

VII LINEAR EQUATIONS IN ONE VARIABLE

Examples:-

1) Find the solution of $2x - 3 = 7$

Solution:- $2x - 3 = 7$

$$\Rightarrow 2x = 7 + 3$$

$$\Rightarrow 2x = 10$$

$$\Rightarrow x = \frac{10}{2}$$

$\therefore x = 5$ is the required solution.

2) Solve $2y + 9 = 4$

Solution:-

$$2y = 4 - 9$$

$$\Rightarrow 2y = -5$$

$$\Rightarrow y = -\frac{5}{2} \text{ is the required solution.}$$

3) Solve $\frac{x}{3} + \frac{5}{2} = -\frac{3}{2}$

Solution:-

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

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

$$\Rightarrow \frac{x}{3} = -\frac{8}{2} = -4$$

$$\Rightarrow x = 3 \times -4$$

$\therefore x = -12$ is the required solution.

4) Solve $\frac{15}{4} - 7x = 9$

Solution:-

$$-7x = \frac{9 \times 4}{1 \times 4} - \frac{15}{4}$$

$$\Rightarrow -7x = \frac{36 - 15}{4} = \frac{21}{4}$$

$$\Rightarrow -x = \frac{21^3}{4 \times 71} = \frac{3}{4}$$

$\therefore x = -\frac{3}{4}$ is the required solution.

Exercise 2.1

Solve the following equations:-

1) $x - 2 = 7$

Solution:-

$$x = 7 + 2$$

$\therefore x = \underline{9}$ is the required solution.

2) $y + 3 = 10$

Solution:-

$$y = 10 - 3$$

$\therefore y = \underline{7}$ is the required solution.

3) $6 = z + 2$

Solution:-

$$z + 2 = 6$$

$$\Rightarrow z = 6 - 2$$

$\therefore z = \underline{4}$ is the required solution.

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

Solution:-

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

$$\Rightarrow x = \frac{17 - 3}{7}$$

$$\Rightarrow x = \frac{14}{7}$$

$\therefore x = \underline{2}$ is the required solution.

5) $6x = 12$

Solution:-

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

$\therefore x = \underline{2}$ is the required solution.

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

Solution:-

$$t = 5 \times 10$$

$\therefore t = \underline{50}$ is the required solution.

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

Solution:-

$$2x = 18 \times 3$$

$$\Rightarrow 2x = 54$$

$$\Rightarrow x = \frac{54}{2} = 27$$

$\therefore x = \underline{27}$ is the required solution.

8) $1.6 = \frac{y}{1.5}$

Solution:-

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

$$\Rightarrow y = 1.6 \times 1.5$$

$\therefore y = \underline{2.4}$ is the required solution.

9) $7x - 9 = 16$

Solution:-

$$7x = 16 + 9$$

$$\Rightarrow 7x = 25$$

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

10) $14y - 8 = 13$

Solution:-

$$14y = 13 + 8$$

$$\Rightarrow 14y = 21$$

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

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

11) $17 + 6p = 9$

Solution:-

$$6p = 9 - 17$$

$$\Rightarrow 6p = -8$$

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

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

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

Solution:-

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

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

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

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

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

Examples:-

1) What should be added to twice the rational number $-\frac{7}{3}$ to get $\frac{3}{7}$?

Solution:- Let the required number be x .

$$\text{Then, } 2x - \frac{7}{3} + x = \frac{3}{7}$$

$$-\frac{14}{3} + x = \frac{3}{7}$$

$$x = \frac{3 \times 7 + 14 \times 7}{7 \times 3} = \frac{9 + 98}{21}$$

$$\therefore x = \frac{107}{21}$$

Hence the required number to be added is $\frac{107}{21}$.

2) The perimeter of a rectangle is 13cm and its width is $2\frac{3}{4}$ cm. Find its length.

Solution:- Let the length of the rectangle be x cm.
Then, perimeter of a rectangle = $2(l+b) = 13$
 $\Rightarrow 2(x + \frac{11}{4}) = 13$

$$\Rightarrow x + \frac{11}{4} = \frac{13}{2}$$

$$\Rightarrow x = \frac{13 \times 2}{2 \times 2} - \frac{11}{4}$$

$$\Rightarrow x = \frac{26-11}{4}$$

$$\therefore x = \frac{15}{4} = 3\frac{3}{4} \text{ cm} //$$

Hence the length of the rectangle = $3\frac{3}{4}$ cm.

- 3) The present age of Sahil's mother is three times the present age of Sahil. After 5 years, their ages will add to 66 years. Find their present ages.

Solution:-

Let the present age of Sahil be x years.

Then, present age of Sahil's mother = $3x$

after 5 years, Sahil's age = $x+5$

mother's age = $3x+5$

Then, $x+5+3x+5 = 66$

$$\Rightarrow 4x+10 = 66$$

$$\Rightarrow 4x = 66-10$$

$$\Rightarrow 4x = 56$$

$$\Rightarrow x = \frac{56}{4} = 14$$

$$\therefore x = 14 //$$

Hence the present age of Sahil = 14 years

mother's age = $3x = 3 \times 14 = 42$ years

- 4) Bansi has 3 times as many two-rupee coins as he has five-rupee coins. If he has in all a sum of ₹77, how many coins of each denomination does he have?

Solution:-

Let the number of five-rupee coins be x .

Then, the number of two-rupee coins = $3x$.

$$\text{Total amount} = 5x + 2 \times 3x = 77$$

$$\Rightarrow 5x + 6x = 77$$

$$\Rightarrow 11x = 77$$

$$x = \frac{77}{11} = \underline{\underline{7}}$$

Hence the no. of five-rupee coins = 7

no. of two-rupee coins = $3x = 3 \times 7 = \underline{\underline{21}}$

- 5) The sum of three consecutive multiples of 11 is 363. Find these multiples.

Solution:-

Let the three consecutive multiples of 11 be x , $x+11$ and $x+22$.

$$\text{Then, } x + x + 11 + x + 22 = 363$$

$$\Rightarrow 3x + 33 = 363$$

$$\Rightarrow 3x = 363 - 33 = 330$$

$$\Rightarrow x = \frac{330}{3} = 110 //$$

Hence the required multiples of 11 are

$$x = 110$$

$$x + 11 = 110 + 11 = 121$$

$$x + 22 = 110 + 22 = 132.$$

- 6) The difference between two whole numbers is 66. The ratio of the two numbers is 2:5. What are the two numbers?

Solution:-

Let the two numbers be $2x$ and $5x$.

$$\text{Then, } 5x - 2x = 66$$

$$\Rightarrow 3x = 66$$

$$\therefore x = \frac{66}{3} = 22 //$$

Hence the two numbers are $2x = 2 \times 22 = 44$

$$5x = 5 \times 22 = 110.$$

- 7) Deveshi has a total of ₹590 as currency notes in the denominations of ₹50, ₹20 and ₹10. The ratio of the number of ₹50 notes and ₹20 notes is 3:5. If she has a total of 25 notes, how many notes of each denomination she has?

Solution:-

Let the number of ₹50 notes be $3x$ and no. of ₹20 notes be $5x$.

$$\text{Total no. of notes} = 25$$

$$\therefore \text{no. of ₹10 notes} = 25 - (3x + 5x) \\ = 25 - 8x$$

$$\text{Total amount} = 3x \times 50 + 5x \times 20 + 10(25 - 8x) = 590$$

$$\Rightarrow 150x + 100x + 250 - 80x = 590$$

$$\Rightarrow 170x = 590 - 250$$

$$\Rightarrow 170x = 340$$

$$\therefore x = \frac{340}{170} = 2 //$$

$$\text{Hence the no. of ₹50 notes} = 3x = 3 \times 2 = 6.$$

$$\text{no. of ₹20 notes} = 5x = 5 \times 2 = 10$$

$$\text{no. of ₹10 notes} = 25 - 8x = 25 - 8 \times 2 \\ = 25 - 16 = 9$$

Exercise 2.2

- 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?

Solution:-

Let the number be x .

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

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

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

$$\therefore x = \frac{3}{4} //$$

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

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

Solution:-

Let the breadth be x m.

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

$$\text{Perimeter of rectangular pool} = 2(l+b) = 154$$

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

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

$$\Rightarrow 3x+2 = \frac{154}{2} = 77$$

$$\Rightarrow 3x = 77 - 2$$

$$\Rightarrow 3x = 75$$

$$\therefore x = \frac{75}{3} = 25$$

$$\text{Hence length of the pool} = 2x+2 = 2 \times 25 + 2 = 50+2 = 52 \text{ m}$$

$$\text{breadth of the pool} = x = 25 \text{ m}$$

3) The base of an isosceles Δ 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?

Solution:-

Let the equal sides be x each.

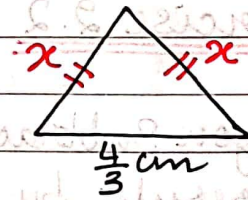
$$\text{Perimeter} = x+x+\frac{4}{3} = \frac{62}{15}$$

$$\Rightarrow 2x = \frac{62}{15} - \frac{4 \times 5}{3 \times 5}$$

$$= \frac{62}{15} - \frac{20}{15}$$

$$= \frac{42}{15} = \frac{14}{5}$$

$$x = \frac{14}{5 \times 2} = \frac{7}{5}$$



Hence the length of each equal sides = $\frac{7}{5} = 1\frac{2}{5}$ cm

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

Solution:-

Let the numbers be x and $x+15$

$$\text{Then, } x + x + 15 = 95$$

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

$$x = \frac{80}{2} = 40 //$$

Hence the numbers be $x = 40$

$$x + 15 = 40 + 15 = 55$$

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

Solution:-

Let the two numbers be $5x$ and $3x$

$$\text{Then, } 5x - 3x = 18$$

$$\Rightarrow 2x = 18$$

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

Hence the numbers are $5x = 5 \times 9 = 45$

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

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

Solution:-

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

$$\text{Then, } x + x + 1 + x + 2 = 51$$

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

$$\Rightarrow 3x = 51 - 3 = 48$$

$$\therefore x = \frac{48}{3} = 16 //$$

Hence the required three integers are $x = 16$

$$x + 1 = 16 + 1 = 17$$

$$x + 2 = 16 + 2 = 18$$

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

Solution:-

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

$$\text{Then, } x+x+8+x+16 = 888$$

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

$$\Rightarrow 3x = 888 - 24 = 864$$

$$\Rightarrow \therefore x = \frac{864}{3} = 288 //$$

Hence the required numbers are $x = 288$

$$x+8 = 288+8 = 296$$

$$x+16 = 288+16 = 304.$$

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.

Solution:-

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

$$\text{Then, } 2x + 3(x+1) + 4(x+2) = 74$$

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

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

$$\Rightarrow 9x = 74 - 11 = 63$$

$$\therefore x = \frac{63}{9} = 7 //$$

Hence the required integers are $x = 7$.

$$x+1 = 7+1 = 8$$

$$x+2 = 7+2 = 9.$$

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?

Solution:-

Let the present age of Rahul be $5x$

and present age of Haroon be $7x$

After 4 years, age of Rahul = $5x+4$

age of Haroon = $7x+4$

$$\text{Then, } 5x+4 + 7x+4 = 56$$

$$12x = 56 - 8 = 48$$

$$\therefore x = \frac{48}{12} = 4 //$$

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

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

- 10) 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?

Solution :-

Let the number of boys and girls be $7x$ and $5x$.

$$\text{Then, } 7x = 5x + 8$$

$$\Rightarrow 7x - 5x = 8$$

$$\Rightarrow 2x = 8$$

$$x = \frac{8}{2} = 4 //$$

Hence the total class strength = $7x + 5x$

$$= 7 \times 4 + 5 \times 4$$

$$= 28 + 20 = 48.$$

- 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?

Solution :-

Let the age of Baichung be x years

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

and grand father's age = $(x + 29) + 26$ years

$$\text{Thus, } x + x + 29 + x + 29 + 26 = 135$$

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

$$\Rightarrow 3x = 135 - 84 = 51$$

$$\therefore x = \frac{51}{3} = 17 //$$

Hence age of Baichung = 17 years

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

grandfather's age = $x + 29 + 26 = 17 + 55 = 72$ years

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

Solution:-

Let the Ravi's present age be x years.

Fifteen years from ^{now}, Ravi's age = $(x+15)$ years

$$\text{Then, } x+15 = 4x$$

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

$$\Rightarrow -3x = -15$$

$$x = \frac{-15}{-3} = \underline{\underline{5}}$$

Hence, Ravi's present age = 5 years.

- 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?

Solution:-

Let the number be x .

$$\text{Then, } (x \times \frac{5}{2}) + \frac{2}{3} = -\frac{7}{12}$$

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

$$\Rightarrow \frac{5x}{2} = -\frac{7}{12} - \frac{2 \times 4}{3 \times 4}$$

$$= -\frac{7-8}{12} = -\frac{15}{12}$$

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

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

- 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?

Solution:-

Let the no. of ₹100, ₹50 and ₹10 ^{notes} be $2x$, $3x$ and $5x$.

$$\text{Then } 2x \times 100 + 3x \times 50 + 5x \times 10 = 400000$$

$$\Rightarrow 200x + 150x + 50x = 400000$$

$$\Rightarrow 400x = 400000$$

$$x = \frac{400000}{400} = 1000$$

$$\text{Hence no. of ₹ 100 notes} = 1000 \times 2 = 2000$$

$$\text{no. of ₹ 50 notes} = 1000 \times 3 = 3000$$

$$\text{no. of ₹ 10 notes} = 1000 \times 5 = 5000$$

- 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?

Solution:-

Let the no. of ₹ 5 coins be x .

Then, no. of ₹ 2 coins = $3x$

Total no. of coins = 160

Thus, no. of ₹ 1 coins = $160 - (x + 3x)$

$$= 160 - 4x$$

$$\therefore \text{Total amount} = x \times 5 + 3x \times 2 + 1(160 - 4x) = 300$$

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

$$\Rightarrow 7x = 300 - 160 = 140$$

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

Hence the no. of ₹ 5 coins = $x = 20$

no. of ₹ 2 coins = $3x = 3 \times 20 = 60$

no. of 1 rupee coins = $160 - 4x = 160 - 80 = 80$.

- 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.

Solution:-

Let the no. of winners be x .

Then, the no. of participants who do not win = $63 - x$

$$\begin{aligned} \text{Thus, } 100x + 25(63-x) &= 3000 \\ \Rightarrow 100x + 1575 - 25x &= 3000 \\ \Rightarrow 75x &= 3000 - 1575 = 1425 \\ \therefore x &= \frac{1425}{75} = 19 // \end{aligned}$$

Hence the no. of winners = 19.

Examples

1) Solve $2x - 3 = x + 2$

Solution:-

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

$$\therefore x = 5 //$$

2) Solve $5x + \frac{7}{2} = \frac{3}{2}x - 14$

Solution:-

$$\frac{5x}{1 \times 2} - \frac{3x}{2} = \frac{-14}{1 \times 2} - \frac{7}{2}$$

$$\Rightarrow \frac{10x - 3x}{2} = \frac{-28 - 7}{2}$$

$$\Rightarrow 7x = -35$$

$$\therefore x = \frac{-35}{7} = -5 //$$

Exercise 2.3

Solve:-

1) $3x = 2x + 18$

Solution:-

$$3x - 2x = 18$$

$$\therefore x = 18 //$$

2) $5t - 3 = 3t - 5$

Solution:-

$$5t - 3t = -5 + 3$$

$$\Rightarrow 2t = -2$$

$$\therefore t = \frac{-2}{2} = -1 //$$

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

Solution:-

$$5x - 3x = 5 - 9$$

$$\Rightarrow 2x = -4$$

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

$$4) \quad 4z + 3 = 6 + 2z$$

Solution:-

$$4z - 2z = 6 - 3$$

$$\Rightarrow 2z = 3$$

$$\therefore z = \frac{3}{2} //$$

$$5) \quad 2x - 1 = 14 - x$$

Solution:-

$$2x + x = 14 + 1$$

$$\Rightarrow 3x = 15$$

$$\therefore x = \frac{15}{3} = 5 //$$

$$6) \quad 8x + 4 = 3(x - 1) + 7$$

Solution:-

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

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

$$\Rightarrow 5x = 0$$

$$\therefore x = \frac{0}{5} = 0 //$$

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

Solution:-

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

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

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

$$\therefore x = 40 //$$

$$8) \quad \frac{2x}{3} + 1 = \frac{7x}{15} + 3$$

Solution:-

$$\frac{2x \times 5}{3 \times 5} - \frac{7x}{15} = 3 - 1$$

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

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

$$\therefore x = 2 \times 5 = \underline{\underline{10}}$$

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

Solution:-

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

$$\Rightarrow 3y = \frac{21}{3} = 7$$

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

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

Solution:-

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

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

$$\therefore m = \frac{8}{2 \times 5} = \frac{4}{5}$$

Examples

1) The digits of a two-digit number differ by 3. If the digits are interchanged and the resulting number is added to the original number, we get 143. What can be the original number?

Solution:-

Let the digit in the unit place be x and digit in the ten's place be $x+3$.

Then, original number = $10(x+3) + x$

reversed number = $10x + x+3$

$$\text{Thus, } (10x + 30 + x) + (10x + x + 3) = 143$$

$$\Rightarrow 11x + 30 + 11x + 3 = 143$$

$$\Rightarrow 22x + 33 = 143$$

$$\Rightarrow 22x = 143 - 33 = 110$$

$$\therefore x = \frac{110}{22} = 5$$

Hence the original number is $10(x+3) + x$

$$= 10(5+3) + 5$$

$$= 10 \times 8 + 5$$

$$= \underline{\underline{85}}$$

- 2) Arjun is twice as old as Shriya. Five years ago, his age was three times Shriya's age. Find their present ages.

Solution:-

Let the present age of Shriya be x years.

Then, present age of Arjun = $2x$ years

Five years ago, Shriya's age = $(x-5)$ years

Arjun's age = $(2x-5)$ years

$$\text{Then, } 2x - 5 = 3(x - 5)$$

$$\Rightarrow 2x - 5 = 3x - 15$$

$$\Rightarrow 2x - 3x = -15 + 5$$

$$\Rightarrow -x = -10$$

$$\therefore x = 10$$

Hence the present age of Shriya = 10 years

present age of Arjun = $2x = 20$ years

Exercise 2.4

- 1) 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?

Solution:-

Let the number she thought of be x .

$$\text{Then, } \left(\frac{x - \frac{5}{2}}{1 \times 2} \right) \times 8 = 3x$$

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

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

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

$$\Rightarrow 5x = 20$$

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

Hence the required number is 4.

- 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?

Solution:-

Let the numbers be x and $5x$.

$$\text{Then, } 5x + 21 = (x + 21) \times 2$$

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

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

$$\Rightarrow 3x = 21$$

$$\therefore x = \frac{21}{3} = \underline{\underline{7}}$$

Hence the required positive numbers are

$$x = 7$$
$$\text{and } 5x = 5 \times 7 = 35.$$

- 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?

Solution:-

Let the digit in the one's place be x and in the ten's place be $9-x$.

$$\text{Then, original no.} = 10(9-x) + x$$
$$= 90 - 10x + x$$
$$= 90 - 9x$$

$$\text{Interchanged no.} = 10x + 9 - x$$
$$= 9x + 9$$

$$\text{Thus, } (9x + 9) - (90 - 9x) = 27$$

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

$$\Rightarrow 18x - 81 = 27$$

$$\Rightarrow 18x = 27 + 81 = 108$$

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

Hence the required two-digit number = $90 - 9x$

$$= 90 - 9 \times 6$$

$$= 90 - 54 = \underline{\underline{36}}$$

- 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?

Solution:-

Let the digit in the one's place of the two-digit number be x and that of ten's place be $3x$.

T	O
$3x$	x

Then, original number = $10 \times 3x + x = 30x + x = 31x$

interchanged number = $10x + 3x = 13x$

T	O
x	$3x$

$$\text{Thus, } 31x + 13x = 88$$

$$\Rightarrow 44x = 88$$

$$\therefore x = \frac{88}{44} = \underline{\underline{2}}$$

Hence the original number is $31x = 31 \times 2 = \underline{\underline{62}}$

- 5) 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?

Solution:-

Let the present age of Shobo be x years.

Then, present age of mother = $6x$ years

after 5 years, Shobo's age = $(x + 5)$ years.

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

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

$$\Rightarrow x - 2x = -5$$

$$-x = -5$$

$$\therefore x = 5$$

Hence present age of Shobo = 5 years

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

- 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 of ₹100 per m, it will cost the village panchayat ₹75000 to fence the plot. What are the dimensions of the plot?

Solution:-

Let the length and breadth of the rectangular plot be $11x$ and $4x$.

$$\begin{aligned} \text{perimeter of the plot} &= 2(l+b) \\ &= 2(11x+4x) = 2 \times 15x \\ &= 30x \end{aligned}$$

Cost of fencing = perimeter \times rate

$$\Rightarrow 75000 = 30x \times 100$$

$$\Rightarrow 30x = \frac{75000}{100}$$

$$\therefore x = \frac{750}{30} = \underline{\underline{25}}$$

Hence, the dimensions of the plot are $l = 11x = 11 \times 25$

$$= 275 \text{ m}$$

$$b = 4x = 4 \times 25$$

$$= 100 \text{ m}$$

- 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 3 meters of the shirt material he buys 2 metres of trouser material. He sells the materials at 12% and 10% profit respectively. His total sale is ₹36,600. How much trouser material did he buy?

Solution:-

Let the shirt material purchased be $3x$ metres and that of trouser material be $2x$ metres.

Then, Cost price of shirt material = $3x \times 50 = ₹150x$

Cost price of trouser material = $2x \times 90 = ₹180x$

$$\begin{aligned} \text{S.P of shirt material} &= \text{C.P} + \text{Profit \% of C.P} \\ &= 150x + 12\% \text{ of } 150x \\ &= 150x + \frac{12}{100} \times 150x \end{aligned}$$

$$= 150x + 18x = 168x$$

$$\begin{aligned} \text{S.P of trouser material} &= \text{C.P} + \text{Profit \% of C.P} \\ &= 180x + 10\% \text{ of } 180x \\ &= 180x + \frac{10}{100} \times 180x \end{aligned}$$

$$= 198x$$

$$\therefore \text{Total selling price} = 168x + 198x = 36600$$

$$\Rightarrow 366x = 36600$$

$$\therefore x = \frac{36600}{366} = 100 //$$

Hence, he bought $2x = 2 \times 100 = 200\text{m}$ of trouser material.

- 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 the number of deer in the herd.

Solution:-

Let the number of deer in the herd be x .

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

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

$$\Rightarrow \frac{x \times 4}{2 \times 4} + \frac{3x}{8} - \frac{x \times 8}{1 \times 8} = -9$$

$$\Rightarrow \frac{4x + 3x - 8x}{8} = -9$$

$$\Rightarrow \frac{-x}{8} = -9$$

$$\cancel{x} = \cancel{9} \times 8$$

$$\therefore x = \underline{\underline{72}}$$

Hence the number of deer in the herd = 72

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

Solution:-

Let the present age of granddaughter be x years.

Then, present age of grandfather = $10x$

$$\text{Also, } 10x - x = 54$$

$$\Rightarrow 9x = 54$$

$$\therefore x = \frac{54}{9} = \underline{\underline{6}}$$

Hence the present age of granddaughter

$$= x = 6 \text{ years}$$

and present age of grandfather

$$= 10x = 60 \text{ years.}$$

- 10) Aman's age is three times his son's age. 10 years ago, he was five times his son's age. Find their present ages.

Solution:-

Let the present age of son be x years.

Then, present age of Aman = $3x$ years.

10 years ago, son's age = $(x - 10)$ years.

Aman's age = $(3x - 10)$ years.

$$\text{Thus, } 3x - 10 = 5(x - 10)$$

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

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

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

$$\therefore x = \frac{40}{2} = \underline{\underline{20}}$$

Hence the present age of son = 20 years

and present age of Aman = $3x$

$$= 3 \times 20$$

$$= 60 \text{ years.}$$

Examples

1) Solve : $\frac{6x+1}{3} + 1 = \frac{x-3}{6}$

Solution:-

$$\frac{(6x+1)^{x^2}}{3x^2} - \frac{x-3}{6} = -1$$

$$\Rightarrow \frac{12x+2-x+3}{6} = -1$$

$$\Rightarrow \frac{11x+5}{6} = -1$$

$$\Rightarrow 11x+5 = -6$$

$$\Rightarrow 11x = -6-5 = -11$$

$$\therefore x = \frac{-11}{11} = \underline{\underline{-1}}$$

2) Solve $5x - 2(2x-7) = 2(3x-1) + \frac{7}{2}$

Solution:-

$$5x - 2(2x-7) - 2(3x-1) = \frac{7}{2}$$

$$\Rightarrow 5x - 4x + 14 - 6x + 2 = \frac{7}{2}$$

$$\Rightarrow -5x + 16 = \frac{7}{2}$$

$$\Rightarrow -5x = \frac{-16 \times 2}{1 \times 2} + \frac{7}{2}$$

$$\Rightarrow -5x = \frac{-32+7}{2}$$

$$\Rightarrow -5x = \frac{-25}{2}$$

$$\therefore x = \frac{25}{5 \times 2} = \underline{\underline{\frac{5}{2}}}$$

Exercise 2.5

Solve the following linear equations:-

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

Solution:- $\frac{x \times 3}{2 \times 3} - \frac{x \times 2}{3 \times 2} = \frac{1}{4} + \frac{1}{5}$

$$\Rightarrow \frac{3x-2x}{6} = \frac{1 \times 5}{4 \times 5} + \frac{1 \times 4}{5 \times 4}$$

$$\Rightarrow \frac{x}{6} = \frac{5+4}{20}$$

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

$$\therefore x = \frac{9 \times 6 \times 3}{20 \times 10} = \underline{\underline{\frac{27}{10}}}$$

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

Solution:-

$$\frac{n^{x6}}{2 \times 6} - \frac{3n^{x3}}{4 \times 3} + \frac{5n^{x2}}{6 \times 2} = 21$$

$$\Rightarrow \frac{6n - 9n + 10n}{12} = 21$$

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

$$\Rightarrow 7n = 21 \times 12$$

$$\therefore n = \frac{21 \times 12}{7} = 3 \times 12 = \underline{\underline{36}}$$

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

Solution:-

$$\frac{x^{x6}}{1 \times 6} - \frac{8x^{x2}}{3 \times 2} + \frac{5x^{x3}}{2 \times 3} = \frac{17}{6} - \frac{7 \times 6}{1 \times 6}$$

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

$$\Rightarrow 5x = -25$$

$$\therefore x = \frac{-25}{5} = \underline{\underline{-5}}$$

$$4) \quad \frac{x-5}{3} = \frac{x-3}{5}$$

Solution:-

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

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

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

$$\Rightarrow 2x = 16$$

$$\therefore x = \frac{16}{2} = \underline{\underline{8}}$$

$$5) \quad \frac{3t-2}{4} - \frac{2t+3}{3} = \frac{2}{3} - t$$

Solution:-

$$\frac{(3t-2)^{x3}}{4 \times 3} - \frac{(2t+3)^{x4}}{3 \times 4} + \frac{t^{x12}}{1 \times 12} = \frac{2}{3}$$

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

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

$$\Rightarrow \frac{13t - 18}{12} = \frac{2}{3}$$

$$\Rightarrow 13t - 18 = \frac{2}{3} \times 12$$

$$\Rightarrow 13t = 8 + 18 = 26$$

$$\therefore t = \frac{26}{13} = \underline{\underline{2}}$$

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

Solution:-

$$\frac{m \times 6}{1 \times 6} - \frac{(m-1) \times 3}{2 \times 3} + \frac{(m-2) \times 2}{3 \times 2} = 1$$

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

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

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

$$\Rightarrow 5m - 1 = 6$$

$$\Rightarrow 5m = 6 + 1 = 7$$

$$\therefore m = \frac{7}{5}$$

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

Solution:-

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

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

$$\Rightarrow -7t = 14$$

$$\therefore t = \frac{-14}{7} = \underline{\underline{-2}}$$

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

Solution:-

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

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

$$\Rightarrow 18y = 12$$

$$\therefore y = \frac{12}{18} = \frac{2}{3}$$

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

Solution:-

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

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

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

$$-35z = -70$$

$$z = \frac{-70}{-35} = 2$$

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

Solution:-

$$1f - 0.75 = 0.5f - 0.45$$

$$\Rightarrow f - 0.5f = -0.45 + 0.75$$

$$\Rightarrow 0.5f = 0.3$$

$$f = \frac{0.3}{0.5} = \frac{3}{5}$$

Examples

$$1) \text{ Solve } \frac{x+1}{2x+3} = \frac{3}{8}$$

Solution:-

$$8(x+1) = 3(2x+3)$$

$$\Rightarrow 8x+8 = 6x+9$$

$$\Rightarrow 8x-6x = 9-8$$

$$\Rightarrow 2x = 1$$

$$\therefore x = \frac{1}{2}$$

2) Present ages of Anu and Raj are in the ratio 4:5. Eight years from now, the ratio of their ages will be 5:6. Find their present ages.

Solutions:-

Let the present ages of Anu and Raj be $4x$ and $5x$ respectively.

After 8 years, Anu's age = $4x+8$

Raj's age = $5x+8$

$$\text{Then, } \frac{4x+8}{5x+8} = \frac{5}{6}$$

$$\Rightarrow 6(4x+8) = 5(5x+8)$$

$$\Rightarrow 24x+48 = 25x+40$$

$$\Rightarrow 24x-25x = 40-48$$

$$-x = -8$$

$$\therefore \underline{x = 8}$$

Hence the present age of Anu = $4x = 4 \times 8 = 32$ years
present age of Raj = $5x = 5 \times 8 = 40$ years.

Exercise 2.6

Solve the following equations:-

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

Solution:-

$$8x-3 = 6x$$

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

$$\Rightarrow 2x = 3$$

$$\therefore \underline{x = \frac{3}{2}}$$

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

Solution:-

$$9x = 15(7-6x)$$

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

$$\Rightarrow 9x + 90x = 105$$

$$\Rightarrow 99x = 105$$

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

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

Solution:-

$$9z = 4(z+15)$$

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

$$\Rightarrow 9z - 4z = 60$$

$$\Rightarrow 5z = 60$$

$$\therefore z = \frac{60}{5} = \underline{\underline{12}}$$

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

Solution:-

$$5(3y+4) = -2(2-6y)$$

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

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

$$\Rightarrow 3y = -24$$

$$\therefore y = \frac{-24}{3} = \underline{\underline{-8}}$$

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

Solution:-

$$3(7y+4) = -4(y+2)$$

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

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

$$\Rightarrow 25y = -20$$

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

- 6) 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.

Solution:-

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

After 4 years, Hari's age = $5x+4$

Harry's age = $7x+4$

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

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

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

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

$$\Rightarrow 9z - 4z = 60$$

$$\Rightarrow 5z = 60$$

$$\therefore z = \frac{60}{5} = \underline{\underline{12}}$$

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

Solution:-

$$5(3y+4) = -2(2-6y)$$

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

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

$$\Rightarrow 3y = -24$$

$$\therefore y = \frac{-24}{3} = \underline{\underline{-8}}$$

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

Solution:-

$$3(7y+4) = -4(y+2)$$

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

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

$$\Rightarrow 25y = -20$$

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

- 6) 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.

Solution:-

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

After 4 years, Hari's age = $5x+4$

Harry's age = $7x+4$

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

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

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

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

$$\Rightarrow -x = -4$$

$$\therefore \underline{\underline{x = 4}}$$

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.

Solution:-

Let the numerator be x .

Then, denominator = $x + 8$

$$\text{Thus } \frac{x+17}{x+8-1} = \frac{3}{2}$$

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

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

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

$$\Rightarrow -x = -13$$

$$\therefore \underline{\underline{x = 13}}$$

Thus, numerator = 13

$$\text{denominator} = x + 8 = 13 + 8 = 21$$

Hence the required rational number = $\frac{13}{21}$.
