SIMPLE EQUATION

7
CHAPTER

CONTENTS

➢ DEFINITION

A statement of equally which involves one or more variables is called an **equation**.

For example **:**

S.No.	Statements	Equations
(i)	A number x increased by 7 is 15	$x + 7 = 15$
(ii)	9 exceeds a number x by 3	$9 - x = 3$
(iii)	4 times a number x is 24	$4x = 24$
(iv)	A number y divided by 5 is 7	$\frac{y}{5} = 7$
(v)	The sum of the number x and twice the number y is 12	$x + 2y = 12$

Clearly, each one of the above statements is a statement of equality, containing one or more variables. Thus, each one of them is an equation.

Each of the equations through (i) to (iv) involves only one unknown (i.e. variable), while the equation (v) contains two unknown, namely, x and y.

➢ LINEAR EQUATION

An equation in which the highest power of the variables involved is 1 is called a **linear equation**. Clearly, the sign of equality in an equation divides it into two sides, namely, the left-hand side and the right-hand side, written as LHS and RHS respectively.

➢ SOLUTION OF AN EQUATION

A number which makes LHS = RHS when it is substituted for the variable in an equation is said to satisfy the equation and is called a **solution** or **root** of the equation.

Solving an equation is finding the roots of the equation.

➢ SOLVING A LINEAR EQUATION BY THE TRIAL AND ERROR METHOD

In this method, we often make a guess of the root of the equations. We try several values of the variables and find the values of the LHS and the RHS in each case. When LHS = RHS for a particular value of the variable, we say that it is a root of the equation.

❖ EXAMPLES ❖

Ex.1 Find the solution of the equation $4x = 12$ by the trial-and-error method.

Sol. We try several values of x and find the values of the LHS and the RHS. We stop when for a particular value of x, LHS = RHS.

x	LHS	RHS
1	$4 \times 1 = 4$	12
2	$4 \times 2 = 8$	12
3	$4 \times 3 = 12$	12

$\therefore$ $x = 3$ is the solution of the given equation.

Ex.2 Solve the equation $3x - 5 = 7 - x$ by the trail and error method.

Sol. We try several values of x and find the values of the LHS and the RHS. We stop when for a particular value of x, LHS = RHS.

x	LHS	RHS
1	$3 \times 1 - 5 = -2$	$7 - 1 = 6$
2	$3 \times 2 - 5 = 1$	$7 - 2 = 5$
3	$3 \times 3 - 5 = 4$	$7 - 3 = 4$

$\therefore$ $x = 3$ is the solution of the given equation.

Ex.3 Solve the equation $\frac{1}{3}y + 5 = 8$ by the trial and error method.

Sol. We make a guess and try several values of y, and find the values of the LHS as well as the RHS in each case. We stop when for a particular value of y, LHS = RHS.

y	LHS	RHS
3	$\frac{1}{3} \times 3 + 5 = 6$	8
6	$\frac{1}{3} \times 6 + 5 = 7$	8
9	$\frac{1}{3} \times 9 + 5 = 8$	8

Thus, when y = 9, we have: LHS = RHS

$\therefore$ $y = 9$ is the solution of the given equation.

➢ SYSTEMATIC METHOD FOR SOLVING AN EQUATION

We have the following rules :

Rule (i) :

We can add the same number to both the sides of an equation.

Rule (ii) :

We can subtract the same number from both the sides of an equation.

Rule (iii) :

We can multiply both the sides of an equation by the same nonzero number.

Rule (iv) :

We can divide both the sides of an equation by the same nonzero number.

❖ EXAMPLES ❖

Ex.4 Solve the equation $x - 5 = 7$ and check the result.

Sol. $x - 5 = 7$

$\Rightarrow$ $x - 5 + 5 = 7 + 5$ [adding 5 to both sides]

$\Rightarrow$ $x = 12$

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

Check : Substituting $x = 12$ in the given equation, we get LHS = $12 - 5 = 7$ & RHS = 7.

$\therefore$ when $x = 12$, we have : LHS = RHS

Ex.5 Solve the equation $8 + x = 3$ and check the result.

Sol. $8 + x = 3$

$\Rightarrow$ $8 + x - 8 = 3 - 8$ [subtracting 8 from both sides]

$\Rightarrow$ $x + 8 - 8 = 3 - 8$ [Θ $8 + x = x + 8$]

$\Rightarrow x = -5$

So, $x = -5$ is the solution of the given equation.

Check : Substituting $x = -5$ in the given equation, we get LHS = $8 - 5 = 3$ and RHS = 3

$\therefore$ When $x = -5$, we have : LHS = RHS

Ex.6 Solve the equation $8x = 24$ and check the result.

Sol. $8x = 24$

$\Rightarrow$ $\frac{8x}{8} = \frac{24}{8}$ [dividing both sides by 8]

$\Rightarrow x = 3$

$\Rightarrow x = 3$ is the solution of the given equation.

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

LHS = $8 \times 3 = 24$ and RHS = 24

$\therefore$ when $x = 3$,

we have : LHS = RHS

Ex.7 Solve the equation $\frac{2}{3}x = 18$ and check the result.

Sol. $\frac{2}{3}x = 18 \Rightarrow \frac{2}{3}x \times \frac{3}{2} = 18 \times \frac{3}{2}$

[multiplying both sides by $\frac{3}{2}$]

$\Rightarrow \frac{2}{3} \times \frac{3}{2} \times x = 27 \Rightarrow x = 27$

$\therefore$ x = 27 is the solution of the given equation.

Check : Substituting x = 27 in the given equation, we get

LHS = $\frac{2}{3} \times 27 = 18$ and RHS = 18

$\therefore$ when x = 27, we have : LHS = RHS

➢ TRANSPOSITION

You know that one can add or subtract a number from both sides of the equation. So, for the equation x – 4 = 5 . We can write

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

Similarly, for the equation x + 5 = 3, we can write

x + 5 – 5 = 3 – 5 $\Rightarrow$ x = 3 – 5.

In both these cases you will notice that after this operation, the number appears on the other side of the equation, but with the opposite sign. So, you can straightway change the sign of a term and transfer it from one side of an equation to the other side. This is called **transposition.**

❖ EXAMPLES ❖

Ex.8 Solve : 3x + 5 = 13 – x . Check the result.

Sol. 3x + 5 = 13 – x

$\Rightarrow$ 3x + x = 13 – 5

[transposition –x to LHS and +5 to RHS]

$\Rightarrow$ 4x = 8

$\Rightarrow \frac{4x}{4} = \frac{8}{4}$ [dividing both sides by 4]

$\Rightarrow$ x = 2

$\therefore$ x = 2 is the solution of the given equation

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

LHS = 3 × 2 + 5 = 11 and RHS = 13 – 2 = 11

$\therefore$ LHS = RHS, when x = 2.

Ex.9 Solve : $x - 7 = 5 + \frac{x}{2}$. Check the result.

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

[transposing $\frac{x}{2}$ to LHS and –7 to RHS]

$\Rightarrow \frac{x}{2} = 12$

$\Rightarrow \frac{x}{2} \times 2 = 12 \times 2$ [multiplying both sides by 2]

$\Rightarrow$ x = 24 is the solution of the given equation.

Check : Substituting x = 24 in the given equation, we get

LHS = (24 – 7) = 17

and RHS = $\left(5 + \frac{1}{2} \times 24\right) = 17$.

$\therefore$ LHS = RHS, when x = 24.

Ex.10 Solve : 3(x + 3) – 2(x –1) = 5(x – 5).

Check the result.

Sol. 3(x + 3) – 2(x – 1) = 5(x – 5)

$\Rightarrow$ 3x + 9 – 2x + 2 = 5x – 25

[removing parentheses]

$\Rightarrow$ x + 11 = 5x – 25

$\Rightarrow$ x – 5x = –25 –11

[transposing 5x to LHS and 11 to RHS]

$\Rightarrow$ –4x = –36

$\Rightarrow$ x = 9 [dividing both sides by –4]

$\therefore$ x = 9 is the solution of the given equation.

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

LHS = 3(9 + 3) – 2 (9 – 1) = (3 × 12 – 2 × 8) = 36 – 16 = 20

RHS = 5(9 – 5) = 5 × 4 = 20

$\therefore$ LHS = RHS, when x = 9.

Ex.11 Solve : $\frac{x}{8}-\frac{1}{2}=\frac{x}{6}-2$. Check the result.

Sol. Multiplying each term by 24, the LCM of 8, 2 and 6, the given equation becomes :

$3x - 12 = 4x - 48$

$\Rightarrow$ $3x - 4x = -48 + 12$

[transposing 4x to LHS and –12 to RHS]

$\Rightarrow$ $-x = -36$

$\Rightarrow$ $x = 36$

$\therefore x = 36$ is the solution of the given equation.

Check : Substituting x = 36 in the given equation, we get

$$\text{LHS} = \left(\frac{36}{8}-\frac{1}{2}\right) = \left(\frac{36-4}{8}\right) = \frac{32}{8} = 4$$

$$\text{and RHS} = \left(\frac{36}{6}-2\right) = (6-2) = 4$$

$\therefore$ LHS = RHS, when x = 36.

➢ APPLICATION OF EQUATIONS

If a problem on numbers is given, we shall first translate it in the form of an equation and then solve it.

❖ EXAMPLES ❖

Ex.12 If 5 is subtracted from three times a number, the result is 16. Find the number.

Sol. Let the required number be x. Then,

$3x - 5 = 16$

$\Rightarrow$ $3x = 16 + 5$ [on transposing – 5 to RHS]

$\Rightarrow$ $3x = 21$

$\Rightarrow$ $x = 7$ [dividing both sides by 3]

Hence, the required number is 7.

Ex.13 Find two numbers such that one of them exceeds the other by 9 and their sum is 81.

Sol. Let the smaller number be x.

Then, the other number = (x + 9)

$\therefore$ $x + (x + 9) = 81 \Rightarrow 2x + 9 = 81$

$\Rightarrow$ $2x = 81 - 9$ [on transposing 9 to RHS]

$\Rightarrow$ $2x = 72$

$\Rightarrow$ $x = 36$ [Dividing both sides by 2]

Hence, one number = 36, and the other number = (36 + 9) = 45.

Ex.14 The length of a rectangular field is twice its breadth. If the perimeter of the field is 228 meters. Find the dimension of the field.

Sol. Let the breadth of the field be x metres. Then, its length = 2x metres

$\therefore$ Perimeter of the field = 2 (length + breadth)

= 2(2x + x) metres = 6x metres.

So, $6x = 228 \Rightarrow x = \frac{228}{6}$

[dividing both sides by 6]

$\Rightarrow$ $x = 38$

Hence, breadth of the field = 38 metres, and length of the field = (2 × 38) metres = 76 metres

Ex.15 Mona's father is thrice as old as Mona. After 12 years, his age will be twice that of his daughter. Find their present ages.

Sol. Let Mona's present age be x years.

Then, her father's present age = 3x years.

Mona's age after 12 years = (x + 12) years

Mona's father's age after 12 years = (3x + 12) years

$\therefore$ $3x + 12 = 2(x + 12)$

$\Rightarrow$ $3x + 12 = 2x + 24$

$\Rightarrow$ $3x - 2x = 24 - 12$

[transposing 2x to LHS and 12 to RHS]

$\Rightarrow$ $x = 12$

$\therefore$ Mona's present age = 12 years

And, her father's present age

= (3 × 12) years = 36 years.

EXERCISE # 1

Q.1 Write each of the following statements as an equation

(i) 5 times a number equals 40.

(ii) A number increased by 8 equals 15.

(iii) 25 exceeds a number by 7.

(iv) A number exceeds 5 by 3.

(v) 5 subtracted from thrice a number is 16.

(vi) If 12 is subtracted from a number, the result is 24.

(vii) Twice a number subtracted from 19 is 11.

(viii) A number divided by 8 gives 7.

(ix) 3 less than 4 times a number is 17.

(x) 6 times a number is 5 more than the number.

Q.2 Write a statement for each of the equations, given below :

(i) $x - 7 = 14$

(ii) $2y = 18$

(iii) $11 + 3x = 17$

(iv) $2x - 3 = 13$

(v) $12y - 30 = 6$

(vi) $\frac{2z}{3} = 8$

Q.3 Verify by substitution that

(i) the root of $3x - 5 = 7$ is $x = 4$.

(ii) the root of $3 + 2x = 9$ is $x = 3$.

(iii) the root of $5x - 8 = 2x - 2$ is $x = 2$.

(iv) the root of $8 - 7y = 1$ is $y = 1$.

(v) the root of $\frac{z}{7} = 8$ is $z = 56$.

Q.4 Solve each of the following equations by the trial and error method :

(i) $y + 9 = 13$

(ii) $x - 7 = 10$

(iii) $4x = 28$

(iv) $3y = 36$

(v) $11 + x = 19$

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

(vii) $2x - 3 = 9$

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

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

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

Solve each of the following equations and verify the answer in each cases :

Q.5 $x + 5 = 12$

Q.6 $x + 3 = -2$

Q.7 $x - 7 = 6$

Q.8 $x - 2 = -5$

Q.9 $3x - 5 = 13$

Q.10 $4x + 7 = 15$

Q.11 $\frac{x}{5} = 12$

Q.12 $\frac{3x}{5} = 15$

Q.13 $5x - 3 = x + 17$

Q.14 $2x - \frac{1}{2} = 3$

Q.15 $3(x + 6) = 24$

Q.16 $6x + 5 = 2x + 17$

Q.17 $\frac{x}{4} - 8 = 1$

Q.18 $\frac{x}{2} = \frac{x}{3} + 1$

Q.19 $3(x + 2) - 2(x - 1) = 7$

Q.20 $5(x - 1) + 2(x + 3) + 6 = 0$

Q.21 $6(1 - 4x) + 7(2 + 5x) = 53$

Q.22 $16(3x - 5) - 10(4x - 8) = 40$

Q.23 $3(x + 6) + 2(x + 3) = 64$

Q.24 $3(2 - 5x) - 2(1 - 6x) = 1$

Q.25 $\frac{n}{4} - 5 = \frac{n}{6} + \frac{1}{2}$

Q.26 $\frac{2m}{3} + 8 = \frac{m}{2} - 1$

Q.27 $\frac{2x}{5} - \frac{3}{2} = \frac{x}{2} + 1$

Q.28 $\frac{x - 3}{5} - 2 = \frac{2x}{5}$

Q.29 $\frac{3x}{10} - 4 = 14$

Q.30 $\frac{3}{4}(x - 1) = x - 3$

ANSWER KEY

1. (i) $5x = 40$ (ii) $x + 8 = 15$ (iii) $25 - x = 7$ (iv) $x - 5 = 3$ (v) $3x - 5 = 16$

(vi) $x - 12 = 24$ (vii) $19 - 2x = 11$ (viii) $\frac{x}{8} = 7$ (ix) $4x - 3 = 17$ (x) $6x = x + 5$

2. (i) 7 less from the number x is 14

(ii) Twice the number y is 18

(iii) 11 increased by thrice the number x is 17

(iv) 3 less from twice the number x is 13

(v) 12 times the number y decreased by 30 is 6

(vi) Twice the number z divided by 3 is 8

4. (i) $y = 4$ (ii) $x = 17$ (iii) $x = 7$ (iv) $y = 12$ (v) $x = 8$

(vi) $x = 12$ (vii) $x = 6$ (viii) $x = 8$ (ix) $x = 4$ (x) $z = 2$

5. $x = 7$ **6.** $x = -5$ **7.** $x = 13$ **8.** $x = -3$ **9.** $x = 6$

10. $x = 2$ **11.** $x = 60$ **12.** $x = 25$ **13.** $x = 5$ **14.** $x = \frac{7}{4}$

15. $x = 2$ **16.** $x = 3$ **17.** $x = 36$ **18.** $x = 6$ **19.** $x = -1$

20. $x = -1$ **21.** $x = 3$ **22.** $x = 5$` **23.** $x = 8$ **24.** $x = 1$

25. $n = 66$ **26.** $m = -54$ **27.** $x = -25$ **28.** $x = -13$ **29.** $x = 60$

30. $x = 9$

EXERCISE # 2

Q.1 If 9 is added to a certain number, the result is 36. Find the number.

Q.2 If 11 is subtracted from 4 times a number, the result is 89. Find the number.

Q.3 Find a number which when multiplied by 5 is increased by 80.

Q.4 The sum of three consecutive natural numbers is 114. Find the numbers.

Q.5 When Raju multiplies a certain number by 17 and adds 4 to the product, he gets 225. Find that number.

Q.6 If a number is tripled and the result is increased by 5, we get 50. Find the number.

Q.7 Find two numbers such that one of them exceeds the other by 18 and their sum is 92.

Q.8 One out of two numbers is thrice the other. If their sum is 124. Find the numbers.

Q.9 Find two numbers such that one of them is five times the other and their difference is 132.

Q.10 The sum of two consecutive even numbers is 74. Find the numbers.

Q.11 The sum of three consecutive odd numbers is 21. Find the numbers.

Q.12 Reena is 6 years older than her brother Ajay. If the sum of their ages is 28 years, what are their present ages ?

Q.13 Deepak is twice as old as his brother Vikas. If the difference of their ages be 11 years, find their present ages?

Q.14 Mrs Goel is 27 years older than her daughter Rekha. After 8 years she will be twice as old as Rekha. Find their present ages.

Q.15 A man is 4 times as old as his son. After 16 years he will be only twice as old as his son. Find their present ages.

Q.16 A man is thrice as old as his son. Five years ago the man was four times as old as his son. Find their present ages.

Q.17 After 16 years, Fatima will be three times as old as she is now. Find her present age.

Q.18 After 32 years, Rahim will be 5 times as old as he was 8 years ago. How old is Rahim today ?

Q.19 A bag contians 25-paisa and 50-paisa coins whose total value is ₹30. If the number of 25-paisa coins is four time that of 50-paisa coins, find the number of each types of coins.

Q.20 Five times the price of a pen is ₹17 more than three times its price. Find the price of the pen.

Q.21 The number of boys in a school is 334 more than the number of girls. If the total strength of the school is 572, find the number of girls in the school.

Q.22 The length of a rectangular park is thrice its breadth. If the perimeter of the park is 168 metres, find its dimensions.

Q.23 The length of a rectangular hall is 5 metres more than its breadth. If the perimeter of the hall is 74 meters, find its length and breadth.

Q.24 A wire of length 86 cm is bent in the form of a rectangle such that its length is 7 cm more than its breadth. Find the length and the breadth of the rectangle so formed.

ANSWER KEY

1. 27 **2.** 25 **3.** 20 **4.** 37, 38, 39 **5.** 13

6. 15 **7.** 37, 55 **8.** 31, 93 **9.** 33, 165 **10.** 36, 38

11. 5, 7, 9

12. Ajay's age = 11 years, Reena's age = 17 years

13. 22 years, 11 years

14. 46 years, 19 years

15. 32 years, 8 years

16. 45 years, 15 years

17. 8 years

18. 18 years

19. 80 and 20

20. ₹ 8.50

21. 119

22. *l* = 63 m, b = 21 m

23. *l* = 21 m, b = 16 m

24. *l* = 25 cm, b = 18 cm

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