SIMPLE EQUATIONS

3.0 Introduction

You have already come across simple equations like $4x = 44$, $2m = 10$ and their solutions in Class VI. You have seen how these equations help us in solving puzzles and daily life problems. Let us review what we have already learnt about simple equations and their solutions through the
following exercise.

Exercise - 1

1. Write L.H.S and R.H.S of the following simple equations.

(i) $2x = 10$ (ii) $2x–3 = 9$

(iii) $4z + 1 = 8$ (iv) $5p + 3 = 2p + 9$

(v) $14 = 27 – y$ (vi) $2a – 3 = 5$

(vii) $7m = 14$ (viii) $8 = q + 5$

2. Solve the following equations by trial and error method.

(i) $2 + y = 7$ (ii) $a – 2 = 6$

(iii) $5m = 15$ (iv) $2n = 14$

3.1 Equation - Weighing balance

You have seen in class VI that an equation is compared with a weighing balance with equal weights on both sides.

What will happen if the left pan of a weighing balance holds 5 kg and the right pan holds 2 kg?

What will happen if the left pan of a weighing balance holds 3 kg and the right pan holds 7 kg?

What will happen if the left pan of a weighing balance holds 3 kg and the right pan holds 3 kg?

A weighing balance needs to have equal weights on both sides to be perfectly balanced.

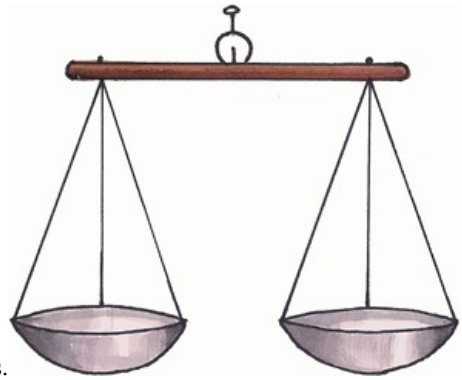
The same principles will hold in an equality.

Consider the equality $12–2 = 6 + 4$

Here-

LHS = $12 – 2 = 10$ and

RHS = $6 + 4 = 10$



Since both sides are equal, the equality holds.

What will happen if we add 3 on both sides of an equation? Will the values of both sides remain equal? Will the values be equal if 10 is added? Try with some other number of your choice.

What will happen if we subtract 5 from both sides of the equation? Will both sides remain equal? Will the values be equal if 7 is subtracted? Try with some other numbers of your choice.

What will happen if we multiply both sides by 6? Will both sides remain equal? Will they be equal if 8 multiplied by 8? Try with some other numbers of your choice.

What will happen if we divide both sides of the equation by 5? Will both sides remain equal? Will they be equal if both sides are divided by 2?

You will find that answer is 'yes' in all cases. If the same number is added or subtracted on both sides or if both sides of the equality are either multiplied or divided by same number ; the equality remains unchanged. This principle of equality is going to help in solving equations ahead.

3.2 Solving equations

You have already learnt how to solve equations using the trial and error method. Now we will use the above principles of equality to solve equations in a much lesser time.

To solve equations we first need to separate the numerical terms from the terms containing variables/unknowns by taking them on the two different sides of the equality and then use the principles of equality.

Let us study the examples given below.

Example 1 : Solve $x + 3 = 7$

Given equation is

Solution : $x + 3 = 7$ ..... (1)

The L.H.S of the equation is $x + 3$.

Total value of L.H.S. is 3 more than x

To find the value of 'x' we have to remove 3 from the LHS. Thus, we need to subtract 3 from the LHS. If 3 is subtracted from LHS it should also be subtracted from RHS, to balance the equality.

We have, $x + 3 = 7$

$x + 3 - 3 = 7 - 3$

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

$x = 4$

Thus, $x = 4$.

From (1) and (2) it is clear that removing '+3' from LHS is equivalent to 'subtracting 3' from the RHS. That means '+3' on LHS transforms as '–3' to RHS.

Check: let us substitute 4 for x in the given equation and find whether LHS = RHS.

LHS = $x + 3$

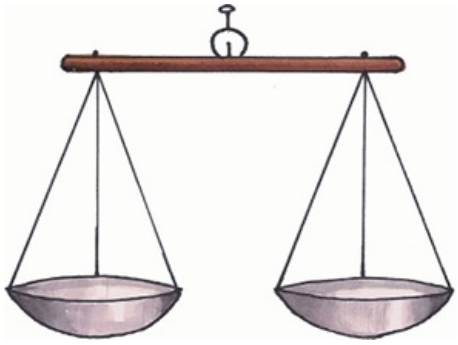
= 4 + 3 (substituting x = 4)

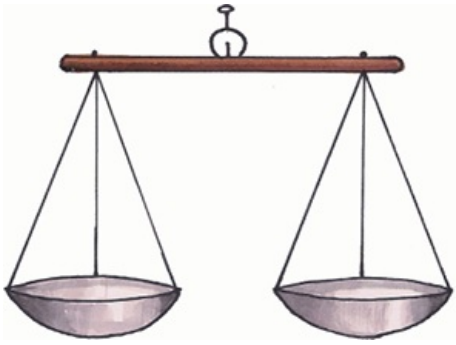
= 7

RHS = 7

LHS = RHS.

Let us also understand the above solution with a weighing balance:





Example 2 : Solve $y - 7 = 9$

Solution : $y - 7 = 9$ ..... (1)

Here the L.H.S of the equation is $y - 7$

So to get the value of 'y' we have to add 7 on both sides of the equation.

Therefore, $y - 7 + 7 = 9 + 7$

$y = 9 + 7$ ..... (2)

$y = 16$

Thus, $y = 16$.

From (1) and (2) it is clear that '–7' on LHS transforms to RHS as '+7'.

Check : Substitute '16' for 'y' and check whether LHS = RHS

From (1) and (2) it is clear that divison '6'on LHS transforms to RHS as 'multipier 6'.

Example 3 : Solve $5x = -30$

Solution : $5x = -30$ ..... (1)

$\frac{5x}{5} = \frac{-30}{5}$ (dividing both sides by 5)

$x = \frac{-30}{5}$ ..... (2)

$\therefore \quad x = -6$

From (1) and (2) it is clear that multiplier '5'on LHS transforms to RHS as 'divisor'.

Check: Substitute $x = -6$ and check whether LHS = RHS.

Example 4 : Solve $\frac{z}{6} = -3$

Solution : $\frac{z}{6} = -3$ ..... (1)

$6\left(\frac{z}{6}\right) = 6 \times (-3)$ (multiplying both sides by 6)

$z = 6 \times (-3)$ ..... (2)

$\therefore \quad z = -18$

From (1) and (2) it is clear that divison '6'on LHS transforms to RHS as 'multipier 6'.

Check : Substitute z = –18 and check whether LHS = RHS.

Example 5 : Solve $3x + 5 = 5x - 11$

Solution : $3x + 5 = 5x - 11$

$3x + 5 - 5x = 5x - 11 - 5x$ (subtracting 5x from both sides)

$-2x + 5 = -11$

$-2x + 5 - 5 = -11 - 5$ (subtracting '5' from both sides)

$-2x = -16$

$\frac{-2x}{-2} = \frac{-16}{-2}$ (Dividing both sides by '–2')

$\therefore \quad x = 8$

Check : Substituting x=8 in the given equation:

LHS = $3x + 5 = 3(8) + 5 = 24 + 5 = 29$

RHS = $5x - 11 = 5(8) - 11 = 40 - 11 = 29$

$\therefore$ LHS = RHS

Thus, in transforming terms from L.H.S. to R.H.S.

'+ quantity' becomes '– quantity'

'– quantity' becomes '+ quantity'

'× quantity' becomes ÷ quantity

'÷ quantity' becomes ' × quantity'

Example 6 : Solve $12 = x + 3$

Here if 12 is moved from LHS to RHS it becomes –12 and if x+3 is moved from RHS to LHS it becomes $-x - 3$.

i.e $-x - 3 = -12$

Multiplying both sides by –1

$-1(-x - 3) = -1(-12)$

$x + 3 = 12$

$x = 12 - 3$

$\therefore x = 9$

Therefore, if both LHS and RHS of an equation are moved (transposed) from one side to another side, the values of terms remain same.

Exercise - 2

1. Solve the following equations without transposing and check your result.

(i) $x + 5 = 9$ (ii) $y - 12 = -5$

(iii) $3x + 4 = 19$ (iv) $9z = 81$

(v) $3x + 8 = 5x + 2$ (vi) $5y + 10 = 4y - 10$

2. Solve the following equations by transposing the terms and check your result.

(i) $2 + y = 7$ (ii) $2a - 3 = 5$

(iii) $10 - q = 6$ (iv) $2t - 5 = 3$

(v) $14 = 27 - x$ (vi) $5(x+4) = 35$

(vii) $-3x = 15$ (viii) $5x - 3 = 3x - 5$

(ix) $3y + 4 = 5y - 4$ (x) $3(x - 3) = 5(2x + 1)$

3.3 Usage of algebraic equations in solving day to day problems.

Let us look at the following examples:

(i) The total number of boys and girls in a class is 52. If the number of girls is 10 more than boys, find the number of boys?

(ii) The present age of Ramu's father is three times that of Ramu. After five years the sum of their ages will be 70 years. Find their present ages.

(iii) A purse contains ` 250 in the denomination of `10 and ` 50. If the number of `10 notes is one more than that of `50 notes find the number of notes of each denomination.

(iv) Length of a rectangle is 8 m less than twice its breadth. The perimeter of the rectangle is 56 m. Find its length and breadth.

Likes in all the problems given above, we can use simple equations to solve various problems of day to day life. The following steps can be followed in doing so

Step 1: Read the problem carefully.

Step 2 : Denote the unknown or the quantity to be found with some letters such as *x, y, z, u, v, w, p,t*.

Step 3: Write the problem in the form of an algebraic equation by making a relation among the quantities.

Step 4: Solve the equation.

Step 5: Check the solution.

Example 7: Total number of the boys and girls in a class is 52. If the number of girls is 10 more than that of boys, find the number of boys?

Solution : Let us assume the number of boys to be x.

The number of girls will be $x + 10$.

The total number of boys and girls $= x + (x + 10)$

$= x + x + 10$

$= 2x + 10$

According to the question, the total number of boys and girls is 52.

Therefore, $2x + 10 = 52$

Solving this equation, $2x + 10 = 52$

$2x = 52 - 10$ (transposing 10 from LHS to RHS)

$2x = 42$

$x = \frac{42}{2}$ (transposing 2 from LHS to RHS)

$\therefore$ $x = 21$

Thus, the number of boys = 21

and the number of girls = 21 + 10 = 31

Check : 21 + 31 = 52 i.e. the total number of boys andgirls is 52.

And 31 – 21=10 i.e. the number of girls is 10 more than the number of boys.

Example 8: The present age of Ramu's father is three times that of Ramu. After five years the sum of their ages would be 70 years. Find their present ages.

Solution : Let Ramu's present age = x years.

Then the present age of his father = $3x$ years.

After 5 years Ramu's age = x+5 years.

His father's age = $3x + 5$ years.

Sum of their ages after 5 years is = $(x + 5) + (3x + 5) = 4x + 10$ years.

According to the problem

Sum of their ages $4x + 10 = 70$

$4x = 70 - 10$

$4x = 60$

Thus, Ramu's present age = 15 years.

So, present age of his father = $3x \times 15$ years = 45 years.

Check : 45 is three times of 15 i.e., at present Ramu's father is 3 times that of Ramu,

After 5 years Ramu's age = 15 + 5 = 20 years and his father's age = 45 + 5 = 50 years.

Sum of their ages 20 + 50 = 70 years.

Example 9 : A purse contains ` 250 in the denomination of ` 10 and ` 50. If the number of ` 10 notes is one more than that of ` 50 notes, find the number of notes of each denomination.

Solution : Let the number of ` 50 notes $= x$

Then the total value of ` 50 notes $= 50x$

Number of ` 10 notes $= x + 1$

Then the total value of ` 10 notes $= 10 (x+1)$

$\therefore$ Total value of money $= 50x + 10 (x+1)$

$= 50x + 10x + 10$

$= 60x + 10$

By problem total value of the money that the purse contains is ₹250

Therefore, $60x + 10 = 250$

$60x = 250 - 10$

$60x = 240$

$x = \frac{240}{60}$

$\therefore x = 4$

Thus, the number of ` 50 notes = 4

Number of ` 10 notes = 4 + 1 = 5

Check : ` 10 notes (5) are one more than ` 50 notes (4).

Value of the money = (50×4) + (10×5)

= 200 + 50

= ₹250

Example 10: Length of a rectangle is 8 m less than twice its breadth. If the perimeter of the rectangle is 56 m, find its length and breadth.

Solution : Let the breadth of the rectangle $= x$ m.

Twice the breadth $= 2x$ m.

Therefore, its length $= (2x - 8)$ m. (by problem)

Perimeter of the rectangle $= 2$ (length + breadth)

Thus, perimeter $= 2(2x - 8 + x)$ m.

$= 2(3x - 8)$ m.

$= (6x - 16)$ m.

By problem, the perimeter of the rectangle is 56 m.

Therefore, $6x - 16 = 56$

$6x = 56 + 16$

$6x = 72$

$\therefore \quad x = 12$

Breadth of the rectangle $= 12$ m.

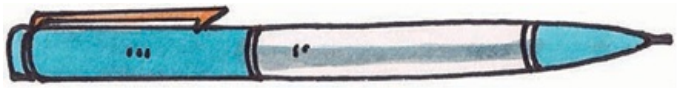
Length of the rectangle $= 2 \times 12 - 8 = 16$ m.

Check : Perimeter $= 2(16 + 12) = 2 \times 28 = 56$ m.

Exercise 3

1 Write the information given in the picture in the formof an equation. Also, find 'x' in the following figure

2. Write the information given in the picture in the form of an equation. Also, find 'y' in the following figure.



3. If we add 7 to twice a number, we get 49. Find the number.

4. If we subtract 22 from three times a number, we get 68. Find the number.

5. Find a number which when multiplied by 7 and then reduced by 3 is equal to 53.

6. Sum of two numbers is 95. If one exceeds the other by 3, find the numbers.

7. Sum of three consecutive integers is 24. Find the integers.

8. Find the length and breadth of the rectangle given below if its perimeter is 72m.

$5x + 4$

$x - 4$

9. Length of a rectangle exceeds its breadth by 4 m. If the perimeter of the rectangle is 84 m, find its length and breadth.

10. After 15 years, Hema's age will become four times that of her present age. Find her present age.

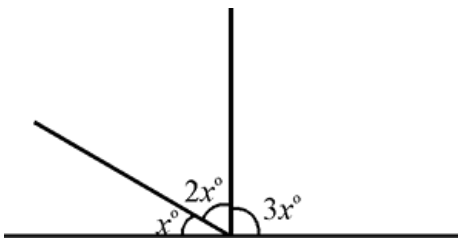
11. A sum of ₹.3000 is to be given in the form of 63 prizes. If the prize money is either ₹.100 or ₹.25. Find the number of prizes of each type.

12. A number is divided into two parts such that one part is 10 more than the other. If the two parts are in the ratio 5:3, find the number and the two parts.

13 . Suhana said, "multiplying my number by 5 and adding 8 to it gives the same answer as subtracting my number from 20".
Find Suhana's numbers.

14. The teacher tells the class that the highest marks obtained by a student in her class is twice the lowest marks plus 7. The highest mark is 87. What is the lowest mark?

15. In adjacent figure find the magnitude of each of the three angles formed?



(Hint: Sum of all angles at a point on a line is 180^o)

16. Solve the following riddle:

I am a number

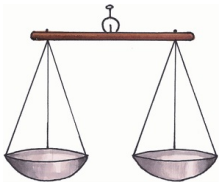
Tell my identity.
Take me two times over
And add a thirty six.
To reach a century
You still need four.

Looking Back

- Simple equations help in solving various problems in daily life.
- For balancing an equation we

(i) add the same number on both the sides or
(ii) subtract the same number form both the sides or
(iii) multiply both sides with the same number or
(iv) divides both the sides by the same number, so that the equality remains undisturbed.

- An equation remains same if the LHS and the RHS are interchanged.



$x+3$
7

$x+3-3$
$7-3$

From (1) and (2) it is clear that removing '+3' from LHS is equivalent to 'subtracting 3' from the RHS.
That means '+3' on LHS transforms as '–3' to RHS.
From (1) and (2) it is clear that '–7' on LHS transforms to RHS as '+7'.

x
4

From (1) and (2) it is clear
that multiplier '5' on LHS transforms
to RHS as 'divisor'.
From (1) and (2) it is clear that
divison '6' on LHS transforms to
RHS as 'multipier 6'.

x cm

15 cm

11 cm

‘y’ cm

13 cm

8 cm