MEASUREMENTS IN PHYSICS

Measurement is a very important aspect of Physics and other sciences. No fact in science is accepted, no law is established, unless it can be exactly measured and quantified. As Physics is based on exact measurements, every such measurement requires two things; first a number (or quantity), and secondly a unit. For example 10 metres; 10 is the quantity and metre is the unit of the measured quantity. The measured quantity here is length or distance or height.

A unit or standard of measurement should be such that (a) must be possible to define unambiguously, (b) is easily reproducible, (c) does not vary with time and place, and (d) should be possible to multiply or divide with each one of the standard.

Quantities in Physics

Quantity is simply any parameter or variable to be measured. Every quantity have unit. For example the unit for measuring time is seconds. In physics, we could

classify quantities based on their derivations or based on if they have direction or not.

Based on Derivation Quantities could be *fundamental* or *derived* when classified based on derivation.

Fundamental quantities are the basic quantities that are independent of other quantities and cannot be defined in terms of other quantities or derived from them. They are the basic quantities upon which most (though not all) quantities depend. The units of fundamental quantities are called fundamental units. The three most important basic or fundamental quantities in Physics are length, mass and time and their respective units are metre, kilogram, and seconds. Other fundamental quantities are electric current, temperature, amount of substance, etc. and their respective units are ampere, kelvin, mole, etc. respectively.

Derived quantities are those obtained by some simple combination of the fundamental quantities. They are dependent on the fundamental quantities. Their

units are also derived. Some derived quantities, their derivations, and their units are given below:

Quantity	Derivation/Formula	Unit
Area (A)	$length \times breadth$	m^2
Volume (V)	$length \times breadth \times depth$	m^3
Density	$\frac{mass}{volume}$	kgm^{-3}
Velocity (v)	$\frac{displacement}{time}$	ms^{-1}
Acceleration (a)	$\frac{change\ in\ velocity}{time}$	ms^{-2}
Force (F)	$mass \times acceleration$	$kgms^{-2}$ (N, Newton)
Energy or Work (W)	$Force \times Distance$	Nm (Joules, J)
Power (P)	$\frac{work}{time}$	$J.s^{-1}$ (Watt, W)
Pressure (P)	$\frac{Force}{Area}$	Nm^{-2} (Pascal, Pa)
Frequency (f)	$\frac{number\ of\ oscillations}{time}$	s^{-1} (Hertz, Hz)

Based on Direction Quantities in Physics can also be classified based on if they have direction or not. On this basis, they could either be *scalar* or *vectors quantities*.

Scalar quantities are those quantities which have only magnitude (or numerical value) but no direction. Examples of scalar quantities, are length (or distance) mass, volume, density, time, speed, temperature, and energy. Scalar quantities are added by ordinary algebraic methods, e.g. addition of volume, $5cm^3$ + $10cm^3$ = $15cm^3$.

Vector quantities are those quantities which have both magnitude (size) and direction. Vector quantities cannot be completely described unless their magnitudes and directions are specified. Examples are displacement, velocity, acceleration, weight, force, momentum, etc. Vector quantities are added by geometrical methods.