Chapter 1

Unit & Dimension

To measure a physical quantity like length mass and time we require a standard of measurement this standard of measurement is called the unit of that physical quantity. For example, the unit of length isometries and a standard length of 1 meter has a precise definition. To measure the length of an object is to determine how many times this standard-length meter is contained in the length of a room. The comparison of a physical quantity with a standard quantity is called measurement

PHYSICAL QUANTITIES

Those quantities which can describe the laws of physics are called the physical quantity. A physical quantity is one that can be measured. Thus, length, mass, time, pressure, temperature, current and resistance are the physical quantities.

Classification of physical quantities

The physical quantities are classified into

1. Fundamental quantities or base quantities
2. Derived quantities

The physical quantities that are independent of each other are called fundamental quantities. All the other quantities which can be expressed in terms of the fundamental quantities are called the derived quantities.

Units

The reference standard used to measure the physical quantities is called the unit.

Properties of Unit

- The unit should be of some suitable size
- The unit must be well-defined
- The unit should be easily reproducible at all places
- The unit must not change with time
- The unit should not change with physical conditions like temperature, pressure etc.
- The unit must be easily comparable experimentally with similar physical quantities.

Types of Units

1. **Fundamental Units**

   The units defined for the fundamental quantities are called fundamental units.

2. **Derived Units**

   The units of all other physical quantities which are derived from the fundamental units are called the derived units.

System of Units

1. **FPS System:**

   In this system, the unit of length is foot, unit of mass is pound and the unit of time is second.

2. **CGS System:**

   In this system, the units of length, mass and time are centimeter, gram and second, respectively.

3. **MKS System:**

   In this system, the unit of length, mass and time are meters, kilogram and second, respectively.

4. **SI System:**

   This system is widely used in all measurements throughout the world. The system is based on seven basic units and two supplementary units.

Definition of Basic and Supplementary Units

Basic Units

1. **Meter (m):**

   One meter is the distance travelled by light in the vacuum during a time interval of (1/299792458) seconds.

2. **Kilogram (kg):**

   It is the mass of a platinum-iridium cylinder kept at the National Bureau of weights and measurements, Paris.

3. **Second (s):**

   The second is the time taken by the light of a specified wavelength emitted by a cesium-133 atom to execute 9192631770 vibrations.

4. **Ampere (A):**

   One ampere is that current which when passed through two straight parallel conductors of infinite length and of negligible cross-section kept at a distance of 1 meter apart in the vacuum produces between them a force equal to 2×10^{-7} newton per meter length.

5. **Kelvin (K):**

   It is the fraction 1/273.6 of the thermodynamic temperature of the triple point of water.

6. **Candela (cd):**

   A candela is defined as 1/60 th of luminous intensity of 1 square centimeter of a perfect black body maintained at the freezing temperature of platinum (1773°C).

7. **Mole (md):**

   One mole is the amount of substance that contains elementary units equal to the number of atoms in 0.012 kg of carbon-12.

Supplementary Units

1. **Radian (rad):**

   The radian is the angle subtended at the centre of the circle by the arc whose length is equal to the radius of the circle.

2. **Steradian (Sr):**

   The steradian is the solid angle subtended at the centre of a sphere by a spherical surface of an area equal to the square of its radius.