2 Linear Equations in One Variable

Learn and Remember

1. An algebraic equation is an equality involving variables. It says that the value of the expression on one side of the equality sign is equal to the value of the expression on the other side.
2. Linear equations are those equations whose highest power of the variable appearing in the equation is 1. And it contains only one solution.
   For example, $x + 8 = 0$, here, power of x is 1.
3. A linear equation may have for its solution as natural number or any rational number.
4. A linear equation may have linear expressions on both sides.
5. Regarding a number, variables can also be transposed from one side of the equation to the other.
6. Occasionally, the expressions forming equations have to be simplified before we can solve them by usual methods.
7. Some equations may not even be linear to begin with, but these equations can be brought to a linear form by multiplying both sides of the equation by a suitable expression.
8. The utility of linear equations is in their diverse applications; different problems on numbers, ages, perimeters, combination of currency notes, and so on can be solved using linear equations.
9. The values of the expression on the L.H.S. and R.H.S. are equal in an equation. This happens to be true only for certain values of the variable. These values are known as the **solution** of the equation.

TEXTBOOK QUESTIONS SOLVED

EXERCISE 2.1 (*Page –23-24*)

Solve the following equations.

1. $x - 2 = 7$ **2.** $y + 3 = 10$ **3.** $6 = z + 2$

4. $\frac{3}{7} + x = \frac{17}{7}$ **5.** $6x = 12$ **6.** $\frac{t}{5} = 10$

7. $\frac{2x}{3} = 18$ 8. $1.6 = \frac{y}{1.5}$ 9. $7x - 9 = 16$

10. $14y - 8 = 13$ 11. $17 + 6p = 9$ 12. $\frac{x}{3} + 1 = \frac{7}{15}$

Sol. 1. $x - 2 = 7$

$\Rightarrow$ $x = 7 + 2 = 9$ (Transposing 2 to R.H.S.)

Hence, $x = 9$ is the required solution.

2. $y + 3 = 10$

$\Rightarrow$ $y = 10 - 3 = 7$ (Transposing 3 to R.H.S.)

Hence, $y = 7$ is the required solution.

3. $6 = z + 2$

$\Rightarrow$ $-z = 2 - 6$ (Transposing 6 to R.H.S. and z to L.H.S.)

$\Rightarrow$ $-z = -4$

or $z = 4$

Hence, $z = 4$ is the required solution.

4. $\frac{3}{7} + x = \frac{17}{7}$

$\Rightarrow$ $x = \frac{17}{7} - \frac{3}{7}$ $\left[\text{Transposing } \frac{3}{7} \text{ to R.H.S.}\right]$

$\Rightarrow$ $x = \frac{17-3}{7}$ or $x = \frac{14}{7} = 2.$

Hence, $x = 2$ is the required solution.

5. $6x = 12$

$\Rightarrow$ $\frac{6x}{6} = \frac{12}{6}$ (Dividing both sides by 6.)

or $x = 2$

Hence, $x = 2$ is the required solution.

6. $\frac{t}{5} = 10$

$\Rightarrow$ $\frac{t}{5} \times 5 = 10 \times 5$ (Multiplying both sides by 5.)

or $t = 5$

Hence, $t = 50$ is the required solution.

7. $\frac{2x}{3} = 18$

$\Rightarrow$ $\frac{2x}{3} \times 3 = 18 \times 3$ (Multiplying both sides by 3.)

$\Rightarrow$ $2x = 18 \times 3$

$\Rightarrow$ $\frac{2x}{2} = \frac{18 \times 3}{2}$ (Dividing both sides by 2.)

$\Rightarrow$ $x = 9 \times 3 = 27$

Hence, $x = 27$ is the required solution.

8. $\frac{1.6}{1} = \frac{y}{1.5}$

$\Rightarrow$ $\frac{y}{1.5} = \frac{1.6}{1}$

$\Rightarrow$ $\frac{1.5y}{1.5} = 1.6 \times 1.5$ (Multiplying both sides by 1.5.)

or $y = 2.40$

Hence, $y = 2.4$ is the required solution.

9. $7x - 9 = 16$

$\Rightarrow$ $7x = 16 + 9$ (Transposing 9 to R.H.S.)

$\Rightarrow$ $7x = 25.$

$\Rightarrow$ $\frac{7x}{7} = \frac{25}{7}$ (Dividing both sides by 7.)

or $x = \frac{25}{7}$

Hence, $x = \frac{25}{7}$ is the required solution.

10. $14y - 8 = 13$

$\Rightarrow$ $14y = 13 + 8$ (Transposing 8 to R.H.S.)

$14y = 21$

$\Rightarrow$ $\frac{14y}{14} = \frac{21}{14}$ (Dividing both sides by 14.)

$\Rightarrow$ $y = \frac{21}{14} = \frac{3}{2}$

Hence, $y = \frac{3}{2}$ is the required solution.

11. $17 + 6p = 9$

$\Rightarrow \quad 6p = 9 - 17$ (Transposing 17 to R.H.S.)

$\Rightarrow \quad 6p = -8$

$\Rightarrow \quad \frac{6p}{6} = \frac{-8}{6}$ (Dividing both sides by 6.)

$\Rightarrow \quad p = \frac{-8}{6} = \frac{-4}{3}$

Hence, $p = \frac{-4}{3}$ is the required solution.

12. $\frac{x}{3} + 1 = \frac{7}{15}$

$\Rightarrow \quad \frac{x}{3} = \frac{7}{15} - \frac{1}{1}$ (Transposing 1 to R.H.S.)

$\Rightarrow \quad \frac{x}{3} = \frac{7-15}{15} \quad \Rightarrow \quad \frac{x}{3} = \frac{-8}{15}$

$\Rightarrow \quad \frac{3 \times x}{3} = \frac{-8}{15} \times 3$ (Multiplying both sides by 3.)

or $\quad x = \frac{-8}{5}$

Hence, $x = \frac{-8}{5}$ is the required solution.

EXERCISE 2.2 *(Page –28)*

Q1. If you subtract $\frac{1}{2}$ from a number and multiply the result by $\frac{1}{2}$, you get $\frac{1}{8}$. What is the number?

Sol. Let the number be x.

According to the conditions,

$$\frac{1}{2}\left(x - \frac{1}{2}\right) = \frac{1}{8}$$

$\Rightarrow \quad 8\left(x - \frac{1}{2}\right) = 2$ (By cross multiplication)

$\Rightarrow \quad 8x - 4 = 2$

$\Rightarrow \quad 8x = 2 + 4$ (Transposing 4 to R.H.S.)

$\Rightarrow \quad 8x = 6$

$\Rightarrow \quad x = \frac{6}{8}$ (Dividing both sides by 8.)

or $\quad x = \frac{3}{4}$

Hence, the required number is $\frac{3}{4}$.

Q2. The perimeter of a rectangular swimming pool is 154 m. Its length is 2 m more than twice its breadth. What are the length and the breadth of the pool?

Sol. Let the breadth of the pool be x m.

Then, the length of the pool = $(2x + 2)$ m

Perimeter $= 2(l + b)$

According to the conditions,

$154 = 2(2x + 2 + x)$

$\Rightarrow \quad 154 = 2(3x + 2)$

$\Rightarrow \quad 154 = 6x + 4$

$\Rightarrow \quad 154 - 4 = 6x$ (Transposing 4 to L.H.S.)

$\Rightarrow \quad 6x = 150$ (Changing the positions)

$\Rightarrow \quad x = \frac{150}{6}$ (Dividing both sides by 6)

or $\quad x = 25$

Hence, the length of the pool $(2x + 2)$ m $= 2 \times 25 + 2 = 52$ m and the breadth of the pool = 25 m.

Q3. The base of an isosceles triangle is $\frac{4}{3}$ cm. The perimeter of the triangle is $4\frac{2}{15}$ cm. What is the length of either of the remaining equal sides?

Sol. Let equal sides of an isosceles triangle be x cm.

We know that, Perimeter of triangle $= a + b + c$

According to the condition,

$$4\frac{2}{15} = \frac{4}{3} + x + x$$

$\Rightarrow$ $\frac{62}{15} - \frac{4}{3} = 2x$ (Transposing $\frac{4}{3}$ to L.H.S.)

$\Rightarrow$ $\frac{62-20}{15} = 2x$

$\Rightarrow$ $\frac{42}{15} = \frac{2x}{1}$

$\Rightarrow$ $30x = 42$ (By cross multiplication)

$\Rightarrow$ $x = \frac{42}{30}$ (Dividing both sides by 30.)

or $x = \frac{7}{5} = 1\frac{2}{5}$ cm

Hence, each equal side of an isosceles triangle is $1\frac{2}{5}$ cm.

Q4. Sum of two numbers is 95. If one exceeds the other by 15, find the numbers.

Sol. Given, sum of two numbers = 95

Let the first number be x, then the second number be $x + 15$.

According to the condition,

$x + x + 15 = 95$

$\Rightarrow$ $2x + 15 = 95$

$\Rightarrow$ $2x = 95 - 15$ (Transposing 15 to R.H.S.)

$\Rightarrow$ $2x = 80$

$\Rightarrow$ $x = \frac{80}{2}$ (Dividing both sides by 2.)

or $x = 40$

Hence, the first number = 40

and the second number = $x + 15 = 40 + 15 = 55$.

Q5. Two numbers are in the ratio 5 : 3. If they differ by 18, what are the numbers?

Sol. Given, difference of the numbers = 18

Let two numbers be $5x$ and $3x$ respectively.

According to the conditions,

$5x - 3x = 18$

$\Rightarrow$ $2x = 18$

$\Rightarrow$ $x = \frac{18}{2}$ (Dividing both sides by 2.)

or $x = 9$

Hence, first number = $5x = 5 \times 9 = 45$

and second number = $3x = 3 \times 9 = 27$.

Q6. Three consecutive integers add up to 51. What are these integers?

Sol. Given, sum of three consecutive integers = 51.

Let three consecutive integers be x, $x + 1$ and $x + 2$.

According to the conditions,

$(x) + (x + 1) + (x + 2) = 51$

$\Rightarrow$ $3x + 3 = 51$

$\Rightarrow$ $3x = 51 - 3$ (Transposing 3 to R.H.S.)

$\Rightarrow$ $3x = 48$

$\Rightarrow$ $x = \frac{48}{3}$ (Dividing both sides by 3.)

or $x = 16$

Hence, first integer = 16,

second integer = $16 + 1 = 17$

and third integer = $16 + 2 = 18$

Therefore, the consecutive integers are 16, 17 and 18.

Q7. The sum of three consecutive multiples of 8 is 888. Find the multiples.

Sol. Given, the sum of three consecutive multiples of 8 = 888.

Let the three consecutive multiples of 8 be x, $x + 8$ and $x + 16$.

According to the conditions,

$(x) + (x + 8) + (x + 16) = 888$

$\Rightarrow$ $3x + 24 = 888$

$\Rightarrow$ $3x = 888 - 24$ (Transposing 24 to R.H.S.)

$\Rightarrow$ $3x = 864$

$\Rightarrow$ $x = \frac{864}{3}$ (Dividing both sides by 24.)

or $x = 288$

Hence, first multiple of 8 = x = 288,

second multiple of 8 = $x + 8 = 288 + 8 = 296$,

and third multiple of $8 = x + 16 = 288 + 16 = 304$.

Therefore, the three consecutive multiples of 8 are 288, 296 and 304.

Q8. Three consecutive integers are such that when they are taken in increasing order and multiplied by 2, 3 and 4 respectively, they add up to 74. Find these numbers.

Sol. Let, three consecutive integers x, $x + 1$ and $x + 2$ and given sum of these numbers is 74.

According to the conditions,

$$2x + 3(x + 1) + 4(x + 2) = 74$$

$$\Rightarrow 2x + 3x + 3 + 4x + 8 = 74$$

$$\Rightarrow 9x + 11 = 74$$

$$\Rightarrow 9x = 74 - 11 \quad \text{(Transposing 11 to R.H.S.)}$$

$$\Rightarrow 9x = 63$$

$$\Rightarrow x = \frac{63}{9} = 7 \quad \text{(Dividing both sides by 9.)}$$

or $x = 7$

Hence, first integer $= x = 7$,

second integer $= (x + 1) = (7 + 1) = 8$,

and third integer $= (x + 2) = (7 + 2) = 9$.

Therefore, the three consecutive integers are 7, 8 and 9.

Q9. The ages of Rahul and Haroon are in the ratio 5 : 7. Four years later the sum of their ages will be 56 years. What are their present ages?

Sol. Let the present ages of Rahul and Haroon be $5x$ years and $7x$ years respectively.

After four years, the age of Rahul $= (5x + 4)$ years

and the age of Haroon $= (7x + 4)$ years

According to the conditions,

$$5x + 4 + 7x + 4 = 56$$

$$\Rightarrow 12x + 8 = 56$$

$$\Rightarrow 12x = 56 - 8 \quad \text{(Transposing 8 to R.H.S.)}$$

$$\Rightarrow 12x = 48$$

$$\Rightarrow x = \frac{48}{12} \quad \text{(Dividing both sides by 12.)}$$

or $x = 4$

Hence, present age of Rahul $= 5x = 5 \times 4 = 20$ years

and present age of Haroon $= 7x = 7 \times 4 = 28$ years.

Q10. The number of boys and girls in a class are in the ratio 7 : 5. The number of boys is 8 more than the number of girls. What is the total class strength?

Sol. Let the number of girls be x.

Then, the number of boys $= x + 8$

According to the conditions,

$$\frac{8 + x}{x} = \frac{7}{5}$$

$$5 \times (8 + x) = 7 \times x \quad \text{(By cross multiplication)}$$

$$\Rightarrow 40 + 5x = 7x$$

$$\Rightarrow 5x - 7x = -40 \quad \text{(Transposing } 7x \text{ to L.H.S. and 40 to R.H.S.)}$$

$$\Rightarrow -2x = -40$$

$$\Rightarrow x = \frac{-40}{-2} \quad \text{(Dividing both sides by } -2.)$$

or $x = 20$

The number of girls $= x = 20$

and the number of boys $= x + 8 = 20 + 8 = 28$.

Hence, the strength of the class $= 28 + 20 = 48$ students.

Q11. Baichung's father is 26 years younger than Baichung's grandfather and 29 years older than Baichung. The sum of the ages of all the three is 135 years. What is the age of each one of them?

Sol. Let Baichung's age be x years.

Then, Baichung's father's age $= (x + 29)$ years

and Baichung's grandfather's age $= (x + 29 + 26)$ years

$= (x + 55)$ years

According to the conditions,

$$x + x + 29 + x + 55 = 135$$

$$\Rightarrow 3x + 84 = 135$$

$$\Rightarrow 3x = 135 - 84 \quad \text{(Transposing 84 to R.H.S.)}$$

$$\Rightarrow 3x = 51$$

$\Rightarrow \quad x = \frac{51}{3}$ (Dividing both sides by 3.)

or $\quad x = 17$

Hence, Baichung's age = 17 years,

Baichung's father's age = $x + 29 = 17 + 29 = 46$ years

and Baichung's grandfather's age = $x + 55 = 17 + 55 = 72$ years.

Q12. Fifteen years from now Ravi's age will be four times his present age. What is Ravi's present age?

Sol. Let Ravi's present age be x years.

After fifteen years, Ravi's age = $4x$ years

Fifteen years from now Ravi's age = $(x + 15)$ years

According to the conditions,

$4x = x + 15$

$\Rightarrow \quad 4x - x = 15$ (Transposing x to L.H.S.)

$\Rightarrow \quad 3x = 15$

$\Rightarrow \quad x = \frac{15}{3}$ (Dividing both sides by 3.)

or $\quad x = 5$

Hence, Ravi's present age is 5 years.

Q13. A rational number is such that when you multiply it by $\frac{5}{2}$ and add $\frac{2}{3}$ to the product, you get $\frac{-7}{12}$. What is the number?

Sol. Let the rational number be x.

According to the conditions,

$\frac{5}{2} \times x + \frac{2}{3} = \frac{-7}{12}$

$\Rightarrow \quad \frac{5x}{2} = \frac{-7}{12} - \frac{2}{3}$ (Transposing $\frac{2}{3}$ to R.H.S.)

$\Rightarrow \quad \frac{5x}{2} = \frac{-7-8}{12}$ (L.C.M. of 3 and 12 is 12.)

$\Rightarrow \quad \frac{5x}{2} = \frac{-15}{12}$

$\Rightarrow \quad 5x \times 12 = -15 \times 2$ (By cross multiplication.)

$\Rightarrow \quad 60x = -30$

$\Rightarrow \quad x = \frac{-30}{60}$ (Dividing both sides by 60.)

or $\quad x = \frac{-1}{2}$

Hence, the rational number is $\frac{-1}{2}$.

Q14. Lakshmi is a cashier in a bank. She has currency notes of denominations ₹ 100, ₹ 50 and ₹ 10 respectively. The ratio of the number of these notes is 2 : 3 : 5. The total cash with Lakshmi is ₹ 4,00,000. How many notes of each denomination does she have?

Sol. Let number of notes be $2x$, $3x$ and $5x$.

According to the conditions,

$100 \times 2x + 50 \times 3x + 10 \times 5x = 4,00,000$

$\Rightarrow \quad 200x + 150x + 50x = 4,00,000$

$\Rightarrow \quad 400x = 4,00,000$

$\Rightarrow \quad x = \frac{4,00,000}{400}$

or $\quad x = 1000$

Hence, number of denominations of ₹ 100 notes = 2×1000

$= 2,000$

Number of denominations of ₹ 50 notes = $3 \times 1000 = 3,000$

Number of denominations of ₹ 10 notes = $5 \times 1000 = 5,000$

Therefore, required denominations of notes of ₹ 100, ₹ 50 and ₹ 10 are 2,000, 3,000 and 5,000 respectively.

Q15. I have a total of ₹ 300 in coins of denomination ₹ 1, ₹ 2 and ₹ 5. The number of ₹ 2 coins is 3 times the number of ₹ 5 coins. The total number of coins is 160. How many coins of each denomination are with me?

Sol. Given, total sum of money = ₹ 300

Let the number of ₹ 5 coins be x.

Then, number of ₹ 2 coins = $3x$

and number of ₹ 1 coins = $160 - (x + 3x) = 160 - 4x$.

According to the conditions,

$5 \times x + 2 \times (3x) + 1 \times (160 - 4x) = 300$

$5x + 6x + 160 - 4x = 300$

$\Rightarrow \quad 7x + 160 = 300$

$\Rightarrow \quad 7x = 300 - 160$ (Transposing 160 to R.H.S.)

$\Rightarrow \quad 7x = 140$

$\Rightarrow \quad x = \frac{140}{7}$ (Dividing both sides by 7.)

or $\quad x = 20$

Hence, number of coins of ₹ 5 denomination = 20

Number of coins of ₹ 2 denomination = $3x = 3 \times 20 = 60$

Number of coins of ₹ 1 denomination = $160 - 4x$

$= 160 - 4 \times 20$

$= 160 - 80 = 80.$

Therefore, the number of ₹ 1 coins, ₹ 2 coins and ₹ 5 coins are 80, 60 and 20 respectively.

Q16. The organisers of an essay competition decide that a winner in the competition gets a prize of ₹ 100 and a participant who does not win, gets a prize of ₹ 25. The total prize money distributed is ₹ 3,000. Find the number of winners, if the total number of participants is 63.

Sol. Total sum of money = ₹ 3000

Let the number of winners of ₹ 100 be x

and those who are not winners = $63 - x$.

According to the conditions,

$100 \times x + 25 \times (63 - x) = 3000$

$\Rightarrow \quad 100x + 1575 - 25x = 3000$

$\Rightarrow \quad 75x = 3000 - 1575$

(Transposing 1575 to R.H.S.)

$\Rightarrow \quad 75x = 1425$

$\Rightarrow \quad x = \frac{1425}{75}$ (Dividing both sides by 75.)

$\Rightarrow \quad x = 19$

Hence, the number of winners = 19.

EXERCISE 2.3 (*Page –30*)

Solve the following equations and check your results.

1. $3x = 2x + 18$
2. $5t - 3 = 3t - 5$
3. $5x + 9 = 5 + 3x$
4. $4z + 3 = 6 + 2z$
5. $2x - 1 = 14 - x$
6. $8x + 4 = 3(x - 1) + 7$
7. $x = \frac{4}{5}(x + 10)$
8. $\frac{2x}{3} + 1 = \frac{7x}{15} + 3$
9. $2y + \frac{5}{3} = \frac{26}{3} - y$
10. $3m = 5m - \frac{8}{5}$

Sol. 1. The given linear equation is

$3x = 2x + 18$

$\Rightarrow \quad 3x - 2x = 18$ (Transposing $2x$ to L.H.S.)

$\Rightarrow \quad x = 18$

To check:

On putting $x = 18$ in L.H.S. and R.H.S. of the given equation,

L.H.S. $= 3x = 3 \times 18 = 54$

R.H.S. $= 2x + 18 = 2 \times 18 + 18$

$= 36 + 18 = 54$

$\Rightarrow$ L.H.S. = R.H.S.

Hence, $x = 18$ is the required solution.

2. The given linear equation is

$5t - 3 = 3t - 5$

$\Rightarrow \quad 5t - 3t = -5 + 3$ (Transposing $3t$ to L.H.S. and 3 to R.H.S.)

$\Rightarrow \quad 2t = -2$

$\Rightarrow \quad \frac{2t}{2} = \frac{-2}{2}$ (Dividing both sides by 2.)

$\Rightarrow \quad t = -1$

To check:

On putting $t = -1$, in L.H.S. and R.H.S. of the given equation,

L.H.S. $= 5t - 3 = 5 \times (-1) - 3 = -5 - 3 = -8$

R.H.S. $= 3t - 5 = 3 \times (-1) - 5 = -3 - 5 = -8$

$\Rightarrow$ L.H.S. = R.H.S.

Hence, $t = -1$ is the required solution.

3. The given linear equation is

$$5x + 9 = 5 + 3x$$

$\Rightarrow$ $5x - 3x = 5 - 9$ (Transposing $3x$ to L.H.S. and 9 to R.H.S.)

$\Rightarrow$ $2x = -4$

$\Rightarrow$ $\frac{2x}{2} = \frac{-4}{2}$ (Dividing both sides by 2.)

or $x = -2$

To check:

On putting $x = -2$ in L.H.S. and R.H.S. of the given equation,

L.H.S. $= 5x + 9 = 5 \times (-2) + 9 = -10 + 9 = -1$

R.H.S. $= 5 + 3x = 5 + 3 \times (-2) = 5 - 6 = -1$

$\Rightarrow$ L.H.S. = R.H.S.

Hence, $x = -2$ is the required solution.

4. The given linear equation is

$$4z + 3 = 6 + 2z$$

$\Rightarrow$ $4z - 2z = 6 - 3$ (Transposing $2z$ to L.H.S. and 3 to R.H.S.)

$\Rightarrow$ $2z = 3$ (Dividing both sides by 2.)

$\Rightarrow$ $\frac{2z}{2} = \frac{3}{2}$ (Dividing both sides by 2.)

or $z = \frac{3}{2}$

To check:

On putting $z = \frac{3}{2}$ in L.H.S. and R.H.S. of the given equation,

L.H.S. $= 4z + 3 = 4 \times \frac{3}{2} + 3 = 2 \times 3 + 3 = 6 + 3 = 9$

R.H.S. $= 6 + 2z = 6 + 2 \times \frac{3}{2} = 6 + 3 = 9$

$\Rightarrow$ L.H.S. = R.H.S.

Hence, $z = \frac{3}{2}$ is the required solution.

5. The given linear equation is

$$2x - 1 = 14 - x$$

$\Rightarrow$ $2x + x = 14 + 1$ (Transposing x to L.H.S. and 1 to R.H.S.)

$\Rightarrow$ $3x = 15$

$\Rightarrow$ $\frac{3x}{3} = \frac{15}{3}$ (Dividing both sides by 3.)

or $x = 5$

To check:

On putting $x = 5$ in L.H.S. and R.H.S. of the given equation,

L.H.S. $= 2x - 1 = 2 \times 5 - 1 = 10 - 1 = 9$

R.H.S. $= 14 - x = 14 - 5 = 9$

$\Rightarrow$ L.H.S. = R.H.S.

Hence, $x = 5$, is the required solution.

6. The given linear equation is

$$8x + 4 = 3(x - 1) + 7$$

$\Rightarrow$ $8x + 4 = 3x - 3 + 7$

$\Rightarrow$ $8x - 3x = -3 + 7 - 4$ (Transposing $3x$ to L.H.S. and 4 to R.H.S.)

$\Rightarrow$ $5x = 4 - 4$

$\Rightarrow$ $5x = 0$

or $x = \frac{0}{5} = 0$ (Dividing both sides by 5.)

To check:

On putting $x = 0$ in L.H.S. and R.H.S. of the given equation,

L.H.S. $= 8x + 4 = 8 \times 0 + 4 = 0 + 4 = 4$

R.H.S. $= 3(x - 1) + 7 = 3(0 - 1) + 7 = -3 + 7 = 4$

$\Rightarrow$ L.H.S. = R.H.S.

Hence, $x = 0$ is the required solution.

7. The given linear equation is

$$x = \frac{4}{5}(x + 10)$$

$\Rightarrow$ $5x = 5 \times \frac{4}{5}(x + 10)$ (Multiplying both sides by 5.)

$\Rightarrow$ $5x = 4(x + 10)$

$\Rightarrow$ $5x = 4x + 40$

$\Rightarrow \quad 5x - 4x = 40$ (Transposing $4x$ to L.H.S.)

or $\quad x = 40$

To check:

On putting $x = 40$ in L.H.S. and R.H.S. of the given equation,

$$\text{L.H.S.} = x = 40$$

$$\text{R.H.S.} = \frac{4}{5}(x+10) = \frac{4}{5}(40+10) = \frac{4}{5} \times 50 = 40$$

$\Rightarrow$ L.H.S. = R.H.S.

Hence, $x = 40$ is the required solution.

8. The given linear equation is

$$\frac{2x}{3} + 1 = \frac{7x}{15} + 3$$

$$\Rightarrow \quad \frac{2x}{3} - \frac{7x}{15} = 3 - 1$$

$\left(\text{Transposing } \frac{7x}{15} \text{ to L.H.S. and 1 to R.H.S.}\right)$

$$\Rightarrow \quad \frac{10x - 7x}{15} = 2$$

$$\Rightarrow \quad 3x = 30 \quad \text{(Multiplying both sides by 15.)}$$

$$\Rightarrow \quad x = \frac{30}{3} \quad \text{(Dividing both sides by 3.)}$$

or $\quad x = 10$

To check:

On putting $x = 10$ in L.H.S. and R.H.S. of the given equation,

$$\text{L.H.S.} = \frac{2x}{3} + 1 = \frac{2\times 10}{3} + 1 = \frac{20}{3} + 1 = \frac{20+3}{3} = \frac{23}{3}$$

$$\text{R.H.S.} = \frac{7x}{15} + 3 = \frac{7\times 10}{15} + 3 = \frac{7\times 2}{3} + 3 = \frac{14}{3} + 3$$

$$= \frac{14+9}{3} = \frac{23}{3}$$

$\Rightarrow$ L.H.S. = R.H.S.

Hence, $x = 10$ is the required solution.

9. The given linear equation is

$$2y + \frac{5}{3} = \frac{26}{3} - y$$

$$\Rightarrow \quad 2y + y = \frac{26}{3} - \frac{5}{3} \quad \text{(Transposing } y \text{ to L.H.S. and } \frac{5}{3} \text{ to R.H.S.)}$$

$$\Rightarrow \quad 3y = \frac{26-5}{3}$$

$$\Rightarrow \quad 3y = \frac{21}{3}$$

$$\Rightarrow \quad \frac{3y}{3} = \frac{21}{3\times 3} \quad \text{(Dividing both sides by 3.)}$$

or $\quad y = \frac{7}{3}$

To check:

On putting $y = \frac{7}{3}$ in L.H.S. and R.H.S. of the given equation,

$$\text{L.H.S.} = 2y + \frac{5}{3} = 2\times\frac{7}{3} + \frac{5}{3} = \frac{14}{3} + \frac{5}{3} = \frac{14+5}{3} = \frac{19}{3}$$

$$\text{R.H.S.} = \frac{26}{3} - y = \frac{26}{3} - \frac{7}{3} = \frac{26-7}{3} = \frac{19}{3}$$

$\Rightarrow$ L.H.S. = R.H.S.

Hence, $y = \frac{7}{3}$ is the required solution.

10. The given linear equation is

$$3m = 5m - \frac{8}{5}$$

$$\Rightarrow \quad 3m - 5m = \frac{-8}{5} \quad \text{(Transposing } 5m \text{ to L.H.S.)}$$

$$\Rightarrow \quad -2m = \frac{-8}{5}$$

$$\Rightarrow \quad \frac{-2m}{2} = \frac{-8}{5\times 2} \quad \text{(Dividing both sides by 2.)}$$

$$\Rightarrow \quad -m = \frac{-4}{5}$$

or $\quad m = \frac{4}{5}$

To check:

On putting $m = \frac{4}{5}$ in L.H.S. and R.H.S. of given equation,

$$\text{L.H.S.} = 3m = 3 \times \frac{4}{5} = \frac{12}{5}$$

$$\text{R.H.S.} = 5m - \frac{8}{5} = 5 \times \frac{4}{5} - \frac{8}{5} = \frac{4}{1} - \frac{8}{5} = \frac{20-8}{5} = \frac{12}{5}$$

$\Rightarrow$ L.H.S. = R.H.S.

Hence, $m = \frac{4}{5}$ is the required solution.

EXERCISE 2.4 (*Page –31-32*)

Q1. Amina thinks of a number and subtracts $\frac{5}{2}$ from it. She multiplies the result by 8. The result now obtained is 3 times the same number she thought of. What is the number?

Sol. Let Amina think a number, x

After subtracting $\frac{5}{2}$ from it we have $= x - \frac{5}{2}$

According to the conditions given,

$$8\left(x - \frac{5}{2}\right) = 3x$$

$$\Rightarrow \quad 8x - \frac{8 \times 5}{2} = 3x$$

$$\Rightarrow \quad 8x - 4 \times 5 = 3x$$

$$\Rightarrow \quad 8x - 20 = 3x$$

$\Rightarrow$ $8x - 3x = 20$ (Transposing $3x$ to L.H.S. and 20 to R.H.S.)

$$\Rightarrow \quad 5x = 20$$

$\Rightarrow$ $x = \frac{20}{5}$ (Dividing both sides by 5.)

or $x = 4$

Hence, the required number is 4.

Q2. A positive number is 5 times another number. If 21 is added to both the numbers, then one of the new numbers becomes twice the other new number. What are the numbers?

Sol. Let another number be x.

Then, positive number $= 5x$

According to the given conditions,

$$(5x + 21) = 2(x + 21)$$

$\Rightarrow$ $5x + 21 = 2x + 42$

$\Rightarrow$ $5x - 2x = 42 - 21$ (Transposing $2x$ to L.H.S. and 21 to R.H.S.)

$\Rightarrow$ $3x = 21$

$\Rightarrow$ $x = \frac{21}{3}$ (Dividing both sides by 3.)

or $x = 7$

and positive number, $5x = 5 \times 7 = 35$

Hence, required numbers are 7 and 35.

Q3. Sum of the digits of a two-digit number is 9. When we interchange the digits, it is found that the resulting new number is greater than the original number by 27. What is the two-digit number?

Sol. Given : sum of the digits of a two-digit number = 9

Let the units place digit of a number be x.

Then, tens place digit of a number $= 9 - x$.

So, the original number formed by these digits $= 10(9 - x) + x$

($\because$ 2-digit number = 10 times of tens place digit + unit place digit)

On interchanging the digits, then new number $= 10x + (9 - x)$

According to the conditions,

New number = Original number + 27

$$10x + (9 - x) = 10(9 - x) + x + 27$$

$\Rightarrow$ $10x + 9 - x = 90 - 10x + x + 27$

$\Rightarrow$ $9x + 9 = 90 - 9x + 27$

$\Rightarrow$ $9x + 9x = 90 + 27 - 9$ (Transposing $9x$ to L.H.S. and 9 to R.H.S.)

$\Rightarrow$ $18x = 108$

$\Rightarrow \quad x = \frac{108}{18}$ (Dividing both sides by 18.)

or $\quad x = 6$

Hence, the two-digit number $= 10(9 - x) + x$

$= 10(9 - 6) + 6$

$= 10 \times 3 + 6 = 30 + 6 = 36.$

Therefore, the required two-digit number is 36.

Q4. One of the two digits of a two-digit number is three times the other digit. If you interchange the digits of this two-digit number and add the resulting number to the original number, you get 88. What is the original number?

Sol. Let the units place digit be x

and tens place digit $= 3x$

Then, original number $= 10 \times 3x + x = 30x + x$

After interchanging the digits, then new number $= 10x + 3x$

According to conditions,

New number + original number = 88

$10x + 3x + 30x + x = 88$

$\Rightarrow \quad 44x = 88$

$\Rightarrow \quad x = \frac{88}{44}$ (Dividing both sides by 44.)

or $\quad x = 2$

Original number $= 10 \times 3x + x = 30x + x = 30 \times 2 + 2$

$= 60 + 2 = 62$

Hence, required number = 62.

Q5. Shobo's mother's present age is six times Shobo's present age. Shobo's age five years from now will be one third of his mother's present age. What are their present ages?

Sol. Let Shobo's present age be x years

and Shobo's mother's present age $= 6x$ years

After five years, Shobo's age $= (x + 5)$ years

According to the conditions,

$$x + 5 = \frac{1}{3} \times 6x$$

$\Rightarrow \quad x + 5 = 2x$

$\Rightarrow \quad 2x = x + 5$ (Interchanging the positions)

$\Rightarrow \quad 2x - x = 5$ (Transposing x to L.H.S.)

or $\quad x = 5$

Hence, Shobo's present age = 5 years

and Shobo's mother's present age $= 6x = 6 \times 5 = 30$ years.

Q6. There is a narrow rectangular plot, reserved for a school, in Mahuli village. The length and breadth of the plot are in the ratio 11 : 4. At the rate ₹ 100 per metre it will cost the village panchayat ₹ 75,000 to fence the plot. What are the dimensions of the plot?

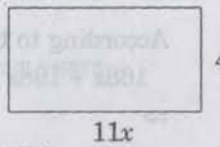
Sol. Let the length and breadth of the plot be 11 x and 4 x respectively.

Perimeter of the plot $= \frac{\text{Total cost}}{\text{Cost of 1 metre}}$

$= \frac{75000}{100} = 750$ m

We know that

Perimeter = 2(length + breadth)



According to the condition,

$\Rightarrow \quad 750 = 2(11x + 4x) = 2 \times (15x)$

$\Rightarrow \quad 750 = 30x$

$\Rightarrow \quad 30x = 750$ (Interchanging the positions.)

$\Rightarrow \quad x = \frac{750}{30}$ (Dividing both sides by 30.)

or $\quad x = 25$

Hence, length $= 11x = 11 \times 25 = 275$ m

and breadth $= 4x = 4 \times 25 = 100$ m.

Therefore, the length and breadth of the plot are 275 m and 100 m.

Q7. Hasan buys two kinds of cloth materials for school uniforms, shirt material that costs him ₹ 50 per metre and trouser material that costs him ₹ 90 per metre. For every 2 metres of the trouser material he buys 3 metres of the shirt material. He sells the materials at

12% and 10% profit respectively. His total sale is *₹ 36,600. How much trouser material did he buy?

Sol. Let, ratio between shirt material and trouser material be $3x : 2x$.

The cost of shirt material = $50 \times 3x = 150x$

The selling price at 12% gain = $\frac{100+12}{100} \times 150x$

$\left[\because \text{S.P.} = \frac{100+\text{P\%}}{100} \times \text{C.P.}\right]$

$= \frac{112}{100} \times 150x = \frac{16800x}{100}$

$= 168x$

The cost of trouser material = $90 \times 2x = 180x$

The selling price at 10% profit = $\frac{100+10}{100} \times 180x$

$= \frac{110}{100} \times 180x = 198x$

According to the condition,

$168x + 198x = 36{,}600$

$\Rightarrow \quad 366x = 36600$

$x = \frac{36600}{366}$ (Dividing both sides by 366.)

or $x = 100$

Now, trouser material = $2x$

$= 2 \times 100 = 200$ metres.

Hence, Hasan bought 200 metres of the trouser material.

Q8. Half of a herd of deer are grazing in the field and three fourths of the remaining are playing nearby. The rest 9 are drinking water from the pond. Find the number of deer in the herd.

Sol. Let the total number of deer in the herd be x.

According to the conditions,

$$x = \frac{x}{2} + \frac{3}{4} \times \left(x - \frac{x}{2}\right) + 9$$

*We take 36,600 in place of 36,660 as given in NCERT.

$$\Rightarrow \quad x = \frac{x}{2} + \frac{3}{4} \times \left(\frac{2x-x}{2}\right) + 9$$

$$\Rightarrow \quad x = \frac{x}{2} + \frac{3}{4} \times \frac{x}{2} + 9$$

$$\Rightarrow \quad x = \frac{x}{2} + \frac{3}{8}x + \frac{9}{1}$$

$$\Rightarrow \quad x = \frac{4x+3x+72}{8}$$

$$\Rightarrow \quad x = \frac{7x+72}{8}$$

$\Rightarrow \quad 8x = 7x + 72$ (By cross multiplication)

$\Rightarrow \quad 8x - 7x = 72$ (Transposing $7x$ to L.H.S.)

or $\quad x = 72$

Hence, total number of deer in the herd is 72.

Q9. A grandfather is ten times older than his granddaughter. He is also 54 years older than her. Find their present ages.

Sol. Let present age of his granddaughter be x years.

Grandfather's age = $10 \times x = 10x$ years

According to the conditions,

Grandfather's age = Granddaughter's age + 54

$10x = x + 54$

$\Rightarrow \quad 10x - x = 54$ (Transposing x to L.H.S.)

$\Rightarrow \quad 9x = 54$

$\Rightarrow \quad x = \frac{54}{9}$ (Dividing both sides by 9.)

or $\quad x = 6$

Hence, his granddaughter's age = 6 years.

and grandfather's age = $10x = 10 \times 6 = 60$ years.

Q10. Aman's age is three times his son's age. Ten years ago he was five times his son's age. Find their present ages.

Sol. Let the present age of his son be x years.

Aman's age = $3x$ years

Ten years ago, his son's age = $x - 10$

Ten years ago, Aman's age = $3x - 10$

According to the condition,

$$3x - 10 = 5(x - 10)$$

$$\Rightarrow \quad 3x - 10 = 5x - 50$$

$$\Rightarrow \quad -10 + 50 = 5x - 3x \quad \text{(Transposing 50 to L.H.S. and } 3x \text{ to R.H.S.)}$$

$$\Rightarrow \quad 5x - 3x = 50 - 10 \quad \text{(Interchanging the position.)}$$

$$\Rightarrow \quad 2x = 40$$

$$\Rightarrow \quad x = \frac{40}{2} \quad \text{(Dividing both sides by 20.)}$$

or $\quad x = 20$

Hence, Aman's son's age = 20 years

and Aman's age = $3x = 3 \times 20 = 60$ years.

EXERCISE 2.5 *(Page 33–34)*

Solve the following linear equations.

1. $\frac{x}{2} - \frac{1}{5} = \frac{x}{3} + \frac{1}{4}$ 2. $\frac{n}{2} - \frac{3n}{4} + \frac{5n}{6} = 21$

3. $x + 7 - \frac{8x}{3} = \frac{17}{6} - \frac{5x}{2}$ 4. $\frac{x-5}{3} = \frac{x-3}{5}$

5. $\frac{3t-2}{4} - \frac{2t+3}{3} = \frac{2}{3} - t$ 6. $m - \frac{m-1}{2} = 1 - \frac{m-2}{3}$

Sol. The given linear equation is

1. $$\frac{x}{2} - \frac{1}{5} = \frac{x}{3} + \frac{1}{4}$$

$$\Rightarrow \quad \frac{x}{2} - \frac{x}{3} = \frac{1}{4} + \frac{1}{5}$$

$$\left(\text{Transposing } \frac{x}{3} \text{ to L.H.S. and } \frac{1}{5} \text{ to R.H.S.}\right)$$

$$\Rightarrow \quad \frac{3x - 2x}{6} = \frac{5+4}{20}$$

$$\Rightarrow \quad \frac{x}{6} = \frac{9}{20}$$

$$\Rightarrow \quad \frac{x \times 6}{6} = \frac{9 \times 6}{20} \quad \text{(Multiplying both sides by 6.)}$$

or $\quad x = \frac{27}{10}$

For checking:

On putting $x = \frac{27}{10}$ in L.H.S. and R.H.S. of the given equation,

$$\text{L.H.S.} = \frac{x}{2} - \frac{1}{5} = \frac{27}{2 \times 10} - \frac{1}{5} = \frac{27}{20} - \frac{1}{5} = \frac{27-4}{20} = \frac{23}{20}$$

$$\text{R.H.S.} = \frac{x}{3} + \frac{1}{4} = \frac{27}{3 \times 10} + \frac{1}{4} = \frac{9}{10} + \frac{1}{4} = \frac{18+5}{20} = \frac{23}{20}$$

$$\Rightarrow \quad \text{L.H.S.} = \text{R.H.S.}$$

Hence, the value of $x = \frac{27}{10}$ is the required solution.

2. The given linear equation is

$$\frac{n}{2} - \frac{3n}{4} + \frac{5n}{6} = 21$$

$$\frac{6n - 9n + 10n}{12} = 21 \quad \text{(L.C.M. of 2, 4 and 6 is 12.)}$$

$$\Rightarrow \quad \frac{7n}{12} = \frac{21}{1}$$

$$\Rightarrow \quad 7n = 21 \times 12 \quad \text{(By cross multiplication)}$$

$$\Rightarrow \quad \frac{7n}{7} = \frac{21 \times 12}{7} \quad \text{(Dividing both sides by 7.)}$$

or $\quad n = 36$

For checking:

On putting $n = 36$ in L.H.S. of the given equation,

$$\text{L.H.S.} = \frac{n}{2} - \frac{3n}{4} + \frac{5n}{6}$$

$$= \frac{36}{2} - \frac{3 \times 36}{4} + \frac{5 \times 36}{6}$$

$$= 18 - 3 \times 9 + 5 \times 6$$

$$= 18 - 27 + 30 = 21 = \text{R.H.S.}$$

Hence, the value of $n = 36$ is the required solution.

3. The given linear equation is

$$x + 7 - \frac{8x}{3} = \frac{17}{6} - \frac{5x}{2}$$

$$\Rightarrow \frac{x}{1} - \frac{8x}{3} + \frac{5x}{2} = \frac{17}{6} - \frac{7}{1}$$ (Transposing $\frac{5x}{2}$ to L.H.S. and 7 to R.H.S.)

$$\Rightarrow \frac{6x - 16x + 15x}{6} = \frac{17 - 42}{6}$$

$$\Rightarrow \left(\frac{21x - 16x}{6}\right) = \frac{-25}{6}$$

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

$$\Rightarrow 5x \times 6 = 6 \times -25$$ (By cross multiplication.)

$$\Rightarrow 30x = -150$$

$$\Rightarrow x = \frac{-150}{30}$$ (Dividing both sides by 30.)

or $x = -5$

For checking:

On putting, $x = -5$ in L.H.S. and R.H.S. of the given equation,

$$\text{L.H.S.} = x + 7 - \frac{8x}{3} = -5 + 7 - \frac{8 \times (-5)}{3}$$

$$= 2 + \frac{40}{3} = \frac{6 + 40}{3} = \frac{46}{3}$$

$$\text{R.H.S.} = \frac{17}{6} - \frac{5x}{2} = \frac{17}{6} - \frac{5 \times (-5)}{2}$$

$$= \frac{17}{6} + \frac{25}{2} = \frac{17 + 75}{6} = \frac{92}{6}$$

$$= \frac{46}{3} = \text{L.H.S.}$$

$\Rightarrow$ L.H.S. = R.H.S.

Hence, the value of $x = -5$ is the required solution.

4. The given linear equation is

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

$\Rightarrow 5 \times (x - 5) = 3 \times (x - 3)$ (By cross multiplication.)

$\Rightarrow 5x - 25 = 3x - 9$

$\Rightarrow 5x - 3x = -9 + 25$ (Transposing $3x$ to L.H.S. and 25 to R.H.S.)

$\Rightarrow 2x = 16$

$\Rightarrow x = \frac{16}{2}$ (Dividing by 2 on both sides.)

or $x = 8$

For checking:

On putting $x = 8$ in L.H.S. and R.H.S. of the given equation,

$$\text{L.H.S.} = \frac{x-5}{3} = \frac{8-5}{3} = \frac{3}{3} = 1$$

$$\text{R.H.S.} = \frac{x-3}{5} = \frac{8-3}{5} = \frac{5}{5} = 1$$

$\Rightarrow$ L.H.S. = R.H.S.

Hence, the value of $x = 8$ is the required solution.

5. The given linear equation is

$$\frac{3t-2}{4} - \frac{2t+3}{3} = \frac{2}{3} - t$$

$$\Rightarrow \frac{3(3t-2) - 4(2t+3)}{12} = \frac{2-3t}{3}$$ (L.C.M. of 4 and 3 is 12.)

$$\Rightarrow \frac{9t - 6 - 8t - 12}{12} = \frac{2-3t}{3}$$

$$\Rightarrow \frac{t-18}{12} = \frac{2-3t}{3}$$

$$\Rightarrow t - 18 = 12 \times \frac{(2-3t)}{3} = 4(2-3t)$$

(Multiplying both sides by 12.)

$\Rightarrow t - 18 = 8 - 12t$

$\Rightarrow t + 12t = 8 + 18$ (Transposing $12t$ to L.H.S. and 18 to R.H.S.)

$\Rightarrow 13t = 26$

$\Rightarrow t = \frac{26}{13}$ (Dividing both sides by 13.)

or $t = 2$

For checking;

On putting $t = 2$ in L.H.S. and R.H.S. of the given equation,

$$\text{L.H.S.} = \frac{3t-2}{4} - \frac{2t+3}{3} = \frac{3\times2-2}{4} - \frac{2\times2+3}{3}$$

$$= \frac{6-2}{4} - \frac{4+3}{3} = \frac{4}{4} - \frac{7}{3} = 1 - \frac{7}{3} = \frac{3-7}{3} = \frac{-4}{3}$$

$$\text{R.H.S.} = \frac{2}{3} - t = \frac{2}{3} - \frac{2}{1} = \frac{2-6}{3} = \frac{-4}{3}$$

$\Rightarrow$ L.H.S. = R.H.S.

Hence, the value of $t = 2$ is the required solution.

6. The given linear equation is

$$m - \frac{m-1}{2} = 1 - \frac{m-2}{3}$$

$$\Rightarrow \frac{m}{1} - \frac{m-1}{2} + \frac{m-2}{3} = 1 \text{ (Transposing } \frac{m-2}{3} \text{ to R.H.S.)}$$

$$\Rightarrow \frac{6m-3(m-1)+2(m-2)}{6} = 1 \quad \text{(L.C.M. of 1, 2 and 3 is 6.)}$$

$$\Rightarrow \frac{6m-3m+3+2m-4}{6} = 1$$

$$\Rightarrow \frac{5m-1}{6} = 1$$

$$\Rightarrow 5m - 1 = 6 \text{ (Multiplying both sides by 6.)}$$

$$\Rightarrow 5m = 6 + 1 \text{ (Transposing 1 to R.H.S.)}$$

$$\Rightarrow 5m = 7$$

$$\Rightarrow m = \frac{7}{5} \text{ (Dividing both sides by 5.)}$$

For checking:

On putting $m = \frac{7}{5}$ in L.H.S. and R.H.S. of the given equation,

$$\text{L.H.S.} = m - \frac{m-1}{2} = \frac{7}{5} - \frac{\frac{7}{5}-1}{2} = \frac{7}{5} - \frac{\frac{7}{5}-\frac{1}{1}}{2} = \frac{7}{5} - \frac{\frac{7-5}{5}}{2}$$

$$= \frac{7}{5} - \frac{\frac{2}{5}}{2} = \frac{7}{5} - \frac{2}{5\times2} = \frac{7}{5} - \frac{1}{5} = \frac{7-1}{5} = \frac{6}{5}$$

$$\text{R.H.S.} = 1 - \frac{m-2}{3} = 1 - \frac{\frac{7}{5}-\frac{2}{1}}{3} = 1 - \frac{\frac{7-10}{5}}{3} = 1 - \frac{\left(\frac{-3}{5}\right)}{3}$$

$$= 1 + \frac{3}{5\times3} = 1 + \frac{1}{5} = \frac{5+1}{5} = \frac{6}{5}$$

$\Rightarrow$ L.H.S. = R.H.S.

Hence, the value of $m = \frac{7}{5}$ is the required solution.

Simplify and solve the following linear equations.

7. $3(t-3) = 5(2t+1)$

8. $15(y-4) - 2(y-9) + 5(y+6) = 0$

9. $3(5z-7) - 2(9z-11) = 4(8z-13) - 17$

10. $0.25(4f-3) = 0.05(10f-9)$

Sol. 7. The given linear equation is

$$3(t-3) = 5(2t+1)$$

$$\Rightarrow 3t - 9 = 10t + 5$$

$$\Rightarrow 3t - 10t = 9 + 5 \quad \text{(Transposing 9 to R.H.S. and } 10t \text{ to L.H.S.)}$$

$$\Rightarrow -7t = 14$$

$$\Rightarrow t = \frac{14}{-7} \quad \text{(Dividing both sides by } -7.)$$

or $t = -2$

For checking:

L.H.S. $= 3(t-3) = 3(-2-3) = 3(-5) = -15$

R.H.S. $= 5(2t+1) = 5\{2\times(-2)+1\} = 5\{-4+1\} = 5(-3) = -15$

$\Rightarrow$ L.H.S. = R.H.S.

Hence, $t = -2$ is the required solution.

8. $15(y-4) - 2(y-9) + 5(y+6) = 0$

$$\Rightarrow 15y - 60 - 2y + 18 + 5y + 30 = 0$$

$$\Rightarrow 15y + 5y - 2y - 60 + 30 + 18 = 0$$

$$\Rightarrow 18y - 12 = 0$$

$$\Rightarrow 18y = 12$$

(Transposing 12 to R.H.S.)

$$\Rightarrow y = \frac{12}{18}$$

(Dividing both sides by 18.)

or $y = \frac{2}{3}$

For checking:

On putting $y = \frac{2}{3}$ in L.H.S. of the given equation,

$$\text{L.H.S.} = 15(y-4) - 2(y-9) + 5(y+6)$$

$$= 15\left(\frac{2}{3}-4\right) - 2\left(\frac{2}{3}-9\right) + 5\left(\frac{2}{3}+6\right)$$

$$= 15\left(\frac{2-12}{3}\right) - 2\left(\frac{2-27}{3}\right) + 5\left(\frac{2+18}{3}\right)$$

$$= 15 \times \left(\frac{-10}{3}\right) - 2 \times \left(\frac{-25}{3}\right) + 5 \times \left(\frac{20}{3}\right)$$

$$= \frac{(-150)}{3} + \frac{50}{3} + \frac{100}{3} = \frac{-150+50+100}{3}$$

$$= \frac{-150+150}{3} = \frac{0}{3} = 0 = \text{R.H.S.}$$

Hence, $y = \frac{2}{3}$ is the required solution.

9. The given linear equation is

$3(5z-7) - 2(9z-11) = 4(8z-13) - 17$

$\Rightarrow 15z - 21 - 18z + 22 = 32z - 52 - 17$

$\Rightarrow -3z + 1 = 32z - 69$

$\Rightarrow -3z - 32z = -69 - 1$ (Transposing 1 to R.H.S. and $32z$ to L.H.S.)

$\Rightarrow -35z = -70$

$\Rightarrow z = \frac{-70}{-35}$ (Dividing both sides by -35.)

or $z = 2$

For checking:

On putting $z = 2$ in L.H.S. and R.H.S. of the given equation,

$$\text{L.H.S.} = 3(5z-7) - 2(9z-11)$$

$$= 3(5 \times 2 - 7) - 2(9 \times 2 - 11)$$

$$= 3(10-7) - 2(18-11)$$

$$= 3 \times 3 - 2 \times 7$$

$$= 9 - 14 = -5$$

$$\text{R.H.S.} = 4(8z-13) - 17$$

$$= 4(8 \times 2 - 13) - 17$$

$$= 4(16-13) - 17$$

$$= 4 \times 3 - 17$$

$$= 12 - 17 = -5$$

$\Rightarrow$ L.H.S. = R.H.S.

Hence, $z = 2$ is the required solution.

10. The given equation is

$0.25(4f-3) = 0.05(10f-9)$

$\Rightarrow 1.00f - 0.75 = 0.50f - 0.45$

$\Rightarrow 1.00f - 0.50f = -0.45 + 0.75$ (Transposing $0.50f$ to L.H.S. and 0.75 to R.H.S.)

$\Rightarrow 0.50f = 0.3$

$\Rightarrow f = \frac{0.3}{0.50}$ (Dividing both sides by 0.50.)

or $f = 0.6$

For checking:

On putting $f = 0.6$ in L.H.S. and R.H.S. of the given equation,

$$\text{L.H.S.} = 0.25(4f-3) = 0.25(4 \times 0.6 - 3)$$

$$= 0.25(2.4-3) = 0.25 \times (-0.6) = -0.150$$

$$\text{R.H.S.} = 0.05(10f-9) = 0.05(10 \times 0.6 - 9)$$

$$= 0.05 \times (6.0-9) = 0.05 \times -3 = -0.15$$

$\Rightarrow$ L.H.S. = R.H.S.

Hence, $f = 0.6$ is the required solution.

EXERCISE 2.6 (*Page–35*)

Solve the following equations.

1. $\frac{8x-3}{3x} = 2$ **2.** $\frac{9x}{7-6x} = 15$ **3.** $\frac{z}{z+15} = \frac{4}{9}$

4. $\frac{3y+4}{2-6y} = \frac{-2}{5}$ **5.** $\frac{7y+4}{y+2} = \frac{-4}{3}$

Sol. 1. The given equation is $\frac{8x-3}{3x} = 2$

$\Rightarrow \frac{(8x-3)}{3x} \times 3x = 2 \times 3x$ (Multiplying both sides by $3x$.)

$\Rightarrow \quad 8x - 3 = 6x$

$\Rightarrow \quad 8x - 6x = 3$ (Transposing $6x$ to L.H.S. and 3 to R.H.S.)

$\Rightarrow \quad 2x = 3$

$\Rightarrow \quad \frac{2x}{2} = \frac{3}{2}$ (Dividing both sides by 2.)

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

Hence, $x = \frac{3}{2}$ is the required solution.

2. The given equation is $\frac{9x}{7-6x} = 15$

$\Rightarrow \quad \frac{9x \times (7-6x)}{(7-6x)} = 15 \times (7-6x)$ (Multiplying both sides by $(7-6x)$.)

$\Rightarrow \quad 9x = 15 \times (7-6x)$

$\Rightarrow \quad 9x = 105 - 90x$

$\Rightarrow \quad 9x + 90x = 105$ (Transposing $90x$ to L.H.S.)

$\Rightarrow \quad 99x = 105$

$\Rightarrow \quad x = \frac{105}{99}$ (Dividing both sides by 99.)

or $\quad x = \frac{35}{33}$

Hence, $x = \frac{35}{33}$ is the required solution.

3. The given equation is $\frac{z}{z+15} = \frac{4}{9}$

$\Rightarrow \quad \frac{z}{(z+15)} \times (z+15) = \frac{4}{9} \times (z+15)$

(Multiplying both sides by $(z+15)$.)

$\Rightarrow \quad z = \frac{4}{9} \times (z+15)$

$\Rightarrow \quad 9 \times z = 9 \times \frac{4}{9}(z+15)$ (Multiplying both sides by 9.)

$\Rightarrow \quad 9z = 4(z+15)$

$\Rightarrow \quad 9z = 4z + 60$

$\Rightarrow \quad 9z - 4z = 60$ (Transposing $4z$ to L.H.S.)

$5z = 60$

$\Rightarrow \quad \frac{5z}{5} = \frac{60}{5}$ (Dividing both sides by 5.)

or $\quad z = 12$

Hence, $z = 12$ is the required solution.

4. The given equation is $\frac{3y+4}{2-6y} = \frac{-2}{5}$

$\Rightarrow \quad \frac{(3y+4)}{(2-6y)} \times (2-6y) = \frac{-2}{5} \times (2-6y)$

(Multiplying both sides by $(2-6y)$.)

$\Rightarrow \quad (3y+4) = \frac{-2}{5} \times (2-6y)$

$\Rightarrow \quad (3y+4) \times 5 = \frac{-2}{5}(2-6y) \times 5$

(Multiplying both sides by 5.)

$\Rightarrow \quad (3y+4) \times 5 = -2(2-6y)$

$\Rightarrow \quad 15y + 20 = -4 + 12y$

$\Rightarrow \quad 15y - 12y = -4 - 20$ (Transposing $12y$ to L.H.S. and 20 to R.H.S.)

$\Rightarrow \quad 3y = -24$

$\Rightarrow \quad y = \frac{-24}{3}$ (Dividing both sides by 3.)

or $\quad y = -8$

Hence, the required value of y is -8.

5. The given equation is $\frac{7y+4}{y+2} = \frac{-4}{3}$

$\Rightarrow \quad \frac{7y+4}{(y+2)} \times (y+2) = \frac{-4}{3} \times (y+2)$

(Multiplying both sides by $(y+2)$.)

$\Rightarrow \quad 7y + 4 = \frac{-4}{3}(y+2)$

$\Rightarrow \quad 3 \times (7y+4) = 3 \times \frac{-4}{3}(y+2)$ (Multiplying both sides by 3.)

$\Rightarrow \quad 21y + 12 = -4y - 8$

$\Rightarrow \quad 21y + 4y = -8 - 12$ (Transposing $4y$ to L.H.S. and 12 to R.H.S.)

$\Rightarrow \quad 25y = -20$

$\Rightarrow \quad y = \frac{-20}{25}$ (Dividing both sides by 25.)

or $\quad y = \frac{-4}{5}$

Hence, $y = \frac{-4}{5}$ is the required solution.

Q6. The ages of Hari and Harry are in the ratio 5 : 7. Four years from now the ratio of their ages will be 3 : 4. Find their present ages.

Sol. Let the ages of Hari and Harry be $5x$ years and $7x$ years.

After four years, the age of Hari = $(5x + 4)$ years

and, the age of Harry = $(7x + 4)$ years

According to the conditions,

$$\frac{5x+4}{7x+4} = \frac{3}{4}$$

$\Rightarrow \frac{(5x+4)}{(7x+4)} \times (7x+4) = \frac{3}{4} \times (7x+4)$ (Multiplying both sides by $(7x + 4)$)

$$(5x+4) = \frac{3}{4} \times (7x+4)$$

$\Rightarrow \quad 4 \times (5x+4) = 4 \times \frac{3}{4} \times (7x+4)$ (Multiplying both sides by 4)

$\Rightarrow \quad 20x + 16 = 21x + 12$

$\Rightarrow \quad 20x - 21x = 12 - 16$ (Transposing $21x$ to L.H.S. and 16 to R.H.S.)

$\Rightarrow \quad -x = -4$

or $\quad x = 4$

Hence, the age of Hari = $5x = 5 \times 4 = 20$ years

Age of Harry = $7x = 7 \times 4 = 28$ years.

Q7. The denominator of a rational number is greater than its numerator by 8. If the numerator is increased by 17 and the denominator is decreased by 1, the number obtained is $\frac{3}{2}$. Find the rational number.

Sol. Let the numerator of a rational number be x, the denominator is $x + 8$.

$$\text{Rational number} = \frac{x}{x+8}$$

According to the conditions,

$\Rightarrow \quad \frac{x+17}{x+8-1} = \frac{3}{2}$

$\Rightarrow \quad \frac{x+17}{x+7} = \frac{3}{2}$

$\Rightarrow \frac{(x+17)}{(x+7)} \times (x+7) = \frac{3}{2} \times (x+7)$ (Multiplying both sides by $(x + 7)$.)

$\Rightarrow \quad x + 17 = \frac{3}{2}(x+7)$

$\Rightarrow \quad 2 \times (x+17) = 2 \times \frac{3}{2}(x+7)$ (Multiplying both sides by 2.)

$\Rightarrow \quad 2x + 34 = 3x + 21$

$\Rightarrow \quad 2x - 3x = 21 - 34$ (Transposing $3x$ to L.H.S. and 34 to R.H.S.)

$\Rightarrow \quad -x = -13$

$\Rightarrow \quad x = 13$

Hence, the required rational number $\frac{x}{x+8} = \frac{13}{13+8} = \frac{13}{21}$.

□□