ii) from it, we have

$$\begin{array}{rrrr} & 2x + 2y & = & 10 \\ & 2x - 3y & = & 4 \\ - & + & - & \\ \hline & 5y & = & 6 \end{array}$$

$$\Rightarrow \quad y = \frac{6}{5}$$

Putting this value in equation (i), we get

$$x + \frac{6}{5} = 5$$

$$x = 5 - \frac{6}{5} = \frac{25 - 6}{5} \Rightarrow \boxed{x = \frac{19}{5}}$$

By Substitution Method:

Equations are $x + y = 5$ ... (i)

and $2x - 3y = 4$ ... (ii)

From equation (i)

$$x = 5 - y$$

Putting this value in equation (ii), we have

$$2(5 - y) - 3y = 4 \quad \Rightarrow 10 - 2y - 3y = 4$$

$$\Rightarrow \quad 10 - 5y = 4 \quad \Rightarrow 6 = 5y \Rightarrow \boxed{y = \frac{6}{5}}$$

Putting the value of y in equation (i), we get

$$x + \frac{6}{5} = 5 \quad \Rightarrow x = 5 - \frac{6}{5} \Rightarrow \boxed{x = \frac{19}{5}}$$

(ii) By Elimination method:

Equations are $3x + 4y = 10$

and $2x - 2y = 2$

Multiplying equation (ii) by 2 and adding to equation (i), we

$$\begin{array}{r} 3x + 4y = 10 \\ 4x - 4y = 4 \\ \hline 7x = 14 \end{array}$$

$$\Rightarrow \quad \boxed{x = 2}$$

Now, putting the value of x in equation (i), we get

$3(2) + 4y = 10 \quad \Rightarrow 6 + 4y = 10$

$\Rightarrow \quad 4y = 4 \quad \Rightarrow \boxed{y = 1}$

By Substitution Method:

Equations are

$3x + 4y = 10$ ... (i)

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

From equation (i)

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

Putting this value in equation (ii), we get

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

$$\Rightarrow \quad \frac{10 - 4y}{3} - y = 1$$ [on putting the value of x]

$\Rightarrow \quad 10 - 4y - 3y = 3 \quad \Rightarrow 7 = 7y \Rightarrow \boxed{y = 1}$

Putting $y = 1$ in equation (i), we get

$3x + 4 \times 1 = 10 \quad \Rightarrow 3x = 6 \Rightarrow \boxed{x = 2}$

(iv) x/2 + 2y/3 = -1 and x-y/3 = 3

By the method of Elimination.

3x + 4y = -6 ..... (i)

x-y/3 = 3

3x – y = 9 ..... (ii)

When the equation (ii) is subtracted from equation (i) we get,

5y = -15

y = -3 .....(iii)

When the equation (iii) is substituted in (i) we get,

3x – 12 = -6

3x = 6

x = 2

Hence, x = 2 , y = -3

By the method of Substitution:

From the equation (ii) we get,

x = (y+9)/3.....(v)

Putting the value obtained from equation (v) in equation (i) we get,

3(y+9)/3 +4y =−6

5y = -15

y = -3

When y = -3 is substituted in equation (v) we get,

x = (-3+9)/3 = 2

Therefore, x = 2 and y = -3

Question 3:

Form the pair of linear equations for the following problems and find their solution by substitution method:

(i) If we add 1 to the numerator and subtract 1 from the denominator, a fraction reduces to 1. It becomes 1/2, if we only add 1 to the denominator. What is the fraction?.

(ii) Five years ago, Nuri was thrice as old as Sonu. Ten years later, Nuri will be twice as old as Sonu. How old are Nuri and Sonu?

(iii) The sum of the digits of a two-digit number is 9. Also, nine times this number is twice the number obtained by reversing the order of the digits. Find the number.

(iv) Meena went to a bank to withdraw ₹2000. She asked the cashier to give her ₹50 and ₹100 notes only. Meena got 25 notes in all. Find how many notes of ₹50 and ₹100 she received.

(v) A lending library has a fixed charge for the first three days and an additional charge for each day thereafter. Saritha paid ₹ 27 for a book kept for seven days, while Susy paid ₹21 for the book she kept for five days. Find the fixed charge and the charge for each extra day.

Solutions:

(i) Let the fraction be $\frac{x}{y}$.

Then according to the question, we have:

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

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

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

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

$$\Rightarrow \quad 2x = y + 1$$

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

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

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

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

$$3 - y = -2$$

$$\Rightarrow \quad y = 5$$

Thus, the fraction is $\frac{3}{5}$.

(ii) Let the present ages of Nuri and Sonu be x years and y years respectively.

Five years ago,

Nuri's age was $(x - 5)$ years.

Sonu's age was $(y - 5)$ years.

According to the first condition, we have:

$$x - 5 = 3(y - 5)$$
$$\Rightarrow \quad x - 5 = 3y - 15$$
$$\Rightarrow \quad x - 3y = 5 - 15$$
$$\Rightarrow \quad x - 3y = -10 \qquad \ldots(1)$$

Ten years later,

Nuri's age will be $(x + 10)$ years.

Sonu's age will be $(y + 10)$ years.

According to the second condition, we have:

$$x + 10 = 2(y + 10)$$
$$\Rightarrow \quad x + 10 = 2y + 20$$
$$\Rightarrow \quad x - 2y = 20 - 10$$
$$\Rightarrow \quad x - 2y = 10 \qquad \ldots(2)$$

Subtracting equation (1) from eqution (2), we get:

$$\begin{array}{rrrr} \cancel{x} & - 2y & = & 10 \\ \cancel{x} & - 3y & = & -10 \\ - & + & & + \\ \hline & y & = & 20 \end{array}$$

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

$$x - 2 \times 20 = 10$$
$$\Rightarrow \quad x - 40 = 10$$
$$\Rightarrow \quad x = 50.$$

Hence, the present ages of Nuri and Sonu are **50 years** and **20 years** respectively.

(iii) Let the digit at ones place be x and the digit at tens place be y.

Then, the two-digit number $= 10y + x$.

New number formed on reversing the digits

$$= 10x + y$$

According to the first condition, we have:

$$x + y = 9 \qquad \ldots(1)$$

According to the second condition, we have:

$$9 \times (10y + x) = 2(10x + y)$$

$$\Rightarrow \quad 90y + 9x = 20x + 2y$$

$$\Rightarrow \quad 11x = 88y$$

$$\Rightarrow \quad x = \frac{88}{11}y$$

$$\Rightarrow \quad x = 8y \qquad \ldots(2)$$

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

$$8y + y = 9$$

$$\Rightarrow \quad 9y = 9$$

$$\Rightarrow \quad y = 1$$

Now substituting the value of y in equation (2), we get:

$$x = 8 \times 1 = 8.$$

Hence, the required number is $10 \times 1 + 8 = \mathbf{18}$.

(iv) Let the number of 50-rupee notes be x and that of 100-rupee notes be y.

Then according to the question, we have:

$$x + y = 25 \qquad \ldots(1)$$

and $50x + 100y = 2000$

$$\Rightarrow \quad x + 2y = 40 \qquad \ldots(2)$$

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

$$2y - y = 40 - 25$$

$$\Rightarrow \quad y = 15$$

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

$$x + 15 = 25$$

$$\Rightarrow \quad x = 10.$$

Hence, the number of 50-rupee notes is **10** and of 100-rupee notes is **15**.

(v) Let the fixed charge be ₹ x

and additional charge per day be ₹ y.

Then according to the question, we have:

$$x + 4y = 27 \qquad \ldots(1)$$

and $\quad x + 2y = 21 \qquad \ldots(2)$

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

$$4y - 2y = 27 - 21$$

$$\Rightarrow \quad 2y = 6$$

$$\Rightarrow \quad y = 3$$

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

$$x + 4 \times 3 = 27$$

$$\Rightarrow \quad x = 27 - 12 = 15.$$

Hence, fixed charge for first three days and additional charge per extra day are **₹ 15** and **₹ 3** respectively.