

Linear Equation In One Variable

Ex 9A

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.

$$x + 7 = 12$$

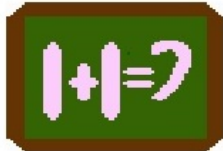
Equation is a mathematical sentence indicating that two expressions are equal. The symbol "=" is used to indicate equality.

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

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

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:

$$\begin{array}{l} x \xrightarrow{\times 2} \xrightarrow{+ 3} 13 \\ x \xrightarrow{\div 2} \xrightarrow{- 3} 13 \end{array}$$

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

$$2x + 3 = 13$$

$$- 3$$

$$2x = 10$$

$$\div 2$$

$$x = 5$$

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

Solve $4x + 6 = 14$

$$4x + 6 = 14$$

$$- 6$$

$$4x = 8$$

$$\div 4$$

$$x = 2$$

Solve $3x - 8 = 19$

$$3x - 8 = 19$$

$$+ 8$$

$$3x = 27$$

$$\div 3$$

$$x = 9$$

Q1

Answer :

(i) Let the required number be x .

So, five times the number will be $5x$.

$$\therefore 5x = 40$$

(ii) Let the required number be x .

So, when it is increased by 8, we get $x + 8$.

$$\therefore x + 8 = 15$$

(iii) Let the required number be x .

So, when 25 exceeds the number, we get $25 - x$.

$$\therefore 25 - x = 7$$

(iv) Let the required number be x .

So, when the number exceeds 5, we get $x - 5$.

$$\therefore x - 5 = 3$$

(v) Let the required number be x .

So, thrice the number will be $3x$.

$$\therefore 3x - 5 = 16$$

(vi) Let the required number be x .

So, 12 subtracted from the number will be $x - 12$.

$$\therefore x - 12 = 24$$

(vii) Let the required number be x .

So, twice the number will be $2x$.

$$\therefore 19 - 2x = 11$$

(viii) Let the required number be x .

So, the number when divided by 8 will be $\frac{x}{8}$.

$$\therefore \frac{x}{8} = 7$$

(ix) Let the required number be x .

So, four times the number will be $4x$.

$$\therefore 4x - 3 = 17$$

(x) Let the required number be x .

So, 6 times the number will be $6x$.

$$\therefore 6x = x + 5$$

Answer :

(i) $y + 9 = 13$

We try several values of y until we get the L.H.S. equal to the R.H.S.

y	L.H.S.	R.H.S.	Is LHS = RHS ?
1	$1 + 9 = 10$	13	No
2	$2 + 9 = 11$	13	No
3	$3 + 9 = 12$	13	No
4	$4 + 9 = 13$	13	Yes

$\therefore y = 4$

(ii) $x - 7 = 10$

We try several values of x until we get the L.H.S. equal to the R.H.S.

x	L.H.S.	R.H.S.	Is L.H.S. = R.H.S.?
10	$10 - 7 = 3$	10	No
11	$11 - 7 = 4$	10	No
12	$12 - 7 = 5$	10	No
13	$13 - 7 = 6$	10	No
14	$14 - 7 = 7$	10	No
15	$15 - 7 = 8$	10	No
16	$16 - 7 = 9$	10	No
17	$17 - 7 = 10$	10	Yes

$\therefore x = 17$

(iii) $4x = 28$

We try several values of x until we get the L.H.S. equal to the R.H.S.

x	L.H.S.	R.H.S.	Is L.H.S. = R.H.S.?
1	$4 \times 1 = 4$	28	No
2	$4 \times 2 = 8$	28	No
3	$4 \times 3 = 12$	28	No
4	$4 \times 4 = 16$	28	No
5	$4 \times 5 = 20$	28	No
6	$4 \times 6 = 24$	28	No
7	$4 \times 7 = 28$	28	Yes

$\therefore x = 7$

(iv) $3y = 36$

We try several values of x until we get the L.H.S. equal to the R.H.S.

y	L.H.S.	R.H.S.	Is L.H.S. = R.H.S.?
6	$3 \times 6 = 18$	36	No
7	$3 \times 7 = 21$	36	No
8	$3 \times 8 = 24$	36	No
9	$3 \times 9 = 27$	36	No
10	$3 \times 10 = 30$	36	No
11	$3 \times 11 = 33$	36	No
12	$3 \times 12 = 36$	36	Yes

$\therefore y = 12$

(v) $11 + x = 19$

We try several values of x until we get the L.H.S. equal to the R.H.S.

x	L.H.S.	R.H.S.	Is L.H.S. = R.H.S.?
1	$11 + 1 = 12$	19	No
2	$11 + 2 = 13$	19	No
3	$11 + 3 = 14$	19	No
4	$11 + 4 = 15$	19	No
5	$11 + 5 = 16$	19	No
6	$11 + 6 = 17$	19	No
7	$11 + 7 = 18$	19	No
8	$11 + 8 = 19$	19	Yes

$\therefore x = 8$

$$(vi) \frac{x}{3} = 4$$

Since R.H.S. is a natural number so L.H.S. must also be a natural number. Thus, x has to be a multiple of 3.

x	L.H.S.	R.H.S.	Is L.H.S. = R.H.S.?
3	$\frac{3}{3} = 1$	4	No
6	$\frac{6}{3} = 2$	4	No
9	$\frac{9}{3} = 3$	4	No
12	$\frac{12}{3} = 4$	4	Yes

$$\therefore x = 12$$

$$(vii) 2x - 3 = 9$$

We try several values of x until we get the L.H.S. equal to the R.H.S.

x	L.H.S.	R.H.S.	Is L.H.S. = R.H.S.?
1	$2 \times 1 - 3 = -1$	9	No
2	$2 \times 2 - 3 = 1$	9	No
3	$2 \times 3 - 3 = 3$	9	No
4	$2 \times 4 - 3 = 5$	9	No
5	$2 \times 5 - 3 = 7$	9	No
6	$2 \times 6 - 3 = 9$	9	Yes

$$\therefore x = 6$$

$$(viii) \frac{1}{2}x + 7 = 11$$

Since, R.H.S. is a natural number so L.H.S. must be a natural number Thus, we will try values if x which are multiples of 'x'

x	L.H.S.	R.H.S.	Is L.H.S. = R.H.S.?
2	$2/2 + 7 = 8$	11	No
4	$4/2 + 7 = 9$	11	No
6	$6/2 + 7 = 10$	11	No
8	$8/2 + 7 = 11$	11	Yes

$$\therefore x = 8$$

$$(ix) 2y + 4 = 3y$$

We try several values of y until we get the L.H.S. equal to the R.H.S.

y	L.H.S.	R.H.S.	Is L.H.S. = R.H.S.?
1	$2 \times 1 + 4 = 6$	$3 \times 1 = 3$	No
2	$2 \times 2 + 4 = 8$	$3 \times 2 = 6$	No
3	$2 \times 3 + 4 = 10$	$3 \times 3 = 9$	No
4	$2 \times 4 + 4 = 12$	$3 \times 4 = 12$	Yes

$$\therefore y = 4$$

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

We try several values of z till we get the L.H.S. equal to the R.H.S.

z	L.H.S.	R.H.S.	Is L.H.S. = R.H.S.?
1	$1 - 3 = -2$	$2 \times 1 - 5 = -3$	No
2	$2 - 3 = -1$	$2 \times 2 - 5 = -1$	Yes

$$\therefore z = 2$$

Linear Equation In One Variable

Ex 9B

Q1

Answer :

$$x + 5 = 12$$

Subtracting 5 from both the sides:

$$\Rightarrow x + 5 - 5 = 12 - 5$$

$$\Rightarrow x = 7$$

Verification:

Substituting $x = 7$ in the L.H.S.:

$$\Rightarrow 7 + 5 = 12 = \text{R.H.S.}$$

L.H.S. = R.H.S.

Hence, verified.

Q2

Answer :

$$x + 3 = -2$$

Subtracting 3 from both the sides:

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

$$\Rightarrow x = -5$$

Verification:

Substituting $x = -5$ in the L.H.S.:

$$\Rightarrow -5 + 3 = -2 = \text{R.H.S.}$$

L.H.S. = R.H.S.

Hence, verified.

Q3

Answer :

$$x - 7 = 6$$

Adding 7 on both the sides:

$$\Rightarrow x - 7 + 7 = 6 + 7$$

$$\Rightarrow x = 13$$

Verification:

Substituting $x = 13$ in the L.H.S.:

$$\Rightarrow 13 - 7 = 6 = \text{R.H.S.}$$

L.H.S. = R.H.S.

Hence, verified.

Q4

Answer :

$$x - 2 = -5$$

Adding 2 on both sides:

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

$$\Rightarrow x = -3$$

Verification:

Substituting $x = -3$ in the L.H.S.:

$$\Rightarrow -3 - 2 = -5 = \text{R.H.S.}$$

L.H.S. = R.H.S.

Hence, verified.

Q5

Answer :

$$3x - 5 = 13$$

$$\Rightarrow 3x - 5 + 5 = 13 + 5 \quad [\text{Adding 5 on both the sides}]$$

$$\Rightarrow 3x = 18$$

$$\Rightarrow \frac{3x}{3} = \frac{18}{3} \quad [\text{Dividing both the sides by 3}]$$

$$\Rightarrow x = 6$$

Verification:

Substituting $x = 6$ in the L.H.S.:

$$\Rightarrow 3 \times 6 - 5 = 18 - 5 = 13 = \text{R.H.S.}$$

L.H.S. = R.H.S.

Hence, verified.

Q6

Answer :

$$4x + 7 = 15$$

$$\Rightarrow 4x + 7 - 7 = 15 - 7 \quad [\text{Subtracting 7 from both the sides}]$$

$$\Rightarrow 4x = 8$$

$$\Rightarrow \frac{4x}{4} = \frac{8}{4} \quad [\text{Dividing both the sides by 4}]$$

$$\Rightarrow x = 2$$

Verification:

Substituting $x = 2$ in the L.H.S.:

$$\Rightarrow 4 \times 2 + 7 = 8 + 7 = 15 = \text{R.H.S.}$$

L.H.S. = R.H.S.

Hence, verified.

Q7

Answer :

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

$$\Rightarrow \frac{x}{5} \times 5 = 12 \times 5 \quad [\text{Multiplying both the sides by 5}]$$

$$\Rightarrow x = 60$$

Verification:

Substituting $x = 60$ in the L.H.S.:

$$\Rightarrow \frac{60}{5} = 12 = \text{R.H.S.}$$

L.H.S. = R.H.S.

Hence, verified.

Q8

Answer :

$$\begin{aligned}\frac{3x}{5} &= 15 \\ \Rightarrow \frac{3x}{5} \times 5 &= 15 \times 5 && \text{[Multiplying both the sides by 5]} \\ \Rightarrow 3x &= 75 \\ \Rightarrow \frac{3x}{3} &= \frac{75}{3} \\ \Rightarrow x &= 25\end{aligned}$$

Verification:

Substituting $x = 25$ in the L.H.S.:

$$\begin{aligned}\Rightarrow \frac{3 \times 25}{5} &= 15 = \text{R.H.S.} \\ \Rightarrow \text{L.H.S.} &= \text{R.H.S.} \\ \text{Hence, verified.}\end{aligned}$$

Q9

Answer :

$$\begin{aligned}5x - 3 &= x + 17 \\ \Rightarrow 5x - x &= 17 + 3 && \text{[Transposing } x \text{ to the L.H.S. and } 3 \text{ to the R.H.S.]} \\ \Rightarrow 4x &= 20 \\ \Rightarrow \frac{4x}{4} &= \frac{20}{4} && \text{[Dividing both the sides by 4]} \\ \Rightarrow x &= 5\end{aligned}$$

Verification:

Substituting $x = 5$ on both the sides:

$$\begin{aligned}\text{L.H.S.: } &5(5) - 3 \\ \Rightarrow &25 - 3 \\ \Rightarrow &22\end{aligned}$$

$$\begin{aligned}\text{R.H.S.: } &5 + 17 = 22 \\ \Rightarrow \text{L.H.S.} &= \text{R.H.S.} \\ \text{Hence, verified.}\end{aligned}$$

Q10

Answer :

$$\begin{aligned}2x - \frac{1}{2} &= 3 \\ \Rightarrow 2x - \frac{1}{2} + \frac{1}{2} &= 3 + \frac{1}{2} && \text{[Adding } \frac{1}{2} \text{ on both the sides]} \\ \Rightarrow 2x &= \frac{6+1}{2} \\ \Rightarrow 2x &= \frac{7}{2} \\ \Rightarrow \frac{2x}{2} &= \frac{7}{2 \times 2} && \text{[Dividing both the sides by 2]} \\ \Rightarrow x &= \frac{7}{4}\end{aligned}$$

Verification:

Substituting $x = \frac{7}{4}$ in the L.H.S.:

$$\begin{aligned}2\left(\frac{7}{4}\right) - \frac{1}{2} \\ = \frac{7}{2} - \frac{1}{2} = \frac{6}{2} = 3 = \text{R.H.S.}\end{aligned}$$

L.H.S. = R.H.S.
Hence, verified.

Q11

Answer :

$$\begin{aligned}3(x + 6) &= 24 \\ \Rightarrow 3 \times x + 3 \times 6 &= 24 && \text{[On expanding the brackets]} \\ \Rightarrow 3x + 18 &= 24 \\ \Rightarrow 3x + 18 - 18 &= 24 - 18 && \text{[Subtracting 18 from both the sides]} \\ \Rightarrow 3x &= 6 \\ \Rightarrow \frac{3x}{3} &= \frac{6}{3} && \text{[Dividing both the sides by 3]} \\ \Rightarrow x &= 2\end{aligned}$$

Verification:

Substituting $x = 2$ in the L.H.S.:

$$\begin{aligned}3(2 + 6) &= 3 \times 8 = 24 = \text{R.H.S.} \\ \text{L.H.S.} &= \text{R.H.S.} \\ \text{Hence, verified.}\end{aligned}$$

Q12

Answer :

$$6x + 5 = 2x + 17$$

$$\Rightarrow 6x - 2x = 17 - 5$$

[Transposing $2x$ to the L.H.S. and 5 to the R.H.S.]

$$\Rightarrow 4x = 12$$

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

[Dividing both the sides by 4]

$$\Rightarrow x = 3$$

Verification:

Substituting $x = 3$ on both the sides:

$$\text{L.H.S.: } 6(3) + 5$$

$$= 18 + 5$$

$$= 23$$

$$\text{R.H.S.: } 2(3) + 17$$

$$= 6 + 17$$

$$= 23$$

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

Hence, verified.

Q13

Answer :

$$\frac{x}{4} - 8 = 1$$

$$\Rightarrow \frac{x}{4} - 8 + 8 = 1 + 8$$

[Adding 8 on both the sides]

$$\Rightarrow \frac{x}{4} = 9$$

$$\Rightarrow \frac{x}{4} \times 4 = 9 \times 4$$

[Multiplying both the sides by 4]

$$\text{or, } x = 36$$

Verification:

Substituting $x = 36$ in the L.H.S.:

$$\text{or, } \frac{36}{4} - 8 = 9 - 8 = 1 = \text{R.H.S.}$$

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

Hence, verified.

Q14

Answer :

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

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

[Transposing $\frac{x}{3}$ to the L.H.S.]

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

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

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

[Multiplying both the sides by 6]

$$\text{or, } x = 6$$

Verification:

Substituting $x = 6$ on both the sides:

$$\text{L.H.S.: } \frac{6}{2} = 3$$

$$\text{R.H.S.: } \frac{6}{3} + 1 = 2 + 1 = 3$$

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

Hence, verified.

Q15

Answer :

$$3(x + 2) - 2(x - 1) = 7$$

$$\Rightarrow 3 \times x + 3 \times 2 - 2 \times x - 2 \times (-1) = 7$$

[On expanding the brackets]

$$\text{or, } 3x + 6 - 2x + 2 = 7$$

$$\text{or, } x + 8 = 7$$

$$\text{or, } x + 8 - 8 = 7 - 8$$

[Subtracting 8 from both the sides]

$$\text{or, } x = -1$$

Verification:

Substituting $x = -1$ in the L.H.S.:

$$3(-1 + 2) - 2(-1 - 1)$$

$$\text{or, } 3(1) - 2(-2)$$

$$\text{or, } 3 + 4 = 7 = \text{R.H.S.}$$

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

Hence, verified.

Q16

Answer :

$$\begin{aligned}5(x-1) + 2(x+3) + 6 &= 0 \\ \Rightarrow 5x - 5 + 2x + 6 + 6 &= 0 && \text{(Expanding within the brackets)} \\ \Rightarrow 7x + 7 &= 0 \\ \Rightarrow x + 1 &= 0 && \text{(Dividing by 7)} \\ \Rightarrow x &= -1\end{aligned}$$

Verification:

Putting $x = -1$ in the L.H.S.:

$$\begin{aligned}\text{L.H.S.: } 5(-1 - 1) + 2(-1 + 3) + 6 \\ &= 5(-2) + 2(2) + 6 \\ &= -10 + 4 + 6 = 0 = \text{R.H.S.}\end{aligned}$$

Hence, verified.

Q17

Answer :

$$\begin{aligned}6(1 - 4x) + 7(2 + 5x) &= 53 \\ \text{or, } 6 \times 1 - 6 \times 4x + 7 \times 2 + 7 \times 5x &= 53 && \text{[On expanding the brackets]} \\ \text{or, } 6 - 24x + 14 + 35x &= 53 \\ \text{or, } 11x + 20 &= 53 \\ \text{or, } 11x + 20 - 20 &= 53 - 20 && \text{[Subtracting 20 from both the sides]} \\ \text{or, } 11x &= 33 \\ \text{or, } \frac{11x}{11} &= \frac{33}{11} && \text{[Dividing both the sides by 11]} \\ \text{or, } x &= 3\end{aligned}$$

Verification:

Substituting $x = 3$ in the L.H.S.:

$$\begin{aligned}6(1 - 4 \times 3) + 7(2 + 5 \times 3) \\ \Rightarrow 6(1 - 12) + 7(2 + 15) \\ \Rightarrow 6(-11) + 7(17) \\ \Rightarrow -66 + 119 = 53 = \text{R.H.S.}\end{aligned}$$

L.H.S. = R.H.S.

Hence, verified.

Q18

Answer :

$$\begin{aligned}16(3x - 5) - 10(4x - 8) &= 40 \\ \text{or, } 16 \times 3x - 16 \times 5 - 10 \times 4x - 10 \times (-8) &= 40 && \text{[On expanding the brackets]} \\ \text{or, } 48x - 80 - 40x + 80 &= 40 \\ \text{or, } 8x &= 40 \\ \text{or, } \frac{8x}{8} &= \frac{40}{8} && \text{[Dividing both the sides by 8]} \\ \text{or, } x &= 5\end{aligned}$$

Verification:

Substituting $x = 5$ in the L.H.S.:

$$\begin{aligned}16(3 \times 5 - 5) - 10(4 \times 5 - 8) \\ \Rightarrow 16(15 - 5) - 10(20 - 8) \\ \Rightarrow 16(10) - 10(12) \\ \Rightarrow 160 - 120 = 40 = \text{R.H.S.}\end{aligned}$$

L.H.S. = R.H.S.

Hence, verified.

Q19

Answer :

$$3(x + 6) + 2(x + 3) = 64$$

$$\Rightarrow 3 \times x + 3 \times 6 + 2 \times x + 2 \times 3 = 64 \quad \text{[On expanding the brackets]}$$

$$\Rightarrow 3x + 18 + 2x + 6 = 64$$

$$\Rightarrow 5x + 24 = 64$$

$$\Rightarrow 5x + 24 - 24 = 64 - 24 \quad \text{[Subtracting 24 from both the sides]}$$

$$\Rightarrow 5x = 40$$

$$\Rightarrow \frac{5x}{5} = \frac{40}{5} \quad \text{[Dividing both the sides by 5]}$$

$$\Rightarrow x = 8$$

Verification:

Substituting $x = 8$ in the L.H.S.:

$$3(8 + 6) + 2(8 + 3)$$

$$3(14) + 2(11)$$

$$42 + 22 = 64 = \text{R.H.S.}$$

L.H.S. = R.H.S.

Hence, verified.

Q20

Answer :

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

$$\text{or, } 3 \times 2 + 3 \times (-5x) - 2 \times 1 - 2 \times (-6x) = 1 \quad \text{[On expanding the brackets]}$$

$$\text{or, } 6 - 15x - 2 + 12x = 1$$

$$\text{or, } 4 - 3x = 1$$

$$\text{or, } 3 = -3x$$

$$\text{or, } x = 1$$

Verification:

Substituting $x = 1$ in the L.H.S.:

$$3(2 - 5 \times 1) - 2(1 - 6 \times 1)$$

$$\Rightarrow 3(2 - 5) - 2(1 - 6)$$

$$\Rightarrow 3(-3) - 2(-5)$$

$$\Rightarrow -9 + 10 = 1 = \text{R.H.S.}$$

L.H.S. = R.H.S.

Hence, verified.

Q21

Answer :

$$\frac{n}{4} - 5 = \frac{n}{6} + \frac{1}{2}$$

$$\text{or, } \frac{n}{4} - \frac{n}{6} = \frac{1}{2} + 5$$

[Transposing $n/6$ to the L.H.S. and 5 to the R.H.S.]

$$\text{or, } \frac{3n-2n}{12} = \frac{1+10}{2}$$

$$\text{or, } \frac{n}{12} = \frac{11}{2}$$

$$\text{or, } \frac{n}{12} \times 12 = \frac{11}{2} \times 12$$

[Dividing both the sides by 12]

$$\text{or, } n = 66$$

Verification:

Substituting $n = 66$ on both the sides:

L.H.S.:

$$\frac{66}{4} - 5 = \frac{33}{2} - 5 = \frac{33-10}{2} = \frac{23}{2} = \frac{23}{2} \quad \text{R.H.S.: } \frac{66}{6} + \frac{1}{2} = 11 + \frac{1}{2} = \frac{22+1}{2} = \frac{23}{2}$$

L.H.S. = R.H.S.

Hence, verified.

Q22

Answer :

$$\frac{2m}{3} + 8 = \frac{m}{2} - 1$$

$$\text{or, } \frac{2m}{3} - \frac{m}{2} = -1 - 8 \quad [\text{Transposing } m/2 \text{ to the L.H.S. and } 8 \text{ to the R.H.S.}]$$

$$\text{or, } \frac{4m-3m}{6} = -9$$

$$\text{or, } \frac{m}{6} = -9$$

$$\text{or, } \frac{m}{6} \times 6 = -9 \times 6 \quad [\text{Multiplying both the sides by } 6]$$

$$\text{or, } m = -54$$

Verification:

Substituting $x = -54$ on both the sides:

L.H.S.:

$$\frac{2(-54)}{3} + 8 = \frac{-54}{2} - 1$$

$$= \frac{-108}{3} + 8$$

$$= -36 + 8$$

$$= -28$$

R.H.S.:

$$\frac{-54}{2} - 1$$

$$= -27 - 1$$

$$= -28$$

L.H.S. = R.H.S.

Hence, verified.

Q23

Answer :

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

$$\text{or, } \frac{2x}{5} - \frac{x}{2} = 1 + \frac{3}{2} \quad [\text{Transposing } x/2 \text{ to the L.H.S. and } 3/2 \text{ to R.H.S.}]$$

$$\text{or, } \frac{4x-5x}{10} = \frac{2+3}{2}$$

$$\text{or, } \frac{-x}{10} = \frac{5}{2}$$

$$\text{or, } \frac{-x}{10} (-10) = \frac{5}{2} \times (-10) \quad [\text{Multiplying both the sides by } -10]$$

$$\text{or, } x = -25$$

Verification:

Substituting $x = -25$ on both the sides:

$$\text{L.H.S. : } \frac{2(-25)}{5} - \frac{3}{2}$$

$$= \frac{-50}{5} - \frac{3}{2}$$

$$= -10 - \frac{3}{2} = \frac{-23}{2}$$

$$\text{R.H.S. : } \frac{-25}{2} + 1 = \frac{-25+2}{2} = \frac{-23}{2}$$

L.H.S. = R.H.S.

Hence, verified.

Q24

Answer :

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

$$\text{or, } \frac{x}{5} - \frac{3}{5} - 2 = \frac{2x}{5}$$

$$\text{or, } -\frac{3}{5} - 2 = \frac{2x}{5} - \frac{x}{5} \quad [\text{Transposing } x/5 \text{ to the R.H.S.}]$$

$$\text{or, } \frac{-3-10}{5} = \frac{x}{5}$$

$$\text{or, } \frac{-13}{5} = \frac{x}{5}$$

$$\text{or, } \frac{-13}{5} (5) = \frac{x}{5} \times (5) \quad [\text{Multiplying both the sides by } 5]$$

$$\text{or, } x = -13$$

Verification:

Substituting $x = -13$ on both the sides:

$$\text{L.H.S. : } \frac{-13-3}{5} - 2$$

$$= \frac{-16}{5} - 2 = \frac{-16-10}{5} = \frac{-26}{5} \quad \text{R.H.S. : } \frac{2 \times (-13)}{5} = \frac{-26}{5}$$

L.H.S. = R.H.S.

Hence, verified.

Q25

Answer :

$$\frac{3x}{10} - 4 = 14$$

$$\text{or, } \frac{3x}{10} - 4 + 4 = 14 + 4 \quad [\text{Adding 4 on both the sides}]$$

$$\text{or, } \frac{3x}{10} = 18$$

$$\text{or, } \frac{3x}{10} \times 10 = 18 \times 10 \quad [\text{Multiplying both the sides by 10}]$$

$$\text{or, } 3x = 180$$

$$\text{or, } \frac{3x}{3} = \frac{180}{3} \quad [\text{Dividing both the sides by 3}]$$

$$\text{or, } x = 60$$

Verification:

Substituting $x = 60$ on both the sides:

$$\begin{aligned} \frac{3 \times 60}{10} - 4 \\ = \frac{180}{10} - 4 = 18 - 4 = 14 = \text{R.H.S.} \end{aligned}$$

L.H.S. = R.H.S.

Hence, verified.

Q26

Answer :

$$\frac{3}{4}(x-1) = x-3$$

$$\Rightarrow \frac{3}{4} \times x - \frac{3}{4} \times 1 = x - 3 \quad [\text{On expanding the brackets}]$$

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

$$\Rightarrow \frac{3x}{4} - x = -3 + \frac{3}{4} \quad [\text{Transposing } x \text{ to the L.H.S. and } -\frac{3}{4} \text{ to the R.H.S.}]$$

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

$$\Rightarrow \frac{-x}{4} = \frac{-9}{4}$$

$$\Rightarrow \frac{-x}{4} \times (-4) = \frac{-9}{4} \times (-4) \quad [\text{Multiplying both the sides by } -4]$$

$$\text{or, } x = 9$$

Verification:

Substituting $x = 9$ on both the sides:

$$\text{L.H.S. : } \frac{3}{4}(9-1)$$

$$= \frac{3}{4}(8)$$

$$= 6$$

$$\text{R.H.S.: } 9 - 3 = 6$$

L.H.S. = R.H.S.

Hence, verified.

Linear Equation In One Variable

Ex 9C

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.

$$x + 7 = 12$$

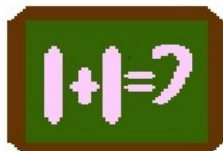
Equation is a mathematical sentence indicating that two expressions are equal. The symbol "=" is used to indicate equality.

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

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

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:

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

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

$$2x + 3 = 13$$

$$2x = 10$$

$$x = 5$$

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

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 $3x - 8 = 19$

$$3x - 8 = 19$$

$$3x = 27$$

$$x = 9$$

$$+ 8$$

$$\div 3$$

Q3

Answer :

Let the required number be x .

According to the question:

$$\text{or, } 5x = x + 80$$

$$\text{or, } 5x - x = 80 \quad [\text{Transposing } x \text{ to the L.H.S.}]$$

$$\text{or, } 4x = 80$$

$$\text{or, } \frac{4x}{4} = \frac{80}{4} \quad [\text{Dividing both the sides by } 4]$$

$$\text{or, } x = 20$$

Thus, the required number is 20.

Q4

Answer :

Let the three consecutive natural numbers be x , $(x+1)$, $(x+2)$.

According to the question:

$$x + (x + 1) + (x + 2) = 114$$

$$\text{or, } x + x + 1 + x + 2 = 114$$

$$\text{or, } 3x + 3 = 114$$

$$\text{or, } 3x + 3 - 3 = 114 - 3 \quad [\text{Subtracting } 3 \text{ from both the sides}]$$

$$\text{or, } 3x = 111$$

$$\text{or, } \frac{3x}{3} = \frac{111}{3} \quad [\text{Dividing both the sides by } 3]$$

$$\text{or, } x = 37$$

Required numbers are:

$$x = 37$$

$$\text{or, } x + 1 = 37 + 1 = 38$$

$$\text{or, } x + 2 = 37 + 2 = 39$$

Thus, the required numbers are 37, 38 and 39.

Q5

Answer :

Let the required number be x .

When Raju multiplies it with 17, the number becomes $17x$.

According to the question :

$$17x + 4 = 225$$

$$\text{or, } 17x + 4 - 4 = 225 - 4 \quad [\text{Subtracting } 4 \text{ from both the sides}]$$

$$\text{or, } 17x = 221$$

$$\text{or, } \frac{17x}{17} = \frac{221}{17} \quad [\text{Dividing both the sides by } 17]$$

$$\text{or, } x = 13$$

Thus, the required number is 13.

Q6

Answer :

Let the required number be x .

According to the question, the number is tripled and 5 is added to it

$$\therefore 3x + 5$$

$$\text{or, } 3x + 5 = 50$$

$$\text{or, } 3x + 5 - 5 = 50 - 5 \quad [\text{Subtracting 5 from both the sides}]$$

$$\text{or, } 3x = 45$$

$$\text{or, } \frac{3x}{3} = \frac{45}{3} \quad [\text{Dividing both the sides by 3}]$$

$$\text{or, } x = 15$$

Thus, the required number is 15.

Q7

Answer :

Let one of the number be x .

$$\therefore \text{The other number} = (x + 18)$$

According to the question:

$$x + (x + 18) = 92$$

$$\text{or, } 2x + 18 - 18 = 92 - 18 \quad [\text{Subtracting 18 from both the sides}]$$

$$\text{or, } 2x = 74$$

$$\text{or, } \frac{2x}{2} = \frac{74}{2} \quad [\text{Dividing both the sides by 2}]$$

$$\text{or, } x = 37$$

Required numbers are:

$$x = \mathbf{37}$$

$$\text{or, } x + 18 = 37 + 18 = \mathbf{55}$$

Q8

Answer :

Let one of the number be ' x '

$$\therefore \text{Second number} = 3x$$

According to the question:

$$x + 3x = 124$$

$$\text{or, } 4x = 124$$

$$\text{or, } \frac{4x}{4} = \frac{124}{4} \quad [\text{Dividing both the sides by 4}]$$

$$\text{or, } x = 31$$

Thus, the required number is $x = \mathbf{31}$ and $3x = 3 \times 31 = \mathbf{93}$.

Q9

Answer :

Let one of the number be x .

$$\therefore \text{Second number} = 5x$$

According to the question:

$$5x - x = 132$$

$$\text{or, } 4x = 132$$

$$\text{or, } \frac{4x}{4} = \frac{132}{4} \quad [\text{Dividing both the sides by 4}]$$

$$\text{or, } x = 33$$

Thus, the required numbers are $x = \mathbf{33}$ and $5x = 5 \times 33 = \mathbf{165}$.

Q10

Answer :

Let one of the even number be x .

Then, the other consecutive even number is $(x + 2)$.

According to the question:

$$x + (x + 2) = 74$$

$$\text{or, } 2x + 2 = 74$$

$$\text{or, } 2x + 2 - 2 = 74 - 2 \quad [\text{Subtracting 2 from both the sides}]$$

$$\text{or, } 2x = 72$$

$$\text{or, } \frac{2x}{2} = \frac{72}{2} \quad [\text{Dividing both the sides by 2}]$$

$$\text{or, } x = 36$$

Thus, the required numbers are $x = \mathbf{36}$ and $x + 2 = \mathbf{38}$.

Q11

Answer :

Let the first odd number be x .

Then, the next consecutive odd numbers will be $(x + 2)$ and $(x + 4)$.

According to the question:

$$x + (x + 2) + (x + 4) = 21$$

$$\text{or, } 3x + 6 = 21$$

$$\text{or, } 3x + 6 - 6 = 21 - 6 \quad [\text{Subtracting 6 from both the sides}]$$

$$\text{or, } 3x = 15$$

$$\text{or, } \frac{3x}{3} = \frac{15}{3} \quad [\text{Dividing both the sides by 3}]$$

$$\text{or, } x = 5$$

\therefore Required numbers are:

$$x = \mathbf{5}$$

$$x + 2 = 5 + 2 = \mathbf{7}$$

$$x + 4 = 5 + 4 = \mathbf{9}$$

Q12

Answer :

Let the present age of Ajay be x years.

Since Reena is 6 years older than Ajay, the present age of Reena will be $(x + 6)$ years.

According to the question:

$$x + (x + 6) = 28$$

$$\text{or, } 2x + 6 = 28$$

$$\text{or, } 2x + 6 - 6 = 28 - 6 \quad [\text{Subtracting 6 from both the sides}]$$

$$\text{or, } 2x = 22$$

$$\text{or, } \frac{2x}{2} = \frac{22}{2} \quad [\text{Dividing both the sides by 2}]$$

$$\text{or, } x = 11$$

\therefore Present age of Ajay = **11 years**

$$\text{Present age of Reena} = x + 6 = 11 + 6$$

$$= \mathbf{17 \text{ years}}$$

Q13

Answer :

Let the present age of Vikas be x years.

Since Deepak is twice as old as Vikas, the present age of Deepak will be $2x$ years.

According to the question:

$$2x - x = 11$$

$$x = 11$$

\therefore Present age of Vikas = **11 years**

$$\text{Present age of Deepak} = 2x = 2 \times 11$$

$$= \mathbf{22 \text{ years}}$$

Q14

Answer :

Let the present age of Rekha be x years.

As Mrs. Goel is 27 years older than Rekha, the present age of Mrs. Goel will be $(x + 27)$ years.

After 8 years:

Rekha's age = $(x + 8)$ years

Mrs. Goel's age = $(x + 27 + 8)$
= $(x + 35)$ years

According to the question:

$$(x + 35) = 2(x + 8)$$

$$\text{or, } x + 35 = 2 \times x + 2 \times 8 \quad [\text{On expanding the brackets}]$$

$$\text{or, } x + 35 = 2x + 16$$

$$\text{or, } 35 - 16 = 2x - x \quad [\text{Transposing 16 to the L.H.S. and } x \text{ to the R.H.S.}]$$

$$\text{or, } x = 19$$

\therefore Present age of Rekha = **19 years**

Present age of Mrs. Goel = $x + 27$
= $19 + 27$
= **46 years**

Q15

Answer :

Let the present age of the son be x years.

As the man is 4 times as old as his son, the present age of the man will be $(4x)$ years.

After 16 years:

Son's age = $(x + 16)$ years

Man's age = $(4x + 16)$ years

According to the question:

$$(4x + 16) = 2(x + 16)$$

$$\text{or, } 4x + 16 = 2 \times x + 2 \times 16 \quad [\text{On expanding the brackets}]$$

$$\text{or, } 4x + 16 = 2x + 32$$

$$\text{or, } 4x - 2x = 32 - 16 \quad [\text{Transposing 16 to the R.H.S. and } 2x \text{ to the L.H.S.}]$$

$$\text{or, } 2x = 16$$

$$\text{or, } \frac{2x}{2} = \frac{16}{2} \quad [\text{Dividing both the sides by 2}]$$

$$\text{or, } x = 8$$

\therefore Present age of the son = **8 years**

Present age of the man = $4x = 4 \times 8$
= **32 years**

Q16

Answer :

Let the present age of the son be x years.

As the man is 3 times as old as his son, the present age of the man will be $(3x)$ years.

5 years ago:

Son's age = $(x - 5)$ years

Man's age = $(3x - 5)$ years

According to the question:

$$(3x - 5) = 4(x - 5)$$

$$\text{or, } 3x - 5 = 4x - 20 \quad [\text{On expanding the brackets}]$$

$$\text{or, } 3x - 5 = 4x - 20$$

$$\text{or, } 20 - 5 = 4x - 3x \quad [\text{Transposing } 3x \text{ to the R.H.S. and } 20 \text{ to the L.H.S.}]$$

$$\text{or, } x = 15$$

\therefore Present age of the son = **15 years**

$$\begin{aligned} \text{Present age of the man} &= 3x = 3 \times 15 \\ &= \mathbf{45 \text{ years}} \end{aligned}$$

Q17

Answer :

Let the present age of Fatima be x years.

After 16 years:

Fatima's age = $(x + 16)$ years

According to the question:

$$x + 16 = 3(x)$$

$$\text{or, } 16 = 3x - x \quad [\text{Transposing } x \text{ to the R.H.S.}]$$

$$\text{or, } 16 = 2x$$

$$\text{or, } \frac{2x}{2} = \frac{16}{2} \quad [\text{Dividing both the sides by } 2]$$

$$\text{or, } x = 8$$

\therefore Present age of Fatima = 8 years

Q18

Answer :

Let the present age of Rahim be x years.

After 32 years:

Rahim's age = $(x + 32)$ years

8 years ago:

Rahim's age = $(x - 8)$ years

According to the question:

$$x + 32 = 5(x - 8)$$

$$\text{or, } x + 32 = 5x - 5 \times 8$$

$$\text{or, } x + 32 = 5x - 40$$

$$\text{or, } 40 + 32 = 5x - x \quad [\text{Transposing 'x' to the R.H.S. and } 40 \text{ to the L.H.S.}]$$

$$\text{or, } 72 = 4x$$

$$\text{or, } \frac{4x}{4} = \frac{72}{4} \quad [\text{Dividing both the sides by } 4]$$

$$\text{or, } x = 18$$

Thus, the present age of Rahim is 18 years.

Q19

Answer :

Let the number of 50 paise coins be x .

Then, the number of 25 paise coins will be $4x$.

According to the question:

$$0.50(x) + 0.25(4x) = 30$$

$$\text{or, } 0.5x + x = 30$$

$$\text{or, } 1.5x = 30$$

$$\text{or, } \frac{1.5x}{1.5} = \frac{30}{1.5} \quad [\text{Dividing both the sides by } 1.5]$$

$$\text{or, } x = 20$$

Thus, the number of 50 paise coins is 20.

$$\text{Number of 25 paise coins} = 4x = 4 \times 20 = 80$$

Q20

Answer :

Let the price of one pen be Rs x.

According to the question:

$$5x = 3x + 17$$

$$\text{or, } 5x - 3x = 17 \quad [\text{Transposing } 3x \text{ to the L.H.S.}]$$

$$\text{or, } 2x = 17$$

$$\text{or, } \frac{2x}{2} = \frac{17}{2} \quad [\text{Dividing both the sides by } 2]$$

$$\text{or, } x = 8.50$$

\therefore Price of one pen = Rs 8.50

Q21

Answer :

Let the number of girls in the school be x.

Then, the number of boys in the school will be (x + 334).

Total strength of the school = 572

$$\therefore x + (x + 334) = 572$$

$$\text{or, } 2x + 334 = 572$$

$$\text{or, } 2x + 334 - 334 = 572 - 334 \quad \{\text{Subtracting } 334 \text{ from both the sides}\}$$

$$\text{or, } 2x = 238$$

$$\text{or, } \frac{2x}{2} = \frac{238}{2} \quad [\text{Dividing both the sides by } 2]$$

$$\text{or, } x = 119$$

\therefore Number of girls in the school = 119

Q22

Answer :

Let the breadth of the park be x metres.

Then, the length of the park will be 3x metres.

Perimeter of the park = 2 (Length + Breadth) = 2 (3x + x) m

Given perimeter = 168 m

$$\therefore 2(3x + x) = 168$$

$$\text{or, } 2 (4x) = 168$$

$$\text{or, } 8x = 168 \quad [\text{On expanding the brackets}]$$

$$\text{or, } \frac{8x}{8} = \frac{168}{8} \quad [\text{Dividing both the sides by } 8]$$

$$\text{or, } x = 21 \text{ m}$$

\therefore Breadth of the park = x = **21 m**

Length of the park = 3x = 3 \times 21 = **63 m**

Q23

Answer :

Let the breadth of the hall be x metres.

Then, the length of the hall will be (x + 5) metres.

Perimeter of the hall = 2(Length + Breadth) = 2(x + 5 + x) metres

Given perimeter of the rectangular hall = 74 metres

$$\therefore 2(x + 5 + x) = 74$$

$$\text{or, } 2 (2x + 5) = 74$$

$$\text{or, } 2 \times 2x + 2 \times 5 = 74 \quad [\text{On expanding the brackets}]$$

$$\text{or, } 4x + 10 = 74$$

$$\text{or, } 4x + 10 - 10 = 74 - 10 \quad [\text{Subtracting } 10 \text{ from both the sides}]$$

$$\text{or, } 4x = 64$$

$$\text{or, } \frac{4x}{4} = \frac{64}{4} \quad [\text{Dividing both the sides by } 4]$$

$$\text{or, } x = 16 \text{ metres}$$

\therefore Breadth of the park = x

$$= \mathbf{16 \text{ metres}}$$

Length of the park = x + 5 = 16 + 5

$$= \mathbf{21 \text{ metres}}$$

Q24

Answer :

Let the breadth of the rectangle be x cm.

Then, the length of the rectangle will be $(x + 7)$ cm.

Perimeter of the rectangle = $2(\text{Length} + \text{Breadth}) = 2(x + 7 + x)$ cm

Given perimeter of the rectangle = Length of the wire = 86 cm

$$\therefore 2(x + 7 + x) = 86$$

$$\text{or, } 2(2x + 7) = 86$$

$$\text{or, } 2 \times 2x + 2 \times 7 = 86$$

[On expanding the brackets]

$$\text{or, } 4x + 14 = 86$$

$$\text{or, } 4x + 14 - 14 = 86 - 14$$

[Subtracting 14 from both the sides]

$$\text{or, } 4x = 72$$

$$\text{or, } \frac{4x}{4} = \frac{72}{4}$$

[Dividing by 4 on both the sides]

$$\text{or, } x = 18 \text{ metres}$$

Breadth of the hall = x

$$= \mathbf{18 \text{ metres}}$$

Length of the hall = $x + 7$

$$= 18 + 7$$

$$= \mathbf{25 \text{ metres}}$$