

## Exponential Notations

The number written like, 45673.86, is known as the ordinary number. It is written in a row starting from left to right with or without a decimal point. Such numbers are cumbersome in any kind of calculations. Hence, these ordinary numbers are transformed into exponential numbers for ease of mathematical operations.

The exponential number is a number that is represented as a multiple of 10 that has the following general form:

$$a = 10^{\pm n}$$

Where  $a$  is known as the prefix or the pre-multiplier, 10 is the base, and  $n$  is the exponent. The exponent can be positive or negative; if the number is equal to or greater than 10, the exponent is positive and if the number is less than or equal to  $1/10^{\text{th}}$ , the exponent is negative. Ordinary numbers can be converted to exponential numbers by shifting the decimal place either to the left or to the right depending on the nature of the number. Let us consider some common examples.

$$1 = 1 \times 10^0$$

$$10 = 1 \times 10^1$$

$$100 = 10 \times 10 = 1 \times 10^2$$

$$1000 = 10 \times 10 \times 10 = 1 \times 10^3$$

$$10000 = 10 \times 10 \times 10 \times 10 = 1 \times 10^4$$

$$1/10 = 1 / (1 \times 10^1) = 0.1 = 1 \times 10^{-1}$$

$$1/100 = 1 / (1 \times 10^2) = 0.01 = 1 \times 10^{-2}$$

$$1/1000 = 1 / (1 \times 10^3) = 0.001 = 1 \times 10^{-3}$$

Let us convert the number, 45673.86, into exponential notation

$$45673.86 = 4567.386 \times 10^1 \rightarrow \text{shifting one decimal place to the left}$$

$$= 456.7386 \times 10^2 \rightarrow \text{shifting two decimal places to the left}$$

$$= 45.67386 \times 10^3 \rightarrow \text{shifting three decimal places to the left}$$

$$= 4.567386 \times 10^4 \rightarrow \text{shifting four decimal places to the left}$$

Even though, all four numbers on right hand side of the equal sign look different, they are mathematically the same. The magnitude of the original number is still retained. They look different because the original number is transformed into different exponential notations. Few observations:

- If the exponent increases, the prefix decreases and vice versa to preserve the magnitude of the original number.

- The exponent of 10 indicates the number of times the decimal place is shifted, for example,  $10^3$ , means the decimal place is shifted to the left three times.

### **Scientific Notations**

**Scientific numbers** impose one stringent condition on exponential numbers, that is, the prefix must be between 1 and 10. Among the above four derived numbers, only the last number ( $4.567386 \times 10^4$ ) is the scientific number.

*Exponential numbers are not necessarily scientific numbers, but scientific numbers are definitely exponential numbers.*

Some additional examples scientific notations are,

$$3,000,000,000 \text{ g} = 3 \times 10^9 \text{ g}$$

$$0.000000000850 \text{ mm} = 8.50 \times 10^{-10} \text{ mm}$$