1 UNITS AND MEASUREMENTS

In physics we are required to measure the physical quantities. Accurate measurements of physical quantities are needed. Measurement consists of the **comparison of an unknown quantity with a known fixed quantity**.

Measurement is compulsory part of development technology. Accuracy of measurement depends on

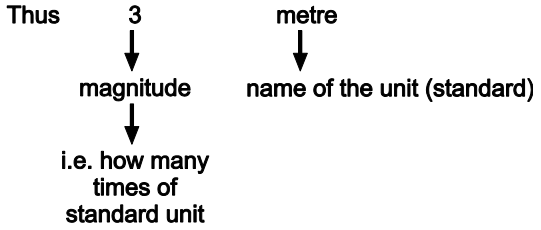
- Method of measurement.
- Measuring instrument.

Measurement consists of the comparison of given quantity with standard.

e.g. Length of table is 3 metre.

i.e. Any measurement consists of two parts.

The **first is the number** which **indicates the magnitude of quantity** and **second indicates the standard**. In the above example, 3 is the magnitude and metre is the standard (unit) of that quantity. It gives exact sense that the length of the table is 3 times the standard.



1.1 UNIT, PHYSICAL QUANTITIES

1.1 Unit of a Physical Quantity

Any physical quantity can be measured and represented in terms of number and unit.

Unit (Definition) : The standard used for measurement of a physical quantity is called unit of that quantity.

In the above example, 3 metre is the length of the table. Here metre is the standard (unit) used for the measurement of the length.

Requirements of standard unit :

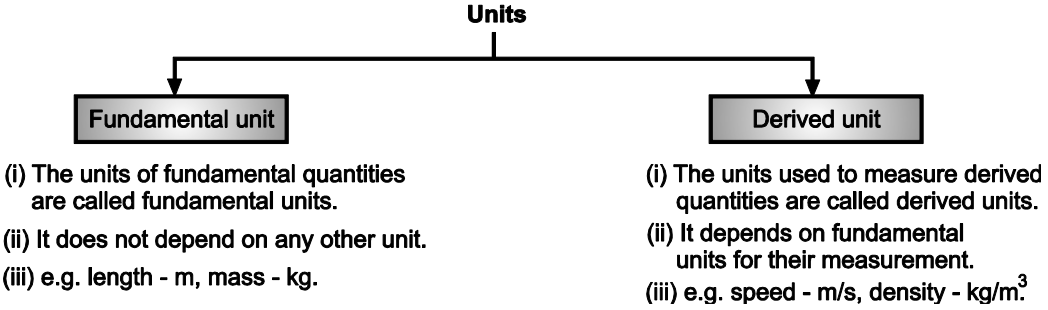
The unit selected should have following characteristics :

1. It should be universally accepted (i.e. accepted by all).
2. It should be definite and well defined.
3. It should be invariable (fixed) with time and place.
4. It should be easily reproducible and non-perishable.

5. It should be easily comparable with other similar units.
6. Its size should be such that the quantities measured with it should not be too large or too small.
7. It should be readily available.

A body named General Conference on Weight and Measures has authority to decide units by international agreement.

Units can be classified into two groups.



1.2 Physical Quantities

Physical Quantity (Definition) : A physical quantity is a quantity which can be measured (computed, quantified or enumerated).

OR

Any quantity, which can be measured, is called a physical quantity.

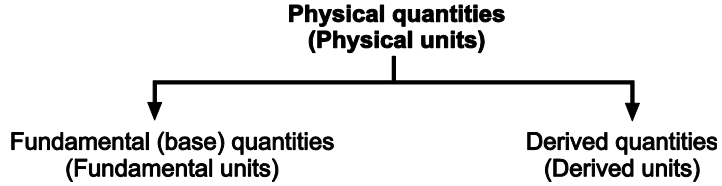
Examples of physical quantities :

Length, mass, time, current, force, work, power ..... etc.

e.g. Length of table is **3 m**.

1.2.1 Fundamental (Base) Quantities, Derived Quantities and their Units

In physics, there are seven basic quantities (fundamental quantities), using which we can derive any physical quantity.



2.1.1 Fundamental Quantities and Fundamental Units

Fundamental Quantities (Definition) : The physical quantities which do not depend on any other physical quantities for their measurements are called fundamental quantities or base quantities.

Fundamental Units (Definition) : The units used to measure fundamental quantities are called fundamental units. i.e. the unit of fundamental quantity is called fundamental unit. It does not depend on any other unit.

There are seven fundamental (basic) physical quantities: Length, mass, time, temperature, electric current, luminous intensity and amount of a substance and their units are fundamental units.

Following are the fundamental quantities with their units and symbol of units.

Table 1.1

Fundamental (basic) quantity	Fundamental unit (S.I.)	Symbol of unit
1. Length	metre	m
2. Mass	kilogram	Kg
3. Time	second	s
4. Temperature	kelvin	K
5. Electric current	ampere	A
6. Luminous intensity	candela	cd
7. Amount of a substance	mole	mol

There are two supplementary quantities (units) to fundamental quantities.

Supplementary quantity	Supplementary unit	Symbol of unit
1. Plane angle	radian	rad
2. Solid angle	steradian	sr

1.2.1.2 Derived Quantities and Derived Units

Derived Quantities (Definition) :

Physical quantities which depend on one or more fundamental quantities for their measurements are called derived quantities.

OR

The physical quantities which are derived using one or more fundamental quantities are called derived quantities.

Derived Units (Definition) :

The units used to measure derived quantities are called derived units.

OR

The units of derived quantities which depend on fundamental units for their measurement are called derived units.

Thus units of derived quantities are derived units.

As we have seen there are seven fundamental quantities. **The remaining all quantities are derived quantities.**

Examples :

(1) Density = **Fehler!**

= **Fehler!** = **Fehler!** …… kg/m^3

It is derived using two fundamental quantities i.e. mass and length.

Following are some derived quantities with their units and symbol of unit.

Table 1.2

Sr. No.	Derived physical quantity	Derived unit (S.I.)	Symbol of unit
1.	Area	square metre	m^2
2.	Volume	cubic metre	m^3
3.	Velocity	metre/sec	m/s
4.	Acceleration	metre/sec^2	m/s^2
5.	Force	newton	N
6.	Pressure	newton/$metre^2$	N/m^2
7.	Density	kilogram/$metre^3$	kg/m^3
8.	Speed	metre/sec	m/s
9.	Work	joule	J