

# Linear Equations in One Variable

## Ex.A

**Linear equation in one variable** is an equation which can be written in the form of  $ax + b = 0$ , where  $a$  and  $b$  are real-number constants and  $a \neq 0$ .

Ex.

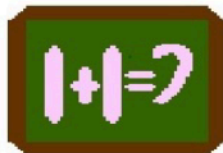
$$x + 7 = 12$$

**Equation** is a mathematical sentence indicating that two expressions are equal. The symbol "=" is used to indicate equality.

Ex.

$2x + 5 = 9$  is a conditional equation since its truth or falsity depends on the value of  $x$

$2 + 9 = 11$  is identity equation since both of its sides are identical to the same number 11.



## Solution Set of a Linear Equation

Example

$$4x + 2 = 10$$

this statement is either true or false

If  $x = 1$ , then  $4x + 2 = 10$

is false because  $4(1) + 2$  is  $\neq 10$

If  $x = 2$ , then  $4x + 2 = 10$

is true because  $4(2) + 2 = 10$

### ONE STEP SUBTRACTION EXAMPLE

The Opposite of Subtraction is Addition

$$\begin{array}{r} x - 120 = 80 \\ +120 \quad +120 \\ \hline x = 200 \checkmark \end{array}$$

The value which makes the equation true is 200.

$x - 4 = 7$	Original problem
$x - 4 = 7$	We want to remove the minus 4.
$x - 4 + 4 = 7 + 4$	The opposite of minus 4 is plus 4, so I added 4 to BOTH sides of the equation.
$x = 11$	$-4 + 4 = 0$ , so $x$ remains on the left and $7 + 4 = 11$ ; therefore $x = 11$
Check: $x - 4 = 7$ $11 - 4 = 7$	This is a correct statement, so my answer is $x = 11$ is correct!

# Solving simple two-step equations

To solve an equation, find the value that makes the equation true.

Solve  $2x + 3 = 13$

This means:  $x \xrightarrow{\times 2} \xrightarrow{+ 3} = 13$

To solve, we reverse the process:

$x \xrightarrow{\times 2} \xrightarrow{+ 3} 13$

$x \xrightarrow{\div 2} \xrightarrow{- 3} 13$

Use the opposite (inverse) operation and undo in reverse order.

$2x + 3 = 13$

$2x = 10$

$x = 5$

We have solved the equation when we get to a single value of  $x$  (here,  $x = 5$ ).

Solve  $4x + 6 = 14$

$4x + 6 = 14$

$4x = 8$

$x = 2$

$- 6$   
 $\div 4$

Solve  $3x - 8 = 19$

$3x - 8 = 19$

$3x = 27$

$x = 9$

$+ 8$   
 $\div 3$

Q1

Answer :

$3x - 5 = 0$

$\Rightarrow 3x = 5$  (Transposing  $- 5$  to RHS)

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

CHECK : By substituting  $x = \frac{5}{3}$  in the given equation, we get :

LHS =  $3\left(\frac{5}{3}\right) - 5 = 5 - 5 = 0$

RHS = 0

$\therefore$  LHS = RHS

Hence checked.

Q2

Answer :

$8x - 3 = 9 - 2x$

$\Rightarrow 8x + 2x = 9 + 3$  (By transposition)

$\Rightarrow 10x = 12$

$\Rightarrow x = \frac{12}{10} = \frac{6}{5}$

CHECK : By substituting  $x = \frac{6}{5}$  in the given equation, we get :

LHS :  $8\left(\frac{6}{5}\right) - 3 = \frac{48}{5} - 3 = \frac{48-15}{5} = \frac{33}{5}$

RHS :  $9 - 2\left(\frac{6}{5}\right) = 9 - \frac{12}{5} = \frac{45-12}{5} = \frac{33}{5}$

$\therefore$  LHS = RHS

Hence checked.

Q3

Answer :

We have:

$7 - 5x = 5 - 7x$

$\Rightarrow -5x + 7x = 5 - 7$  [transposing  $-7x$  to LHS and 7 to RHS]

$\Rightarrow 2x = -2$

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

$\Rightarrow x = -1$

Thus,  $x = -1$  is a solution to the given equation.

CHECK: Substituting  $x = -1$  in the given equation, we get:

LHS:  $= 7 - 5x$   
 $= 7 - 5 \times (-1)$   
 $= 7 + 5$   
 $= 12$

RHS:  
 $= 5 - 7x$   
 $= 5 - 7 \times (-1)$   
 $= 5 + 7$   
 $= 12$

$\therefore$  LHS = RHS

Hence,  $x = -1$  is a solution of the given equation.

Q4

**Answer :**

We have:

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

$$\Rightarrow 2x + x + 3 - 1 = 0 \quad (\text{By transposition})$$

$$\Rightarrow 3x + 2 = 0$$

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

CHECK: Substituting  $x = -\frac{2}{3}$  in the given equation, we get:

LHS:  $3 + 2x$

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

$$= 3 - \frac{4}{3}$$

$$= \frac{9-4}{3}$$

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

RHS:  $1 - x$

$$= 1 - \left(-\frac{2}{3}\right)$$

$$= 1 + \frac{2}{3}$$

$$= \frac{3+2}{3}$$

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

$\therefore$  LHS = RHS

Hence,  $x = -\frac{2}{3}$  is a solution of the given equation.

Q5

**Answer :**

We have:

$$2(x - 2) + 3(4x - 1) = 0$$

$$\Rightarrow 2x - 4 + 12x - 3 = 0$$

$$\Rightarrow 14x - 7 = 0$$

$$\Rightarrow 14x = 7 \quad (\text{By transposition})$$

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

CHECK: Substituting  $x = \frac{1}{2}$  in the given equation, we get:

LHS:  $2(x - 2) + 3(4x - 1)$

$$= 2x - 4 + 12x - 3$$

$$= 2 \times \frac{1}{2} - 4 + 12 \times \frac{1}{2} - 3$$

$$= 1 - 4 + 6 - 3$$

$$= -7 + 7$$

$$= 0$$

RHS: 0

$\therefore$  LHS = RHS

Hence,  $x = \frac{1}{2}$  is a solution of the given equation.

Q6

**Answer :**

We have:

$$5(2x - 3) - 3(3x - 7) = 5$$

$$\Rightarrow 10x - 15 - 9x + 21 = 5$$

$$\Rightarrow 10x - 9x = 5 + 15 - 21 \quad (\text{By transposition})$$

$$\Rightarrow x = 20 - 21$$

$$\Rightarrow x = -1$$

CHECK: Substituting  $x = -1$  in the given equation, we get:

LHS:  $5(2x - 3) - 3(3x - 7)$

$$= 10x - 15 - 9x + 21$$

$$= 10 \times (-1) - 15 - 9 \times (-1) + 21$$

$$= -10 - 15 + 9 + 21$$

$$= -25 + 30$$

$$= 5$$

RHS: 5

$\therefore$  LHS = RHS

Hence,  $x = -1$  is a solution of the given equation.

Q7

Answer :

We have:

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

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

$$\Rightarrow 3x = \frac{3 \times 1 + 5 \times 1}{15}$$

$$\Rightarrow 3x = \frac{3+5}{15}$$

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

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

$$\Rightarrow x = \frac{8}{45}$$

CHECK: Substituting  $x = \frac{8}{45}$  in the given equation, we get:

$$\begin{aligned} \text{LHS: } 2x - \frac{1}{3} &= 2 \times \frac{8}{45} - \frac{1}{3} \\ &= \frac{16}{45} - \frac{1}{3} \\ &= \frac{16 \times 1 - 15 \times 1}{45} \\ &= \frac{16-15}{45} \\ &= \frac{1}{45} \end{aligned}$$

$$\begin{aligned} \text{RHS: } \frac{1}{5} - x &= \frac{1}{5} - \frac{8}{45} \\ &= \frac{1 \times 9 - 1 \times 8}{45} \\ &= \frac{9-8}{45} \\ &= \frac{1}{45} \end{aligned}$$

$\therefore \text{LHS} = \text{RHS}$

Hence,  $x = \frac{8}{45}$  is a solution of the given equation.

Q8

Answer :

We have:

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

$$\Rightarrow \frac{1}{2}x - \frac{1}{3}x = 5 + 3 \quad \left( \text{transposing } \frac{1}{3}x \text{ to LHS and } -3 \text{ to RHS} \right)$$

$$\Rightarrow \left( \frac{1 \times 3 - 1 \times 2}{6} \right) x = 8$$

$$\Rightarrow \left( \frac{3-2}{6} \right) x = 8$$

$$\Rightarrow \frac{1}{6}x = 8$$

$$\Rightarrow x = 8 \times 6$$

$$\Rightarrow x = 48$$

CHECK: Substituting  $x=48$  in the given equation, we get:

$$\begin{aligned} \text{LHS: } \frac{1}{2}x - 3 &= \frac{1}{2} \times 48 - 3 \\ &= 24 - 3 \\ &= 21 \end{aligned}$$

$$\begin{aligned} \text{RHS: } 5 + \frac{1}{3}x &= 5 + \frac{1}{3} \times 48 \\ &= 5 + 16 \\ &= 21 \end{aligned}$$

$\therefore \text{LHS} = \text{RHS}$

Hence,  $x=48$  is a solution of the given equation.

Q9

Answer :

$$\begin{aligned}\frac{x}{2} + \frac{x}{4} &= \frac{1}{8} \\ \Rightarrow \frac{x \times 2 + x \times 1}{4} &= \frac{1}{8} \\ \Rightarrow \frac{2x + x}{4} &= \frac{1}{8} \\ \Rightarrow \frac{3x}{4} &= \frac{1}{8} \\ \Rightarrow 3x &= \frac{1}{8} \times 4^1 \\ \Rightarrow 3x &= \frac{1}{2} \\ \Rightarrow x &= \frac{1}{6}\end{aligned}$$

CHECK: Substituting  $x = \frac{1}{6}$  in the given equation, we get:

$$\begin{aligned}\text{LHS: } \frac{x}{2} + \frac{x}{4} &= \frac{x \times 2 + x \times 1}{4} \\ &= \frac{2x + x}{4} \\ &= \frac{3x}{4} \\ &= \frac{3}{4} \times \frac{1}{6} \\ &= \frac{1}{8}\end{aligned}$$

$$\text{RHS: } \frac{1}{8}$$

$\therefore \text{LHS} = \text{RHS}$

Hence,  $x = \frac{1}{6}$  is a solution of the given equation.

Q10

Answer :

We have:

$$\begin{aligned}3x + 2(x + 2) &= 20 - (2x - 5) \\ \Rightarrow 3x + 2x + 4 &= 20 - 2x + 5 \\ \Rightarrow 3x + 2x + 2x &= 20 + 5 - 4 \quad (\text{Transposing } -2x \text{ to LHS and } 4 \text{ to RHS}) \\ \Rightarrow 7x &= 21 \\ \Rightarrow x &= \frac{21}{7} \\ \Rightarrow x &= 3\end{aligned}$$

CHECK: Substituting  $x = 3$  in the given equation, we get:

$$\begin{aligned}\text{LHS} &= 3x + 2(x + 2) \\ &= 3x + 2x + 4 \\ &= 5x + 4 \\ &= 5 \times 3 + 4 \\ &= 15 + 4 \\ &= 19\end{aligned}$$

$$\begin{aligned}\text{RHS} &= 20 - (2x - 5) \\ &= 20 - 2x + 5 \\ &= 25 - 2 \times 3 \\ &= 25 - 6 \\ &= 19\end{aligned}$$

$\therefore \text{LHS} = \text{RHS}$

Hence,  $x = 3$  is a solution of the given equation.

Q11

**Answer :**

We have:

$$13(y - 4) - 3(y - 9) - 5(y + 4) = 0$$

$$\Rightarrow 13y - 52 - 3y + 27 - 5y - 20 = 0$$

$$\Rightarrow 13y - 3y - 5y = 52 + 20 - 27 \quad (\text{Transposing } -52, -20 \text{ and } 27 \text{ to RHS})$$

$$\Rightarrow 5y = 45$$

$$\Rightarrow y = \frac{45}{5}$$

$$\Rightarrow y = 9$$

CHECK: Substituting  $x=9$  in the given equation, we get:

$$\text{LHS} = 13(y - 4) - 3(y - 9) - 5(y + 4)$$

$$= 13y - 52 - 3y + 27 - 5y - 20$$

$$= 13y - 3y - 5y - 52 + 27 - 20$$

$$= 5y - 45$$

$$= 5 \times 9 - 45$$

$$= 45 - 45$$

$$= 0$$

$$\text{RHS} = 0$$

$$\therefore \text{LHS} = \text{RHS}$$

Hence,  $x=9$  is a solution of the given equation.

Q12

**Answer :**

We have,

$$\frac{2m+5}{3} = 3m - 10$$

$$\Rightarrow 2m + 5 = 3(3m - 10)$$

$$\Rightarrow 2m + 5 = 9m - 30$$

$$\Rightarrow 2m - 9m = -30 - 5 \quad (\text{Transposing } 9m \text{ to LHS and } 5 \text{ to RHS})$$

$$\Rightarrow -7m = -35$$

$$\Rightarrow m = \frac{-35}{-7}$$

$$\Rightarrow m = 5$$

CHECK: Substituting  $m = 5$  in the given equation, we get:

$$\text{LHS} = \frac{2m+5}{3}$$

$$= \frac{2 \times 5 + 5}{3}$$

$$= \frac{10+5}{3}$$

$$= \frac{15}{3}$$

$$= 5$$

$$\text{RHS} = 3m - 10$$

$$= 3 \times 5 - 10$$

$$= 15 - 10$$

$$= 5$$

$$\therefore \text{LHS} = \text{RHS}$$

Hence,  $x=5$  is a solution of the given equation.

Q13

**Answer :**

We have:

$$\begin{aligned}6(3x+2) - 5(6x-1) &= 3(x-8) - 5(7x-6) + 9x \\ \Rightarrow 18x+12 - 30x+5 &= 3x-24 - 35x+30 + 9x \\ &\Rightarrow 18x - 30x - 3x + 35x - 9x = -24 + 30 - 12 \\ -5 \quad (\text{Transposing } 3x, 9x \text{ and } -35x \text{ to LHS and } 12 \text{ and } 5 \text{ to RHS}) \\ \Rightarrow 53x - 42x &= 30 - 41 \\ \Rightarrow 11x &= -11 \\ \Rightarrow x &= \frac{-11}{11} \\ \Rightarrow x &= -1\end{aligned}$$

CHECK: Substituting  $x = -1$  in the given equation, we get:

$$\begin{aligned}\text{LHS} &= 6(3x+2) - 5(6x-1) \\ &= 18x+12 - 30x+5 \\ &= -12x+17 \\ &= -12 \times (-1) + 17 \\ &= 12+17 \\ &= 29\end{aligned}$$

$$\begin{aligned}\text{RHS} &= 3(x-8) - 5(7x-6) + 9x \\ &= 3x-24 - 35x+30 + 9x \\ &= 12x-35x-24+30 \\ &= -23x+6 \\ &= -23 \times (-1) + 6 \\ &= 23+6 \\ &= 29\end{aligned}$$

$\therefore \text{LHS} = \text{RHS}$

Hence,  $x = -1$  is a solution of the given equation.

Q14

**Answer :**

We have:

$$\begin{aligned}t - (2t+5) - 5(1-2t) &= 2(3+4t) - 3(t-4) \\ \Rightarrow t - 2t - 5 - 5 + 10t &= 6+8t - 3t + 12 \\ \Rightarrow t - 2t + 10t - 8t + 3t &= 6 + 12 + 5 + 5 \quad (\text{By transposition}) \\ \Rightarrow 14t - 10t &= 28 \\ \Rightarrow 4t &= 28 \\ \Rightarrow x &= \frac{28}{4} \\ \Rightarrow x &= 7\end{aligned}$$

CHECK: Substituting  $x=7$  in the given equation, we get:

$$\begin{aligned}\text{LHS} &= t - (2t+5) - 5(1-2t) \\ &= t - 2t - 5 - 5 + 10t \\ &= 11t - 2t - 10 \\ &= 9t - 10 \\ &= 9 \times 7 - 10 \\ &= 63 - 10 \\ &= 53\end{aligned}$$

$$\begin{aligned}\text{RHS} &= 2(3+4t) - 3(t-4) \\ &= 6+8t - 3t + 12 \\ &= 5t + 18 \\ &= 5 \times 7 + 18 \\ &= 35 + 18 \\ &= 53\end{aligned}$$

$\therefore \text{LHS} = \text{RHS}$

Hence,  $x=7$  is a solution of the given equation.

Q15

**Answer :**

We have:

$$\frac{2}{3}x = \frac{3}{8}x + \frac{7}{12}$$

$$\Rightarrow \frac{2}{3}x - \frac{3}{8}x = \frac{7}{12} \quad \left( \text{Transposing } \frac{3}{8}x \text{ to LHS} \right)$$

$$\Rightarrow \left( \frac{2 \times 8 - 3 \times 3}{24} \right) x = \frac{7}{12}$$

$$\Rightarrow \left( \frac{16-9}{24} \right) x = \frac{7}{12}$$

$$\Rightarrow \frac{7}{24}x = \frac{7}{12}$$

$$\Rightarrow x = \frac{7^1}{+24^1} \times \frac{12^1}{-7^1}$$

$$\Rightarrow x = 2$$

CHECK: Substituting  $x=2$  in the given equation, we get:

$$\text{LHS} = \frac{2}{3}x$$

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

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

$$\text{RHS} = \frac{3}{8}x + \frac{7}{12}$$

$$= \frac{3}{8} \times 2 + \frac{7}{12}$$

$$= \frac{6}{8} + \frac{7}{12}$$

$$= \frac{6 \times 3 + 7 \times 2}{24}$$

$$= \frac{18+14}{24}$$

$$= \frac{32}{24}$$

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

$\therefore \text{LHS} = \text{RHS}$

Hence,  $x=2$  is a solution of the given equation.

Q16

**Answer :**

We have:

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

$$\Rightarrow \frac{7(3x-1) - 5x}{35} = 3$$

$$\Rightarrow \left( \frac{21x-7-5x}{35} \right) = 3$$

$$\Rightarrow \left( \frac{16x-7}{35} \right) = 3$$

$$\Rightarrow 16x - 7 = 3 \times 35 \quad \left( \text{Transposing } 35 \text{ to RHS} \right)$$

$$\Rightarrow 16x - 7 = 105$$

$$\Rightarrow 16x = 105 + 7$$

$$\Rightarrow 16x = 112$$

$$\Rightarrow x = \frac{112}{16}$$

$$\Rightarrow x = 7$$

CHECK: Substituting  $x=7$  in the given equation, we get:

$$\begin{aligned}
 \text{LHS} &= \frac{3x-1}{5} - \frac{x}{7} \\
 &= \frac{7(3x-1) - 5x}{35} \\
 &= \left( \frac{21x-7-5x}{35} \right) \\
 &= \left( \frac{16x-7}{35} \right) \\
 &= \left( \frac{16 \times 7 - 7}{35} \right) \\
 &= \frac{112-7}{35} \\
 &= \frac{1+0-5^3}{-3-5^{-1}} \\
 &= -3
 \end{aligned}$$

$$\text{RHS} = 3$$

$$\therefore \text{LHS} = \text{RHS}$$

Hence,  $x=3$  is a solution of the given equation.

Q17

**Answer :**

We have:

$$\begin{aligned}
 2x - 3 &= \frac{3}{10} (5x - 12) \\
 \Rightarrow 10(2x - 3) &= 3(5x - 12) \\
 \Rightarrow 20x - 30 &= 15x - 36 \\
 \Rightarrow 20x - 15x &= -36 + 30 \quad (\text{Transposing } 15x \text{ to LHS and } -30 \text{ to RHS}) \\
 \Rightarrow 5x &= -6 \\
 \Rightarrow x &= \frac{-6}{5}
 \end{aligned}$$

CHECK: Substituting  $x = \frac{-6}{5}$  in the given equation, we get:

$$\begin{aligned}
 \text{LHS} &= 2x - 3 \\
 &= 2 \times \left( \frac{-6}{5} \right) - 3 \\
 &= \frac{-12}{5} - 3 \\
 &= \frac{-12 - (3 \times 5)}{5} \\
 &= \frac{-12 - 15}{5} \\
 &= \frac{-27}{5}
 \end{aligned}$$

$$\begin{aligned}
 \text{RHS} &= \frac{3}{10} (5x - 12) \\
 &= \frac{3}{10} \left( \frac{-6}{5} \times 5 - 12 \right) \\
 &= \frac{3}{10} \times (-18) \\
 &= \frac{3}{10} \times -18 \\
 &= \frac{-27}{5}
 \end{aligned}$$

$$\therefore \text{LHS} = \text{RHS}$$

Hence,  $x = \frac{-6}{5}$  is a solution of the given equation.

Q18

**Answer :**

We have:

$$\begin{aligned}
 \frac{y-1}{3} - \frac{y-2}{4} &= 1 \\
 \Rightarrow \frac{4(y-1) - 3(y-2)}{12} &= 1 \\
 \Rightarrow \left( \frac{4y-4-3y+6}{12} \right) &= 1 \\
 \Rightarrow \left( \frac{y+2}{12} \right) &= 1 \\
 \Rightarrow y+2 &= 1 \times 12 \\
 \Rightarrow y &= 12 - 2 \\
 \Rightarrow y &= 10
 \end{aligned}$$

CHECK: Substituting  $y=10$  in the given equation, we get:

$$\begin{aligned} \text{LHS} &= \frac{y-1}{3} - \frac{y-2}{4} \\ &= \frac{4(y-1) - 3(y-2)}{12} \\ &= \left( \frac{y+2}{12} \right) \\ &= \left( \frac{10+2}{12} \right) \\ &= \frac{+2}{+2} \\ &= 1 \end{aligned}$$

$$\text{RHS} = 1$$

$$\therefore \text{LHS} = \text{RHS}$$

Hence,  $y=10$  is a solution of the given equation.

Q19

**Answer :**

We have:

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

$$\Rightarrow \frac{x-2}{4} + \frac{2x-1}{3} - x = -\frac{1}{3} \quad \left( \text{Transposing } -\frac{2x-1}{3} \text{ to LHS and } \frac{1}{3} \text{ to RHS} \right)$$

$$\Rightarrow \left( \frac{3(x-2) + 4(2x-1) - 12x}{12} \right) = -\frac{1}{3}$$

$$\Rightarrow \left( \frac{3x-6+8x-4-12x}{12} \right) = -\frac{1}{3}$$

$$\Rightarrow 11x - 12x - 10 = -\frac{1}{3} \times 12$$

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

$$\Rightarrow -x = 6$$

$$\Rightarrow x = -6$$

CHECK: Substituting  $x = -6$  in the given equation, we get:

$$\begin{aligned} \text{LHS} &= \frac{x-2}{4} + \frac{1}{3} \\ &= \frac{-6-2}{4} + \frac{1}{3} \\ &= -2 + \frac{1}{3} \\ &= \frac{-5}{3} \end{aligned}$$

$$\begin{aligned} \text{RHS} &= x - \frac{2x-1}{3} \\ &= -6 - \frac{2 \times (-6) - 1}{3} \\ &= -6 - \frac{(-13)}{3} \\ &= -6 + \frac{13}{3} \\ &= \frac{-5}{3} \end{aligned}$$

$$\therefore \text{LHS} = \text{RHS}$$

Hence,  $y=10$  is a solution of the given equation.

Q20

**Answer :**

We have:

$$\frac{2x-1}{3} - \frac{6x-2}{5} = \frac{1}{3}$$

$$\Rightarrow \frac{5(2x-1) - 3(6x-2)}{15} = \frac{1}{3}$$

$$\Rightarrow \frac{10x-5-18x+6}{15} = \frac{1}{3}$$

$$\Rightarrow \frac{-8x+1}{15} = \frac{1}{3}$$

$$\Rightarrow -8x + 1 = \frac{1}{3} \times 15$$

$$\Rightarrow -8x = 5 - 1$$

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

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

CHECK: Substituting  $x = -\frac{1}{2}$  in the given equation, we get:

$$\begin{aligned} \text{LHS} &= \frac{2x-1}{3} - \frac{6x-2}{5} \\ &= \frac{-8x+1}{15} \\ &= \frac{-8 \times \left(-\frac{1}{3}\right) + 1}{15} \\ &= \frac{5}{15} \\ &= \frac{1}{3} \\ \text{RHS} &= \frac{1}{3} \end{aligned}$$

$\therefore \text{LHS} = \text{RHS}$

Hence,  $y = -\frac{1}{2}$  is a solution of the given equation.

Q21

**Answer :**

We have:

$$\begin{aligned} \frac{y+7}{3} &= 1 + \frac{3y-2}{5} \\ \Rightarrow \frac{y+7}{3} &= \frac{5 \times 1 + 3y - 2}{5} \\ \Rightarrow 5(y+7) &= 3(3+3y) \\ \Rightarrow 5y+35 &= 9+9y \\ \Rightarrow 9y-5y &= 35-9 \\ \Rightarrow 4y &= 26 \\ \Rightarrow y &= \frac{13}{2} \end{aligned}$$

CHECK: Substituting  $x = \frac{13}{2}$  in the given equation, we get:

$$\begin{aligned} \text{LHS} &= \frac{y+7}{3} \\ &= \frac{\frac{13}{2}+7}{3} \\ &= \frac{1 \times 13 + 2 \times 7}{2 \times 3} \\ &= \frac{13+14}{6} \\ &= \frac{27}{6} \\ &= \frac{9}{2} \end{aligned}$$

$$\begin{aligned} \text{RHS} &= 1 + \frac{3 \times \frac{13}{2} - 2}{5} \\ &= 1 + \frac{\frac{39-2 \times 2}{2}}{5} \\ &= 1 + \frac{35}{10} \\ &= \frac{45}{10} \\ &= \frac{9}{2} \end{aligned}$$

$\therefore \text{LHS} = \text{RHS}$

Hence,  $y = \frac{13}{2}$  is a solution of the given equation.

Q22

**Answer :**

We have:

$$\begin{aligned} \Rightarrow \frac{2}{7}(x-9) + \frac{x}{3} &= 3 \\ \Rightarrow \frac{2 \times 3(x-9) + 7x}{21} &= 3 \\ \Rightarrow 6(x-9) + 7x &= 3 \times 21 \\ \Rightarrow 6x - 54 + 7x &= 63 \\ \Rightarrow 13x &= 63 + 54 \\ \Rightarrow 13x &= 117 \\ \Rightarrow x &= 9 \end{aligned}$$

CHECK: Substituting  $x=9$  in the given equation we get.

$$\begin{aligned} \text{LHS} &= \frac{2}{7}(x-9) + \frac{x}{3} \\ &= \frac{2}{7}(9-9) + \frac{x}{3} \\ &= 0 + \frac{9}{3} \\ &= \frac{9}{3} \\ &= 3 \end{aligned}$$

$$\text{RHS} = 3$$

$$\therefore \text{LHS} = \text{RHS}$$

Hence,  $x=9$  is a solution of the given equation.

Q23

**Answer :**

We have:

$$\begin{aligned} \Rightarrow \frac{2x-3}{5} + \frac{x+3}{4} &= \frac{4x+1}{7} \\ \Rightarrow \frac{4(2x-3)+5(x+3)}{20} &= \frac{4x+1}{7} \\ \Rightarrow \frac{8x-12+5x+15}{20} &= \frac{4x+1}{7} \\ \Rightarrow \frac{13x+3}{20} &= \frac{4x+1}{7} \\ \Rightarrow 7(13x+3) &= 20(4x+1) \\ \Rightarrow 91x+21 &= 80x+20 \\ \Rightarrow 91x-80x &= 20-21 \\ \Rightarrow 11x &= -1 \\ \Rightarrow x &= \frac{-1}{11} \end{aligned}$$

**CHECK:** Substituting  $x = \frac{-1}{11}$  in the given equation, we get:

**LHS:**

$$\begin{aligned} \text{LHS} &= \frac{2x-3}{5} + \frac{x+3}{4} \\ &= \frac{2 \times \frac{-1}{11} - 3}{5} + \frac{\frac{-1}{11} + 3}{4} \\ &= \frac{-2-33}{55} + \frac{33-1}{44} \\ &= -\frac{35}{55} + \frac{32}{44} \\ &= \frac{-140+160}{220} \\ &= \frac{20}{220} = \frac{1}{11} \end{aligned}$$

$$\begin{aligned} \text{RHS} &= \frac{4x+1}{7} \\ &= \frac{4 \times \left(\frac{-1}{11}\right) + 1}{7} \\ &= \frac{-4+11}{7 \times 11} \\ &= \frac{7}{77} \\ &= \frac{1}{11} \end{aligned}$$

$$\therefore \text{LHS} = \text{RHS}$$

Hence,  $x = \frac{-1}{11}$  is a solution of the given equation.

Q24

**Answer :**

We have:

$$\begin{aligned} \frac{3}{4}(7x-1) - \left(2x - \frac{1-x}{2}\right) &= x + \frac{3}{2} \\ \Rightarrow \frac{3}{4}(7x-1) - 2x + \frac{1-x}{2} - x &= \frac{3}{2} \\ \Rightarrow \frac{3 \times 7}{4}x - \frac{3}{4} - 2x + \frac{1}{2} - \frac{x}{2} - x &= \frac{3}{2} \\ \Rightarrow \frac{21}{4}x - 2x - \frac{x}{2} - x &= \frac{3}{2} + \frac{3}{4} - \frac{1}{2} \quad (\text{By transposition}) \\ \Rightarrow \frac{21x-8x-2x-4x}{4} &= 1 + \frac{3}{4} \\ \Rightarrow \frac{21x-14x}{4} &= \frac{7}{4} \\ \Rightarrow \frac{7x}{4} &= \frac{7}{4} \\ \Rightarrow x &= 1 \end{aligned}$$

**CHECK:** Substituting  $x=1$  in the given equation, we get:

$$\begin{aligned} \text{LHS} &= \frac{3}{4} (7x - 1) - \left( 2x - \frac{1-x}{2} \right) \\ &= \frac{3}{4} (7 \times 1 - 1) - \left( 2 \times 1 - \frac{1-1}{2} \right) \\ &= \frac{3}{4} \times 6 - 2 \\ &= \frac{9}{2} - 2 \\ &= \frac{9-4}{2} \\ &= \frac{5}{2} \end{aligned}$$

$$\begin{aligned} \text{RHS} &= x + \frac{3}{2} \\ &= 1 + \frac{3}{2} \\ &= \frac{2+3}{2} \\ &= \frac{5}{2} \end{aligned}$$

$\therefore \text{LHS} = \text{RHS}$

Hence,  $x=1$  is a solution of the given equation.

Q25

**Answer :**

**We have :**

$$\begin{aligned} \frac{x+2}{6} - \left( \frac{11-x}{3} - \frac{1}{4} \right) &= \frac{3x-4}{12} \\ \Rightarrow \frac{x+2}{6} - \left( \frac{11-x}{3} \right) + \frac{1}{4} &= \frac{3x-4}{12} \\ \Rightarrow \frac{x+2}{6} - \left( \frac{11-x}{3} \right) - \frac{3x-4}{12} &= -\frac{1}{4} \quad (\text{By transposition}) \\ \Rightarrow \frac{2(x+2) - 4(11-x) - 1(3x-4)}{12} &= -\frac{1}{4} \\ \Rightarrow \frac{2x+4 - 44+4x - 3x+4}{12} &= -\frac{1}{4} \\ \Rightarrow 3x - 36 &= -\frac{1}{4} \times 12 \\ \Rightarrow 3x &= -3 + 36 \\ \Rightarrow x &= \frac{33}{3} \\ \Rightarrow x &= 11 \end{aligned}$$

CHECK: Substituting  $x=11$  in the given equation, we get:

$$\begin{aligned} \text{LHS} &= \frac{x+2}{6} - \left( \frac{11-x}{3} - \frac{1}{4} \right) \\ &= \frac{11+2}{6} - \left( \frac{11-11}{3} - \frac{1}{4} \right) \\ &= \frac{13}{6} - \left( -\frac{1}{4} \right) \\ &= \frac{13}{6} + \frac{1}{4} \\ &= \frac{13 \times 2 + 3}{12} \\ &= \frac{29}{12} \end{aligned}$$

$$\begin{aligned} \text{RHS} &= \frac{3x-4}{12} \\ &= \frac{3 \times 11 - 4}{12} \\ &= \frac{33-4}{12} \\ &= \frac{29}{12} \end{aligned}$$

$\therefore \text{LHS} = \text{RHS}$

Hence,  $x = 11$  is a solution of the given equation.

Verified.

Q26

**Answer :**

We have:

$$\frac{9x+7}{2} - \left(x - \frac{x-2}{7}\right) = 36$$

$$\Rightarrow \frac{9x+7}{2} - x + \frac{x-2}{7} = 36$$

$$\Rightarrow \frac{7(9x+7) - 14x + 2(x-2)}{14} = 36$$

$$\Rightarrow \frac{63x+49-14x+2x-4}{14} = 36$$

$$\Rightarrow 51x + 45 = 36 \times 14$$

$$\Rightarrow 51x = 504 - 45$$

$$\Rightarrow x = \frac{459}{51}$$

$$\Rightarrow x = 9$$

$$\Rightarrow x = 9$$

CHECK: Substituting  $x=9$  in the given equation, we get:

$$\text{LHS} = \frac{9x+7}{2} - \left(x - \frac{x-2}{7}\right)$$

$$= \frac{9 \times 9 + 7}{2} - \left(9 - \frac{9-2}{7}\right)$$

$$= \frac{88}{2} - 9 + \frac{7}{7}$$

$$= 44 - 9 + 1$$

$$= 36$$

$$\text{RHS} = 36$$

$\therefore \text{LHS} = \text{RHS}$

Hence,  $x = 9$  is a solution of the given equation.

Verified.

Q27

**Answer :**

We have:

$$0.5x + \frac{x}{3} = 0.25x + 7$$

$$\Rightarrow \frac{1}{2}x + \frac{x}{3} = \frac{x}{4} + 7$$

$$\Rightarrow \frac{x}{2} + \frac{x}{3} - \frac{x}{4} = 7$$

$$\Rightarrow \frac{6x+4x-3x}{12} = 7$$

$$\Rightarrow \frac{7x}{12} = 7$$

$$\Rightarrow x = 12$$

CHECK: Substituting  $x=12$  in the given equation, we get:

$$\text{LHS} = 0.5x + \frac{x}{3}$$

$$= 0.5 \times 12 + \frac{12}{3}$$

$$= \frac{1}{2} \times 12 + 4$$

$$= 6 + 4$$

$$= 10$$

$$\text{RHS} = 0.25x + 7$$

$$= 0.25 \times 12 + 7$$

$$= 3 + 7$$

$$= 10$$

$\therefore \text{LHS} = \text{RHS}$

Hence,  $x = 12$  is a solution of the given equation.

Verified.

Q28

**Answer :**

We have:

$$0.18(5x - 4) = 0.5x + 0.8$$

$$\Rightarrow 100 \times 0.18(5x - 4) = 100(0.5x + 0.8) \quad (\text{Multiplying both sides by 100})$$

$$\Rightarrow 18(5x - 4) = 100 \times 0.5x + 100 \times 0.8$$

$$\Rightarrow 90x - 72 = 50x + 80$$

$$\Rightarrow 90x - 50x = 80 + 72$$

$$\Rightarrow 40x = 152$$

$$\Rightarrow x = \frac{152}{40}$$

$$\Rightarrow x = \frac{19}{5} = 3.8$$

CHECK: Substituting  $x = 3.8$  in the given equation, we get:

$$\begin{aligned} \text{LHS} &= 0.18(5x - 4) \\ &= 0.18(5 \times 3.8 - 4) \\ &= 0.18 \times 15 \\ &= 2.7 \end{aligned}$$

$$\begin{aligned} \text{RHS} &= 0.5x + 0.8 \\ &= 0.5 \times 3.8 + 0.8 \\ &= 1.9 + 0.8 \\ &= 2.7 \end{aligned}$$

$$\therefore \text{LHS} = \text{RHS}$$

Hence,  $x = 3.8$  is a solution of the given equation.

Verified.

Q29

**Answer :**

We have:

$$\Rightarrow 2.4(3 - x) - 0.6(2x - 3) = 0$$

$$\Rightarrow 10 \times 2.4(3 - x) - 10 \times 0.6(2x - 3) = 0$$

$$\Rightarrow 24(3 - x) - 6(2x - 3) = 0 \quad (\text{Multiplying both sides by 10 to remove decimals})$$

$$\Rightarrow 6[4(3 - x) - (2x - 3)] = 0$$

$$\Rightarrow 4(3 - x) - (2x - 3) = 0$$

$$\Rightarrow 12 - 4x - 2x + 3 = 0$$

$$\Rightarrow 15 - 6x = 0$$

$$\Rightarrow -6x = -15$$

$$\Rightarrow x = \frac{15}{6}$$

$$\Rightarrow x = \frac{5}{2} = 2.5$$

CHECK: Substituting  $x = 2.5$  in the given equation, we get:

$$\begin{aligned} \text{LHS} &= 2.4(3 - x) - 0.6(2x - 3) \\ &= 2.4(3 - 2.5) - 0.6(2 \times 2.5 - 3) \\ &= 2.4 \times 0.5 - 0.6 \times 2 \\ &= 1.2 - 1.2 \\ &= 0 \end{aligned}$$

$$\text{RHS} = 0$$

$$\therefore \text{LHS} = \text{RHS}$$

Hence,  $x = \frac{19}{5}$  is a solution of the given equation.

Verified.

Q30

**Answer :**

We have:

$$\begin{aligned}0.5x - (0.8 - 0.2x) &= 0.2 - 0.3x \\ \Rightarrow 0.5x + 0.3x - 0.8 + 0.2x &= 0.2 && \text{(By transposition)} \\ \Rightarrow (0.5 + 0.3 + 0.2)x &= 0.2 + 0.8 \\ \Rightarrow 1x &= 1 \\ \Rightarrow x &= 1\end{aligned}$$

CHECK: Substituting  $x=1$  in the given equation, we get:

$$\begin{aligned}\text{LHS} &= 0.5x - (0.8 - 0.2x) \\ &= 0.5 \times 1 - (0.8 - 0.2 \times 1) \\ &= 0.5 - 0.8 + 0.2 \\ &= -0.1\end{aligned}$$

$$\begin{aligned}\text{RHS} &= 0.2 - 0.3x \\ &= 0.2 - 0.3 \times 1 \\ &= -0.1\end{aligned}$$

$\therefore$  LHS=RHS

Hence,  $x = 1$  is a solution of the given equation.

Verified.

Q31

**Answer :**

We have:

$$\begin{aligned}\frac{x+2}{x-2} &= \frac{7}{3} \\ \Rightarrow (x+2) \times 3 &= 7 \times (x-2) && \text{(Cross multiplication)} \\ \Rightarrow 3x + 6 &= 7x - 14 \\ \Rightarrow 4x &= 20 \\ \Rightarrow x &= \frac{20}{4} \\ \Rightarrow x &= 5\end{aligned}$$

CHECK: Substituting  $x=5$  in the given equation, we get.

$$\begin{aligned}\text{LHS} &= \frac{x+2}{x-2} \\ &= \frac{5+2}{5-2} \\ &= \frac{7}{3}\end{aligned}$$

$$\text{RHS} = \frac{7}{3}$$

$\therefore$  LHS=RHS

Hence,  $x = 5$  is a solution of the given equation.

Verified.

Q32

**Answer :**

We have:

$$\begin{aligned}\frac{2x+5}{3x+4} &= 3 \\ \Rightarrow \frac{2x+5}{3x+4} &= \frac{3}{1} \\ \Rightarrow 1 \times (2x+5) &= 3 \times (3x+4) \\ \Rightarrow 2x+5 &= 9x+12 \\ \Rightarrow 7x &= -7 \\ \Rightarrow x &= -1\end{aligned}$$

CHECK: Substituting  $x=-1$  in the given equation, we get:

$$\text{LHS} : \frac{2x+5}{3x+4}$$

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

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

$$= \frac{3}{1}$$

$$\text{RHS} = 3$$

$\therefore$  LHS = RHS

Hence,  $x = -1$  is a solution of the given equation.

Verified.

# Linear Equations in One Variable

## Ex 7B

**Linear equation in one variable** is an equation which can be written in the form of  $ax + b = 0$ , where  $a$  and  $b$  are real-number constants and  $a \neq 0$ .

Ex.

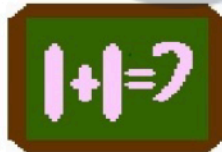
$$x + 7 = 12$$

**Equation** is a mathematical sentence indicating that two expressions are equal. The symbol "=" is used to indicate equality.

Ex.

$2x + 5 = 9$  is a conditional equation since its truth or falsity depends on the value of  $x$ .

$2 + 9 = 11$  is identity equation since both of its sides are identical to the same number 11.



## Solution Set of a Linear Equation

Example

$$4x + 2 = 10$$

this statement is either true or false

If  $x = 1$ , then  $4x + 2 = 10$

is false because  $4(1) + 2$  is  $\neq 10$

If  $x = 2$ , then  $4x + 2 = 10$

is true because  $4(2) + 2 = 10$

### ONE STEP SUBTRACTION EXAMPLE

The Opposite of Subtraction is Addition

$$\begin{array}{r} x - 120 = 80 \\ +120 \quad +120 \\ \hline x = 200 \checkmark \end{array}$$

The value which makes the equation true is 200.

$x - 4 = 7$	Original problem
$x - 4 = 7$	We want to remove the minus 4.
$x - 4 + 4 = 7 + 4$	The opposite of minus 4 is plus 4, so I added 4 to BOTH sides of the equation.
$x = 11$	$-4 + 4 = 0$ , so $x$ remains on the left and $7 + 4 = 11$ ; therefore $x = 11$
Check: $x - 4 = 7$ $11 - 4 = 7$	This is a correct statement, so my answer is $x = 11$ is correct!

## Solving simple two-step equations

To solve an equation, find the value that makes the equation true.

Solve  $2x + 3 = 13$

This means:  $x \xrightarrow{\times 2} \xrightarrow{+ 3} = 13$

To solve, we reverse the process:

$$x \xrightarrow{\times 2} \xrightarrow{+ 3} 13$$

$$x \xrightarrow{\div 2} \xrightarrow{- 3} 13$$

Use the opposite (inverse) operation and undo in reverse order.

$$2x + 3 = 13$$

$$2x = 10$$

$$x = 5$$

$$- 3$$

$$\div 2$$

We have solved the equation when we get to a single value of  $x$  (here,  $x = 5$ ).

Solve  $4x + 6 = 14$

$$4x + 6 = 14$$

$$4x = 8$$

$$x = 2$$

$$- 6$$

$$\div 4$$

Solve  $3x - 8 = 19$

$$3x - 8 = 19$$

$$3x = 27$$

$$x = 9$$

$$+ 8$$

$$\div 3$$



Q1

**Answer :**

Let the number be  $x$ .

Then, we have :

$$\Rightarrow 2x - 7 = 45$$

$$\Rightarrow 2x = 45 + 7$$

$$\Rightarrow x = \frac{45+7}{2}$$

$$\Rightarrow x = \frac{52}{2}$$

$$\Rightarrow x = 26$$

$\therefore$  The required number is 26.

Q2

**Answer :**

Let the number be  $x$ .

Then, we have:

$$\Rightarrow 3x + 5 = 44$$

$$\Rightarrow 3x = 44 - 5$$

$$\Rightarrow x = \frac{44-5}{3}$$

$$\Rightarrow x = \frac{39}{3}$$

$$\Rightarrow x = 13$$

$\therefore$  The required number is 13

Q3

**Answer :**

Let the number be  $x$ .

Then, we have:

$$\Rightarrow 2x + 4 = \frac{26}{5}$$

$$\Rightarrow 2x = \frac{26}{5} - 4$$

$$\Rightarrow 2x = \frac{26-20}{5}$$

$$\Rightarrow x = \frac{6}{10}$$

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

$\therefore$  The required fraction is  $\frac{3}{5}$ .

Q4

**Answer :**

Let the required number be  $x$ .

Then, we have:

$$\Rightarrow x + \frac{x}{2} = 72$$

$$\Rightarrow \frac{2x+x}{2} = 72$$

$$\Rightarrow \frac{3x}{2} = 72$$

$$\Rightarrow 3x = 72 \times 2$$

$$\Rightarrow x = \frac{72 \times 2}{3}$$

$\therefore$  The required number is 48.



Q5

**Answer :**

Let the required number be  $x$ .

Then, we have:

$$\Rightarrow x + \frac{2x}{3} = 55$$

$$\Rightarrow \frac{3x+2x}{3} = 55$$

$$\Rightarrow 5x = 55 \times 3$$

$$\Rightarrow x = \frac{55 \times 3}{5}$$

$\therefore$  The required number is 33.

Q6

**Answer :**

Let the required number be  $x$ .

Then, we have:

$$\Rightarrow 4x - x = 45$$

$$\Rightarrow 3x = \frac{45}{3}$$

$$\Rightarrow x = 15$$

$\therefore$  The required number is 15.

Q7

**Answer :**

Let the number be  $x$ .

Then, we have:

$$(x - 21) = (71 - x)$$

$$\Rightarrow x + x = 71 + 21$$

$$\Rightarrow 2x = 92$$

$$\Rightarrow x = \frac{92}{2}$$

$$\Rightarrow x = 46$$

$\therefore$  The required number is 46.

Q8

**Answer :**

Let the original number be  $x$ .

Then, we have:

$$\Rightarrow \frac{2}{3}x = x - 20$$

$$\Rightarrow \frac{2x}{3} - x = -20$$

$$\Rightarrow \frac{2x - 3x}{3} = -20$$

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

$$\Rightarrow x = 60$$

$\therefore$  The original number is 60.

Q9

**Answer :**

Let the number be  $x$ .

Then, the other number will be  $\frac{2x}{5}$ .

Now, we have:

$$\Rightarrow x + \frac{2x}{5} = 70$$

$$\Rightarrow \frac{5x + 2x}{5} = 70$$

$$\Rightarrow \frac{7x}{5} = 70$$

$$\Rightarrow x = \frac{70 \times 5}{7}$$

$$\therefore \text{Other number} = 50 \times \frac{2}{5} = 20$$

Hence, the numbers are 50 and 20.

Q10

**Answer :**

Let the number be  $x$ .

Then, we have:

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

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

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

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

$$\Rightarrow x - 2x = 3 \times (-3)$$

$$\Rightarrow -x = -9$$

$\therefore$  The required number is 9.

Q11



**Answer :**

Let the number be  $x$ .

Then, we have:

$$\Rightarrow \frac{x}{5} + 5 = \frac{x}{4} - 5$$

$$\Rightarrow \frac{x}{5} - \frac{x}{4} = -5 - 5$$

$$\Rightarrow \frac{-x}{20} = -10$$

$$\Rightarrow x = 200$$

$\therefore$  The required number is 200.

Q12

**Answer :**

Let the two consecutive natural number be  $x$  and  $(x + 1)$ .

Then, we have:

$$x + (x + 1) = 63$$

$$\Rightarrow x + x + 1 = 63$$

$$\Rightarrow 2x = 63 - 1$$

$$\Rightarrow x = \frac{62}{2}$$

$$\Rightarrow x = 31$$

$\therefore$  The required numbers are 31 and 32 (i.e., 31+1).



Q13

**Answer :**

Let the two consecutive odd integers whose sum is 76 be  $x$  and  $(x + 2)$ .

Then,  $x + x + 2 = 76$

$$\Rightarrow 2x + 2 = 76$$

$$\Rightarrow 2x = 76 - 2$$

$$\Rightarrow x = 74 \div 2$$

$$\Rightarrow x = 37$$

$\therefore$  The required integers are 37 and 39 (i.e., 37 + 2).

Q14

**Answer :**

Let the three consecutive positive even integers be  $x$ ,  $(x + 2)$  and  $(x + 4)$ .

Let  $x$  be the even number.

Then,  $x + x + 2 + x + 4 = 90$

$$\Rightarrow 3x = 90 - 6$$

$$\Rightarrow 3x = 84$$

$$\Rightarrow x = \frac{84}{3} = 28$$

$\therefore$  The required numbers are 28, 30 and 32.

Q15

**Answer :**

Let the two parts be  $x$  and  $(184 - x)$ .

Then, we have:

$$\frac{1}{3}x = \frac{1}{7}(184 - x) + 8$$

$$\Rightarrow \frac{1}{3}x - \frac{1}{7}(184 - x) = 8$$

$$\Rightarrow \frac{1}{3}x - \frac{184}{7} + \frac{x}{7} = 8$$

$$\Rightarrow \frac{1}{3}x + \frac{1}{7}x = \frac{184}{7} + 8$$

$$\Rightarrow \frac{7x+3x}{21} = 8 + \frac{184}{7}$$

$$\Rightarrow \frac{10x}{21} = \frac{56+184}{7}$$

$$\Rightarrow \frac{10x}{21} = \frac{240}{7}$$

$$\Rightarrow x = \frac{240 \times 21}{7 \times 10}$$

$$= 72$$

Now, other part  $= 184 - 72 = 112$

$\therefore$  The two parts are 72 and 112.

Q16

**Answer :**

Let the number of five rupee notes be  $x$ .

Then, the number of ten rupee notes will be  $(90 - x)$ .

According to the question, we have :

$$5x + 10(90 - x) = 500$$

$$\Rightarrow 5x + 900 - 10x = 500$$

$$\Rightarrow -5x = -400$$

$$\Rightarrow x = 80$$

Number of ten rupee notes  $= 90 - 80 = 10$

$\therefore$  There are 80 five rupee notes and 10 ten rupee notes.

Q17

**Answer :**

Let the numbers of 50 paise coins and 25 paise coins be  $x$  and  $2x$ , respectively.

Then, we have :

$$50x + 25 \times 2x = 3400$$

$$\Rightarrow 50x + 50x = 3400$$

$$\Rightarrow 100x = 3400$$

$$\Rightarrow x = 34$$

$\therefore$  Number of 50 paise coins  $= 34$

and number of 25 paise coins  $= 68$

Q18

**Answer :**

Let the present ages of Raju and his cousin be  $(x-19)$  yrs and  $x$  yrs.

According to the question, we have :

$$\frac{(x-19)+5}{x+5} = \frac{2}{3}$$

$$\Rightarrow 3(x-14) = 2x+10$$

$$\Rightarrow 3x-42 = 2x+10$$

$$\Rightarrow x = 52$$

$\therefore$  Age of Raju's cousin  $= 52$  yrs

and age of Raju  $= 52 - 19 = 33$  yrs

Q19

**Answer :**

Let the age of the son and the father be  $x$  yrs and  $(x + 30)$  yrs, respectively.

According to the question, we have :

$$3 \times (x + 12) = x + 30 + 12$$

$$\Rightarrow 3x + 36 = x + 42$$

$$\Rightarrow 3x - x = 42 - 36$$

$$\Rightarrow 2x = 6$$

$$\Rightarrow x = 3$$

$\therefore$  Son's age = 3 yrs

Father's age =  $(x + 30)$  yrs =  $(3 + 30)$  yrs = 33 yrs

Q20

**Answer :**

Given ratio of Sonal's and Manoj's ages = 7 : 5

Let the ages of Sonal and Manoj be  $7x$  yrs and  $5x$  yrs.

According to the question, we have :

$$\frac{7x+10}{5x+10} = \frac{9}{7}$$

$$\Rightarrow 7(7x + 10) = 9(5x + 10)$$

$$\Rightarrow 49x + 70 = 45x + 90$$

$$\Rightarrow 49x - 45x = 90 - 70$$

$$\Rightarrow 4x = 20$$

$$\Rightarrow x = 5$$

$\therefore$  Sonal's present age is  $7 \times 5 = 35$  yrs

Manoj's present age is  $5 \times 5 = 25$  yrs

Q21

**Answer :**

Let  $x$  yrs be the present age of son.

Then, the age of the son 5 years ago would be  $(x - 5)$  yrs

Then, Age of father =  $7 \left( x - 5 \right)$  yrs

After 5 yrs, the age of the son will be  $\left( x + 5 \right)$  yrs

Then, Age of father =  $3 \left( x + 5 \right)$  yrs

Now, we have  $3(x + 5) = 7(x - 5) + 10$

$$\Rightarrow 3x + 15 = 7x - 35 + 10$$

$$\Rightarrow 4x = 40$$

$$\Rightarrow x = 10$$

$\therefore$  Present age of the father is =  $3(x+5)-5$

$$= 3 \left( 10 + 5 \right) - 5$$

$$= 40 \text{ yrs}$$

Q22

**Answer :**

Let  $x$  be the present age of Manoj.

According to the question, we have :

$$\Rightarrow x + 12 = 3(x - 4)$$

$$\Rightarrow x + 12 = 3x - 12$$

$$\Rightarrow 2x = 24$$

$$\Rightarrow x = 12$$

$\therefore$  Manoj's present age is 12 years.

Q23

**Answer :**

Let  $x$  be the total marks.

According to the question, we have:

$$40\% \text{ of } x = 185 + 15$$

$$\Rightarrow \frac{40x}{100} = 200$$

$$\Rightarrow 40x = 200 \times 100$$

$$\Rightarrow 40x = 20000$$

$$\Rightarrow x = 500$$

$\therefore$  Total marks = 500

Q24

**Answer :**

Let  $x$  be the digit in the units place.

Sum of the units and tens digits = 8

Then, tens digit =  $(8 - x)$

$\therefore$  The number is  $10(8 - x) + x$ .

Now,  $10(8 - x) + x + 18 = 10x + (8 - x)$

$$\Rightarrow 80 - 10x + x + 18 = 10x + 8 - x$$

$$\Rightarrow 98 - 9x = 9x + 8$$

$$\Rightarrow 18x = 90$$

$$\Rightarrow x = 5$$

i.e., tens digit =  $(8 - 5) = 3$

$\therefore$  Required number =  $10(8 - 5) + 5 = 10 \times 3 + 5 = 35$

Q25

**Answer :**

Let Rs  $x$  be the cost of the chair.

Then, the cost of the table is Rs  $(x + 75)$ .

Now,  $3(x + 75) + 2x = 1850$

$$\Rightarrow 3x + 225 + 2x = 1850$$

$$\Rightarrow 5x = 1625$$

$$\Rightarrow x = \frac{1625}{5} = 325$$

$\therefore$  Cost of the chair = Rs 325; cost of the table =  $(325 + 75) =$ Rs 400

Q26

**Answer :**

Let the cost price of the article be Rs  $x$ .

According to the question, we have:

SP = Rs 495

$$\therefore \text{Gain \%} = \frac{\text{Gain}}{\text{CP}} \times 100$$

$$\Rightarrow 10 = \frac{\text{Gain}}{x} \times 100$$

$$\Rightarrow \text{Gain} = \frac{10x}{100} = \text{Rs } \frac{x}{10}$$

Now, CP + Gain = SP

$$\Rightarrow x + \frac{x}{10} = 495$$

$$\Rightarrow \frac{x + 10x}{10} = 495$$

$$\Rightarrow 11x = 495 \times 10$$

$$\Rightarrow x = \frac{495 \times 10}{11}$$

$$\Rightarrow x = \frac{4950}{11}$$

$$\Rightarrow x = 450$$

$\therefore$  CP = Rs 450

Q27

**Answer :**

Let the length and breadth of the rectangular field be  $l$  m and  $b$  m, respectively.

According to the question, we have :

$$2(l + b) = 150 \quad \dots (i)$$

$$\Rightarrow l + b = 75$$

$$\text{Given that } l = 2b \quad \dots (ii)$$

Using (ii) in (i), we have:

$$2b + b = 75$$

$$\Rightarrow 3b = 75$$

$$\Rightarrow b = 25$$

$$\therefore l = 50 \text{ m and } b = 25 \text{ m}$$

Q28

**Answer :**

Let the length of third side be  $x$  m. Then, the length of the two equal sides will be  $(2x - 5)$  m.

$$\therefore (2x - 5) + (2x - 5) + x = 55$$

$$\Rightarrow 2x - 5 + 2x - 5 + x = 55$$

$$\Rightarrow 5x - 10 = 55$$

$$\Rightarrow 5x = 65$$

$$\Rightarrow x = \frac{65}{5} = 13$$

$$\therefore \text{Length of the third side} = 13 \text{ m}$$

$$\text{And length of the other two equal sides} = (2 \times 13) - 5 = 21 \text{ m}$$

Q29

**Answer :**

Let the two complementary angles be  $x^\circ$  and  $(90 - x)^\circ$ .

According to the question, we have :

$$x - (90 - x) = 8$$

$$\Rightarrow x - 90 + x = 8$$

$$\Rightarrow 2x = 98$$

$$\Rightarrow x = 49$$

$$\therefore \text{The measures of the complementary angles are } 49^\circ \text{ and } (90 - 49)^\circ = 41^\circ.$$

Q30

**Answer :**

Let the two supplementary angles be  $x^\circ$  and  $(180 - x)^\circ$ .

$$\therefore x - (180 - x) = 44$$

$$\Rightarrow x - 180 + x = 44$$

$$\Rightarrow 2x = 224$$

$$\Rightarrow x = 112$$

$$\therefore \text{The measures of the supplementary angles are } 112^\circ \text{ and } (180 - 112)^\circ, \text{ i.e., } 68^\circ.$$

Q31

**Answer :**

Let the base angles of the isosceles triangle be  $x^\circ$  each.

Then, the measure the vertex angle will be  $(2x)^\circ$ .

According to the question, we have :

$$x + x + 2x = 180 \quad (\text{Sum of three sides of a triangle})$$

$$\Rightarrow 4x = 180$$

$$\Rightarrow x = \frac{180}{4}$$

$$\Rightarrow x = 45$$

$$\therefore \text{Each base angle measures } 45^\circ \text{ and the vertex angle measures } (2 \times 45)^\circ, \text{ i.e., } 90^\circ.$$

Q32

**Answer :**

Let the length of the total journey be  $x$  km.

According to the question, we have:

$$\frac{3}{5}x + \frac{1}{4}x + \frac{1}{8}x + 2 = x$$

$$\Rightarrow \frac{24x + 10x + 5x + 80}{40} = x$$

$$\Rightarrow 39x + 80 = 40x$$

$$\Rightarrow x = 80$$

$\therefore$  The length of his total journey is 80 km.

Q33

**Answer :**

Let  $x$  be the number of days of his absence.

$\therefore$  Number of days of his presence =  $(20 - x)$

Now,  $(20 - x)120 - 10x = 1880$

$$\Rightarrow 2400 - 120x - 10x = 1880$$

$$\Rightarrow 2400 - 1880 = 130x$$

$$\Rightarrow 130x = 520$$

$$\Rightarrow x = 4$$

$\therefore$  Number of days of his absence = 4

Q34

**Answer :**

Let the worth of Hari Babu's property be Rs  $x$ .

According to the question, we have:

$$\text{Son's share} = \frac{1}{4}x$$

$$\text{Daughter's share} = \frac{1}{3}x$$

$$\text{Wife's share} = \left\{ x - \left( \frac{1}{4}x + \frac{1}{3}x \right) \right\}$$

It is given that his wife's share is Rs 18000.

$$\text{i.e., } x - \left( \frac{1}{4}x + \frac{1}{3}x \right) = 18000$$

$$\Rightarrow x - \left( \frac{1}{3}x + \frac{1}{4}x \right) = 18000$$

$$\Rightarrow x - \frac{7x}{12} = 18000$$

$$\Rightarrow \frac{5x}{12} = 18000$$

$$\Rightarrow x = \frac{18000 \times 12}{5}$$

$$\Rightarrow x = 43200$$

$\therefore$  Hari Babu's total property is worth Rs 43200.

Q35

**Answer :**

Let the volume of the pure alcohol be  $x$  ml.

Initial concentration = 15%

So, initial amount of alcohol in the solution will be =  $\frac{15}{100} \times 400 = 60$  ml

To make the strength of the solution 32%, we will keep the amount of water constant and add

On adding pure alcohol, the volume of the solution increases to  $400 + x$ .

According to the question, we have :

$$\frac{x+60}{400+x} = \frac{32}{100}$$

$$\Rightarrow 100x + 6000 = 12800 + 32x$$

$$\Rightarrow 100x - 32x = 12800 - 6000$$

$$\Rightarrow 68x = 6800$$

$$\Rightarrow x = 100$$

So, amount of pure alcohol to be added = 100 ml

# Linear Equations in One Variable

## Ex 7C

Q1

Answer :

$$(d) \frac{1}{36}$$

We have:

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

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

$$\Rightarrow 3x = \frac{-8+9}{12}$$

$$\Rightarrow x = \frac{1}{12 \times 3}$$

$$\Rightarrow x = \frac{1}{36}$$

Q2

Answer :

$$(d) \frac{4}{3}$$

We have:

$$2z + \frac{8}{3} = \frac{1}{4}z + 5$$

$$\Rightarrow 2z - \frac{1}{4}z = 5 - \frac{8}{3}$$

$$\Rightarrow \frac{8z-z}{4} = \frac{15-8}{3}$$

$$\Rightarrow \frac{7z}{4} = \frac{7}{3}$$

$$\Rightarrow z = \frac{7^1 \times 4}{3 \times 7^1}$$

$$\Rightarrow z = \frac{4}{3}$$

Q3

Answer :

$$(a) 5$$

We have:

$$(2n+5) = 3(3n-10)$$

$$\Rightarrow 2n+5 = 9n-30$$

$$\Rightarrow 2n-9n = -30-5$$

$$\Rightarrow \cancel{7n} = \cancel{35}$$

$$\Rightarrow n = \frac{-35}{-7}$$

$$\Rightarrow n = 5$$

Q4

Answer :

$$(c) 8$$

We have:

$$\frac{x-1}{x+1} = \frac{7}{9}$$

$$\Rightarrow 9(x-1) = 7(x+1)$$

$$\Rightarrow 9x-9 = 7x+7$$

$$\Rightarrow 9x-7x = 7+9$$

$$\Rightarrow 2x = 16$$

$$\Rightarrow x = \frac{16}{2}$$

$$\Rightarrow x = 8$$

Q5

Answer :

$$(c) \frac{1}{2}$$

We have:

$$8(2x-5) - 6(3x-7) = 1$$

$$\Rightarrow 16x-40-18x+42 = 1$$

$$\Rightarrow -2x+2 = 1$$

$$\Rightarrow -2x = 1-2$$

$$\Rightarrow \cancel{2}x = \cancel{1}$$

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



Q6

Answer :

(d) 30

We have:

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

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

$$\Rightarrow 3(x-2) = 2(x+12)$$

$$\Rightarrow 3x - 6 = 2x + 24$$

$$\Rightarrow 3x - 2x = 24 + 6$$

$$\Rightarrow x = 30$$

Q7

Answer :

(a) 2

We have:

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

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

$$\Rightarrow 3(2x-1) = 3(x+1)$$

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

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

$$\Rightarrow 3x = 6$$

$$\Rightarrow x = \frac{6}{3}$$

$$= 2$$

Q8

Answer :

(b) 26

Let the consecutive whole numbers be  $x$  and  $(x+1)$ .

$$\text{Then, } x + (x+1) = 53$$

$$\Rightarrow 2x + 1 = 53$$

$$\Rightarrow 2x = 53 - 1$$

$$\Rightarrow x = \frac{53-1}{2}$$

$$\Rightarrow x = 26$$

Q9

Answer :

(d) 44

Let the two consecutive even numbers be  $x$  and  $(x+2)$ .

$$\text{Then, } x + (x+2) = 86$$

$$\Rightarrow 2x + 2 = 86$$

$$\Rightarrow 2x = 86 - 2$$

$$\Rightarrow x = \frac{86-2}{2}$$

$$\Rightarrow x = 42$$

 $\therefore$  The required numbers are 42 and  $(42+2)$ , i.e., 44.

Q10

Answer :

(b) 17

Let the two consecutive odd numbers be  $(x+1)$  and  $(x+3)$ .

$$\text{Then, } (x+1) + (x+3) = 36$$

$$\Rightarrow 2x + 4 = 36$$

$$\Rightarrow 2x = 36 - 4$$

$$\Rightarrow x = \frac{36-4}{2}$$

$$\Rightarrow x = 16$$

 $\therefore$  The smaller number is 17.

Q11

Answer :

(d) 11

Let the whole number be  $x$ .

$$\text{Then, } 2x + 9 = 31$$

$$\Rightarrow 2x = 31 - 9$$

$$\Rightarrow 2x = 22$$

$$\Rightarrow x = \frac{22}{2}$$

$$\Rightarrow x = 11$$

Q12

Answer :

(a) 6

Let the whole number be  $x$ .

$$\text{Then, } 3x + 6 = 24$$

$$\Rightarrow 3x = 24 - 6$$

$$\Rightarrow 3x = 18$$

$$\Rightarrow x = \frac{18}{3}$$

$$\Rightarrow x = 6$$

Q13

**Answer :**

(a) 30

Let the original number be  $x$ .

Then,  $\frac{2}{3}x = x - 10$

$$\Rightarrow 2x = 3x - 30$$

$$\Rightarrow 2x - 3x = -30$$

$$\Rightarrow -x = -30$$

$$\Rightarrow x = 30$$

$\therefore$  The required number is 30.

Q14

**Answer :**

(b)  $50^\circ$

Let the angle be  $x^\circ$ .

Then, complementary of  $x = 90^\circ - x^\circ$

According to the question, we have :

$$x - 90 - x = 10$$

$$\Rightarrow 2x = 90 + 10$$

$$\Rightarrow 2x = 100$$

$$\Rightarrow x = 50$$

So, the larger angle is  $50^\circ$ .

Q15

**Answer :**

(b)  $80^\circ$

Let the angle be  $x^\circ$ .

Then, complementary angle of  $x = 180^\circ - x^\circ$

According to the question, we have :

$$x - (180 - x) = 20$$

$$\Rightarrow x - 180 + x = 20$$

$$\Rightarrow 2x = 20 + 180$$

$$\Rightarrow 2x = 200$$

$$\Rightarrow x = 100$$

Hence, the smaller angle is  $80^\circ$ .

Q16

**Answer :**

(c) 15 years

Let the present ages of A and B be  $5x$  and  $3x$ , respectively.

According to the question, we have :

$$\frac{5x+6}{3x+6} = \frac{7}{5}$$

$$\Rightarrow 25x + 30 = 21x + 42$$

$$\Rightarrow 25x - 21x = 42 - 30$$

$$\Rightarrow 4x = 12$$

$$\Rightarrow x = \frac{12}{4}$$

$$\Rightarrow x = 3$$

$\therefore$  A's present age =  $5 \times 3$  years = 15 years

Q17

**Answer :**

(b) 20

Let the number be  $x$ .

Then,  $5x = x + 80$

$$\Rightarrow 5x - x = 80$$

$$\Rightarrow 4x = 80$$

$$\Rightarrow x = \frac{80}{4}$$

$$\Rightarrow x = 20$$

$\therefore$  The required number is 20.

Q18 **Answer :**

(c) 32 m

Let the width of the rectangle be  $x$ . Then, its length will be  $3x$ .

Perimeter of the rectangle = 96 m

Now,  $2(l + b) = 96$

$$\Rightarrow 2(3x + x) = 96$$

$$\Rightarrow 2 \times 4x = 96$$

$$\Rightarrow 8x = 96$$

$$\Rightarrow x = \frac{96}{8}$$

$$\Rightarrow x = 12$$

$\therefore$  Length of the rectangle =  $3 \times 12$  m = 36 m