

Mathematics

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(Chapter 3) (Pair of Linear Equations in two variables)

(Class 10)

Exercise 3.4

Question 1:

Solve the following pair of linear equations by the elimination method and the substitution 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 $x - \frac{y}{3} = 3$

Answer 1:

(i) $x + y = 5$... (1)

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

Multiply equation (1) by 2 and subtracting from equation (2), we get

$$\begin{array}{r} 2x - 3y = 4 \\ 2x + 2y = 10 \\ \hline -5y = -6 \\ \Rightarrow y = \frac{6}{5} \end{array}$$

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

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

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

(ii) $3x + 4y = 10$... (1)

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

Multiply equation (2) by 2 and adding with equation (1), we get

$$\begin{array}{r} 3x + 4y = 10 \\ 4x - 4y = 4 \\ \hline 7x = 14 \\ \Rightarrow x = \frac{14}{7} = 2 \end{array}$$

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

$$3(2) + 4y = 10 \Rightarrow 4y = 4 \Rightarrow y = 1$$

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

(iii) $3x - 5y - 4 = 0$... (1)

$9x - 2y = 7$... (2)

Multiply equation (1) by 3 and subtracting from equation (2), we get

$$\begin{array}{r} 9x - 2y = 7 \\ 9x - 15y = 12 \\ \hline -13y = -5 \\ \Rightarrow y = -\frac{5}{13} \end{array}$$

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

$$9x - 2\left(-\frac{5}{13}\right) = 7 \Rightarrow 9x = 7 - \frac{10}{13} = \frac{81}{13} \Rightarrow x = \frac{9}{13}$$

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

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

$\Rightarrow 3x + 4y = -6$... (1)

and $x - \frac{y}{3} = 3 \Rightarrow 3x - y = 9$... (2)

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

$$\begin{array}{r} 3x + 4y = -6 \\ 3x - y = 9 \\ \hline - \quad + \quad - \\ \quad 5y = -15 \\ \Rightarrow y = -3 \end{array}$$

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

$$3x + 4(-3) = -6 \Rightarrow 3x = 6 \Rightarrow x = 2$$

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

Question 2:

Form the pair of linear equations in the following problems, and find their solutions (if they exist) by the elimination method:

- If we add 1 to the numerator and subtract 1 from the denominator, a fraction reduces to 1. It becomes $\frac{1}{2}$ if we only add 1 to the denominator. What is the fraction?
- 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?
- 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.
- 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.
- 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.

Answer 2:

(i) Let the numerator = x

Let the denominator = y

Therefore, the fraction = $\frac{x}{y}$

According to first condition,

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

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

According to second condition,

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

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

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

Multiply equation (1) by 2 and subtracting from equation (2), we get

$$\begin{array}{r} 2x - y = 1 \\ 2x - 2y = -4 \\ \hline - \quad + \quad + \\ \quad y = 5 \end{array}$$

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

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

Hence, the fraction = $\frac{x}{y} = \frac{3}{5}$.

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(ii) Let the age of Nuri = x years

Let the age of Sonu = y years

5 years ago, age of Nuri = $x - 5$ years and age of Sonu = $y - 5$ years

According to question,

$$\begin{aligned}x - 5 &= 3(y - 5) &\Rightarrow x - 5 &= 3y - 15 \\ \Rightarrow x - 3y &= -10 && \dots (1)\end{aligned}$$

After 10 years,

Age of Nuri = $x + 10$ years

Age of Sonu = $y + 10$ years

According to question,

$$\begin{aligned}x + 10 &= 2(y + 10) &\Rightarrow x + 10 &= 2y + 20 \\ \Rightarrow x - 2y &= 10 && \dots (2)\end{aligned}$$

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

$$\begin{array}{r}x - 3y = -10 \\ x - 2y = 10 \\ \hline - \quad + \quad - \\ \quad \quad \quad -y = -20 \\ \Rightarrow y = 20\end{array}$$

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

$$x - 3(20) = -10 \Rightarrow x = 50$$

Hence, age of Nuri is 50 years age of Sonu is 20 years.

(iii) Let the one's place = x and let the ten's place = y

Therefore, the number = $10y + x$

Sum of digits is 9, therefore

$$x + y = 9 \quad \dots (1)$$

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

According to question,

$$\begin{aligned}9(10y + x) &= 2(10x + y) &\Rightarrow 90y + 9x &= 20x + 2y &\Rightarrow 11x - 88y = 0 \\ \Rightarrow x - 8y &= 0 && \dots (2)\end{aligned}$$

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

$$\begin{array}{r}x + y = 9 \\ x - 8y = 0 \\ \hline - \quad + \quad - \\ \quad \quad \quad 9y = 9 \\ \Rightarrow y = 1\end{array}$$

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

$$x + 1 = 9 \Rightarrow x = 8$$

Therefore, the number = $10y + x = 10(1) + 8 = 18$

Hence, the two digit number is 18.

(iv) Let the number of notes of ₹50 = x

Let the number of notes of ₹100 = y

Total number of notes is 25, therefore

$$x + y = 25 \quad \dots (1)$$

The total amount of ₹50 and ₹100 is ₹2000, therefore

$$\begin{aligned}50x + 100y &= 2000 \\ \Rightarrow x + 2y &= 40 && \dots (2)\end{aligned}$$

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

$$\begin{array}{r} x + y = 25 \\ x + 2y = 40 \\ \hline -y = -15 \\ \Rightarrow y = 15 \end{array}$$

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

$$x + 15 = 25 \Rightarrow x = 10$$

Hence, the number of ₹50 notes is 10 and the number of ₹100 is 15.

(v) Let the charge for first three days = ₹ x

Let the additional charge for each day = ₹ y

Charge for seven days is ₹27, therefore

$$x + 4y = 27 \quad \dots (1)$$

Charge for 5 days is ₹21, therefore

$$x + 2y = 21 \quad \dots (2)$$

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

$$\begin{array}{r} x + 4y = 27 \\ x + 2y = 21 \\ \hline 2y = 6 \\ \Rightarrow y = 3 \end{array}$$

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

$$x + 4(3) = 27 \Rightarrow x = 15$$

Hence, the fixed charge is ₹15 and the additional charge for each day is ₹3.

