CBSE Class–10 Mathematics

NCERT solution

Chapter - 3

Pair of Linear Equations in Two Variables - Exercise 3.3

1. Solve the following pair of linear equations by the substitution method.

(i) $x + y = 14$

$x - y = 4$

(ii) $s - t = 3$

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

(iii) $3x - y = 3$

$9x - 3y = 9$

(iv) $0.2x + 0.3y = 1.3$

$0.4x + 0.5y = 2.3$

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

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

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

$$\frac{x}{3}+\frac{y}{2}=\frac{13}{6}$$

Ans. (i) $x + y = 14$ ...(1)

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

$x = 4 + y$ from equation (2)

Putting this in equation (1), we get

$4 + y + y = 14$

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

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

$x + 5 = 14$

$\Rightarrow x = 14 - 5 = 9$

Therefore, $x = 9$ and $y = 5$

(ii) $s - t = 3$ ... (1)

$$\frac{s}{3} + \frac{t}{2} = 6 \text{ ...(2)}$$

Using equation (1), we can say that $s = 3 + t$

Putting this in equation (2), we get

$$\frac{3+t}{3} + \frac{t}{2} = 6$$

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

$\Rightarrow 5t + 6 = 36$

$\Rightarrow 5t = 30 \Rightarrow t = 6$

Putting value of t in equation (1), we get

$s - 6 = 3 \Rightarrow s = 3 + 6 = 9$

Therefore, $t = 6$ and $s = 9$

(iii) $3x - y = 3$ ... (1)

$9x - 3y = 9$ ... (2)

Comparing equation $3x - y = 3$ with $a_1x+b_1y+c_1 = 0$ and equation $9x - 3y = 9$ with $a_2x+b_2y+c_2 = 0$,

We get $a_1 = 3, b_1 = -1, c_1 = -3, a_2 = 9, b_2 = -3 \text{ and } c_2 = -9$

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

Therefore, we have infinite many solutions for x and y

(iv) $0.2x + 0.3y = 1.3$ ... (1)

$0.4x + 0.5y = 2.3$ ... (2)

Using equation (1), we can say that

$0.2x = 1.3 - 0.3y$

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

Putting this in equation (2), we get

$0.4\left(\frac{1.3-0.3y}{0.2}\right) + 0.5y = 2.3$

$\Rightarrow 2.6 - 0.6y + 0.5y = 2.3$

$\Rightarrow -0.1y = -0.3 \Rightarrow y = 3$

Putting value of y in (1), we get

$0.2x + 0.3\ (3) = 1.3$

$\Rightarrow 0.2x + 0.9 = 1.3$

$\Rightarrow 0.2x = 0.4 \Rightarrow x = 2$

Therefore, $x = 2$ and $y = 3$

(v) $\sqrt{2}x+\sqrt{3}y=0$ .....(1)

$\sqrt{3}x-\sqrt{8}y=0$ .....(2)

Using equation (1), we can say that

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

Putting this in equation (2), we get

$$\sqrt{3}\left(\frac{-\sqrt{3}y}{\sqrt{2}}\right)-\sqrt{8}y=0 \Rightarrow \frac{-3y}{\sqrt{2}}-\sqrt{8}y=0$$

$$\Rightarrow y\left(\frac{-3}{\sqrt{2}}-\sqrt{8}\right)=0 \Rightarrow y = 0$$

Putting value of y in (1), we get $x = 0$

Therefore, $x = 0$ and $y = 0$

(vi) $\frac{3x}{2}-\frac{5y}{3}=-2$ ... (1)

$\frac{x}{3}+\frac{y}{2}=\frac{13}{6}$ ... (2)

Using equation (2), we can say that

$x = \left(\frac{13}{6}-\frac{y}{2}\right)\times 3$

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

Putting this in equation (1), we get

$$\frac{3}{2}\left(\frac{13}{2}-\frac{3y}{2}\right)-\frac{5y}{3}=\frac{-2}{1}$$

$$\Rightarrow \frac{39}{4}-\frac{9y}{4}-\frac{5y}{3}=-2$$

$$\Rightarrow \frac{-27y-20y}{12}=-2-\frac{39}{4}$$

$$\Rightarrow \frac{-47y}{12}=\frac{-8-39}{4}$$

$$\Rightarrow \frac{-47y}{12}=\frac{-47}{4} \Rightarrow y = 3$$

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

$$\frac{x}{3}+\frac{3}{2}=\frac{13}{6}$$

$$\Rightarrow \frac{x}{3}=\frac{13}{6}-\frac{3}{2}=\frac{13-9}{6}=\frac{4}{6}=\frac{2}{3}$$

$$\Rightarrow \frac{x}{3}=\frac{2}{3}$$

$\Rightarrow$ x = 2

Therefore, x = 2 and y = 3

2. Solve $2x + 3y = 11$ and $2x - 4y = -24$ and hence find the value of 'm' for which

$y = mx + 3$.

Ans. $2x + 3y = 11$ ... (1)

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

Using equation (2), we can say that

$2x = -24 + 4y$

$\Rightarrow x = -12 + 2y$

Putting this in equation (1), we get

$2(-12 + 2y) + 3y = 11$

$\Rightarrow -24 + 4y + 3y = 11$

$\Rightarrow 7y = 35 \Rightarrow y = 5$

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

$2x + 3(5) = 11$

$\Rightarrow 2x + 15 = 11$

$\Rightarrow 2x = 11 - 15 = -4 \Rightarrow x = -2$

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

Putting values of x and y in $y = mx + 3$, we get

$5 = m(-2) + 3$

$\Rightarrow 5 = -2m + 3$

$\Rightarrow -2m = 2 \Rightarrow m = -1$

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

(i) The difference between two numbers is 26 and one number is three times the other. Find them.

(ii) The larger of two supplementary angles exceeds the smaller by 18 degrees. Find them.

(iii)The coach of a cricket team buys 7 bats and 6 balls for Rs 3800. Later, she buys 3 bats

and 5 balls for Rs 1750. Find the cost of each bat and each ball.

(iv) The taxi charges in a city consist of a fixed charge together with the charge for the distance covered. For a distance of 10 km, the charge paid is Rs 105 and for a journey of 15 km, the charge paid is Rs 155. What are the fixed charges and the charge per km? How much does a person have to pay for travelling a distance of 25 km?

(v) A fraction becomes $\frac{9}{11}$, if 2 is added to both the numerator and the denominator. If, 3 is added to both the numerator and denominator it becomes $\frac{5}{6}$. Find the fraction.

(vi) Five years hence, the age of Jacob will be three times that of his son. Five years ago, Jacob's age was seven times that of his son. What are their present ages?

Ans. (i) Let first number be x and second number be y.

According to given conditions, we have

$x - y = 26$ (assuming x > y) ... (1)

$x = 3y$(x > y)... (2)

Putting equation (2) in (1), we get

$3y - y = 26$

$\Rightarrow 2y = 26$

$\Rightarrow y = 13$

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

$x = 3y = 3 \times 13 = 39$

Therefore, two numbers are 13 and 39.

(ii) Let smaller angle =x and let larger angle =y

According to given conditions, we have

$y = x + 18$ ... (1)

Also, $x + y = 180^0$ (Sum of supplementary angles) ... (2)

Putting (1) in equation (2), we get

$x + x + 18 = 180$

$\Rightarrow 2x = 180 - 18 = 162$

$\Rightarrow x = 81^0$

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

$y = x + 18 = 81 + 18 = 99^0$

Therefore, two angles are $81^0 \text{ and } 99^0$.

(iii) Let cost of each bat = Rs x and let cost of each ball = Rs y

According to given conditions, we have

$7x + 6y = 3800$ ... (1)

And, $3x + 5y = 1750$ ... (2)

Using equation (1), we can say that

$7x = 3800 - 6y \Rightarrow x = \frac{3800 - 6y}{7}$

Putting this in equation (2), we get

$3\left(\frac{3800 - 6y}{7}\right) + 5y = 1750$

$\Rightarrow \left(\frac{11400 - 18y}{7}\right) + 5y = 1750$

$$\Rightarrow \frac{5y}{1} - \frac{18y}{7} = \frac{1750}{1} - \frac{11400}{7}$$

$$\Rightarrow \frac{35y - 18y}{7} = \frac{12250 - 11400}{7}$$

$\Rightarrow 17y = 850 \Rightarrow y = 50$

Putting value of y in (2), we get

$3x + 250 = 1750$

$\Rightarrow 3x = 1500 \Rightarrow x = 500$

Therefore, cost of each bat = Rs 500 and cost of each ball = Rs 50

(iv) Let fixed charge = Rs x and let charge for every km = Rs y

According to given conditions, we have

$x + 10y = 105$... (1)

$x + 15y = 155$... (2)

Using equation (1), we can say that

$x = 105 - 10y$

Putting this in equation (2), we get

$105 - 10y + 15y = 155$

$\Rightarrow 5y = 50 \Rightarrow y = 10$

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

$x + 10\ (10) = 105$

$\Rightarrow x = 105 - 100 = 5$

Therefore, fixed charge = Rs 5 and charge per km = Rs 10

To travel distance of 25 Km, person will have to pay = Rs (x + 25y)

= Rs (5 + 25 × 10)

= Rs (5 + 250) = Rs 255

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

According to given conditions, we have

$$\frac{x+2}{y+2}=\frac{9}{11} \ldots (1)$$

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

Using equation (1), we can say that

11 (x + 2) = 9y + 18

⇒ 11x + 22 = 9y + 18

⇒ 11x = 9y – 4

$$\Rightarrow x = \frac{9y-4}{11}$$

Putting value of x in equation (2), we get

$$6\left(\frac{9y-4}{11}+3\right) = 5\ (y + 3)$$

$$\Rightarrow \frac{54y}{11}-\frac{24}{11}+18=5y+15$$

$$\Rightarrow -\frac{24}{11}+\frac{3}{1}=\frac{5y}{1}-\frac{54y}{11}$$

$$\Rightarrow \frac{-24+33}{11} = \frac{55y-54y}{11}$$

$\Rightarrow y = 9$

Putting value of y in (1), we get

$$\frac{x+2}{9+2}=\frac{9}{11}$$

$\Rightarrow x + 2 = 9 \Rightarrow x = 7$

Therefore, fraction = $\frac{x}{y}=\frac{7}{9}$

(vi) Let present age of Jacob = x years

Let present age of Jacob's son = y years

According to given conditions, we have

$(x + 5) = 3 (y + 5)$ ... (1)

And, $(x - 5) = 7 (y - 5)$ ... (2)

From equation (1), we can say that

$x + 5 = 3y + 15$

$\Rightarrow x = 10 + 3y$

Putting value of x in equation (2) we get

$10 + 3y - 5 = 7y - 35$

$\Rightarrow -4y = -40$

$\Rightarrow y = 10$ years

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

$x + 5 = 3 (10 + 5) = 3 \times 15 = 45$

$\Rightarrow x = 45 - 5 = 40$ years

Therefore, present age of Jacob = 40 years and, present age of Jacob's son = 10 years