DIMENSIONS

Dimensions of a physical quantity are the power to which the fundamental quantities must be raised to represent the given physical quantity.

1 USE OF DIMENSIONS

CONVERSION OF UNITS

$$n_1 [u_1] = n_2 [u_2]$$

Suppose the dimensions of a physical quantity are 'a' in mass, 'b' in length and 'c' in time. If the fundamental units in one system are M_1, L_1 and T_1 and in the other system are M_2, L_2 and T_2 respectively. Then we can write.

$$n_1 [M_1^a L_1^b T_1^c] = n_2 [M_2^a L_2^b T_2^c]$$

ANALYZING DIMENSIONAL CORRECTNESS OF A PHYSICAL EQUATION

Every physical equation should be dimensionally balanced. This is called the **'Principle of Homogeneity'**. The dimensions of each term on both sides of an equation must be the same.

Note: A dimensionally correct equation may or may not be physically correct.

PRINCIPLE OF HOMOGENEITY OF DIMENSIONS

This principle states that the dimensions of all the terms in a physical expression should be same.

For e.g, in the physical expression $s = ut + \frac{1}{2} at^2$, the dimensions of **s, ut** and $\frac{1}{2} at^2$ all are same.

Note: Physical quantities separated by the symbols +, −, =, >, < etc., have the same dimensions.

2 LIMITATIONS OF DIMENSIONAL ANALYSIS

- By this method, the value of dimensionless constant can not be calculated.
- By this method, the equation containing trigonometrical, exponential and logarithmic terms cannot be analysed.
- If a physical quantity depends on more than three factors, then relation among them cannot be established because we can have only three equations by equating the powers of **M, L** and **T**.