Date

Expt. No. Page No.

CHAPTER 01

UNITS AND MEASUREMENT

Unit : A standard chosen to measure any physical quantity is called a unit.

- **Example :-** We need the unit meter to measure the Length of an object.

Physical Quantites :- Physical quantites are those quantities that are related to a physical phenomenon and, at the same time, can be measured either directly or indrectly.

For Example :- Length, mass, speed, etc.

Fundamental Quantities :- Those quantites in terms of which all other quantites in science are expressed - namely mass, time, length temperature, luminous intensity and electric current

TopExamNotes
TOP NOTES, TOP RESULTS

Teacher's Signature

Date
Expt. No. Page No.

and amount of substance -are called fundamental quantities, in which the amount of substance is also a fundamental quantity.

Measurement :- Measurement is the process througth which we find out how many times any quantity is of a standard measuring quantity.

Systems of Measurement

Different system of measurement are used at different places, which are as follows:-

1. M.K.S. System :- In this system, length is measured in meters, mass in kilograms, and time in seconds.

2. C.G.S. System :- In this system, length is measured in centimeters, mass in grams and time in seconds.

3. F.P.S. System :- In this system, length is measured in feet, mass in pounds, and time in seconds.

TopExamNotes
TOP NOTES, TOP RESULTS

Teacher's Signature

Date

Expt. No.   Page No.

International System of Measurement

The system of measurement is internationally accepted : it is also called the S.I. system. The meaning of S.I. is "Systeme International d' Unites."
In 1971, this system came into light after the general conference on weights and measures. This system became based on the recommendations made from time to time in the international conferences on weights and measure.

Base Physical Quantities and their Units

Base Physical Quantity	Unit	Symbol
Length	Meter	m
Time	Second	S
Mass	Kilogram	kg
Electric Current	Ampere	A
Temperature	kelvin	K
Amount of Substance	Mole	Mol
Luminous Intensity	Candela	Cd

Teacher's Signature

TopExamNotes
TOP NOTES, TOP RESULTS

Date ______

Expt. No. ______ Page No. ______

Measurement of length

1. **Measurement of extremely small distanes :-** Special methods are used to measure very small distances (Such as the size of atoms or the diameter of molecules), Same of which are as follows:-

(a) **Calculation of the radius of an atom by using Avogadro's hypothesis :-**

The atoms of any substance are bound together through strong forces of attraction. According to avogadro, 1 gram-atom of a substance contains 6.023×10^{23} atoms, and these atoms occupy two-thirds of the total volume of the substance.

Let the mass of the substance $= m$

Atomic weight of the substance $= M$

Volume occupied by the substance $= V$

Similarly, let the radius of an atom $= r$

Avogadro's number $= N$

TopExamNotes

Teacher's Signature

Number of atoms in 1 gram of substance = N/M

Then, number of atoms in m grams of substance

$$= m\left[\frac{N}{M}\right]$$

Similarly,

Volume occupied by one atom = $\left[\frac{4}{3}\pi r^3\right]$

Therefore, volume occupied by all the atoms of the substance

$$= m\left[\frac{N}{M}\right] \times \frac{4}{3}\pi r^3$$

Atoms occupy 2/3 volume of the substance. Total volume occupied = $\frac{2}{3}V$

$$m\left[\frac{N}{M}\right] \times \frac{4}{3}\pi r^3 = \frac{2}{3}V$$

$$m\left[\frac{N}{M}\right] \times 4\pi r^3 = 2V$$ (Multiplying by 3 on both sides)

$$m\left[\frac{N}{M}\right] \times 2\pi r^3 = V$$ (Dividing by 2 on both sides)

therefor :. $r^3 = \frac{Vm}{2\pi m N}$ (By transposing)

Teacher's Signature

Date

Expt. No. Page No.

$$r = \left[\frac{V m}{2 \pi m N} \right]^{1/3}$$

Where :- V → total volume of the substance.
M → Atomic mass.
m → Mass of the substance
N → Avagadro's number
π → 3.14 or $\frac{22}{7}$

Through this medium, the radius of any atom is determined.

2. Measurement of very large distances :- Very large distances, such as the height of a mountain or the distance from earth to the moon, cannot be measured using ordinary scales, for their measurement we use certain indirect methods, among which angular measurement is the most important.

(a) Calculation of the Diameter of the moon :- Let the observation point on the surface of the earth be P. When the moon is viewed through a telescope, the image

Teacher's Signature

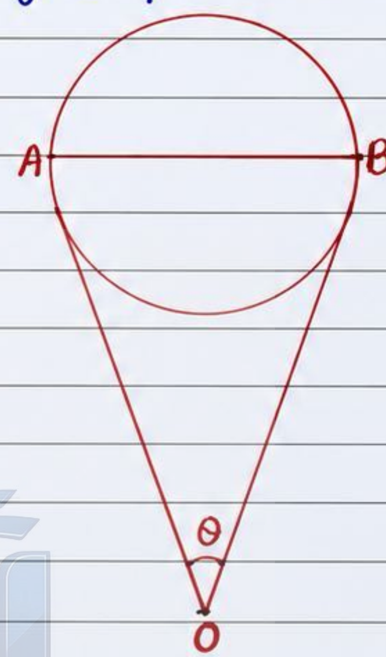
TopExamNotes
TOP NOTES TOP RESULTS

Date

Expt. No. Page No.

of the moon appears as a circulay shape in the telescope.

D = Linear diameter of the moon.



S = Mean distance of the moon from the earth.

θ = Angle formed by the diameter AB of the moon at the observation point p (Angular diameter)

Let the angle formed by the diameter AB of the moon at the observation point P be the angular diameter (θ).

Let the Linear diameter of the moon = D

Mean distance of the moon from the earth = S

and $\boxed{\text{Angle} = \dfrac{\text{Arc}}{\text{Radius}}}$

Hence,

Arc $AB = D$

Radius $PA = PB = S$

Teacher's Signature

Date

Expt. No. Page No.

therefore, Angular Diameter $(\theta) = D/S$

$$\boxed{D = S\theta}$$

therefore, if S is known by measuring the angle θ, the diameter of the moon can be easily determined.

(b) To find the distance of celestial bodies by parallax method :-

The parallax method is used to measure the distance of stars or celestial bodies which are located at a distance of less then approximately 100 light-years from the earth.

Principle and Method :- Let there be a nearby star S whose distance from the earth is to be determined.

We take a very distant star N as a reference.

first observation :- Angular inclination ϕ_1 is measured.

Second observation :- Angular inclination ϕ_2 is measured.

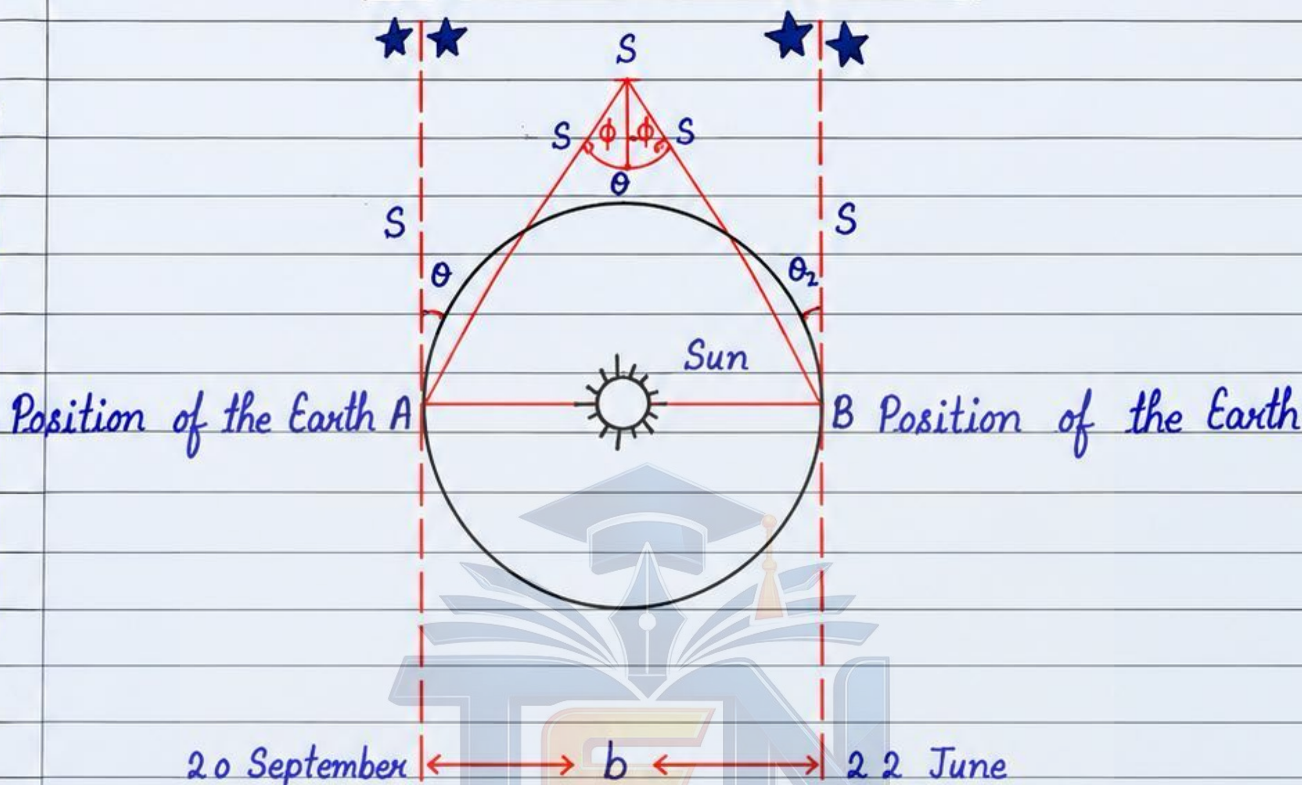
parallax Angle $\phi = \phi_1 + \phi_2$

Teacher's Signature

TopExamNotes
TOP NOTES, TOP RESULTS

Date

Expt. No. Page No.



Mathematical Calculation :-

$$\text{Angle} = \frac{\text{Arc}}{\text{Radius}}$$

arc $AB = b$

$SA = SB = s$ (Radius)

By using the formula :- $\phi = \frac{AB}{s} = \frac{b}{s}$

if the distance of the star is s, then $s = b/\phi$

Teacher's Signature

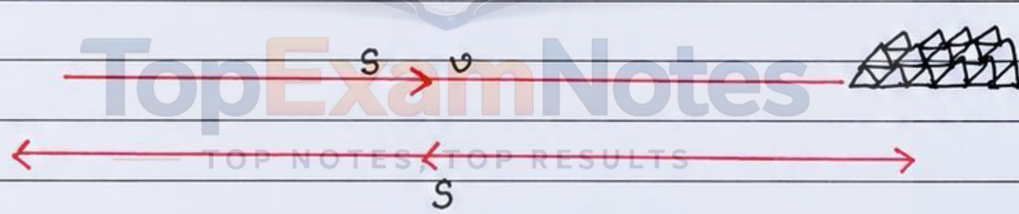
$$S = \frac{b}{\phi}$$

Therefore, if the parallax angle ϕ is known is radian, the distance s can be calculated.

1 light year $\approx 9.46 \times 10^{15}$ m

(C) Calculation of large distance by Echo Method or Reflection method :-

When a person stands at same distance from a hill and produces a sound, it strikes the hill and returns back. This is called an echo.



Suppose we fire a gun towards the hill from a distance. We note down the time interval between the production of the sound and its return (hearing the echo) using a stopwatch.

TopExamNotes
TOP NOTES, TOP RESULTS

Date

Expt. No. Page No.

Mathematical Calculation :- Let time interval = t

Speed / velocity of sound = v
Distance of the hill = S

Since the sound travels to the hill once and then returns, the total distance covered by it will be $2S$.

$$\text{Distance} = \text{Speed} \times \text{Time}$$
$$2S = v \cdot t$$

$$\boxed{S = \frac{v \cdot t}{2}}$$

(d) Laser method to find the distance of the moon from the Earth :-

(Light Amplification by stimulatad Emission of Radiation)-

This method is based on the reflection of light. Laser in monochromatic light. Due to its intensity. It can travel very long distance without spreading.

First of all, a, a laser beam is sent from the earth towards the moon. After hitting the

TopExamNotes
TOP NOTES TOP RESULTS

Teacher's Signature

Date

Expt. No.

Page No.

Surface of the moon, this light returns back to the Earth. The total time (t) taken for the laser to go and come back is noted very accurately.

Let the time for the beam to go to the moon and return be t.

$$\text{Distance} = \text{Speed} \times \text{Time}$$

Total distance of the laser beam $= S + S = 2S$

$$\text{Speed} = \frac{\text{Distance}}{\text{time}}$$

$$\text{Distance } (2S) = \text{Speed } (c) \times \text{Time } (t)$$

$$2S = c \cdot t$$

$$S = \frac{c \cdot t}{2}$$

Speed of Laser Beam $= 3 \times 10^8$ m/sec

Teacher's Signature

TopExamNotes
TOP NOTES, TOP RESULTS