Physics Notes

BY

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Class:10+1
Unit: I
Topic: Physical World & Measurement

SYLLABUS: UNIT-I

1-A **Physics-scope and excitement; Physics, technology and society. Force in nature, conservation laws; Examples of gravitational, electromagnetic and nuclear forces form daily-life experiences (qualitative description only).**

1-B **Need for measurement; Units of measurement; Systems of units; SI units, Fundamental and derived units.**

Length, mass and time measurements.

Dimensions of physical quantities, dimensional analysis and its applications.

Accuracy and precision of measuring instruments, Errors in measurement; Significant figures.

Unit 1-A

Q.1. a) What is Science?
b) Explain 'Scientific Method' with example?

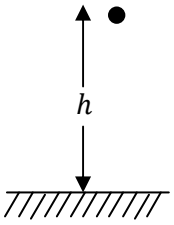
Ans.a) **Science**:-

Science is a systematic attempt to understand natural phenomenon in as much detail and depth as possible and to use the knowledge so gained to predict, modify and control phenomenon.

b) **Scientific Method**:-

Various steps involved are:-

1. **Observations**:-
   Scientist will observe a natural phenomenon with curiosity e.g:- Observation of Newton for a falling apply, motion of moon around earth, etc.



2. **Controlled Experiments**:-
   e.g:- Objects are made to fall from h, where h was different in different experiments.

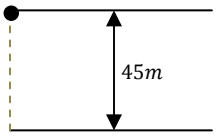
3. **Qualitative Reasoning**:-
   e.g:- If h increases, time of fall t also increases.

4. **Quantitative Reasoning**:-
   e.g:- If h becomes 4 times, t becomes 2 times.

5. **Mathematical Modeling**:-

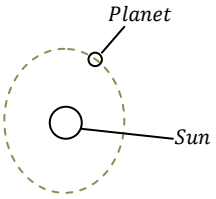
   e.g:- $h = \frac{1}{2}gt^2$

6. **Prediction**:-
   e.g:- If h = 45, time taken to fall will come out to be 3 seconds.



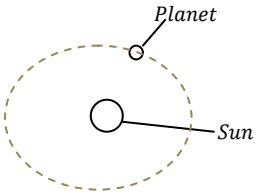
7. **Verification**:-
   Object was made to fall from 45m and time was noted. Time came out be 3.1 seconds.
   Formula was declared "Correct".

Q.2. Give one example of "Minor modification" and one example of "major modification" in theory to explain some phenomenon.



Ans. **Minor Modification**:-

e.g:- Circular Orbits



Kepler's Modification:-

e.g:- Elliptical Orbits

Major Modification:-

e.g:- Classical Mechanics was not sufficient to explain "Atom".

Quantum Physics:-

A new concept was introduced to explain "Atom".
Quantum concept was used to explain Atom.

Additional Knowledge:-

1. Theory
2. Experiment

OR

1. Experiment
2. Theory

e.g. 1.
Rutherford α scattering experiment – 1911
Bohar model of atom (theory) – 1913

e.g.2.
Paul Dirac gave theory of antiparticle – 1930
Confirmed by experiment of Care Anderson – 1932

Example of antiparticle of → e^- e^+
(Electron) (Positron)

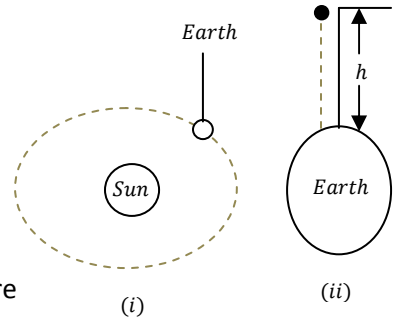
Q.3. a) What is Physics?
b) Explain two principle thrusts in physics i.e., "Unification" and "Reduction".

Ans.a) **Physics**:-

Physics is a branch of natural sciences which deals with the study of physical world by studying basic laws of nature. e.g. Gravity.

b) **Unification**:-

Process in which diverse phenomenon are explained in terms of few laws.

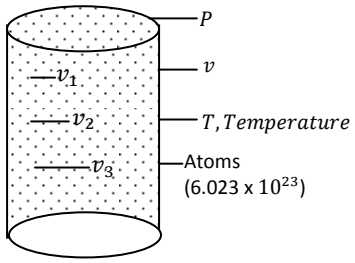


Example:

Falling apple or motion of earth around sun both are explained through the law i.e., "Law of Gravitation".

Reductionism:-

Process to derive the properties of bigger systems by understanding properties of constituent parts.



Example:

Property i.e. temperature, of big system i.e. cylinder, is explained in terms of property i.e. speed of atom.

Q.4. What is 'Scope' and 'Excitement' of physics?

Ans. The two domain of interest in Physics are: ***Macroscopic*** and ***Microscopic***. The macroscopic domain includes the study of phenomenon of involving objects of large finite size on terrestrial deals. This is called Classical Physics. It was developed upto year 1900. The microscopic domain includes the study of phenomenon involving molecular, atoms, nuclei, electrons, etc. This make up Modern Physics.

A new domain intermediate between macroscopic and microscopic domains has emerged. It involves the study of a few tons or hundreds of atoms or molecules. It is called ***Mesoscopic Physics***.

The Classical Physics includes subjects like Mechanics, Thermodynamics, Electrodynamics and Optics.

Mechanics deals with the study of general propulsion of water and sound waves etc. Thermodynamics deals with the study of changes in temperature, internal energy. Modes of transfer of heat, efficiency of heat engines and refrigerator are included in thermodynamics.

Electrodynamics deals with the study of electric and magnetic phenomenon. The basic laws governing these phenomenon are given by Coulombs, Oersted, Ampere and Faraday.

Optics involves the study of various phenomenon involving light and optical instruments like microscope, telescope etc.

Quantum theory is currently accepted as the proper framework for explaining microscopic domain.

Physics includes the study of (small) electron, proton, nuclei, of size 10^{-14}m or less, And at the end, it deals with galaxies and entire universe of size 10^{26}m.

Q.5. How Physics is related to
a) Other Sciences
b) Technology and Society

Ans.a) **Other Sciences**:-

1. **Chemistry**:-
   X-rays are used to study atom or molecular orientation.
2. **Biology**:-
   Microscope is used to see fine structure of leaf, curd, onion, etc.
3. **Astronomy**:-
   Telescope is used to see fine structure of objects far away from earth. e.g: Sun, Moon, Stars, etc.

b) **Technology and Society**:-

Use of Physics has great impact on society. Technologies like T.V., Mobile Phone, etc., have changed the society. It has resulted in betterment of society. e.g. Comfortable life, Knowledge, Connectivity, Big thinking skills, Infrastructure. It has negative impact on our society. e.g. use of weapons, pollution, complicated life.

Q.6. Discuss properties/characteristics of 'Fundamental Forces'.

Ans.a) **<u>Gravitational Force</u>**:-

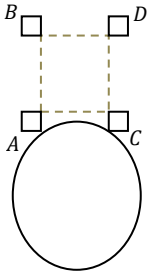
The gravitational force is the force of mutual attraction between any two objects by virtue of their masses.

1. Gravitational force is universal attractive force. It means it acts between two objects having mass
   e.g. It acts between two atoms and also between two planets.
2. These are the weakest forces in nature.
   e.g. m_1 = 1Kg, m_2 = 1Kg, r = 1m, Force = ?
   F = 6.6 x 10^{-v} V
3. Range i.e. distance upto which they operate is very large
   e.g:- Sun & Earth. Distance between two is 15 crore km.
4. Inverse square law i.e.,

   F α $\frac{1}{r^2}$

5. Central force. When force

   To move, masses m_1 and m_2 will move along the line joining centers of two masses.
6. Gravitational forces are 'Conservative Forces'. It means work done does not depend on path followed.
   e.g:- If a particle of mass m moves from A to B, work done is independent of path followed.
7. Field particle is 'Graviton'.



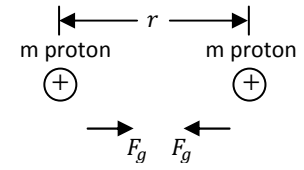
b) **<u>Electromagnetic Force</u>**:-

The electromagnetic forces are force which are by virtue of charges on two particles.

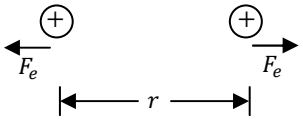
1. Attractive or Repulsive
2. Governed by Coulomb's Law

$$\left[F = 9\ x\ 10^9\ \frac{q_1 q_2}{r^2}\right]$$

3. Inverse square law F α $\frac{1}{r^2}$



4. $\frac{F_{e.m}}{F_{gravity}}$ = 10^{36}
5. Range not as large as gravitational force
6. Central forces
7. Conservative
8. Field particle is 'Photon'.



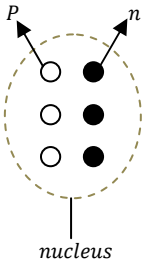
c) **Strong Nuclear Forces**:-

Force that binds the nucleons of nucleus together, is called nuclear force.

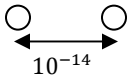
1. Strongest force

$\frac{F_{nuclear}}{F_{gravitation}} = 10^{38}$

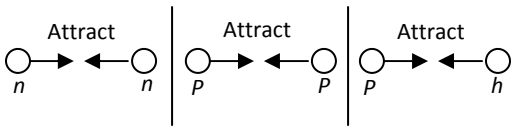
$\frac{F_{nuclear}}{F_{electromagnetic}} = 100$



2. Range:-
Shortest range of the order of 10^{-14}



3. Do not depend on charge



4. Do not obey inverse square law

$F \alpha \frac{1}{r^n}$

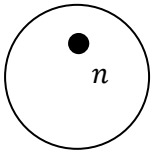
n > 2 i.e. n = 3,4,5,……

5. Attractive for distance > 0.5 Fermi
Repulsive for distance < 0.5 Fermi

6. Non-Central
7. Non-Conservative
8. Field particle → π meson

d) **Weak Nuclear Force**:-

These forces are the forces of interaction between elementary particles of short life times.



$n \rightarrow p^{+1} + e^{-1} + \nu$

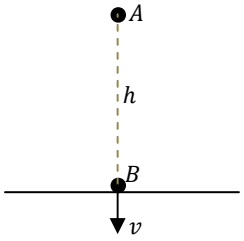
neutron — proton — β-particle (electron) — neutrino

Q.7. State four conservation laws used in Physics.

Ans. 1. Law of Conservation of Energy
2. Law of Conservation of Linear Momentum
3. Law of Conservation of Angular Momentum
4. Law of Conservation of Change

1. **LAW OF CONSERVATION OF ENERGY**:-

Energy can neither be created nor destroyed, it can be changed from one form to another.

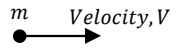


Example:-

i) Potential Energy at A is converted to Kinetic Energy at B
ii) In a Gun, spring energy is converted into Kinetic Energy
iii) In solar furnaces, Solar Energy is converted into Heat Energy.

2. **Law of Conservation of Linear Momentum**:-

Total momentum of system is conserved if there is no external force acting.



P = mv

Example:-

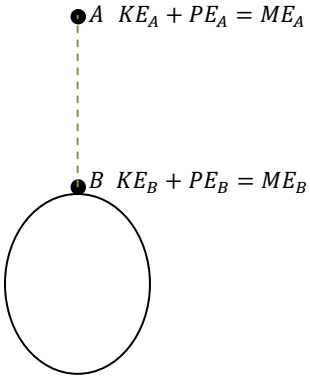
i) When a bullet is fired bullet moves in forward direction and gun moves in backward direction
ii) Man in a boat jump out at the shore, Man jumps in forward direction, whereas the boat moves backward.

3. **Law of Conservation of Angular Momentum**:-

Total Angular Momentum of system is conserved if there is no external torque acting.

Example:-

i) When a person rotates with dumbles in hand, he can change speed by moving the hands in or out



4. **Law of Conservation of Charge**:-

Charge can neither be created nor destroyed.

Example:-

i) n → p^{+1} + e^{-1} + v

Mechanical Energy = KE + PE

$[ME_A = KE_A + PE_A = 0 + 100]$
$[ME_B = KE_B + PE_B = 100 + 0]$

Unit 1-B

Q.1. What is the need for measurement in Physics?

Ans. Physics deals with nature and natural phenomenon. Laws of Physics are described in terms of Physical Quantities.

Measurement of Physical Quantities is must to have a Quantitative Analysis

Example:-

F = m x a

Numerical value of m and a is required to find the numerical value of F. If m = 2Kg, a = $3ms^{-2}$

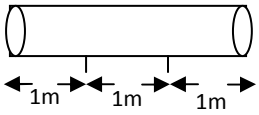
F = m x a

= (2)(3)

F = 6N

Q.2. Explain the measuring process with the help of one example.

Ans. First of all unit is chosen for measuring process. Secondly, measuring process is carried out to find how many such units are equal to given length, area, etc.



Example:-

Process of measuring length of a rod.

1. Unit (say m)
2. How many such units make 1 rod.
   Here it is 3 times.
   So, answer is 3m.

Physical Quantity

Q = n.u

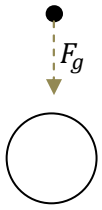
Q → Physical Quantity
n → no. of times
u → Unit

Q = $n_1u_1 = n_2u_2$

Eg:- (1)(Kg) = (1000)(gm)

Q.3. Compare 'Inertial Mass' and 'Gravitational Mass'.

Ans.

	Inertial Mass	Gravitational Mass
01	Measure of Inertia of body	Measure of gravitational full of motion on body
02	m_i F_{app} → ▨ → area, a $F_{applied}$, a are measured $m_i = \frac{F_{app}}{a}$ $= \frac{100N}{20ms^{-2}}$ (say) m_i = 5 Kg	$M_{gravitation} = \frac{F_g}{acc.\ due\ to\ gravity}$ $= \frac{100N}{10ms^{-2}}$ = 10 Kg 
03	Numerical value is same	Numerical value is same

Q.4. What are fundamental and derived units?

Ans. **Fundamental Units**:-

Fundamental Units are basic units those cannot be written in terms of any other basic unit e.g: length, mass, time, etc.

Derived Units:-

Units of measurement of all physical quantities which can be obtained from fundamental units.

Example:-

Area = Length x Breath

= m x m

Area = m^2

Volume = m^3

So, Area and Volume are derived units.

Length is fundamental unit.

Choice of Standard Unit:-

1. It should be of suitable size.
2. It should be accurately defined.
3. It should be easily accessible.
4. Easily reproducible.
5. It should not change with time.
6. It should not change with temperature, pressure, etc.

Q.5. What are various systems of units? Explain SI.

Ans.a) ***f. p. s.* System**:-

f → foot (length)
p → pound (mass)
s → second (time)

b) ***c. g. s.* System**:-

c → centimeter
g → gram
s → second

c) ***m. k. s.* System**:-

m → meter
k → kilogram
s → second

a) ***SI* System**:-

S.No.	Basic Physical Qty.	Fundamental Unit	Symbol
1.	Mass	Kilogram	kg
2.	Length	Meter	m
3.	Time	Second	S
4.	Temperature	Kelvin	k
5.	Electric Current	Ampere	a
6.	Luminous Intensity	Candela	cd
7.	Quantity of Matter	Mole	mol

Q.6. Define SI units ?

Ans.1. **Meter**:-

The meter is the length of the path travelled by light in vacuum in 1/299, 792, 458 of a second.

Explanation:-

1. Speed of light = 3 x 10^8 m/sec.
2. Time = $\frac{Distance}{Speed}$

   = $\frac{1m}{3 \text{ x } 10^8 \text{ m/sec}}$

   Time = $\left(\frac{1}{3 \text{ x } 10^8}\right)$ sec

3. Time = $\frac{1}{2.99792468\ x\ 10^8}$

2. **Kilogram**:-

One kilogram is defined as the mass of the international prototype of the kilogram (which is a standard block of Platinum Iridium Alloy preserved in the International Bureau of Weight and Measures at serves, near Paris, France).

3. **Second**:-

One second is the duration of 9,192,631,770 periods of radiation corresponding to unperturbed transition between the two superfine levels [F = 4, M = 0 and F = 3, M = 0] of the ground state of Cs - 133 atom. Atomic clocks are based on this definition.

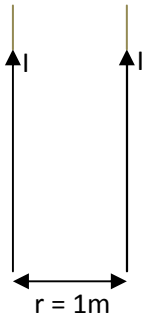
Explanation:-

1. Phenomenon repeats itself after a fixed interval of time.
2. Small units ensure better accuracy.
3. Atomic oscillations have time of order 10^{-9} sec.
4. Cs – 133 is used as atomic clock.
5. Atomic clocks have accuracy of 1 sec in 5000 years.

4. **Ampere**:-

One ampere is the constant current, which when maintained in each of the two straight parallel conductor of infinite length and negligible cross section, hold 1m apart in vacuum, shall produce a force/unit length of 2 x 10^{-7} N/m between them.

Explanation:-



Force/length $= \left(\frac{\mu_0}{2\pi}\right). \frac{I.I}{r}$

$= \left(\frac{4\pi\ x\ 10^{-7}}{2\pi}\right). \frac{I.I}{r}$

Force/length $= 2 \text{ x } 10^{-7} . \frac{I.I}{r}$

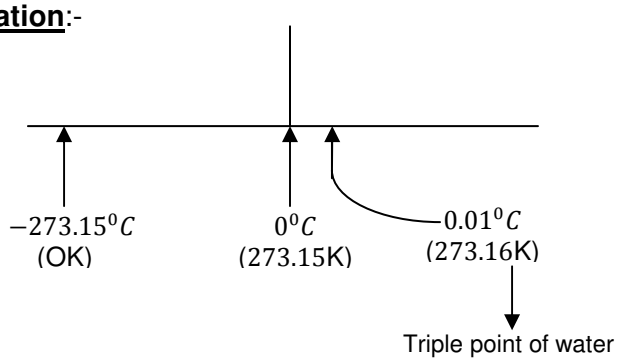
$= 2 \text{ x } 10^{-7} . \frac{I.I}{I}$

Force/length $= 2 \text{ x } 10^{-7}$ N/m

5. **Kelvin**:-

It was adopted as the unit of temperature. One degree Kelvin is the fraction (1/273.16) of the thermodynamical temperature of the triple point of water.

Explanation:-



1. Triple point of water is 273.16K
2. 1K is $\frac{1}{273.16}$ of Triple point of water.
3. Triple point of water is temperature at which all the three state of water co-exists.

6. **Candela**:-

The candela is the luminous intensity, in a given direction, of a source that emits monochromatic radiation of frequency $540x10^{12}$ hertz and that has a radiant intensity in that direction of 1/683 watt per steradian

7. **Mole**:-

The mole is the amount of substance of a system, which contains as many elementary entities as there are atoms in 0.012 kilogram of carbon – 12.

Explanation:-

1. $6.023 \text{ x } 10^{23}$
2. $C^{12} \rightarrow 12g = 6.023 \text{ x } 10^{23}$

Q.7. What is SI System of Units?
What is advantage of SI System of Units?

Ans. **SI Units**:-

International system of units having seven fundamental and two supplementary units.

Advantage of SI:

1. **Coherent System**:-

   All derived units are obtained from fundamental without introducing numerical factors.

   Example:-

   Unit of Energy → joule
   Unit of Force → newton
   Unit of Length → m

   work = force x distance

   J = N x m

   = Kg $\frac{m}{sec^2}$ m

2. **Rational System**:-

   It assigns only one unit to a particular physical quantity.

   Example:-
   Unit of Work → J
   Unit of Heat → J

   All forms of energy are assigned same unit i.e. joule.

3. **Absolute System**:-

   There are no gravitational units in system.

   Example:-

   Weight = 10N and is not → 1Kg.wt.

4. **Metric System**:-

   Multiples and submultiples of units are in power of 10.

   Example:-
   1Kg = 10^3 gram

   1Km = 10^3 m

   1m = 10^2 cm

Q.8. Explain

a) Astronomical Unit

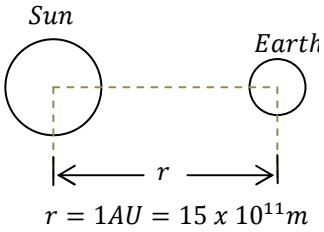
b) Light year

c) Par Second

Find a relation between any two out of three.

Ans.a) **Astronomical Unit (AU)**:-

It is the average distance between the centre of earth and centre of sun.



1 AU = 15 crore km

= 15 x 10^7 x 10^3 m

1 AU = 15 x 10^{10} m

1 AU = 15 x 10^{11} m

b) **Light Year (LY)**:-

Distance travelled by light in vacuum in one year.

Distance = Speed x Time

1LY = S x T

= 3 x $10^8 \frac{m}{sec}$ (1 year)

= $\left(3 \text{ x } 10^8 \frac{m}{sec}\right)$ [365 x 24 x 60 x 60]

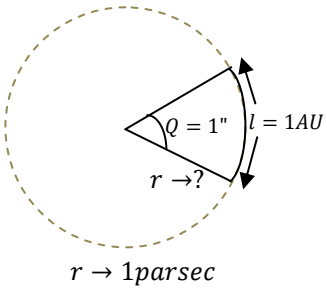
1LY = 9.46 x 10^{15}m

= 10 x 10^{15}

= 10^{16}m (approx)

c) **Parsec (PS)**:-

One Parsec is the radius of circle at the centre of which an arc of length 1AU subtends an angle of 1".



r = $\frac{l}{\theta}$

= $\frac{1\ AU}{1"}$

= $\frac{1.5\ x\ 10^{11} m}{\left[\frac{1}{3600}\right]\left[\frac{2\pi}{360} rad\right]}$

1PS = 3.09 x $10^{16} m$

= 3.1 x $10^{16} m$ (approx)