NCERT Solutions for Class 10th Maths Chapter 3 Pair of Linear Equations in Two Variables Ex 3.3

Question-12

Solve the following pair of linear equation by the substitution method.
x + y = 14
x - y = 4

Solution:
x + y = 14 ..... (1)
x - y = 4 ..... (2)
from (2)
x = y + 4
sub in (1)⇒ y + 4 + y = 14
2y = 10 ⇒ y = 5
x = 9

∴ x = 9, y = 5

Question-13

Solve the following pair of linear equation by the substitution method.
s – t = 3
$\frac{s}{3} + \frac{t}{2} = 6$

Solution:
s – t = 3 ..... (1)
$\frac{s}{3} + \frac{t}{2} = 6$
$\frac{2s + 3t}{6} = 6$
⇒ 2s + 3t = 36 .....(2)
from (1) s = t + 3 .....(3)
sub in (1) 2(t + 3) + 3t = 36
2t + 6 + 3t = 36
5t = 30 ⇒ t = 6
∴ from (3), s = 6 + 3 = 9

Question-14

Solve the following pair of linear equations by the substitution method
3x – y = 3
9x – 3y = 9

Solution:
3x – y = 3 ..... (1);
from(1) y = 3x - 3
Substitute y= 3x – 3 in (2)
9x – 3y = 9 .....(2)
9x – 3(3x – 3) = 9
9x – 9x + 9 = 9
This statement is true for all values of x. However, we do not have a specific value of x as a solution. Therefore, we cannot obtain a specific value of y. This situation has arisen because both the given equations are the same. Therefore, Equations (1) and (2) have infinitely many solutions.

Question-15

Solve the following pair of linear equations by the substitution method

0.2x + 0.3y = 1.3
0.4x + 0.5y = 2.3

Solution:

0.2x + 0.3y = 1.3 …….. (1)
0.4x + 0.5y = 2.3 …….. (2)
(1) × 5 ⇒ 1x + 1.5y = 6.5
∴ x = 6.5 – 1.5 y
sub in (2)
0.4 (6.5 – 1.5y) + 0.5y = 2.3
2.6 – 0.6y + 0.5y = 2.3
-0.1y = -0.3
y = 3
Substitute y = 3 in x = 6.5 – 1.5y
x = 6.5 – 1.5(3)
= 6.5 – 4.5 = 2
∴ x = 2, y = 3

Question-16

Solve the following pair of linear equations by the substitution method

$\sqrt{2}x + \sqrt{3}y = 0$
$\sqrt{3}x - \sqrt{8}y = 0$

Solution:

$\sqrt{2}x + \sqrt{3}y = 0$ ……..(1)
$\sqrt{3}x - \sqrt{8}y = 0$ ……..(2)
(1) × $\sqrt{2}$ ⇒ $2x + \sqrt{6}y = 0$
$\Rightarrow x = -\frac{\sqrt{6}}{2}y$

sub in (2)
$-\sqrt{3} \times \frac{\sqrt{6}}{2}y - \sqrt{8}y = 0$
$y(-\frac{\sqrt{18}}{2} - \sqrt{8}) = 0$
$y(-\frac{3\sqrt{2}}{2} - \sqrt{8}) = 0$
$y(-\frac{3}{\sqrt{2}} - \sqrt{3}) = 0$
⇒ y = 0
Hence x = 0
∴ x = 0, y = 0.

Question-17

Solve the following pair of linear equations by the substitution method

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

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

Solution:

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

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

Multiply (1) and (2) by 6

$3x \times 3 - 5y \times 2 = -12$

(i.e.,) $9x - 10y = -12$ ..... (3)

$2x + 3y = 13$ .....(4)

(3) => $9x = 10y - 12$

$x = \frac{10y - 12}{9}$ sub in (4)

$\frac{2(10y - 12)}{9} + 3y = 13$

$20y - 24 + 27y = 13 \times 9$

$47y = 117 + 24$

$47y = 141$

$\Rightarrow y = 3$

$x = \frac{10y - 12}{9} = \frac{10 \times 3 - 12}{9}$

$= \frac{18}{9} = 2$

$\therefore x = 2, y = 3$

Question-18

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

y = mx + 3

Solution:

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

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

From (1)

$x = \frac{11 - 3y}{2}$, sub in (2)

(2) $\Rightarrow \frac{2(11 - 3y)}{2} - 4y = -24$

$11 - 7y = -24$

$7y = 24 + 11 = 35$

$\Rightarrow y = 5$

Substitute $y = 5$ in $x = \frac{11 - 3y}{2}$

$x = \frac{11 - 15}{2} = -2$

$\therefore x = -2, y = 5.$

For the equation $y = mx + 3$

Substitute $x = -2, y = 5$ then

$5 = -2m + 3$

$-2m = 2$

$\therefore m = -1$

Question-19

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 `3800. Later, she buys 3 bats and 5 balls for `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 `105 and for a journey of 15 km, the charge paid is `155. What are the fixed charge 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

Solution:

(i) Let the 2 numbers be x, y

x – y = 26 .....(1)

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

By substitution method, substituting (2) in (1)

3y – y = 26

y = $\frac{26}{2}$ = 13

Substituting y = 13 in (2)

x = 39, y = 13

(ii) Let the 2 angles be x and y

$x + y = 180°$ ……..(1)

$x - y = 18°$ ……..(2)

from (1) $x = 180 - y$

Substituting in (2) $180 - y - y = 18$

$-2y = 18 - 180$

$y = \frac{162}{2} = 81°$

Substituting $y = 81$ in $x = 180 - y$

$x = 180 - 81$

$x = 99°$

$\therefore x = 99°, y = 81°$

(iii) Let the price of a bat be x and that of a ball be y

$7x + 6y = 3800$ ……..(1)

$3x + 5y = 1750$ ……..(2)

Let us express x in terms of y

From (1) $7x = 3800 - 6y$

$x = \frac{3800 - 6y}{7}$ …….. (3)

Substitute in (2)

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

$11400 - 18y + 35y = 1750 \times 7$

$17y = 12250 - 11400 = 850$

$\therefore y = \frac{850}{17} = 50$

from(3) $x = \frac{3800 - (6 \times 50)}{7} = \frac{3500}{7} = 500$

∴ Cost of bat is `500

∴ Cost of ball is `50

(iv) Let the fixed charge be `x and charge per km be `y

Total charges = $\frac{\text{For a distance of 10 km}}{\text{Fixed charge + (Charge per km} \times \text{Distance Travelled)}}$

$x + 10y = 105$ …….. (1)

$x + 15y = 115$ ……..(2)

from (1), $x = 105 - 10y$

Substituting in (2)

$x + 15y = 115$

$105 - 10y + 15y = 115$

$5y = 115 - 105$

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

$\therefore x = 105 - (2 \times 10) = 85$

Fixed charges = `85/-

Charge per km = `5/-

For travelling a distance of 25km the person has to pay

$x + 25y = 85 + 25(2)$

= `35

(v) Let the fraction be $\frac{x}{y}$, x the numerator and y the denominator

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

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

from (1) $(x+2)11 = 9(y+2)$

$11x + 22 = 9y + 18$

$11x - 9y = -4$

$x = \frac{9y - 4}{11}$ …….. (3)

from (2) $(x+3)6 = (y+3)5$

$6x + 18 = 5y + 15$

$6x - 5y = -3$ ……..(4)

Substituting (3) in (4)

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

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

$\Rightarrow -y = -9$

$\therefore y = 9.$

Substituting y = 9 in (3) we get,

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

$= \frac{9(9)-4}{11}$

$= \frac{81-4}{11} = \frac{77}{11} = 7$

$\therefore$ The fraction is $\frac{7}{9}$.

(vi) Let Jacob's age be x and his son's age be y

5 years hence,

Jacob's age = x + 5

Jacob's son's age = y + 5

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

5 years ago,

Jacob's age = x - 5

Jacob's son's age = y - 5

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

(1) becomes $x + 5 = 3y + 15$

$x - 3y = 10 \Rightarrow x = 3y + 10$ .....(3)

(2) becomes $x - 5 = 7y - 35$

$x - 7y = -30$ .....(4)

sub for x from (3) in (4)

$(3y + 10) - 7y = -30$

$-4y = -10-30 = -40$

$\therefore y = 10$

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

$= 30 + 10 = 40$

$\therefore$ Jacob age = 40 and his son's age = 10.

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