General Physics

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Lecture 1: Introduction

(Physical Quantities and Units)

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About Physics

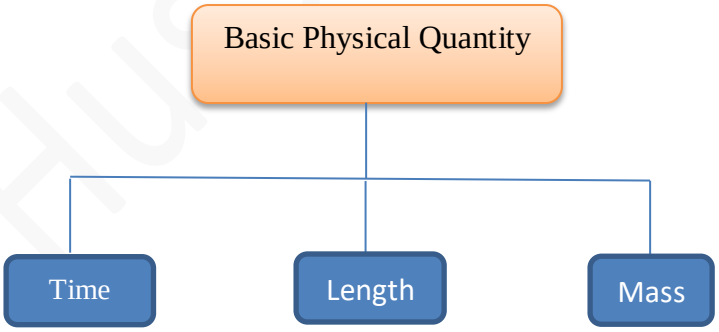
- Explains Nature
- Fundamental science
- Most technology of today (cell phones, DVD player, etc) are result of discoveries that happened in physics last century.
- Develop problem solving and logical reasoning skills – very important in any field of work!!

Physics and Measurements

- Physics is based on experimental observations and quantitative measurements. These observations have described by numbers and units.
- Numbers give us how large our measurement was, and
- the units tell us the nature of this measurement.
- Mathematics provides the bridge between theory and experiment.

Physical Quantities and Units

A physical quantity is defined as a quantity that can be used in mathematical equations of science and technology



- By international agreement the metric system was formalized in 1971 into the International System of Units (SI).
- The currently used metric system of units, with the international abbreviation SI. The system is founded on base units for seven basic physical quantities

Table 1: SI system of units

Physical quantity	Unit	Symbol
Length	Meter	M
Mass	Kilogram	Kg
Time	Second	S
Electric	Ampere	A
Temperature	Kelvin	K
Luminous intensity	Candela	Cd
Amount of substance	Mole	Mol

Definition of Basic Quantities

Mass

The SI unit of mass is the Kilogram, which is defined as the mass of a specific platinum-iridium alloy cylinder.

Time

The SI unit of time is the Second, which is the time required for a cesium-133 atom to undergo 9,192,631,770 vibrations.

Length

The SI unit of length is Meter, which is the distance traveled by light in vacuum during a time of 1/299,792,458 second.

Prefixes

Table 2: Prefixes used with SI units

Prefix	Symbol	Factor	
Tera	T	10^{12}	
Giga	G	10^{9}	
Mega	M	10^{6}	$1Mm=10^{6}$ m
Kilo	K	10^{3}	$1km=10^{3}$ m
Deci	D	10^{-1}	
Centi	C	10^{-2}	
Milli	M	10^{-3}	$1mA=1\times10^{-3}$ A
Micro	μ	10^{-6}	$1\mu C=1\times10^{-6}$ C
Nano	N	10^{-9}	$ns=10^{-9}$ n
Pico	P	10^{-12}	$1PC=1\times10^{-12}$ C
Femto	F	10^{-15}	$1fm=1\times10^{-15}$ m

- 3,000 m = 3 × 1,000 m = 3 × 10^{3} m = 3 km
- 1,000,000,000 = 10^{9} = 1G
- 1,000,000 = 10^{6} = 1M
- 1,000 = 10^{3} = 1k
- 141 kg = ? g,
- 0.003 s = 3 × 0.001 s = 3 × 10^{-3} s = 3 ms
- 0.01 = 10^{-2} = centi
- 0.001 = 10^{-3} = milli
- 0.000 001 = 10^{-6} = micro
- 0.000 000 001 = 10^{-9} = nano
- 0.000 000 000 001 = 10^{-12} = pico = p
- 3 cm = ? m = ? mm

Role of "UNITS" in problem solving

- Need to know conversion.
- Do problems with all units in the same system.
- Only quantities with same units can be added or subtracted.

Derived Quantities

All physical quantities measured by physicists can be expressed in terms of the three basic unit of length, mass, and time. For example, speed is simply length divided by time.

Speed = L / T

Derived quantities: area, volume, density ……

- Area = Length × Length unit for area = m^2
- Volume = Length × Length × Length unit for volume = m^3
- Density = Mass / Volume unit for density = kg/m^3

Quantity	SI Unit		Dimension
velocity	m/s	ms^{-1}	LT^{-1}
acceleration	m/s^2	ms^{-2}	LT^{-2}
force	N $kg\ m/s^2$	$kg\ ms^{-2}$	$M\ LT^{-2}$
energy (or work)	Joule J N m, $kg\ m^2/s^2$	$kg\ m^2s^{-2}$	ML^2T^{-2}
power	Watt W N m/s $kg\ m^2/s^3$	Nms^{-1} $kg\ m^2s^{-3}$	ML^2T^{-3}
pressure (or stress)	Pascal P, N/m^2, $kg/m/s^2$	Nm^{-2} $kg\ m^{-1}s^{-2}$	$ML^{-1}T^{-2}$
density	kg/m^3	$kg\ m^{-3}$	ML^{-3}