

## 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.

$$x + 7 = 12$$

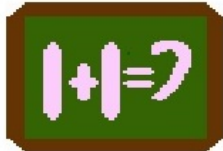
**Equation** is a mathematical sentence indicating that two expressions are equal. The symbol "=" is used to indicate equality.

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

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

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:  $x \times 2 \rightarrow + 3 = 13$

To solve, we reverse the process:

$$\begin{array}{rcl}
 x \times 2 \rightarrow + 3 & 13 \\
 x \div 2 \leftarrow - 3 & 13 \\
 2x + 3 = 13 & | & - 3 \\
 2x = 10 & & \div 2 \\
 x = 5 & & 
 \end{array}$$

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  $4x + 6 = 14$

$$\begin{array}{rcl}
 4x + 6 = 14 & | & - 6 \\
 4x = 8 & & \div 4 \\
 x = 2 & & 
 \end{array}$$

Solve  $3x - 8 = 19$

$$\begin{array}{rcl}
 3x - 8 = 19 & | & + 8 \\
 3x = 27 & & \div 3 \\
 x = 9 & & 
 \end{array}$$

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 :**

- Q3

**Answer :**

(ii)

(iii)

(iv)

(v)

Q4

**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 of x which are multiples of '2'.

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 until 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.:

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

$\Rightarrow$  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 :**

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

Verification:

Substituting  $x = 5$  on both the sides:

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

$$\text{R.H.S.: } 5 + 17 = 22$$

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

Hence, verified.

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.:

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

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

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.:

$$3(2 + 6) = 3 \times 8 = 24 = \text{R.H.S.}$$

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

Hence, verified.

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.:

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

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

$$42 + 22 = 64 = R.H.S.$$

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.:

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

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

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

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

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.:

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

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

Hence, verified.

Q22

**Answer :**

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

$$\text{or, } \frac{2m}{3} - \frac{m}{2} = -1 - 8$$

[Transposing  $m/2$  to the L.H.S. and 8 to the R.H.S.]

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

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

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

[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 :**

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

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

[Transposing  $x/2$  to the L.H.S. and  $3/2$  to R.H.S.]

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

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

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

[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 :**

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

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

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

[Transposing  $x/5$  to the R.H.S.]

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

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

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

[Multiplying both the sides by 5]

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

Verification:

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

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

$$= \frac{-16}{5} - 2 = \frac{-16-10}{5} = \frac{-26}{5}$$

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

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:

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

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:

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

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

$$= 6$$

$$R.H.S.: 9 - 3 = 6$$

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.

$$x + 7 = 12$$

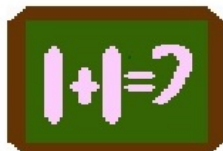
**Equation** is a mathematical sentence indicating that two expressions are equal. The symbol "=" is used to indicate equality.

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

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

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  $3x - 8 = 19$

$$3x - 8 = 19$$

$$3x = 27$$

$$x = 9$$

$$+ 8$$

$$\div 3$$

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:

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

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

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

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

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

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

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

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 :

$$17x + 4 = 225$$

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

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

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

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

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:

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

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

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

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

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

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

Present age of the man =  $3x = 3 \times 15$   
**= 45 years**

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.

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:

$$5x = 3x + 17$$

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

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

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

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

$$\therefore \text{Price of one pen} = \text{Rs } 8.50$$

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

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

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

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

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

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

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

$$\therefore \text{Number of girls in the school} = 119$$

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

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

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

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

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

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

$$\therefore \text{Breadth of the park} = x = \mathbf{21 \text{ m}}$$

$$\text{Length of the park} = 3x = 3 \times 21 = \mathbf{63 \text{ m}}$$

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

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

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

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

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

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

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

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

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

$$\therefore \text{Breadth of the park} = x$$

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

$$\text{Length of the park} = x + 5 = 16 + 5$$

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

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 =  $x + 7$

$$= 18 + 7$$

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