Chapter – 3
Pair of Linear Equations in Two Variables

Exercise 3.3

Q. 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) $\frac{3x}{2} - \frac{5y}{2} = -2$, $\frac{x}{3} + \frac{y}{2} = \frac{13}{6}$

Solution

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

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

From equation (i) take x on one side and when we take y to the other side its sign changes and we get,

$x = 14 - y$ .... (iii)

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

$(14 - y) - y = 4$

$14 - 2y = 4$

2y = 10

$y = \frac{10}{2} = 5$

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

x = 14 - 5 = 9

Hence, x = 9 and y = 5

ii) s - t = 3......................(i)

and,

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

From equation (i) we get,

taking t to the other side, the sign of t changes to positive

s = t + 3...............(iii)

Putting value of x from (iii) to (ii)

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

⇒ 2t + 6 + 3t = 36

⇒ 5t = 30

$\Rightarrow t = \frac{30}{5} = 6$

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

s = 6 + 3 = 9

Hence, s = 9, t = 6

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

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

Comparing with general pair of equations i.e. $a_1x + b_1y + c_1 = 0$

$a_2x + b_2y + c_2 = 0$, we have

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

$a_2 = 9$, $b_2 = -2$ and $c_2 = -9$

Here, $\frac{a_1}{a_2} = \frac{b_1}{b_2} = \frac{c_1}{c_2} = 3$

and In this case, the system of linear equation is consistent and has infinite solutions.

iv) $0.2\,x + 0.3\,y = 1.3$ .... (i)

$0.4\,x + 0.5\,y = 2.3$ .... (ii)

From equation (i) we get,

$0.2\,x = 1.3 – 0.3\,y$

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

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

$x = 6.5 - 1.5\,y$

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

$(6.5 - 1.5\,y) \times 0.4 + 0.5\,y = 2.3$

$6.5 \text{ x } 0.4 - 1.5\,y \text{ x } 0.4 + 0.5\,y = 2.3$

2.6 - 0.6 y + 0.5 y = 2.3

- 0.1 y = -0.3

y = $\frac{-0.3}{-0.1} = 3$

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

x = 6.5 - 1.5 × 3 = 6.5 - 4.5 = 2

Hence, x = 2 and y = 3

v) $\sqrt{2}x + \sqrt{3}y = 0$ …. (i)

$\sqrt{3}x - \sqrt{8}y = 0$ …(ii)

From equation (i), we get,

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

$x = \frac{-\sqrt{3}y}{\sqrt{2}}$ …. (iii)

Putting value of x in equation (ii). we get,

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

⇒ $-\frac{3y}{\sqrt{2}} - 2\sqrt{2}y = 0$ $\sqrt{8} = 2\sqrt{2}$

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

so, y = 0

Putting value of y in equation (iii) we get.

x = 0

Hence, x = 0 and y = 0

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

and

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

From equation (i) we get,

By taking L.C.M and solving we get,

$\frac{3\times3x-2\times5y}{6} = -2$

9 x - 10 y = -12

$x = \frac{-12+10y}{9}$

Putting this value of x in equation (ii), we get,

$\Rightarrow \frac{\frac{-12+10y}{9}}{3} + \frac{y}{2} = \frac{13}{6}$

$\Rightarrow \frac{-12+10y}{27} + \frac{y}{2} = \frac{13}{6}$

$\Rightarrow$ 47y = 117 + 24

$\Rightarrow$ 47y = 141

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

Putting value of y in (iii)

$\Rightarrow$ x = $\frac{-12+10y}{9} = \frac{-12+10\times3}{9} = \frac{18}{9} = 2$

Hence, x = 2 and y = 3

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

Answer:

To Solve: $2x + 3y = 11$ .... (i)

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

Solving by substitution method,

From equation (i)

$2x = 11 - 3y$ .... (iii)

putting value of 2x from equation (iii) to equation (ii)

$(11 - 3y) - 4y = -24$

$\Rightarrow 11 - 7y = -24$

$\Rightarrow -7y = -35$

$y = \frac{-35}{-7}$

$y = 5$

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

$2x = 11 - 3 \times 5 = 11 - 15 = -4$

$x = -\frac{4}{2} = -2$

Now, putting values of x and y in equation

$y = mx + 3$

$5 = -2m + 3$

$= -2m = 2$

$m = -\frac{2}{2} = -1$

Value of m is -1

Q. 3 Form the 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 3bats 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 the 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?

Answer:

i) Let larger number = x

Let smaller number = y

According to the question,

= x – y = 26

= x = 26 + y …….. (i)

And,

= x = 3y …… (ii)

Comparing values of x from both equation, we get,

$26 + y = 3y$

$-2y = -26$

$y = 13$

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

Hence, the numbers are 13 and 39.

ii) Let the first angle = x

Let second angle = y

According to the question,

$= x + y = 180$ (sum of supplementary angles is always 180)

$x = 180 - y$ ….(i)

And,

$= x - y = 18$ ……(ii) Given

Putting value of x from equation (i) to (ii). we get,

$= 180 - y - y = 18$

$= -2y = 18 - 180 = -162$

$= y = \frac{-162}{-2} = 81$

so, $x = 180 = y = 180 - 81 = 99$

Hence the angles are 99^o and 81^o

iii) Let cost of each bat = Rs. X

Let cost of each ball = Rs. Y

According to the question,

$= 7x + 6y = 3800$ Given

$= 6y = 3800 - 7x$

$= y = \frac{3800-7x}{6}$ … (i)

And

= 3x + 5 y = 1750 …. (ii) Given

Putting value of y from Equation (i) to equation (ii)

$= 3x + 5 \times \frac{3800-7x}{6} = 1750$

= 18x + 1900 – 35x = 1750 × 6

$= -17x = 10500 - 19000 = -8500$

$= x = \frac{-8500}{-17} = 500$

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

$= y = \frac{3800-7\times500}{6} = \frac{300}{6} = 50$

Hence,

Cost of each bat = Rs.500 and Cost of each ball = Rs. 50

iv) Let the fixed charge for taxi = Rs. X

Let variable cost per km = Rs. y

We know that,

Total cost = Fixed charge + Variable Charge

According to the question,

= x + 10y = 105 given

= x = 105 – 10y …. (i)

And, For a journey of 15 km charge paid = Rs.155

so, x + 15y = 155 … (ii)

Putting value of x from equation (i) to equation (ii). we get,

= 105 – 10y + 15y = 155

= 5y = 155 – 105 = 50

$y = \frac{50}{5} = 10$

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

= x = 105 – 10 × 10 = 105 – 100 = 5

So, People have to pay for travelling a distance of 25 km

= x + 25y = 5 + 25 × 10 = Rs. 255

v) Let numerator = x

Let denominator = y

Fraction will be = $\frac{x}{y}$

According to the question,

Fraction become $\frac{9}{11}$, if 2 is added in both. Numerator and denominator

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

= 11x +22 = 9y +18 (by cross multiplication)

= 11x = 9y – 4

$= x = \frac{9y-4}{11}$ ….(i)

And, if 3 is added to both numerator and denominator it become $\frac{5}{6}$

$= \frac{x+3}{y+3} = \frac{5}{6}$

= 6x + 18 = 5y + 15 …… (ii) By cross multiplication

Putting value of x from equation (i) to equation (ii)

$= 6 \times \frac{9y-4}{11} + 18 = 5y + 15$

$= 54y - 24 = 55y - 33$

$= -y = -9$

$= y = 9$

Putting value of y in equation (i)

$= x = \frac{9y-4}{11} = \frac{9\times9-4}{11} = \frac{77}{11} = 7$

Hence, the fraction is $\frac{7}{9}$.

vi) Let present age of Jacob = X years

Let present age of his son = Y years

Five year hence,

Age of Jacob = X + 5

Age of son = Y + 5

And, age of Jacob is 3 times of his son Given

= x + 5 = 3 (y +5)

= x + 5 = 3y + 15

= x = 3y + 10 …. (i)

Five years ago,

Age of Jacob = X - 5

Age of son = Y - 5

And, Jacob's age was 7 times of his son Given

= x – 5 = 7 (y- 5)

= x – 5 = 7y – 35

= x – 7y = - 30 …… (ii)

Putting value of X from equation (i) to equation (ii)

= 3y + 10 – 7y = - 30

= - 4y = -40

$= y = \frac{-40}{-4} = 10$

Putting value of Y in (i)

$= x = 3 \times 10 + 10 = 30 + 10 = 40$

Hence, present age of Jacob = 40 years and his son's age = 10 years.