Chapter 11

VARIABLES

We often see around us several things whose values are fixed or constant and many other things whose values keep on changing. For example, the weight of a chair tomorrow and day after and many days later remains the same what it is today but if we notice a germinating seed, the length of the growing plant changes very slowly everyday. Similarly, the length & width of a class room remain constant, but we cannot say anything about the change in the level of water in a well after a month and in the rainy season.

Write down five examples in your notebook about values that remain constant and five examples whose values keep changing.

While writing the examples in the notebooks in the class, Anu said to Rohan, " I shall write that my father's age is changing but his height is constant." Rohan said, "I'm going to write that the area of my fields measure 4 acres, but the harvest is sometimes less & sometimes more."

These are interesting examples and you notice that some values are constant while others are changing. Below are provided some situations, discuss amongst yourself and write in the blanks whether the concerning values are constant or keep changing.

ACTIVITY 1

S. No.	Situations	Values constant / changing
1.	The number of days in a week.	
2.	The temperature of the day in the month of May.	
3.	The no. of student coming to your class everyday.	
4.	No. of players in hockey team.	
5.	No. of potatoes in one kg of potatoes.	

While solving the last problem, Hamida said to her friends, "If the potatoes are big, then lesser number of potatoes will make 1 kilogram, but if they are smaller in size, their number in one kilogram would be more. Similarly, we cannot say how many potatoes can be put into a bag. Something like this happened at home yesterday. My father put all of us into a maze. He had some toffees tied up in his handkerchief. He asked, "How many toffees are there in this handkerchief?" Now none of us knew the number, so how could we tell him that. We kept thinking, is there not any way to tell the number of toffees in the handkerchief? Raju was listening carefully & said, "Let us go to our mathematics teacher and ask her about this."

The mathematics teacher listened to their problem and put another problem before the students. She asked, “How many pieces of chalk are there in this box? The students told different numbers as per their assumtions. Hamida said ‘12’ and so on, Raju said ‘18’, Anu said ‘16’, Rohan said ‘20’ and so on. The teacher said, “If I take out 5 pieces of chalk from the box, then according to you, how many chalk sticks would be left.” Hamida, Raju, Anu and Rohan calculated on the basis of their own numbers respectively to get 12-5 = 7, 18-5 = 13, 16-5 = 11 & 20-5 =15.

Since the number of chalk sticks in the box were unknown, so the answers were different. But if instead of the original numbers thought of, we write the no. of chalk sticks as 5, then every one would have a common answer, for this we will have to write the number of chalk sticks everytime. Can’t we write it in brief? Do we have a method for this?

If the number of chalk in the box is considered as ‘C’ and take out 5 sticks of chalk from it, then the number of pieces of chalk in the box would be C-5. Similarly if we add 3 pieces of chalk to the box, the number of chalk sticks in the box would be C+3. Let us take another example.

In a packet of toffees, there are 20 toffees but the cost of the packet is not known to us.

If 1 toffee costs 50 paise, then the price of the packet would be

$$= 20 \times 0.50 \text{ rupee} = 10 \text{ rupee}$$

If 1 toffee costs 1 rupee, then the price of the packet

$$= 20 \times 1 \text{ rupee} = 20 \text{ rupee}$$

If 1 toffee costs 2 rupees, then the price of the packet

$$= 20 \times 2 \text{ rupees} = 40 \text{ rupees}$$

Thus, the price of a packet here = 20 × (price of 1 toffee)

Then if instead of the price of one toffee, we write x rupees, y rupees and z rupees or any letter of the alphabet, then the price of the packet will be $20x$ rupees, 20y rupees and 20z rupees.

Let us consider another such example.

In a square, the length of each side is equal to 2 units, the perimeter of the square would be 4 × 2 units. If the length of each side of the square is 3 units, then the perimeter is = 4 × 3 units. If the length of the side is 7 units, then the perimeter would be 4 × 7 units and similarly, if the length of a side of the square be ‘a’ unit, then the perimeter of the square would be $4 \times a$ units.

In all the examples taken above, you have seen that some questions are constant like when the price of packet of toffee is $20x$ rupees, 20 here is constant, but x rupees means the cost of the packet changes according to the price of 1 toffee.

Similarly, in the perimeter of a square $4a$, 4 is constant (sides), but as the value (length) of the side changes (a unit), the perimeter of square also changes.

After observing all the examples, Hamida came to a conclusion that all changing values are indicated by some letter. So, she could have said that ‘my father had z toffees in his handkerchief.’ The value of z can be found out only we had some extra information regarding the toffees, otherwise not!

These quantities which keep changing are known as variables. These can have any value they can be denoted by any letter of Hindi or English alphabet like अ, ब, स, द or a, b, c, d or x, y, z etc. These numbers (denotions) are called variable numbers or algebraic numbers.

Whenever we have a number whose value is not known, instead of the number, we use an algebriac number or valuable number. It is easy to solve such problems by using variable numbers.

Similarly, mathematical examples are also done with the help of variables for example:

1. What is the relationship between a number and its succeeding number? What number comes after 4? This number is 5 which means 4 + 1. Similarly, what comes after 1000? It is 1001, which means 1000 + 1. So, to any given number if one (1) is added, we get the next number. If any number is x, then the next number will be $x + 1$.
2. Can you make a similar rule about the number preceeding any given number?
3. Can you write even numbers as variables? 2, 4, 6, 8 etc. are even numbers. All these numbers have a common multiple factor 2. This means any integer multiplied by 2 will give us an even number. Suppose, 'n' is a natural / countable number, then 2n will be a even number or an even number can be denoted by '2n'.
4. Can you write odd numbers in the form of variables? If you look at numbers, you will find that even and odd numbers come alternately even, odd, even, odd, even, ... like 1, 2, 3, 4, 5, 6, 7, 8, ... Here every number before an even number is an odd number and the number after the even number is also an odd number. We have denoted even numbers by '2n'. $x - 1$, and the number that comes after it is $x + 1$. So, the number before an even number would be 2n - 1 and the number after the even number will be 2n + 1. Thus (2n - 1) or (2n + 1) can be used to denote an odd number.

Below are given some numbers that are related to some rules. Write them in the n^{th} term.

S. No.	Numbers that are related to some rules	First term	Second term	Third term	Seventh term	Ninth term	n^{th} term
1.	3, 6, 9, 12, ... etc	3	6	12	21	27	3n
2.	5, 8, 11, 14, ... etc	5	8	14	----	----	----
3.	3, 7, 11, 15, ... etc	3	7	15	----	----	----

EXERCISE 11

1. Indicate the following by numbers, literal numbers and basic operation signs. Also say what each letter denotes?
   (i) The diameter of a circle is twice its radius
   (ii) The area of a rectangle is the product its length & width.
   (iii) Selling price is equal to the sum of cost price and profit.
   (iv) A number is added to another number.

(v) 7 is subtracted from any number.

(vi) Composite amount is equal to the sum of principle and the Interest.

2. Identify the true and false statements and rewrite the wrong statements correctly.

(i) The number succeeding '*a*' will be $a + 1$.

(ii) The value of '*x*' changes according to situations.

(iii) 2n would be an odd number.

(iv) $m \times n$ would be the product of any two numbers.

(v) Variables are generally indicated by small letters of the English alphabet.

What Have We Learnt ?

1. Any letter that is used to denote numbers, is known as a numerical letter.
2. These letters show numbers as variables, hence follow all rules followed by or applicable to numbers.
3. The quantity that has a definite numerical value is not a variable but a constant.
4. The quantity that can have many numerical values is known as a variable.
5. In arithmatic we use numbers with definite numerical values, where in algebra, we use letters that can have more than one numerical values.
6. The algebraic part of a number is a variable quantity. If $p = 4a$, 4 is a constant, but *a* is variable.