CHAPTER : 1
PHYSICAL QUANTITIES AND MEASUREMENTS

Physics:-

Physics is the branch of science in which study about the properties of matter and energy and their relationships.

Branches of Physics:-

1. Mechanics:-

The branch of physics in which we study about the motion of bodies and the effect of motion is called mechanics.

2. Heat:-

The branch of physics in which we study about the nature of heat and its effect when it transfers from one body to another body is called heat.

3. Sound:-

The branch of physics in which we study about the properties and applications of sound waves is called sound.

4. Light:-

The branch of physics in which we study about the properties of light and the use of optical instruments is called light.

5. Electricity and Magnestism:-

The branch of physics in which we study about the charges when they are at rest and in motion. Also the effect of these charges and their relationship with magnetism is called electricity and magnetism.

6. Atomic Physics:-

The branch of physics in which we study about the structure and properties of atoms is called atomic physics.

7. Nuclear Physics:-

The branch of physics in which we study about the atomic nucleus and the properties of the particles present in the nucleus is called nuclear physics.

8. Plasma Physics:-

The branch of physics in which we study about the ionic state of matter is called plasma physics.

9. Geo Physics:-

The branch of physics in which we study internal structure of the earth is called geophysics.

Physical Quantities:-

All measurable quantities are called physical quantities. A physical quantity possesses at least two characteristic.

1. **Numerical magnitude (value)**
2. **Unit**

Types of Physical Quantities:-

There are two types of physical quantities.

1. **Base Quantities**
2. **Derived Quantities**

1. Base Quantities:-

Those quantities on the basis of which other quantities are expressed are called base Quantities.

There are seven base quantities.

1. Length 2. Mass 3. Time 4. Electric current
5. Temperature 6. Intensity of light 7. Amount of a substance

2. Derived Quantities:-

Those physical Quantities which are expressed in term of base quantities are called derived quantities.

There are seven derived quantities.

1. Speed 2. Acceleration 3. Force 4. Volume
5. Density 6. Pressure 7. Electric charge

Base Units:-

The units that describe base quantities are called base units. Seven quantities and their unit are given in a table.

Quantity		Unit	
Name	**Symbol**	**Name**	**Symbol**
Length	L	meter	m
Mass	M	kilogram	kg
Time	T	second	sec
Electric current	I	ampere	A
Intensity of light	L	candela	cd
Temperature	T	kelvin	k
Amount	N	mole	mol

Base Units:-

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

Quantity		Unit	
Name	**Symbol**	**Name**	**Symbol**
Speed	V	meter per second	m/sec
Acceleration	A	meter per s per s	m/sec^2
Volume	V	cubic meter	m^3
Force	F	neuton	n
Pressure	P	pascal	pa
Density	E	kilogram cubi meter per	kg /m^3
Charge	Q	coulomb	c

Prefixes:-

Prefixes are the words or letter added before SI units such as kilo, mega, giga and milli. These prefixes are very useful to express very large or very small quantities.

Example:-

1. 20,000 g = 20 kg (Here 'kilo' is prefix)
2. 20,000 m/sec = 20 km / sec (Here kilo is prefix)

Example:-

Mass of a body cannot be written as 20 kkg.

Scientific Notation:-

The method in which a number is written in some power of ten is called scientific notation.

In scientific notation a number is expressed as some power of ten multiplied by a number between 1 and 10.

Examples:-

1. 6275 = 6.27×10^3
2. 234678 = 2.34678×10^5
3. 28746 = 287.46×10^2

Standard Forms:-

In scientific notation if a number is written in such a way that only non-zero number comes before then this form of a number is called standard form.

Examples:-

1. 2734 = 2.734×10^3
2. 345 = 3.44×10^2
3. 28746 = 287.46×10^2

The Meter Rules:-

A meter rule is a length measuring instrument.

With the help of a meter rule we can measure length of an object or the distance between two points. It is one meter long and one meter is equal to 100 cm.

1 = 100 cm.

The Measuring Tape:-

Measuring tapes are used to measure length of a body in meters and centimeters. It is used by carpenters to measure of different bodies.

A simple measuring tape consist of a thin and long strip of plastic. It is marked in centimeters as well as in inches. Measuring tape are generally 10m, 20m, 50m and 100m long.

Vernier Calliper

Vernier Calliper:-

Vernier caliper is a device which can be used to measure length of a body up to one tenth part of millimeter (0.1mm)

Construction:-

A vernier caliper consist of two jaws. First jaw of is fixed with main scale.

Main Scale:-

Main scale of vernier caliper is a moveablet jaw. This moveable jaw is attached with vernier scale. Vernier scale has ten divisions over it.

Least count:-

The difference between one small division on main scale and one vernier scale division is 0.1mm and it is called least count of vernier caliper.

The minimum length which can be measured by using vernier calipers is called least count of the vernier caliper. It can be found by using the formula.

Least count of vernier caliper = smallest reading on main scale

$$= \frac{1 \text{ mm}}{10 \text{ divisions}}$$

= 0.1 mm

Or

Least count = 0.01 cm

Working of a vernier callipers:-

First of all we will find any error in the measuring instrument. This error of the instrument is called zero error. To remove the zero error a correction factor is applied. This correction factor is called zero correction.

Zero error and Zero Correction:-

To find zero error we will close the jaws of vernier calipers. If the zero line of the vernier scale coincides with the zero of main scale then the zero error is zero. But if zero line of the vernier scale is not coinciding with the zero of main scale then zero error is exists.

Positive zero error and Zero Correction:-

To find zero error we will close the jaws of vernier calipers. If the zero line of the vernier scale coincides with the zero of main scale then the zero error is zero. But if zero line of the vernier scale is not coinciding with the zero of main scale then zero error is exists.

Positive zero error:-

Zero error will be positive if zero line of vernier scale is on the right side of the zero of the main scale.

Negative zero error:-

Zero error will be negative if zero line of vernier scale is on the left side of the zero of the main scale.

Taking reading on vernier calipers:-

Suppose if we have to find the diameter of a solid cylinder then we place this solid cylinder between jaws of the vernier calipers.

First Step:-

To find zero error we will close the jaws of vernier calipers. If the zero line of the vernier scale coincides with the zero of main scale then the zero error is zero. But if zero line of the vernier scale is not coinciding with the zero of main scale then zero error is exists.

Second Step:-

In second step we will find the vernier scale division that is coinciding with any division on main scale.

Third step:-

In the third step we will multiply the second step reading with least count of vernier calipers and result is added in direct reading. The final result is equal to diameter of solid cylinder.

Screw Gauge:-

Screw guage is a device which can be used to measure length of a body up to one hundred part of a millimeter.

It is also called micrometer screw.

Construction:-

A simple screw gauge consist of U- shaped metal frame with a metal stud at its one end. A hollow cylinder has a millimeter scale over it. This hollow cylinder acts as a nut. It is fixed at one side of U- shaped frame.

Thimble:-

A thimble has threated spindle inside it. As the thimble completes its one rotaion then spindle moves 1 mm long the index line. This distance is called pitch of screw.

Least count of screw gauge:-

The minimum length which can be measured by using screw gauge is called least count of screw gauge. It can be found by using formula.

Least count = pitch of screw guage
= Number of division on circular scale
= $\frac{1 \text{ mm}}{100}$
= 0.01 mm
Or
= 0.001 cm

Physical Balance:-

A physical balance is a device which is used in laboratory to measure the mass of various objects by comparison method.

Construction:-

A simple physical balance consist of a uniform beam. Two pans are suspended from two ends of the beam. The body whose mass is to be measured is put on one pan and the weights are put on the other pan.

Lever Balance:-

A lever balance is a device which is used to measure mass of a body. It consist of a system of lever's its working is similar as that of physical balance.

Stop Watch:-

A stop watch is a device which is used to measure the time interval of an event. There are two types of stop watch

1. Mechanical stop watch
2. Digital stop watch

1. Mechanical stop watch:-

Such a stop watch which can measure time interval of an event up to 0.1 second is called mechanical stop watch.

2. Digital Stop Watch:-

Such a stop watch which can measure time interval of an event up to 0.01 second is called digital stop watch.

Measuring Cylinder:-

A measuring cylinder is a device which can measure volume of liquid in "millimeters". It can also used to find volume of irregular shaped solid which is insoluble in a liquid.

Significant Figures:-

In a measurement all the accurately known digits and first doubtful digit are called significant figures.

Example:-

If a person measures length of table as 12.5cm Then in this case all the three digits (1,2,5) are called significant figures. The first two digits from leftr are called accurately known digits. But third digit (5) is called doubtful digit.

Rules to Find Significant Figures:-

1. All non-zero digits are significant figures.
2. Zero's between two significant figures are also significant.
3. Final zero's or the zero'

Example:-

In 0.035 there are only two significant figures.

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Part 'a'

There are three scientific figures in the above number. Because after decimal point the first two zero's are used to space the decimal points.

Part 'b'

0.00580km

There are three scientific figures in the above number. Because after decimal point the first two zero's are used to space the decimal points.

0.00580 km = 5.8×10^{-3} km is its scientific notation.