LINEAR EQUATIONS IN ONE VARIABLE

NCERT Textbook Questions

EXERCISE 2.1

Solve the following equations:

Q.1. $x - 2 = 7$

Sol. $x - 2 = 7$

or $x - 2 + 2 = 7 + 2$ (Add 2 to both sides)

or $x = 9$, which is the required solution

Alternative method:

$x - 2 = 7$

Transposing – 2 R.H.S., we get

$x = 7 + 2$

or $x = 9$, which is the required solution.

Check: Substituting

$x = 9$ on the L.H.S. of the given equation, we get

L.H.S. $= 9 - 2 = 7 =$ R.H.S

Q.2. $y + 3 = 10$

Sol. $y + 3 = 10$

or $y + 3 - 3 = 10 - 3$ (Subtracting 3 from both sides)

or $y = 7$, which is the required solution.

Q.3. $6 = z + 2$

Sol. $6 = z + 2$

or $z + 2 = 6$

or $z + 2 - 2 = 6 - 2$ (Subtracting 2 from both sides)

or $z = 4$, which is the required solution.

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

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

or $\frac{3}{7}+x-\frac{3}{7}=\frac{17}{7}-\frac{3}{7}$ (Subtracting $\frac{3}{7}$ from both sides)

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

or $x = 2$, which is the required solution.

Q.5. $6x = 12$

Sol. Dividing both sides by 6, we get

$$\frac{6x}{6}=\frac{12}{6}$$

or $x = 2$, which is the required solution.

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

Sol. Multiplying both sides by 5, we get

$$\frac{t}{5}\times 5 = 10 \times 5$$

or $t = 50$, which is the required solution.

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

Sol. Multiplying both sides by 3, we get

$$\frac{2x}{3} \times 3 = 18 \times 3$$

or $2x = 18 \times 3$

Dividing both sides by 2, we get

$$\frac{2x}{2}=\frac{18\times 3}{2}$$

or $x = 27$, which is the required solution.

Alternative method: $\frac{2x}{3}=18$

Multiplying both sides by $\frac{3}{2}$, we get

$$\frac{2x}{3}\times\frac{3}{2} = 18\times\frac{3}{2}$$

or $x = 27$, which is the required solution

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

Sol. Multiplying both sides by 1.5, we get

$$1.6 \times 1.5 = \frac{y}{1.5} \times 1.5$$

or $2.4 = y$

i.e., $y = 2.4$, which is the required solution.

Q.9. $7x - 9 = 16$

Sol. $7x - 9 = 16$

Transposing – 9 to R.H.S., we get

$7x = 16 + 9$

or $7x = 25$

Dividing both sides by 7, we get $\frac{7x}{7} = \frac{25}{7}$ or $x = \frac{25}{7}$, which is the required solution.

Q.10. $14y - 8 = 13$

Sol. Transposing – 8 to R.H.S., we have

$14y = 13 + 8$

or $14y = 21$

Dividing both sides by 14, we get

$$\frac{14y}{14} = \frac{21}{14}$$

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

Q. 11. $17 + 6p = 9$

Sol. $17 + 6p = 9$

Transposing 17 to R.H.S. we have,

$$6p = 9 - 17$$

or $$6p = -8$$

Dividing both sides by 6, we get

$$p = \frac{-8}{6}$$

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

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

Sol. Transposing 1 to R.H.S. we have

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

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

Multiplying both sides by 3, we get

$$\frac{x}{3} \times 3 = \frac{-8}{15} \times 3$$

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

EXERCISE 2.2

Q.1. 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 required number be x.

According to the question, we have

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

or $x - \frac{1}{2} = 2 \times \frac{1}{8}$

or $x - \frac{1}{2} = \frac{1}{4}$

Transposing $-\frac{1}{2}$ to R.H.S. we get

$x = \frac{1}{4} + \frac{1}{2}$

or $x = \frac{1+2}{4}$

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

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

Q. 2. 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 rectangular swimming pool be x m.

$\therefore$ Length of rectangular swimming pool = $(2 \times x + 2)$ m = $(2x + 2)$ m

Further, according to the question, we have

Perimeter of swimming pool = 2 (length + breadth)

or $154 = 2[(2x + 2) + x]$

or $154 = 4x + 4 + 2x$

or $154 = 6x + 4$

or $6x + 4 = 154$

Transposing 4 to R.H.S., we get

$6x = 154 - 4 = 150$

Dividing both sides by 6, we get

$\frac{6x}{6} = \frac{150}{6}$

$\Rightarrow x = 25$

i.e., Breadth of rectangular swimming pool = x = 25m

and length = $(2x + 2)$ m

= $(2 \times 25 + 2)$ m

= $(50 + 2)$ m

= 52 m.

Q.3. 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. Given, triangle is an isosceles triangle.

Let one of the equal side of given triangle is x cm.

We know that, Perimeter of isosceles triangle = Sum of all the three sides

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

$$\text{or} \qquad 2x + \frac{4}{3} = \frac{62}{15}$$

Transposing $\frac{4}{3}$ to R.H.S., we get

$$2x = \frac{62}{15} - \frac{4}{3}$$

$$\text{or} \qquad 2x = \frac{62 - 20}{15}$$

$$\text{or} \qquad 2x = \frac{42}{15}$$

Dividing both sides by 2, we get

$$\frac{2x}{2} = \frac{42}{15 \times 2}$$

$$\text{or} \qquad x = \frac{21}{15} = \frac{7}{5} = 1\frac{2}{5}$$

Thus, the length of either of the remaining equal sides is $1\frac{2}{5}$ cm.

Q.4. Sum of two numbers is 95. If one exceeds the other by 15, find the numbers.

Sol. Let the one number be x.

Then the other number = $(x + 15)$ (As per condition)

According to the question, we have

$$x + (x + 15) = 95$$

$$\text{or} \qquad 2x + 15 = 95$$

Transposing 15 to R.H.S, we get

$$2x = 95 - 15 = 80$$

Dividing both sides by 2, we get

$$\frac{2x}{2} = \frac{80}{2}$$

or $x = 40$

i.e., One number = $x = 40$ and the other number = $(x + 15) = (40 + 15) = 55$

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

Sol. Let the numbers be $5x$ and $3x$.

According to the question, we have

$5x - 3x = 18$

or $2x = 18$

Dividing both sides by 2, we get

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

or $x = 9$

i.e., The numbers are 5×9 and 3×9 or 45 and 27.

Q.6. Three consecutive integers add up to 51. What are these integers?

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

According to the question, we have

$x + x + 1 + x + 2 = 51$

or $3x + 3 = 51$

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

or $3x = 48$

Dividing both sides by 3, we get

$$\frac{3x}{3} = \frac{48}{3}$$

or $x = 16$

i.e, the required three consecutive integers are 16, 16 + 1 and 16 + 2 or 16, 17 and 18

Q.7. The sum of three consecutive multiples of 8 is 888. Find the multiples.

Sol. Let the three consecutive multiples of 8 be x, $(x + 8)$ and $(x + 8 + 8)$.

According to the question, we have

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

or $3x + 24 = 888$

or $3x = 888 - 24$

or $3x = 864$

Now dividing both sides by 3, we get

$$\frac{3x}{3} = \frac{864}{3}$$

or $x = 288$

Hence, the three consecutive multiples of 8 are 288, 288 + 8 and 288 + 16 i.e. 288, 296 and 304.

Q.8. 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 the first number be x, then its two consecutive integers are $x + 1$ and $x + 2$.

According to the question, we have

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

or $2x + 3x + 3 + 4x + 8 = 74$

or $9x = 74 - 11 = 63$

Now dividing both sides by 9, we get

$$\frac{9x}{9} = \frac{63}{9}$$

Hence, the three consecutive integers are 7, 7 + 1 and 7 + 2 or 7, 8 and 9.

Q.9. 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 ages of Rahul and Haroon be $5x$ years and $7x$ years respectively.

Four years later,

Age of Rahul = $(5x + 4)$ years; Age of Haroon = $(7x + 4)$ years

According to the question, we have

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

or $12x + 8 = 56$

or $12x = 56 - 8 = 48$ (transposing 8 to R.H.S.)

or $x = \frac{48}{12}$ (Dividing both sides by 12)

or $x = 4$

Therefore, present age of Rahul = 5 × 4 years = 20 years

and present age of Haroon = 7 × 4 years = 28 years

Q.10. The number of boys and girls in a class are in the ratio of 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 boys and girls in a class be $7x$ and $5x$.

Further, according to the question, we have

Number of boys = Number of girls + 8

or $7x = 5x + 8$

or $7x - 5x = 8$ (On transposing)

or $2x = 8$

or $x = \frac{8}{2}$ (Dividing both sides by 2)

or $x = 4$

Therefore, the number of boys = $7 \times 4 = 28$ and number of girls = $5 \times 4 = 20$

Therefore, the total number of students = $20 + 28 = 48$

Q.11. 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 the present age of Baichung be x years.

Then age of Baichung's father = $x + 29$

And age of Baichung's grandfather = $x + 29 + 26 = x + 55$

$\therefore$ $x + x + 29 + x + 55 = 135$

or $3x + 84 = 135$

or $3x = 135 - 84 = 51$

or $x = \frac{51}{3} = 17$

$\therefore$ Baichung's age = 17 years

age of Baichung's father = (17 + 29) years = 46 years

age of Baichung's grandfather = 46 + 26 = 72 years

Q.12. Fifteen years from now Ravi's age will be four times his present age. What is Ravi's present age?

Sol. Let the present age of Ravi be x years.

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

According to the question, we have

$(x + 15) = 4 \times x$

or $x + 15 = 4x$

or $3x = 15$ (on transposing)

or $x = \frac{15}{3}$ (on dividing both sides by 3)

or $x = 5$

Hence, the present age of Ravi is 5 years.

Q.13. 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 question, we have

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

or $\frac{5x}{2} = \frac{-7}{12} - \frac{2}{3}$ (on transposing)

or $\frac{5x}{2} = \frac{-7-8}{12} = \frac{-15}{12}$

or $x = \frac{-15}{12} \times \frac{2}{5} = -\frac{1}{2}$.

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

Q.14. 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 the Lakshmi has notes of ₹ 100, ₹ 50 and ₹ 10 as $2x$, $3x$ and $5x$ respectively.

According to the question, we have

$$200x + 150x + 50x = 4{,}00{,}000$$

or $400x = 4{,}00{,}000$

or $x = 1{,}000$

Hence, Lakshmi has ₹ 100 notes = 2 × ₹ 1,000 = ₹ 2,000

₹ 50 notes = 3 × ₹ 1,000 = ₹ 3,000

and ₹ 10 notes = 5 × ₹ 1,000 = ₹ 5000

Q.15. 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. Let the coin of ₹ 5 be x.

$\therefore$ Coin of ₹ 2 $= 3 \times x = 3x$

$\therefore$ Coin of ₹ 1 = Total no. of coins $- (x + 3x)$

$= 160 - 4x$

Further according to the question, we have

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

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

or $7x = 300 - 160$

or $7x = 140$

or $x = \frac{140}{7} = 20$

$\therefore$ No. of ₹ 5 coins $= 20$

No. of ₹ 2 coins $= 3 \times 20 = 60$

and No. of ₹ 1 coins $= 160 - 4 \times 20 = 160 - 80 = 80$.

Q.16. 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 ₹ 3000. Find the number of winners, if the total number of participants is 63.

Sol. Given, the total number of participants is 63.

Let the number of winners be x.

As per question, winners get ₹ 100 x.

Number of participant who does not win $= 63 - x$

Participants who do not win get = ₹ $(63 - x) \times 25$

Further according to the given condition, we have

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

or $100x + 1575 - 25x = 3000$

or $75x = 3000 - 1575 = 1425$

or $x = \frac{1425}{75} = 19$

Thus, the number of winners is 19.

EXERCISE 2.3

Solve the following equations and check your results

Q.1. $3x = 2x + 18$

Sol. $3x = 2x + 18$

Subtracting $2x$ from both sides, we get

$3x - 2x = 2x + 18 - 2x$

or $x = 18$

Alternative Method: $3x = 2x + 18$

Transposing $2x$ to L.H.S., we get

$3x - 2x = 18$

or $x = 18$

Q.2. $5t - 3 = 3t - 5$

Sol. $5t - 3 = 3t - 5$ or $5t - 3t = -5 + 3$ (On transposing 3 to R.H.S. and $3t$ to L.H.S.)

or $2t = -2$

or $\frac{2t}{2} = \frac{-2}{2}$ (Dividing both sides by 2)

or $t = -1$

Q.3. $5x + 9 = 5 + 3x$

Sol. $5x + 9 = 5 + 3x$

or $5x - 3x = 5 - 9$ (On transposing 9 to R.H.S. and $3x$ to L.H.S.)

or $2x = -4$ (Dividing both sides by 2)

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

or $x = -2$

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

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

or $4z - 2z = 6 - 3$ (On transposing)

or $2z = 3$

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

or $z = 1.5$

Q.5. $2x - 1 = 14 - x$

Sol. $2x - 1 = 14 - x$

or $2x + x = 14 + 1$

or $3x = 14 + 1$ (On transposing)

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

or $x = 5$

Q.6. $8x + 4 = 3(x - 1) + 7$

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

or $8x + 4 = 3x - 3 + 7$

or $8x - 3x = -3 + 7 - 4$ (On transposing)

or $5x = 0$

or $x = 0$ (Dividing both side by 5)

Q.7. $x = \frac{4}{5}(x + 10)$

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

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

or $5x = 4(x + 10)$

or $5x = 4x + 40$

or $5x - 4x = 40$ (On transposing)

or $x = 40$

Q.8. $\frac{2x}{3} + 1 = \frac{7x}{15} + 3$

Sol. $\frac{2x}{3} + 1 = \frac{7x}{15} + 3$ (On transposing)

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

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

or $\frac{3x}{15} = 2$

or $\frac{3x}{15} \times 15 = 2 \times 15$ (Multiplying both sides by 15)

or $3x = 30$

or $\frac{3x}{3} = \frac{30}{3}$ (Dividing both side by 3)

or $x = 10$

Q. 9. $2y + \frac{5}{3} = \frac{26}{3} - y$

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

or $2y + y = \frac{26}{3} - \frac{5}{3}$ (On transposing)

or $3y = \frac{26-5}{3} = \frac{21}{3} = 7$

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

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

Q.10. $3m = 5m - \frac{8}{5}$

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

or $3m - 5m = -\frac{8}{5}$ (On transposing)

or $-2m = -\frac{8}{5}$

or $2m = \frac{8}{5}$

or $\frac{2m}{2} = \frac{8}{5 \times 2}$ (Dividing both sides by 2)

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

EXERCISE 2.4

Q.1. Amina thinks of a number and $\frac{5}{2}$ subtracts 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 the required number be x.

According to the question, we have

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

or $8x - 20 = 3x$

or $8x - 3x = 20$

or $5x = 20$ (On transposing)

Dividing both sides by 5, we get

$$x = \frac{20}{5} = 4.$$

Thus, the required number is 4.

Q.2. 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 one of the positive number be x, then other number be $5x$.

According to the question, we have

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

or $2x + 42 = 5x + 21$

or $2x - 5x = 21 - 42$ (On transposing)

or $-3x = -21$ or $3x = 21$

or $x = \frac{21}{3} = 7$ (Dividing both sides by 3)

$\therefore$ One number $= 7$

and the other number $= 5 \times 7 = 35$

Q.3. 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. Let the unit's digit is x.

Since it is given that the sum of the digits of the number is 9, the tens digit must be $(9 - x)$.

According to the question, we have

$(9 - x) \times 10 + x$ i.e., $90 - 10x + x$ i.e., $90 - 9x$

According to the question, on interchanging the digits of the given number.

$\therefore$ The units becomes $(9 - x)$ and the tens digit becomes x.

Thus, the new number is expressed as

$x \times 10 + (9 - x)$ i.e., $10x + 9 - x$ i.e., $9x + 9$

Further according to the question.

New number exceeds the given number by 27.

$\therefore \quad (9x + 9) - (90 - x) = 27$

or $\quad 9x + 9 - 90 + 9x = 27$

or $\quad 18x - 81 = 27$

or $\quad 18x = 27 + 81$

$= 108$

$\therefore \quad x = \frac{108}{18} = 6$

Thus, units digit $= x = 6$ and tens digit $= 9 - x = 9 - 6 = 3$

Hence, the required number is 36.

Check: Interchanging the digits, we get 63.

Now $63 - 36 = 27$, which is true.

Hence, the solution is correct.

Q.4. 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 unit's digit be x.

Since it is given that the other digit is three times the unit's digit, then the ten's digit must be $3x$.

$\therefore \quad$ Number $= 3x \times 10 + x = 30x + x = 31x$

According to the question, on interchanging the digit of the given number.

$\therefore$ The units digit becomes $3x$ and tens digit becomes x.

Thus, the new number is expressed as $10x + 3x$ i.e. $13x + 31x$.

According to the question,

$13x + 31x = 88$

or $\quad 44x = 88$

or $\quad x = \frac{88}{44} = 2$

Thus, units digit $= x = 2$

and tens digit $= 3x = 3 \times 2 = 6$

Hence, the required number is 62.

Q.5. Shobo's mother's present age is six time 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 the shobo's present age be x years.

Then his mother's present age = $6x$ years

Shobo's age after five years from now = $(x + 5)$ years

According to the question, we have

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

or $x + 5 = 2x$

or $x - 2x = -5$

or $-x = -5$

or $x = 5$

Thus shobo's present age $= x = 5$ years

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

Q.6. 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 ₹ 75000 to fence the plot. What are the dimensions of the plot?

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

Cost for fencing of the plot = ₹ 75,000

Rate for costing = ₹ 100 per metre

We know that, Perimeter of rectangular plot

$= 2$ (Length + Breadth) $= 2(11x + 4x) = 2 \times 15x = 30x$

But, cost of fencing the plot = perimeter × rate

or $75000 = 30x \times 100$

or $750 = 30x$

or $$x = \frac{750}{30} = 25$$

Thus, the length of the plot $= 11x = 11 \times 25$ metre $= 275$ metre

and breadth of the plot $= 4x = 4 \times 25$ metre $= 100$ metre

Q.7. 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 meters 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. Hasan buys shirt and trouser in ratio 2 : 3

Let the ratio be x.

He buys $2x$ m of the trouser and $3x$ m of the shirt material.

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

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

The selling price of the shirt material = ₹ $150x$ + 12% of ₹ $150x$

$$= ₹\left(150x + \frac{12}{100} \times 150x\right) = ₹\ (150x + 16x) = ₹\ 168\ x$$

The selling of the trouser material = ₹ $180x$ + 10% of ₹ $180\ x$

$$= ₹\left(180x + \frac{10}{100} \times 180x\right) = ₹\ (180x + 18x) = ₹\ 198\ x$$

According to the question, we have

$$168x + 198\ x = 36{,}600 \text{ or } 366x = 36{,}600$$

or $$x = \frac{36{,}600}{366} = 100$$

Thus, the trouser material is bought by him = 2 × 100m = 200 m

Q.8. 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 number of deer in the herd.

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

Number of deer whose grazing in the field = $\frac{1}{2}$ of $x = \frac{x}{2}$

$\therefore$ Rest number of deer $= x - \frac{x}{2} = \frac{x}{2}$

Three fourths of the remaining = $\frac{3}{4}$ of $\frac{x}{2} = \frac{3x}{8}$

$\therefore$ Rest of deer $= \frac{x}{2} - \frac{3x}{8}$

or $$9 = \frac{4x - 3x}{8} \quad (\therefore \text{ Given, rest of deer} = 9)$$

or $$72 = x$$

Thus, the number of deer in the herd is 72.

Q.9. A grandfather is ten times older than his granddaughter. He is also 54 years older than her. Find their present ages.

Sol. Let the age of grandfather be x years.

Then his grandfather's age = $10x$ years.

According to the question, we have

$$x + 54 = 10x$$

or $$x - 10x = -54$$

or $$-9x = -54 \text{ or } x = 6$$

Thus, age of granddaughter $= x = 6$ years and

age of grandfather $= 10x = 10 \times 6$ years $= 60$ years.

Q.10. 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 son's present age be x years.

$\therefore$ Father's present age $= 3x$ years

Ten years age son's age $= (x - 10)$ years and

Ten years ago father's age $= (3x - 10)$ years

According to the question, we have

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

or $$3x - 10 = 5x - 50$$

or $$3x - 5x = -50 + 10 \quad \text{(On transposing)}$$

or $$-2x = -40$$

or $$x = \frac{40}{2} = 20$$

Therefore, son's present age $= x = 20$ years

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

EXERCISE 2.5

Solve the following linear equations.

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

Sol. $$\frac{5x-2}{10} = \frac{4x+3}{12} \quad \text{(Taking L.C.M)}$$

or $$12(5x - 2) = 10(4x + 3) \quad \text{(On cross multiplying)}$$

or $60x - 24 = 40x + 30$ (Opening the brackets)

or $60x - 40x = 30 + 24$ (On transposing)

or $20x = 54$

or $\frac{20x}{20} = \frac{54}{20}$ (On dividing both sides by 20)

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

Check: L.H.S. $= \frac{x}{2} - \frac{1}{5} = \frac{27}{2 \times 10} - \frac{1}{5}$ (Putting $x = \frac{27}{10}$)

$= \frac{27}{20} - \frac{1}{5} = \frac{27 - 4}{20} = \frac{23}{20}$

R.H.S $= \frac{x}{3} + \frac{1}{4} = \frac{27}{3 \times 10} + \frac{1}{4} = \frac{27}{30} + \frac{1}{4} = \frac{54 + 15}{60} = \frac{69}{60} = \frac{23}{20}$

L.H.S = R.H.S

So our answer is correct

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

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

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

or $7n = 21 \times 12$ (On cross multiplication)

or $n = \frac{21 \times 12}{7}$ (Dividing by 7)

or $n = 36.$

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

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

or $\frac{3x + 21 - 8x}{3} = \frac{17 - 15x}{6}$

or $\frac{-5x + 21}{3} = \frac{17 - 15x}{6}$

or $6(-5x + 21) = 3(17 - 15x)$ (On cross multiplication)

or $2(-5x + 21) = 17 - 15x$

or $-10x + 42 = 17 - 15x$ (Opening the brackets)

or $-10x + 15x = 17 - 42$ (On transposing)

or $5x = -25$

or $x = \frac{-25}{5}$ (Dividing by 5)

or $x = -5$

Q.4. $\frac{x-5}{3} = \frac{x-3}{5}$

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

or $5(x - 5) = 3(x - 3)$ (On cross multiplication)

or $5x - 25 = 3x - 9$ (Opening brackets)

or $5x - 3x = -9 + 25$ (On transposing)

or $2x = 16$

or $x = \frac{16}{2}$ (Dividing by 2)

or $x = 8.$

Q.5. $\frac{3t-2}{4} - \frac{2t+3}{3} = \frac{2}{3} - t$

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

or $\frac{3(3t-2)-4(2t+3)}{12} = \frac{2-3t}{3}$

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

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

or $\frac{t-18}{4} = 2 - 3t$ (Multiplying by 4)

or $t - 18 = 4(2 - 3t)$ (On cross multiplication)

or $t - 18 = 8 - 12t$ (Opening brackets)

or $t + 12t = 8 + 18$ (On transposing)

or $13t = 26$

or $t = \frac{26}{13}$ (Dividing by 13)

or $t = 2.$

Q.6. $m - \frac{m-1}{2} = 1 - \frac{m-2}{3}$

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

or $\frac{2m-(m-1)}{2} = \frac{3-(m-2)}{3}$ (Taking L.C.M.)

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

or $\frac{m+1}{2} = \frac{-m+5}{3}$

or $3(m+1) = 2(-m+5)$ (On cross multiplication)

or $3m + 3 = -2m + 10$ (Opening brackets)

or $3m + 2m = 10 - 3$ (On transposing)

or $5m = 7$

or $m = \frac{7}{5}.$

Simplify and solve the following linear equations.

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

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

or $3t - 9 = 10t + 5$ (Opening brackets)

or $3t - 10t = 5 + 9$ (On transposing)

or $-7t = 14$

or $t = \frac{-14}{7}$ (On dividing by 7)

or $t = -2$

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

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

or $15y - 60 - 2y + 18 + 5y + 30 = 0$ (Opening brackets)

or $18y - 12 = 0$

or $y = \frac{12}{18}$ (On transposing)

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

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

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

or $15z - 21 - 18z + 22 = 32z - 52 - 17$ (Opening brackets)

or $-3z + 1 = 32z - 69$

or $-3z - 32z = -69 - 1$ (on transposing)

or $-35z = -70$

or $z = \frac{-70}{-35}$ (On dividing by 35)

or $z = 2.$

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

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

or $f - 0.75 = 0.5f - 0.45$ (Opening brackets)

or $f - 0.5f = -0.45 + 0.75$ (On transposing)

or $0.5f = 0.30$

or $f = \frac{0.30}{0.5} = 0.6$

EXERCISE 2.6

Solve the following equations.

Q.1. $\frac{8x - 3}{3x} = 2$

Sol. $\frac{8x - 3}{3x} = 2$

or $8x - 3 = 6x$ (On cross multiplication)

or $8x - 6x = 3$ (On transposing)

or $2x = 3$ (On transposing)

or $x = \frac{3}{2}$ (On dividing both sides by 2)

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

Q.2. $\frac{9x}{7-6x}=15$

Sol. $$\frac{9x}{7-6x}=15$$

Multiplying both sides of the given equation by $(7-6x)$, we have

$$\frac{9x}{(7-6x)}\times(7-6x)=15\times(7-6x)$$

or $$9x=105-90x$$

Transposing $-90x$ to L.H.S., we have

$$9x+90x=105$$

or $$99x=105$$

$$\therefore \quad x=\frac{105}{99}=\frac{35}{33}$$

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

Check: Substituting $x=\frac{35}{33}$ in the L.H.S. of the given equation, we get

L.H.S $$\frac{9\times\frac{35}{33}}{7-6\times\frac{35}{33}}=\frac{3\times\frac{35}{11}}{7-2\times\frac{35}{11}}=\frac{\frac{105}{11}}{7-\frac{70}{11}=}=\frac{\frac{105}{11}}{\frac{77-70}{11}}=\frac{\frac{105}{11}}{\frac{7}{11}}=\frac{105\times11}{7\times11}=\frac{105}{7}=15$$

$$=\text{R.H.S}$$

Hence, the solution is correct.

Q.3. $\frac{z}{z+15}=\frac{4}{9}$

Sol. $$\frac{z}{z+15}=\frac{4}{9}$$

or $9z=4\,(z+15)$ (On cross multiplication)

or $9z=4z+60$

or $9z-4z=60$ (On transposing)

$5z=60$

or $$z=\frac{60}{5}=12$$ (Dividing by 5)

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

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

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

or $5(3y + 4) = -2(2 - 6y)$ (On cross multiplication)

or $15y + 20 = -4 + 12y$ (Opening brackets)

or $15y - 12y = -4 - 20$ (On transposing)

or $3y = -24$

or $y = \frac{-24}{3} = -8$ (Dividing by 3)

Hence, $y = -8$ is the required solution.

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

Sol. $\frac{7y+4}{y+2} = \frac{-4}{3}$

or $3(7y + 4) = -4(y + 2)$ (On cross multiplication)

or $21y + 12 = -4y - 8$

or $21y + 4y = -8 - 12$ (On transposing)

or $25y = -20$

or $y = \frac{-20}{25} = \frac{-4}{5}$

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

Q.6. The ages of Hari and Harry are in the ratio 5 : 7. Four years later, their ages will be in the ratio 3 : 4. Find their present ages.

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

Four years later,

Age of Hari = $5x + 4$

and Age of Harry = $7x + 4$

According to the question, we have

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

On cross-multiplication, we have

$$4(5x + 4) = 3(7x + 4)$$

$$20x + 16 = 21x + 12$$

Transposing $21x$ to L.H.S. and 16 to R.H.S. we get

$$20x - 21x = 12 - 16$$

or $$-x = -4 \Rightarrow x = 4$$

i.e., Present age of Hari $= 5x = 5 \times 4 = 20$ years

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

Thus, the required present ages of Hari and Harry are 20 years and 28 years respectively.

Q.7. 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 the rational number be x.

Since it is given that the denominator is greater than the numerator by 8.

$\therefore$ Denominator $= x + 8$

According to the question,

If numerator is increased by 17 and the denominator is decreased by 1, we have,

new numerator $= x + 17$

and new denominator $= x + 8 - 1 = x + 7$

$$\therefore \quad \text{new number} = \frac{x+17}{x+7}$$

Further given that new number is equal to $\frac{3}{2}$

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

On cross–multiplication, we have

$$2(x + 17) = 3(x + 7)$$

or $$2x + 34 = 3x + 21$$

Transposing $3x$ to L.H.S and 34 to R.H.S. we get

$$2x - 3x = 21 - 34$$

or $$-x = -13$$

i.e., $$x = 13$$

$\therefore$ Denominator $= x + 8 = 13 + 8 = 21$.

Thus, the required number $= \frac{13}{21}$.