Unit

Unit : The chosen standard used for measuring a physical quantity is called unit.

Unit should be :

(i) well defined
(ii) easy to reproduce
(iii)easy to compare
(v) internationally accepted
(iv)independent of changes in physical conditions

Units are of two types-(i) Fundamental Unit; (i) Derived Unit

System of Units-Units depend on choice. Each choice of units leads to a new system (set) of units. The internationally accepted systems are (i) CGS system, (ii) MKS System (iii) FPS System (iv) SI Units.

In SI Units, there are seven fundamental units given in the following table:

S. No	**Physical Quantity**	**SI Unit**	**Symbol**
1.	Length	metre	M
2.	Temperature	kelvin	K
3.	Mass	kilogram	Kg
4.	Luminuous intensity	candela	Cd
5.	Time	second	S
6.	Amount of substance	mole	Mol
7.	Electric Current	ampere	A

Besides these seven fundamental units, two supplementary units are also defined, viz., radian [rad] for plane angle and steradian (sr) for solid angle.

All the units which are defined / expressed in terms of fundamental units are called derived units.

Motion

Scalar Quantities : Physical quantities which have magnitude only and no direction are called scalar quantities.

Example : Mass, speed, volume, work, time, power, energy etc.

Vector Quantities : Physical quantities which have magnitude and direction both and which obey triangle law are called vector quantities.

Example : Displacement, velocity, acceleration, force, momentum, torque etc. Electric current, though has a direction, is a scalar quantity because it does not obey triangle law.
Moment of inertia, pressure, refractive index, stress are tensor quantities.

Distance : Distance is the length of actual path covered by a moving object in a given time interval.

Displacement : Shortest distance covered by a body in a definite direction is called displacement.

1. Distance is a scalar quantity whereas displacement is a vector quantity both having the same unit (metre)

2. Displacement may be positive, negative or zero whereas distance is always positive.

3. In general, magnitude of displacement = distance

Speed : Distance travelled by the moving object in unit time interval is called speed i.e. speed = Distance/Time It is a scalar quantity and its SI unit is metre / second (m/s).

Velocity : Velocity of a moving object is defined as the displacement of the object in unit time interval i.e. velocity = Displacement / Time

It is a vector quantity and its SI unit is metre / second.

Acceleration : Acceleration of an object is defined as the rate of change of velocity of the object i.e. acceleration = Change in Velocity / Time

It is a vector quantity and its SI units is metre / second2 (m/s2)

If velocity decreases with time then acceleration is negative and is called retardation.

Circular Motion : It an object describes a circular path (circle) its motion is called circular motion. If the object moves with uniform speed, its motion is uniform circular motion.

Uniform circular motion is an accelerated motion because the direction of velocity changes continuously.

Angular Velocity : The angle subtended by the line joining the object from the origin of circle in unit time interval is called angular velocity.

It is generally denoted by ? and ? = ?/T

If T = time period = time taken by the object to complete one revolution, n = frequency = no. of revolutions in one second.
then nT = 1 & ? = 2,,/T=2pn.

----> In one revolution, the object travels 2pr distance.
Linear speed = ?r = angular speed x radius

Newton's laws of motion : Newton, the father of physics established the laws of motion in his book "principia" in 1687.

Newton's first law of motion : Every body maintains its initial state of rest or motion with uniform speed on a straight line unless an external force acts on it.

1. First law is also called law of Galileo or law of inertia.

2. Inertia : Inertia is the property of a body by virtue of which the body opposes change in its initial state of rest or motion with uniform speed on a straight line.

----> Inertia is of two types (i) Inertia of rest (ii) Inertia of motion

Some examples of Inertia :

(i) When a car or train starts suddenly, the passengers bends backward.

(ii) When a running horse stops suddenly, the rider bends forward.

(iii) When a coat / blanket is beaten by a stick, the dust particles are removed.

First law gives the definition of force.

Force : Force is that external cause which when acts on a body changes or tries to change the initial state of the body.

Momentum : Momentum is the property of a moving body and is defined as the product of mass and velocity of the body i.e.
momentum = mass x velocity.

It is a vector quantity. Its SI unit is kgm/s.

Newton's second law of motion : The rate of change in momentum of a body is directly proportional to the applied force on the body and takes place in the direction of force.

If F = force applied, a = acceleration produced and m = mass of body the nF = ma.

----> Newton's second law gives the magnitude of force.

----> Newton's first law is contained in the second law.

Newton's Third Law of Motion : To every action, there is an equal and opposite reaction.
Examples of third law-(i) Recoil of a gun (ii) Motion of rocket (iii) Swimming (iv) While drawing water from the well, if the string breaks up the man drawing water falls back.

Principle of conservation of linear momentum : If no external force acts on a system of bodies, the total linear momentum of the system of bodies remains constant.
As a consequence, the total momentum of bodies before and after collision remains the same.

Impulse : When a large force acts on a body for very small time, then force is called impulsive force. Impulse is defined as the product of force and time.
Impulse = force x time = change in momentum.

----> It is a vector quantity and its direction is the direction of force. Its SI unit is newton second (Ns).

Centripetal Force : When a body travels along a circular path, its velocity changes continuously. Naturally an external force always acts on the body towards the centre of the path.
The external force required to maintain the circular motion of the body is called centripetal force.

If a body of mass m is moving on a circular path of radius R with uniform speed v, then the required centripetal force, F = mv2/R.

Centrifugal Force : In applying the Newton's laws of motion, we have to consider some forces which can not be assigned to any object in the surrounding. These forces are called pseudo force or inertial force.
Centrifugal force is such a pseudo force. It is equal and opposite to centripetal force.

----> Cream separator, centrifugal drier work on the principle of centrifugal force.

----> Centrifugal force should not be confused as the reaction to centripetal force because forces of action and reaction act on different bodies.

Moment of force : The rotational effect of a force on a body about an axis of rotation is described in terms of moment of force.
Moment of a force about an axis of rotation is measured as the product of magnitude of force and the perpendicular distance of direction of force from the axis of rotation.
i.e. Moment of force = Force x moment arm

----> It is a vector quantity.

----> Its SI unit is newton metre (Nm)

Centre of Gravity : The centre of gravity of a body is that point through which the entire weight of body acts. The centre of gravity of a body does not change with the change in orientation of body in space.
The weight of a body acts through centre of gravity in the downward direction.
Hence a body can be brought to equilibrium by applying a force equal to its weight in the vertically upward direction through centre of gravity.

Equilibrium : If the resultant of all the forces acting on a body is zero then the body is said to be in equilibrium.
If a body is in equilibrium, it will be either at rest or in uniform motion. If it is at rest, the equilibrium is called static, otherwise dynamic.
Static equilibrium is of the following three types :

(i)Stable Equilibrium : If on slight displacement from equilibrium position, a body has tendency to regain its original position, it is said to be in stable equilibrium.

(ii)Unstable equilibrium : If on slight displacement from equilibrium position, a body moves in the direction of displacement and does not regain its original position, the equilibrium is said to unstable equilibrium. In this equilibrium, the centre of gravity of the body is at the highest position.

(iii)Neutral Equilibrium : If on slight displacement from equilibrium position a body has no tendency to come back to its original position or to move in the direction of displacement, it is said to be in neutral equilibrium. In neutral equilibrium, the centre of gravity always remains at the same height.

Conditions for stable Equilibrium : For stable equilibrium of a body, the following two conditions should be fulfilled.

(i) The centre of gravity of the body should be at the minimum height.

(ii) The vertical line passing through the centre of gravity of the body should pass through the base of the body.

Work, Energy and Power

Work : If a body gets displaced when a force acts on it, work is said to be done. Work is measured by the product of force and displacement of the body along the direction of force.

If a body gets displaced by S when a force F acts on it, then the work W = FS cos?

where 0 = angle between force and displacement.

If both force and displacement are in the same direction, then W = FS

Work is a scalar quantity and its SI unit is joule.

Energy : Capacity of doing work by a body is called its energy.

---> Energy is a scalar quantity and its SI unit is joule.

---> Energy developed in a body due to work done on it is called mechanical energy. Mechanical energy is of two types :

(i) Potential Energy (ii) Kinetic Energy
Potential Energy : The capacity of doing work developed in a body due to its position or configuration is called its potential energy.

Example : (i) energy of stretched or compressed spring (ii) energy of water collected at a height (iii) energy of spring in a watch.

PE of a body in the gravitational field of earth is mgh.

where m = mass, g = acceleration due to gravity, h = height of the body from surface of the earth.

Kinetic Energy : Energy possess by a body due to its motion is called Kinetic Energy of the body If a body of mass m is moving with speed v, then kinetic energy of the body is 1/2 mv2
Principle of Conservation of Energy.

Energy can neither be created nor can be destroyed. Only energy can be transformed from one form to another form. Whenever energy is utilized in one form, equal amount of energy is produced in other form. Hence total energy of the universe always remains the same. This is called the principle of

conservation of energy.
Some Equipments used to Transform Energy

Relation between Momentum and Kinetic Energy

K.E = p2/2m where p = momentum = mv

Clearly when momentum is doubled, kinetic energy becomes four times.

Power : Rate of doing work is called power.
It an agent does W work in time t, then power of agent = W/t
SI unit of power is watt named as a respect to the scientist James Watt.

watt = joule / sec.
1 kW = 103 watt
1 MW = 106 watt

Horse power is a practical unit of power. 1 H.P. = 746 watt.

1 watt second = 1 watt x 1 second = 1 joule.
1 watt hour (Wh) = 3600 joule
1 kilowatt hour (kWh) = 3.6 x 106 joule.

W, kW, MW & H.P. are units of power.
Ws, Wh, kWh are units of work and energy.

Gravitation

Gravitation : Every body attracts other body by a force called force of gravitation.
Newton's law of Gravitation : The force of gravitational attraction between two point bodies is directly proportional to the product of their masses and inversely proportional to the square of the distance between them.

Consider two point bodies of masses m1 and m2 are placed at a distance r. The force of gravitational attraction between them, F = G m1 m2/r2

Here G is constant called universal gravitational constant. The value of G is 6.67 x 10-11 Nm2/kg2.

Gravity : The gravitational force of earth is called gravity i.e. gravity is the force by which earth pulls a body towards its centre.

The acceleration produced in a body due to force of gravity is called acceleration due to gravity (denoted as g) and its value is 9.8 m / s2.

---> Acceleration due to gravity is independent of shape, size and mass of the body.

Variation in g

(i) value of g decreases with height or depth from earth's surface.

(ii) g is maximum at poles.

(iii) g is minimum at equator.

(iv) g decreases due to rotation of earth.

(v) g decreases if angular speed of earth increases and increases if angular speed of earth decreases.

---> If angular speed of earth becomes 17 times its present value, a body on the equator becomes weightless.
Weight of a body in a lift

(i) If lift is stationary or moving with uniform speed (either upward or down ward), the apparent weight of a body is equal to its true weight.

(ii) If lift is going up with acceleration, the apparent weight of a body is more than the true weight.

(iii) If lift is going down with acceleration, the apparent weight of a body is less than the true weight.

(iv) If the cord of the lift is broken, it falls freely. In this situation the weight of a body in the lift becomes zero. This is the situation of weightlessness.

(v) While going down, if the acceleration of lift is more than acceleration due to gravity, a body in the lift goes in contact of the ceiling of lift.

Kepler's Laws of planetary motion

(i) All planets move around the sun in elliptical orbits, with the sun being at rest at one focus of the orbit.

(ii) The position vector of the planet with sun at the origin sweeps out equal area in equal time i.e. The areal velocity of planet around the sun always remains constant.
A consequence of this law is that the speed of planet increases when the planet is closer to the sun and decreases when the planet is far away from sun.
Speed of a planet is maximum when it is at perigee and minimum when it is at apogee.

(iii) The square of the period of revolution of a planet around the sun is directly proportional to the cube of mean distance of planet from the sun.
If T is period of revolution and r is the mean distance of planet from sun then T ? r3.
Clearly distant planets have larger period of revolution. The time period of nearest planet Mercury is 88 days where as time period of farthest planet Pluto is 247.7 years.

Satellite : Satellites are natural or artificial bodies revolving around a planet under its gravitational attraction. Moon is a natural satellite while INSAT-IB is an artificial satellite of earth.
Orbital speed of a satellite

(i) Orbital speed of a satellite is independent of its mass. Hence satellites of different masses revolving in the orbit of same radius have same orbital speed.

(ii) Orbital speed of a satellite depends upon the radius of orbit (height of satellite from the surface of earth). Greater the radius of orbit, lesser will be the orbital speed.

--> The orbital speed of a satellite revolving near the surface of earth is 7.9 km / sec.

Period of Revolution of a satellite : Time taken by a satellite to complete one revolution in its orbit is called its period of revolution.

i.e. period of revolution =circumference of orbit / or bital speed

(i) Period of revolution of a satellite depends upon the height of satellite from the surface of earth. Greater the height, more will be the period of revolution.

(ii) Period of revolution of a satellite is independent of its mass.

--> The period of revolution of satellite revolving near the surface of earth is 1 hour 24 minute (84 minute)

Geo-Stationary Satellite : If a satellite revolves in equatorial plane in the direction of earth's rotation i.e. from west to east with a period of revolution equal to time period of rotation of earth on its own axis i.e. 24 hours, then the satellite will appear stationary relative to earth. Such a satellite is called Geo-stationary satellite. Such a satellite revolves around the earth at a height of 36000 km. The orbit of Geo-stationary satellite is called parking orbit. Arthur C. Clarck was first to predict that a communication satellite can be stationed in the geosynchronous orbit.

Escape velocity : Escape velocity is that minimum velocity with which a body should be projected from the surface of earth so as it goes out of gravitational field of earth and never return to earth.

--> Escape velocity is independent of the mass, shape and size of the body and its direction of projection.

--> Escape velocity is also called second cosmic velocity.

--> For earth, escape velocity = 11.2 km/s. For moon, escape velocity = 2.4 km/s.

--> Orbital velocity of a satellite V0 = vg R and escape velocity Ve = v2gR where R = Radius of earth, i.e. Ve = v2 V0 i.e. escape velocity is v2 times the orbital velocity.

Therefore if the orbital velocity of a satellite is increased to v2 times (increased by 41%), the satellite will leave the orbit and escape.

Pressure

Pressure : Pressure is defined as force acting normally on unit area of the surface.

1. Pressure (P) = F/A = Normal force on the surface / Area of the surface

2. SI unit of pressure is N / m2 also called pascal (Pa). Pressure is a scalar quantity.

Atmospheric Pressure :

Atmospheric pressure is that pressure which is exerted by a mercury column of 76 cm length at 0°C at 45° latitude at the sea-level. It is equal to weight of 76 cm column of mercury of cross-sectional area 1 cm2. Generally it is measured in bar. 1 bar = 105 N/m2

Atmospheric pressure 1 atm = 1.01 bar = 1.01 x 105 N/m2 = 760 torr One torr is the pressure exerted by a mercury column of 1 mm length.

1. Atmospheric pressure decreases with altitude (height from earth's surface). This is why (i) It is difficult to cook on the mountain (ii) The fountain pen of a passenger leaks in aeroplane at height.

2. Atmospheric pressure is measured by barometer. With the help of barometer, weather forecast can be made.

3. Sudden fall in barometric reading is the indication of storm.

4. Slow fall in barometric reading is the indication of rain.

5. Slow rise in the barometric reading is the indication of clear weather.

Pressure in liquid :

Force exerted on unit area of wall or base of the container by the molecules of liquid is the pressure of liquid.
The pressure exerted by liquid at depth h below the surface of liquid is given as p = hdg where d is the density of liquid.

1. Regarding pressure, the following points are worth noting:

(i) In a static liquid at same horizontal level, pressure is same at all points.

(ii) Pressure at a point in a static liquid has same value in all directions

(iii) Pressure at a point in a liquid is proportional to the depth of the point from the free surface.

(iv) Pressure at a point in a liquid is proportional to the density of the liquid.

Pascal law for pressure of liquid

(i) If gravitational attraction is negligible, in equilibrium condition, pressure is same at all points in a liquid.

(ii) If an external pressure is applied to an exclosed fluid, it is transmitted undiminished to every direction.

---> Hydrolic lift, hydrolic press, Hydrolic brake work on Pascal law.

Effect of pressure on Melting Point and Boiling Point

(i) The M.P. of substances which expands on fusion increases with the increase in pressure; for example - wax.

(ii) The M.P. of substances which contracts on fusion decreases with the increase in temperature for example - ice.

(iii) Boiling point of all the substances increases with the increase in pressure.

Floatation

Buoyant Force : When a body is immersed party or wholly in a liquid, a force acts on the body by the liquid in the upward direction. This force is called Buoyant force or force of buoyancy or up thrust. It is equal to the weight of liquid displaced by the body and acts at the centre of gravity of displaced liquid. Its study was first made by Archimedes.

Archimedes Principle : When a body is immersed partly or wholly in a liquid, there is an apparent loss in the weight of the body which is equal to the weight of liquid displaced by the body.

Law of Floatation

A body floats in a liquid if

(i) density of material of body is less than or equal to the density of liquid.

(ii) If density of material of body is equal to density of liquid, the body floats fully submerged in liquid in neutral equilibrium.

(iii) When body floats in neutral equilibrium, the weight of the body is equal to the weight of displaced liquid.

(iv) The centre of gravity of the body and centre of gravity of the displaced liquid should be in one vertical line.

Centre of Buoyancy : The centre of gravity of the liquid displaced by a body is called centre of buoyancy.

Meta Centre : When a floating body is slightly tilted from equilibrium position, the centre of buoyancy shifts. The point at which the vertical line passing through the new position of centre of buoyancy meets with the initial line is called meta centre.
Conditions for stable equilibrium of Floating body

(i) The meta centre must always be higher than the centre gravity of the body.

(ii) The line joining the centre of gravity of the body and centre of flotation should be vertical.

Density : Density is defined as mass per unit volume.

Density = mass/volume. Its SI unit is kg/m3.
Relative density = density of material / density of water at 4°C

Since relative density is a ratio, it is unitless.

1. Relative density is measured by Hydrometer.
2. The density of sea water is more than that of normal water. This explains why it is easier to swim in sea water.
3. When ice floats in water, it's the part remain outside the water.
4. If ice floating in water in a vessel melts, the level of water in the vessel does not change.
5. Purity of milk is measured by lactometer.

Viscosity

Viscous force : The force which opposes the relative motion between different layers of liquid or gases is called viscous force.
Viscosity : Viscosity is the property of a liquid by virtue of which it opposes the relative motion between its different layers.

1. Viscosity is the property of liquids and gases both.

2. The viscosity of a liquid is due to cohesive force between its molecules.

3. The viscosity of a gas is due to diffusion of its molecules from one layer to other layer.

4. Viscosity of gases is much less than that of liquids. There is no viscosity in solids.

5. Viscosity of an ideal fluid is zero.

6. With rise in temperature, viscosity of liquids decreases and that for gases increases.

7. Viscosity of a fluid is measured by its coefficient of viscosity. Its SI unit is decapoise (kg/ms) or pascal second. It is generally denoted by ?.

1. Terminal Velocity : When a body falls in a viscous medium, its velocity first increases and finally becomes constant. This constant velocity is called Terminal velocity.
In this situation, the weight of the body is equal to the sum of viscous force and force of buoyancy i.e. the net force on the body is zero.
Terminal velocity of a spherical body falling in a viscous medium is proportional to the square of radius of the body.

2. Streamline Flow : If a fluid is flowing in such a way that velocity of all the fluid particles reaching a particular point is same at all time, then the flow of fluid is said to be streamline flow. Thus in streamline flow, each particle follows the same path as followed by a previous particle passing through that point.

Critical Velocity : The maximum velocity up to which fluid motion is streamline is called critical velocity. Clearly, if the velocity of flow is below critical velocity, flow is streamline and of the velocity is above the critical velocity, flow is turbulent.
If the velocity of flow is less than critical velocity, the rate of flow of fluid depends basically on viscosity of fluid. If the velocity of flow is more than critical velocity,

the rate of flow depends on the density of fluid and not on viscosity. Due to this reason, on eruption of the volcano the lava coming out of it flows very swiftly although it is very dense having large viscosity.

3. Bernoulli's theorem : According to Bernoulli's theorem, in case of streamline flow of incompressible and non viscous fluid (ideal fluid) through a tube, total energy (sum of pressure energy, potential energy and kinetic energy) per unit volume of fluid is same at all points.
Venturimeter, a device used to measure rate of flow of fluid, works on Bernoulli's theorem.

Elasticity

Elasticity : Elasticity is the property of material of a body by virtue of which the body acquires its original shape and size after the removal of deforming force.

Elastic Limit : Elastic limit is the maximum value of deforming force upto which a material shows elastic property and above which the material looses its elastic property.

Stress : The restoring force per unit area set up inside the body subjected to deforming force is called stress.

Strain : The relative change in dimension or shape of a body which is subjected to stress is called strain.
It is measured by ratio of change in length to the original length (logitudional strain), change in volume to original volume (volume strain).

Hooke's law : Under elastic limit, stress is proportional to strain stress
i.e. stress ∞ strain or stress/strain = E (constant)

E is called elastic constant or modulus of elasticity. Its value is different for different material. Its SI unit is Nm^{-2} also called pascal.

Elastic constant is of three types :

(i) Young's modulus of elasticity Y = Logitudinal stress / Logitudinal strain

(ii) Bulk modules of elasticity K = Volume Stress / Volume Strain

(iii) Rigidity modulus (ή) = Tangential (or shear) stress) / Shear strain

Simple Harmonic Motion

Periodic Motion : Any motion which repeats itself after regular interval of time is called periodic or harmonic motion. Motion of hands of a clock, motion of earth around the sun, motion of the needle of a sewing machine are the examples of periodic motion.

Oscillatory Motion : If a particles repeats its motion after a regular time interval about a fixed point, motion is said to be oscillatory or vibratory. i.e. oscillatory motion is a constrained periodic motion between precisely fixed limits. Motion of piston in an automobile engine, motion of balance wheel of a watch are the examples of oscillatory motion.

Time period : Time taken in one complete oscillation is called time period.

Or, Time after which motion is repeated is called time period.
Frequency = Frequency is the no. of oscillations completed by oscillating body in unit time interval. Its SI unit is Hertz.
If n = frequency, T = time period, then $nT = 1$

Simple Harmonic Motion : If a particle repeats its motion about a fixed point after a regular time interval in such a way that at any moment the acceleration of the particle is directly proportional to its displacement from the fixed point at that moment and is always directed towards the fixed point then the motion of the particle is called simple harmonic motion.
The fixed point is called mean point or equilibrium point.

Characteristics of SHM

When a particle executing SHM passes through the mean position :

(i) No force acts on the particle.
(ii) Acceleration of the particle is zero.
(iii) Velocity is maximum.
(iv) Kinetic energy is maximum.
(v) Potential energy is zero.

When a particle executing SHM is at the extreme end, then :

(i) acceleration of the particle is maximum.
(ii) Restoring force acting on particle is maximum.
(iii) Velocity of particle is zero.

(iv) Kinetic energy of particle is zero.
(v) Potential energy is maximum.

Simple Pendulum : If a point mass is suspended from a fixed support with the help of a massless and inextensible string, the arrangement is called simple pendulum. The above is an ideal definition. Practically a simple pendulum is made by suspending a small ball (called bob) from a fixed support with the help of a light string.

If the bob of a simple pendulum is slightly displaced from its mean position and then released, it starts oscillating in simple harmonic motion. Time period of oscillation of a simple pendulum is given as

$T = 2\pi \sqrt{l/g}$ where *l* is the effective length of the pendulum and *g* is the acceleration due to gravity.

Wave

1. A wave is a disturbance which propagates energy from one place to the other without the transport of matter.

Waves are broadly of two types

(i) Mechanical Wave (ii) Non-mechanical wave

2. Mechanical Wave : The waves which require material medium (solid, liquid or gas) for their propagation are called mechanical waves or elastic wave.

Mechanical wave are of two types

(i) Longitudinal wave : If the particles of the medium vibrate in the direction of propagation of wave, the wave is called longitudinal wave.

Waves on springs or sound waves in air are examples of longitudual waves.

(ii) Transverse Wave : If the particles of the medium vibrate perpendicular to the direction of propagation of wave, the wave is called transverse wave.
Waves on strings under tension, waves on the surface of water are examples of transverse waves.

3. Non-mechanical waves or electromagnetic waves : The waves which do not require medium for their propagation i.e. which can propagate even through the vacuum are called non mechanical wave.
Light, heat are the examples of non-mechanical wave. In fact all the electromagnetic waves are non-mechanical.

4. All the electromagnetic wave consists of photon.

5. The wavelength range of electromagnetic wave is 10-14m to 104 m.

Properties of electromagnetic waves

(i) They are neutral.

(ii) They propagate as transverse wave.

(iii) They propagate with the velocity of light.

(iv) They contains energy and momentum.\

(v) Their concept was introduced by Maxwell.

Following waves are not electromagnetic

(i) Cathode rays (ii) Canal rays (iii) a rays (iv) ß rays (v) Sound wave (vi) Ultrasonic wave

Note : Electromagnetic waves of wavelength range 10-3 m to 10-2 m are called microwaves.

Phase of vibration : Phase of vibration of a vibrating particle at any instant is the physical quantity which express the position as well as direction of motion of the particle at that instant with respect to its equilibrium (mean) position.

Amplitude : Amplitude is defined as the maximum displacement of the vibrating particle on either side from the equilibrium position.

Wavelength : Wavelength is the distance between any two nearest particle of the medium, vibrating in the same phase. It is denoted by the Greek letter lembda. (?)

In transverse wave distance between two consecutive crests or troughs and in longitudinal wave, distance between two consecutive compressions or rarefaction is equal to wavelength.

Relation between wavelength, frequency and velocity of wave

Velocity of wave = frequency x wavelength or, v = n?.s

Sound Wave

---> Sound waves are longitudinal mechanical waves.

---> According to their frequency range, longitudinal mechanical waves are divided into the following categories :

1.Audible or Sound Waves : The longitudinal mechanical waves which lie in the frequency range 20 Hz to 20000 Hz are called audible or sound waves. These waves are sensitive to human ear. These are generated by the vibrating bodies such as tuning fork, vocal cords etc.

2.Infrasonic Waves : The longitudinal mechanical waves having frequencies less than 20 Hz are called Infrasonic. These waves are produced by sources of bigger size such as earth quakes, volcanic eruptions, ocean waves and by elephants and whales.

3.Ultrasonic Waves : The longitudinal mechanical waves having frequencies greater than 20000 Hz are called ultrasonic waves. Human ear can not detect these waves. But certain creatures like dog, cat,, bat, mosquito can detect these waves. Bat not only detect but also produce ultrasonic.
Ultrasonic waves can be produced by Galton's whistle or Hartman's generator or by the high frequency vibrations of a quartz crystal under an alternating electric field (Piezo - electric effect) or by the vibrations of a ferromagnetic rod under an alternating magnetic field (Magnetostriction)

Applications of Ultrasonic Waves

1. For sending signals.

2. For measuring the depth of sea.

3. For cleaning cloths, aeroplanes and machinery parts of clocks.

4. For removing lamp-shoot from the chimney of factories.

5. In sterilizing of a liquid.

6. In Ultrasonography.

Heat

Heat is that form of energy which flows from one body to other body due to difference is temperature between the bodies. The amount of heat contained in a body depends upon the mass of the body.

----> If W work is performed and heat produced is H then W/H = J or W= JH where J is a constant called Mechanical Equivalent of Heat. Its value is 4.186 joule/Calorie. It means if 4.186 joule of work is performed, 1 calorie of heat is consumed.
Units of Heat

C.G.S unit : calorie = It is the amount of heat required to raise the temperature of 1 g of pure water through 1°C.

International calorie : It is the amount of heat required to raise the temperature of 1 g of pure water from 14.5°C to 15.5°C.

F.P.S. unit : B.Th.U (British Thermal Unit) = It is the amount of heat required to raise the temp, of 1 pound of pure water through 1°F.

Relations between different units :

1 B.Th.U = 252 calorie

1 calorie = 4.186 joule

1 Therm = 105 B.Th.U.

1 pound calorie = 453.6 calorie.

Temperature : Temperature is that physical cause which decides the direction of flow of heat from one body to other body. Heat energy always flows from body at higher temperature to body at lower temperature.

Measurement of Temperature

Thermometer : The device which measures the temperature of a body is called thermometer.

Scales of temperature measurement

To measure temperature two fixed points are taken on each thermometer. One of the fixed points is the freezing point of water or ice as lower fixed point (LFP).

The other fixed point is the boiling point of water or steam as upper fixed print (UFP).

The temperatures of these fixed points, the no. of fundamental interval between the two fixed points on different temperature scales is shown by the table given below:

Relation between Temperature on different scales

C-0/100 = F-32/180 = R-0/80 = K-273/100 = Ra-492/180

1. Celsius was initially know as centigrade.

2. While expressing temperature on kelvin scale ° (degree) is not used.

3. Freezing point (F.P.) of mercury is -39°C. Hence to measure temperature below this temperature, alcohal thermometer is used. F.P. of alcohal is -115°C.

Range of different thermometers

Mercury Thermometer : from -30°C to 350°C

Constant volume gas thermometer : from -200°C to 500°C (with H2), below -200°C upto -268°C (with He) above 1000°C upto 1600°C (with N2 gas and bulb of glazed porcelain)

Platinum resistance thermometer : from - 200°C to 1200°C

Thermocouple thermometer : from - 200°C to 1600°C

Total Radiation Pyrometer

When a body is at high temperature, it glows brightly and the radiation emitted by the body is directly proportional to the fourth power of absolute temperature of the body. Radiation pyrometer measures the temperature of a body by measuring the radiation emitted by the body.

This thermometer is not put in contact with the body. But it can not measure temperature below 800°C because at low temperature emission of radiation is very small and can not be detected.
Specific Heat Capacity : Specific heat capacity of a material is the amount of

heat required to raise the temperature of unit mass of substance through 1°. Its SI unit is Joule / kilogram kelvin (J/kg.k)

----> One calorie of heat is required to raise the temperature of 1 gram of water through 1°C. Hence specific heat capacity of water is 1 cal / gram °C.

1 calorie/gram °C = 4200 Joule/kg kelvin.

Thermal Expansion

When a body is heated its length, surface area and volume increase. The increase in length, area and volume with the increase in temperature are measured in terms of coefficient of linear expansion or linear expansivity (a), coefficient of superficial expansion or superficial expansivity (p) and coefficient of cubical expansion or cubical expansivity (?).
Relation between a, ß and ?.
a : ß : ? = 1 : 2 : 3 or, ß = 2 a and ? = 3 a

Anomalous expansion of water : Almost every liquid expands with the increase in temperature. But when temperature of water is increased from 0°C to 4°C, its volume decreases. If the temperature is increased above 4°C, its volume starts increasing. Clearly, density of water is maximum at 4°C.

Transmission of Head : The transfer of heat from one place to other place is called transmission of heat. There are three modes of heat transfer—(i) conduction, (ii) convection and (iii) radiation.

Conduction : In this process, heat is transferred from one place to other place by the successive vibrations of the particles of the medium without bodily movement of the particles of the medium. In solids, heat transfer takes place by conduction.

Convection : In this process, heat is transferred by the actual movement of particles of the movement from one place to other place. Due to movement of particles, a current of particles set up which is called convection current.

In liquids and gases, heat transfer takes place by convection.

----> Earth's atmosphere is heated by convection.

Radiation : In this method transfer of heat takes place with the speed of light without affecting the intervening medium.

Newton's law of cooling : The rate of loss of heat by a body is directly proportional to the difference in temperature between the body and the surrounding.

Kirchhoff's law : According to Kirchhoff's law, the ratio of emissive power to absorptive power is same for all surfaces at the same temperature and is equal to emissive power of black body at that temperature. Kirchhoff's law signifies that good absorbers are good emitter.
If a shining metal ball with some black spot on its surface is heated to a high temperature and seen in dark, the shining ball becomes dull but the black spots shines brilliantly, because black spot absorbs radiation during heating and emit in dark.

Stefan's law : The radiant energy emitted by a black body per unit area per unit time (i.e. emissive power) is directly proportional to the fourth power of its absolute temperature.

i.e. E ? T4 or, E = sT4

where a is a constant called Stefan's constant.

Latent heat or heat of transformation
The amount of heat required to change the state of unit mass of substance at constant temperature is called latent heat.
If Q heat is required to change the state of a substance of mass m at constant temperature and L is the latent heat, then Q = mL.
S.I. unit of latent heat is Joule/kilogram.

Any material has two types of latent heat.

(i) Latent heat of fusion : It is the amount of heat energy required to convert unit mass a substance from solid state to liquid state at its melting point. It is also the amount of heat released by unit mass of liquid when changed into solid at its freezing point.

(ii) Latent heat of vapourisation : It is the amount of heat required to change unit mass of a substance from liquid state to vapour state at its boiling point. It is also the amount of heat released when unit mass of a vapour is changed into liquid.

Sublimation : Sublimation is the process of conversion of a solid directly into vapour.

----> Sublimation takes place when boiling point is less than melting point.

----> Sublimation is shown by camphor or ice in vacuum.

Hoar Frost : Hoar frost is just the reverse process of sublimation i.e. it is the process of direct conversion of vapour into solid.

----> Steam produces more severe burn than water at same temperature because internal energy of steam is more than that of water at same temperature.
Relative Humidity : Relative humidity is defined as the ratio of amount of water vapour present in a given volume of atmosphere to the amount of water vapour required to saturate the same volume at same temperature.
The ratio is multiplied by 100 to express the relative humidity in percentage.

----> Relative humidity is measured by Hygrometer.

----> Relative humidity increases with the increase of temperature.

Air conditioning : For healthy and favourable atmosphere of human being, the conditions are as follows

(i) Temperature : from 23°C to 25°C.

(ii) Relative humidity : from 60% to 65%.

(iii) Speed of air : from 0.75 meter/minute to 2.5 meter/minute

Thermodynamics

First law of thermodynamics : Heat energy given to a system is used in the following two ways :

(i) In increasing the temperature and hence internal energy of the system.

(ii) In doing work by the system.

If ?Q = heat energy given to the system
?U = Increase in the internal energy of the system.
?W = work done by the system

Then, ?Q = ?U + ?W is the mathematical statement of first law of thermodynamics.

----> First law of thermodynamics is equivalent to principle of conservation of energy.

Isothermal Process : If the changes are taking place in a system in such a way that temperature of the system remains constant throughout the change, then the process is said to be an isothermal.

Adiabatic Process : If the changes are taking place in a system in such a way that there is no exchange of heat energy between the system and the surrounding, then the process is said to be an adiabatic process.

----> If carbon dioxide is suddenly expanded, it is changed into dry ice. This is an example of adiabatic process.

Second Law of Thermodynamics : The first law of thermodynamics guarantees that in a thermodynamic process, energy will be conserved. But this law does not tell whether a given process in which energy is conserved will take place or not. The second law of thermodynamics gives the answer.
Through this law can be stated in many forms, the following two forms are worth mentioning :

Kelvin's statement : Whole of the heat can never be converted into work.

Clausius statement : Heat by itself can not flow from a colder body to a hotter body.
Heat Engine : Heat energy is a device, which converts heat energy into mechanical work continuously through a cyclic process. Every heat engine basically consists **of the three parts :** (i) source (a hot body) (ii) sink (a cold body) and (iii) a working substance.

Heat engine may be devided into two types :

(i) Internal Combustion Engine : In this engine, heat is produced in the engine itself. Example : Otto engine or petrol engine (efficiency = 52%), Diesel engine (efficiency = 64%)

(ii)External Cumbustion Engine : In this engine heat is produced outside the engine. Steam engine is an example of external cumbustion engine. (efficiency - 20%).

Refrigerator or Heat Pump : A refrigerator is an apparatus which transfers heat energy from cold to a hot body at the expanse of energy supplied by an external agent. The working substance here is called refrigerant. In actual refrigerator, vapours of freon (CC12F2) acts as refrigerant.

Light

Light is a form of energy which is propagated as electromagnetic waves. In the spectrum of electromagnetic waves it lies between ultra-violet and infra-red region and has wavelength between 3900 A° to 7800 A°.

1. Electromagnetic waves are transverse, hence light is transverse wave.

2. Wave nature of light explains rectilinear propagation, reflection, refraction, interference, diffraction and polarisation of light.

3. The phenomena like photo electric effect, compton effect are not explained on the basis of wave nature of light. These phenomena are explained on the basis of quantum theory of light as proposed by Einstein.

4. In quantum theory, light is regarded as a packet or bundle of energy called photon. Photon is associated with it an energy E where E = hv.

5. Clearly light behaves as wave and particle both. Thus light has dual nature.

6. Speed of light was first measured by Roemer. (1678 AD).

7. Speed of light is maximum in vacuum and air (3 x 108 m/s)

Refractive index : R.I. of a medium is defined as the ratio of speed of light in vacuume to the speed of light in the medium.

μ = c/v = Speed of light in vacuum / Speed of light in the medium

----> Speed of light is different in different media. Velocity of light is large in a medium which has small refractive index.

Speed of light in different mediums

----> Light takes 8 minute 19 second (499 second) to reach from sun to earth.

----> The light reflected from moon takes 1.28 second to reach earth.

Luminous bodies : Those object which emit light by themselves are called luminous bodies.

e.g.—sun, stars, electric bulb etc.

Non-luminous bodies : Those objects which do not emit light by themselves but are visible by the light falling on them emitted by self luminous bodies are called non-luminous bodies.

A material can be classified as :

(i) Transparent : The substances which allow most of the incident light to pass through them are called transparent, e.g. glass, water.

(ii) Translucent : The substances which allow a part of incident light to pass through them are called translucent bodies e.g. oiled paper.

(iii) Opaque : The substances which do not allow the incident light to pass through them are called opaque bodies, e.g., mirror, metal, wood etc.

Reflection of light : Light moving in one medium when falls at the surface of another medium, part of light returns back to the same medium. This phenomenon of returning back of light in the first medium at the interface of two media is known as reflection of light.

Laws of reflection

(i) The incident ray, reflected ray and normal to the reflecting surface at the incident point all lie in the same plane.

(ii) The angle of reflection is equal to the angle of incidence.

Reflection from plane mirror

(i) The image is virtual, laterally inverted.

(ii) The size of image is equal to that of object.

(iii) The distance of image from the mirror is equal to distance of object from the mirror.

(iv) If an object moves towards (or away from) a plane mirror with speed v, relative to the object the image moves towards (or away) with a speed 2v.

(v) If a plane mirror is rotated by an angle 0, keeping the incident ray fixed, the reflected ray is rotated by an angle 20.

(vi) To see his full image in a plane mirror, a person requires a mirror of at least half of his height.

(vii) If two plane mirrors are inclined to each other at an angle 0 the number of images (n) of a point object formed are determined as follows:

(a) if 360/? is even integer, then n = 360/? -1

(b) If 360/? is odd integer,

then n = 360/? -1 for the objects is symmetrically placed. and \

n = 360/? for the objects is not symmetrically placed.

(c) If 360/? is a fraction then n is equal to integral parts.

Reflection from spherical mirror

Spherical mirror are of two types (i) Concave mirror and (ii) Convex mirror

Note: Image formed by a convex mirror is always virtual, erect and diminished.

Uses of Concave mirror:

(i) As a shaving glass.

(ii) As a reflector for the head lights of a vehicle, search light.

(iii) In opthalmoscope to examine eye, ear, nose by doctors.

(iv) In solar cookers.

Uses of Convex mirror:

(i) As a rear view mirror in vehicle because it provides the maximum rear field of view and image formed is always erect.

(ii) In sodium reflector lamp.

Refraction of light : When a ray of light propagating in a medium enters the other medium, it deviates from its path. This phenomenon of change in the direction of propagation of light at the boundary when it passes from one medium to other medium is called refraction of light.
When a ray of light enters from rarer medium to denser medium (as from water to glass) it deviates towards the normal drawn on the boundary of two media at the incident point. Similarly in passing from denser to rarer medium, a ray deviates

away from the normal. If light is incident normally on the boundary i.e. parallel to normal, it enters the second medium undeviated.

Laws of refraction

(i) Incident ray, refracted ray and normal drawn at incident point always lie in the same plane.

(ii) Snell's law : For a given colour of light, the ratio of sine of angle of incidence to the sine of angle of refraction is a constant,

i.e. sin i/sin r = 1μ2 (constant)

This constant 1μ2 is called refractive index of second medium with respect to the first medium.

1. Absolute refractive index of a medium is defined as the ratio of speed of light in free space (vacuum) to that in the given medium.

2. i.e. absolute refractive index (μ) = Speed of light in vacuum/Speed of light in the medium.

3. The refractive index of a medium is different for different colours. The refractive index of a medium decreases with the increase in wavelength of light. Hence refractive index of a medium is maximum for violet colour of light and minimum for red colour of light.

4. The refractive index of a medium decreases with the increase in temperature. But this variation is very small.

5. When a ray of light enters from one medium to other medium, its frequency and phase donot change but wavelength and velocity change.

Some illustrations of Refraction

(i) Bending of a linear object when it is partially dipped in a liquid inclined to the surface of the liquid.

(ii) Twinkling of stars.

(iii) Oval shape of sun in the morning and evening.

(iv) An object in a denser medium when seen from a rarer medium appears to be at a smaller distance.

This is way (a) A fish in a pond when viewed from air appears to be at a smaller depth them actual depth (b) A coin at the base of a vessel filled with water appears raised.

Critical angle : In case of propagation of light from denser to rarer medium through a plane boundary, critical angle is the angle of incidence for which angle of refraction is 90°.

Total Internal Reflection : If light is propagating from denser medium towards the rarer medium and angle of incidence is more than critical angle, then the light incident on the boundary is reflected back in the denser medium, obeying the laws of reflection. This phenomenon is called total internal reflection as total light energy is reflected, no part is absorbed or transmitted.

For total internal reflection,

(i) Light must be propagating from denser to rarer medium.

(ii) Angle of incidence must exceeds the critical angle.

illustrations of total internal reflection

(i) Sparkling of diamond

(ii) Mirage and looming.

(iii) Shining of air bubble in water.

(iv) Increase in duration of sun's visibility-The sun becomes visible even before sun rise and remains visible even after sunset due to total internal reflection of light.

(v) Shining of a smoked ball or a metal ball on which lamp soot is deposited when dipped in water.

(vi) Optical Fibre : Optical fibre consists of thousands of strands of a very fine quality glass or quartz (of refractive index 1.7), each strand coated with a layer of material of lower refractive index (1.5). In it, light is propagated along the axis of fibre through multiple total internal reflection, even though the fibre is curved, without loss of energy.

Applications :

(i) For transmitting optical signals and the two dimensional pictures.

(ii) For transmitting electrical signals by first converting them to light.

(iii) For visualising the internal sites of the body by doctors in endoscopy.

Refraction of Light Through Lens

1. Lens is a section of transparent refractive material of two surfaces of definite geometrical shape of which one surface must be spherical. Lens is generally of two types : (i) Convex lens (ii) Concave lens.

2. When a lens is thicker at the middle than at the edges, it is called a convex lens or a converging lens. When the lens is thicker at the edges than in the middle, it is called as concave lens or diverging lens.

3. Some terms regarding a lens.

O - optical Centre

F - First Focus

C1C2 - Principal axis

F2 - Second Focus

Power of a lens

Power of a lens is its capacity to deviate a ray. It is measured as the reciprocal of the focal length in meters, i.e. P = 1/f SI Unit of power is dioptre (D).
Power of a convex lens is positive and that of a concave lens is negative.
If two lenses are placed in contact, then the power of combination is equal to the sum of powers of individual lenses.

Change in the power of a lens : If a lens is dipped in a liquid, its focal length and power both change. This change depends upon the refractive indices of lens and the liquid. If a lens of refractive index μ is dipped in a liquid of refractive index μ', then the following three situations are possible

(i) μ > μ' i.e. lens is dipped in a liquid of smaller fractive index like a lens of glass (μ = 1.5) is dipped in water (μ' = 1.33), then the focal length of the lens increases and the power of the lens decreases.

(ii) μ = μ' i.e. lens is dipped in a liquid of equal refractive index then the focal length of the lens becomes infinite i.e. its power becomes zero. The lens and the liquid behave as a single medium.

(iii) $\mu < \mu'$ i.e. lens is dipped in a liquid of higher refractive index the focal length increases i.e. power decreases as well as the nature of the lens also changes i.e. convex lens behaves as concave lens and vice-versa. For example, an air bubble trapped in water or glass appears as convex but behaves as concave lens. Similarly a convex lens of glass ($\mu = 1.5$) when dipped in carbon disulphide ($\mu' = 1.68$), it behaves as a concave lens.

Between lens and F on the same sideBetween lens and F on the same side

Dispersion of Light : When a ray of white light (or a composite light) is passed through a prism, it gets splitted into its constituent colours. This phenomenon is called dispersion of light. The coloured pattern obtained on a screen after dispersion of light is called spectrum.

1. **T**he dispersion of light is due to different deviation suffered by different colours of light. The deviation is maximum for violet colour and minimum for red colour of light. The different colours appeared in the spectrum are on the following order, violet, indigo, blue, green, yellow, orange and red. (VIBGYOR)

2. The dispersion of light is due to different velocities of light of different colorus in a medium. As a result, the refractive index of a medium is different for different colours of light.

3. The velocity of light in a medium is maximum for that colour for which refractive index is minimum. Clearly, the velocity of violet colour of light is minimum in a medium and retroactive index of that medium is maximum for violet colour. Similarly, the velocity of light in a medium is maximum for red colour and refractive index of that medium is minimum for red colour.

Rainbow : Rainbow is the coloured display in the form of an arc of a circle hanging in the sky observed during or after a little drizzle appearing on the opposite side of sun. Rainbow is formed due to dispersion of sun light by the suspended water droplets.

Rainbow is of two types : (i) Primary rainbow (ii) Secondary rainbow

----> Primary rainbow is formed due to two refractions and one total internal reflection of light falling on the raindrops. In the primary rainbow, the red colour is on the convex side and violet on the concave side. Primary rainbow has an angular width of 2° at an average angle of elevation of 41°.

----> Secondary rainbow is formed due to two refractions and two internal reflections of light falling on rain drops. The order of colour on the secondary rainbow is in the reverse order and has an angular width of 3.5° at an average elevation of 52.75°. Secondary rainbow is less intense than primary rainbow.

Theory of Colours : Colour is the sensation perceived by the rods in the eye due to light.

Primary Colours : The spectral colours blue, green and red are called primary colours because all the colours can be produced by mixing these in proper proportion.
Blue + Red + Green = White

Secondary Colours : The colour produced by mixing any two primary colours is called a secondary colour. There are three secondary colours yellow, magenta and cyan as

Green + Red = Yellow
Red + Blue = Magenta
Blue + Green = Cyan

When the three secondary colours are mixed, white colour is produced

Yellow + Magenta + Cyan = White

Complementary Colours : Any two colours when added produce white light, are said to be complementary colours. Clearly a secondary colour and the remaining primary colour are complementary colours. Red and cyan, blue and yellow and green and magenta are complementary of each other.

----> The different colours and their mixtures are shown by the colour triangle.

----> In coloured television, the three primary colours are used.
Colour of bodies : The colour of a body is the colour of light which it reflects or transmits. An object is white, if it reflects all the components of white light and it is black if it absorbs all the light incident over it. This is why a red rose appears red when viewed in white or red light but appears black when viewed in blue or green light.
How a body will appear in light of different colour can be understood by the following table

Scattering of light : When light waves fall on small bodies such as dust particles, water particles in suspension, suspended particles in colloidal solution, they are thrown out in all directions. This phenomenon is called scattering of light.

Scattering of light is maximum in case of violet colour and minimum in case of red colour of light.

1. Blue colour of sky is due to scattering of light.

2. The brilliant red colour of rising and setting sun is due to scattering of light. Interference of light : When two light waves of exactly the same frequency and a constant phase difference travel in same direction and superimpose then the resultant intensity in the region of superposition is different from the sum of intensity of individual waves. This modification in the intensity of light in the region of superposition is called interference of light. Interference is of two types

(i) Constructive interference (ii) Destructive interference

Constructive interference : At some points, where the two waves meet is same phase, resultant intensity is maximum. Such interference is called constructive interference.

Destructive interference : At some points, where the two waves meet in opposite phase, resultant intensity is minimum. Such interference is called destructive interference.

Diffraction of light : When light waves fall on a small sized obstacle or a small aperture whose dimension is comparable to the wavelength of light, then there is a departure from the rectilinear propagation and light energy flavours out into the region of geometrical shadow. The spreading of light energy beyond the limit prescribed by rectilinear propagation of light is called diffraction of light. In other words, diffraction is the process by which a beam of light or other systems of wave is spread out as a result of passing through a narrow opening or across an edge.

Polarisation of light : Polarisation is the only phenomenon which proves that light is a transverse wave. Light is an electromagnetic wave in which electric and magnetic field vectors vibrate perpendicular to each other and also perpendicular to the direction of propagation. In ordinary light, the vibrations of elecltric field vector are in every plane perpendicular to the direction of propagation of wave. Polarisation is the phenomenon of restricting the vibrations of a light in a particular direction in a plane perpendicular to the direction of propagation of wave.

The visible effect of light is only due to electric field vector.

Human Eye

----> Least distance of distinct vision is 25 cm.

Defects of human eye and the remedies :

1.Myopia or short sightedness : A person suffering from myopia can see the near objects clearly while far objects are not clear.

Causes :

(i) Elongation of eye ball along the axis.

(ii) Shortening of focal length of eye lens.

(iii) Over stretching of ciliary muscles beyond the elastic limit.

Remedy : Diverging lens is used.

2.Hyperopia or hypermetropia or longsightedness : A person suffering from hypermetropia can see the distant objects clearly but not the near objects.

Causes :

(i) Shortening of eye ball along the axis.

(ii) Increase in the focal length of eye lens.

(iii) Stiffening of ciliary muscles.

Remedy : A converging lens is sued.

3.Presbyopia : This defect is generally found in elderly person. Due to stiffening of ciliary muscles, eye looses much of its accommodating power. As a result distanct as well as nearby objects can not be seen. For its remedy two separate lens or a bifocal lens is used.

4.Astigmatism : This defect arises due to difference in the radius of curvature of cornea in the different planes. As a result rays from an object in one plane are brought to focus by eye in another plane. For its remedy cylindrical lens is used.

----> There are two kinds of vision cells in the retina. They are called rods and cones on account of their peculiar shape. Rods decides the intensity of light where as cones distinguish colour of light.
Simple microscope : This is simply a convex lens of small focal length. The object to be enlarged is placed within the focus of lens.

Magnifying power of a simple microscope is given as
M = 1 + D/f where D = 25 cm, f = focal length of lens.

Compound microscope : It consists of two convex lenses coaxially fitted in a hollow tube. The lens facing the object is called objective and the lens towards the eye is called eye piece.

1. The aperture of objective is smaller than that of eye piece.

2. Both the lenses are of smaller focal lengths. This increases the magnifying power of instrument.

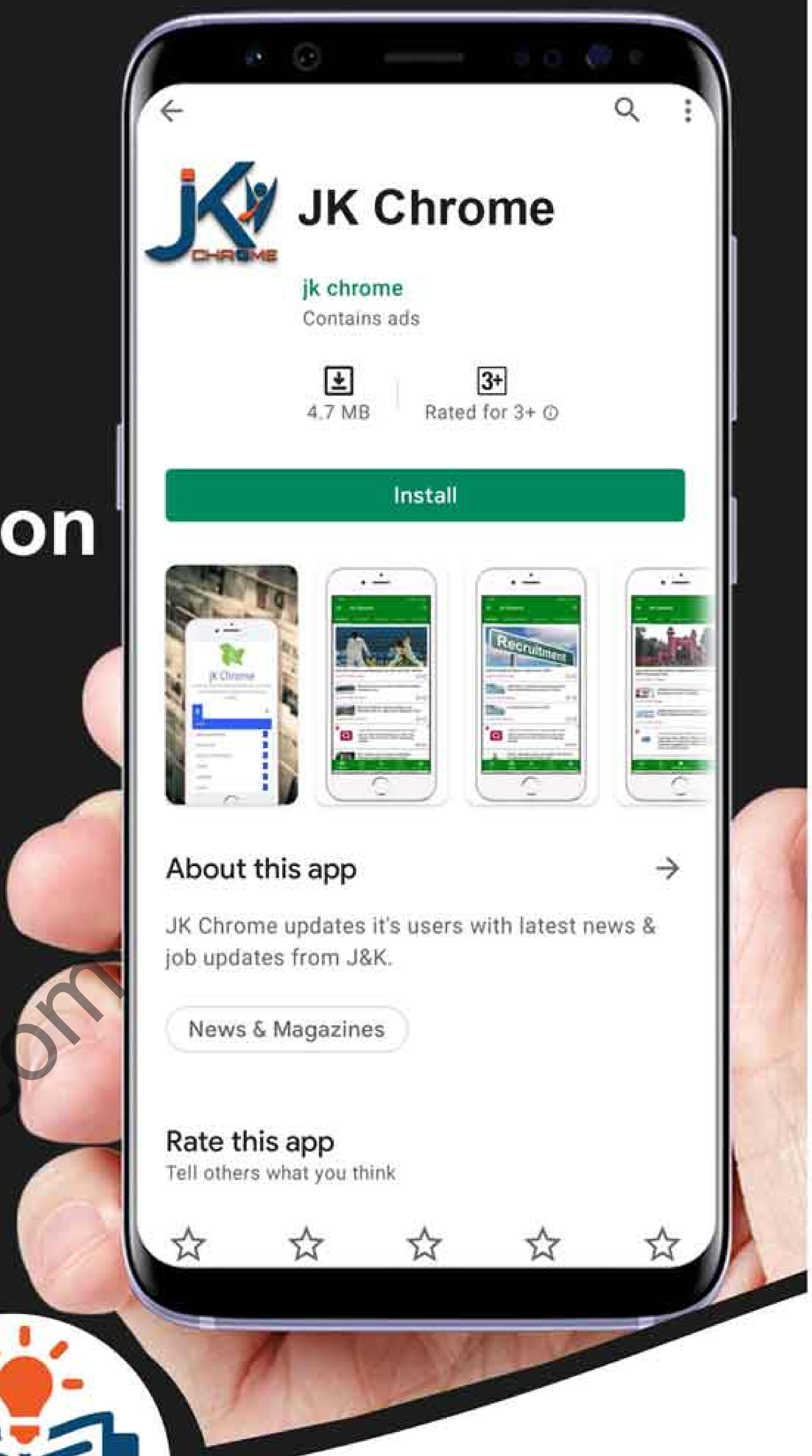
Telescope

Telescopes are used to view distant objects which are not visible to naked eye. Telescope can be divided as astronomical telescope, terrestrial telescope and Galilean telescope.

1. Astronomical telescope consists of two convex lenses placed coaxially in a hollow tube. The lens facing the object is called objective and the lens towards the eye is called eye piece.

2. The objective has large aperture so that the rays from the object can be easily collected.

3. The focal length of objective is larger than that of eye piece.


JK Chrome
jk chrome
Contains ads
4.7 MB
Rated for 3+
Install
About this app
JK Chrome updates it's users with latest news & job updates from J&K.
News & Magazines
Rate this app
Tell others what you think

Static Electricity

When two bodies are rubbed together, they acquire the property of attracting light objects like small bits of paper, dust particles etc. The bodies which acquire this property are said to be electrified or charged with electricity.

Charge: Charge is the basic property associated with matter due to which it produces and experiences eletrical and magnetic effects.

1. Benjamin Frnkline named the two types of charges as positive and negative.

2. Similar charges repel each other and opposite charges attract each other.

3. Charging of bodies takes place due to transfer of electrons from one body to other body.

4. A list of materials has been given below. The list is such that any of the material in the list will be positively charged when rubbed with any other material coming later in the list. The other material will naturally be negtively charged.

Surface density of charge : Surface density of charge is defined as the amount of charge per unit area on the surface of conductor.

The surface density of charge at a point on the surface of conductor depends upon the shape of conductor and presence of other conductors or insulators near the given conductor.

1. **T**he surface density of charge at any part of the conductor is inversely proportional to the radius of curvature of the surface of that part.

2. This is why surface density of charge in maximum at the pointed parts of the condcutor.

Conductor : Conductors are those materials which allow electricity (charge) to pass through themselves.

Examples : (a) Metals like silver, iron, copper (b) Earth (especially the moist part) acts like a huge conductor.

---> Silver is the best conductor.

Insulator or Dielectric : Insulators are those materials which do not allow electricity to flow through themselves.

Examples : Wood, paper, mica, glass, ebonite.

Coulomb's law : According to Coulomb's law, the force of attraction or repulsion between two point charges at rest is directly proportional to the product of the magnitudes of the charges and inversely proportional to the square of the distance between them. This force acts on the line joining the two charges.

Electric Field : Region in space around a charge or charged body where the charge has its electrical effect is called electric field of the charge.
Electric Field Intensity : Electric field intensity at a point in an electric field is the force experienced by a unit positive charge placed at that point.

Electric Field of hollow conductor

Electric field intensity inside a charged hollow conductor is zero. Charge given to such a conductor (or conductor of any shape) remains on its surface only.

This explains why a hollow conductor acts as an electrostatic shield. It is for this reason that it is safer to sit in a car or bus during lightning.

Electric Potential : Electric potential at a point in an electric field is the work done in bringing a unit positive charge from infinity to that point.

SI unit of electric potential is volt. It is a scalar quantity.

Potential Difference : Work done in bringing a unit positive charge from one point to other point is the potential difference between the two points. Its SI unit is volt and is a scalar quantity.

Electric Capacity : Electric capacity of a conductor is defined as the charge required to increase the potential of the condcutor by unity. If potential of a conductor is increased by V when a charge Q is given to it, capacity of the conductor is Q/V. Its SI unit is farad. (F)

Electrochemical Cell : Electrochemical cell is a device which converts chemical energy into electrical energy.

Cells are basically of two types : (i) Primary cell (ii) Secodnary cell.

Primary Cell : In primary cell electrical energy is obtained from the irreversible chemical reaction taking inside the cell. After complete discharge, primary cell becomes unserviceable.

Examples : Voltaic Cell, Leclanche Cell, Daniel Cell, Dry Cell etc.

Secodnary Cell : A secodnary cell is that which has to be charged at first from an external electric source and then can be used to draw current. Such cells are rechargable.

1. Production of electricity by chemical reaction was first discovered by Allexandro de volta (voltaic cell is named after him) in 1794. In voltaic cell zinc rod is used as cathode and copper rod is used as anode. These rods are placed in sulphuric acid kept in a glass vessel.

2. In a Leclanche cell, carbon rod acts as anode and zinc rod acts as cathode. These rods are placed in amonium chloride kept in a glass vessel.

3. The emf of Leclanche cell is 1.5 volt.

4. Leclanche cell is used for intermittent works, i.e. works in which continuous electrical energy is not required like electric bell.

5. In a dry cell, mixture of Mn02 , NH4Cl and carbon is kept in a zinc vessel. A carbon rod is placed in the mixture which acts as anode. The zinc vessel itself acts as cathode. The emf of dry cell is 1.5 volt.

Current Electricity

Electric Current : Electric current is defined as the rate of flow of charge or charge flowing per unit time interval. Its direction is the direction of flow of positive charge. Its SI unit is ampere (A). It is a scalar quantity.

---> A current of one ampere flowing through a conductor means 6.25 x 1018 electrons are entering at one end or leaving the other end of the conductor in one second.

Resistance : The opposition offered by a conductor to the flow of current through it is called resistance. It arises due to collisions of drifting electrons with the core ions. Its SI unit is ohm.

Ohm's law : If physical conditions like temperature, intensity of light etc. remains unchanged then electric current flowing through a conductor is directly proportional to the potential difference across its ends. If V is the potential difference across the ends of a conductor and I is the current through it, then according to ohm's law V ? I or, V = RI where R is a constant called resistance of conductor.

Ohmic Resistance : The resistances of such condcutors which obey ohm's law are called ohmic resistance. For example resistance of manganin wire.

Non ohmic resistance : The resistances of such materials which do not obey ohm's law are called non ohmic resistance.

Example : Resistance of diode valve, resistance of triode valve.

Conductance : Reciprocal of resistance of a conductor is called its conductance
i.e. conductuctance = 1/Resistance
It is denoted by G and (G=1/R)
Its SI unit is ohm-1 (also called mho or siemen.)
The resistance of a conductor is directly proportional to its length and inversely proportional to its cross sectional area. i.e. if / and A are respectively length and cross sectional area of a conductor and R is its resistance then R ? l/A or, p l/A where p is a constant of material of conductor called specific resistance or resistivity. Its SI unit is ohm meter.

Specific conductance or conductivity : The reciprocal of resistivity of a conductor is called its conductivity (s). Its SI unit is mho m-1 or siemen / meter (sm_1)

Combination of Resistance : Various resistances can be combined to form a network mainly in two ways : (i) Series combination (ii) Parallel combination.
In series combination, the equivalent resistance is equal to the sum of the resistances of individual conductors. (R = + R2 +......Rn)
In parallel combination, the reciprocal of equivalent resistance is equal to the sum of the reciprocal of individual resistances.
(1/2 = 1/R1 + R 1/R2 + ... + 1/Rn)

Electric Power : The rate at which electrical energy is consumed in a circuit is called electric power. Its SI unit is watt.

Kilo watt hour : It is the unit of energy and is equal to the energy consumed in the circuit at the rate of 1 kilowatt (1000 J/s) for 1 hour.

1 kilowatt hour = 3.6 x 106 joule

1 kWh is also called board of trade unit.

Ammeter : Ammeter is a device which is used to measure electric current in a circuit. It is connected in series in the circuit.

---> The resistance of an ideal ammeter is zero.

Voltmeter : Voltmeter is a device used to measure the potential difference between two points in a circuit. It is connected in parallel to the circuit.

---> The resistance of an ideal voltmeter is infinite.

Electric fuse : Electric fuse is a protective device used in series with an electric appliance to save it from being damaged due to high current. In general, it is a small conducting wire of alloy of copper, tin and lead having low melting point.

---> Pure fuse is made up of tin.

Galvanometer : Galvanometer is a device used to detect and measure electric current in a circuit. It can measure current up to 10-6 A.

Shunt : Shunt is a wire of very small resistance. In simple words, galvanometer is an instrument for detecting and measuring small electric currents.

---> A galvanometer can be converted into an ammeter by connecting a shunt parallel to it.

---> A galvanometer can be converted into a voltmeter by connecting a very high resistance in its series.

Transformer : Transformer is a device which converts low voltage A.C. into high voltage A.C. and high voltage A.C. into low voltage A.C. It is based on electromagnetic induction and can be used only in case of alternating current.

A.C. Dynamo (or generator) : It is device used to convert mechanical energy into electrical energy. It works on the principle of electro-magnetic induction.

Electric motor : It is a device which converts electrical energy into mechanical energy.

Microphone : It converts sound energy into electrical energy and works on the principle of electromagnetic induction. In other words, microscope is an instrument for changing sound waves into electrical energy which may then be amplified, transmitted or recorded.

---> The current generated in the power stations are alternating current having voltage 22000 volt or more. In grid substations, with the help of transformer, their voltage is increased up to 132000 volt to minimise loss of energy in long distance transmission.

Magnetism

1. Magnetism is the property displayed by magnets and produced by the movement of electric charges, which results in objects being attracted or pushed away.

2. Magnet is a piece of iron or other materials that can attract iron containing objects and that points north and south when suspended.

3. A magnet is characterised by following two properties : (i) Attractive property : A magnet attracts magnetic substances like iron, cobalt, nickel and some of their alloys like magnetite (Fe304) (ii) Directive property : When a magnet is freely suspended, it aligns itself in the geographical north south direction.

4. A magnet may be (i) Natural (ii) Artificial

5. Natural magnet is oxide of iron. But due to irregular shape, weak magnetism and high brittleness, natural magnets find no use in the laboratory.

6. The magnets made by artificial methods are called artificial magnets or man made magnets. They may be of different types like bar magnet, horse shoe magnet, Robinson's ball ended magnet, magnetic needle, electromagnet etc.

7. The two points near the two ends of a magnet where the attracting capacity is maximum are called magnetic poles. When a magnet is freely suspended, its one pole always directs towards the north. This pole is called north pole. The other pole is called south pole.

8. The imaginary line joining the two poles of a magnet is called magnetic axis of the magnet.

9. Similar poles repel each other and dissimilar poles attract each other.

10. When a magnetic substance is placed rear a magnet, it gets magnetised due to induction.

Magnetic Field : Region in space around a magnet where the magnet has its magnetic effect is called magnetic field of the magnet.
Intensity of magnetic field or magnetic flux density : Magnetic flux density of a point in a magnetic field is the force experienced by a north pole of unit strength placed at that point. Its SI unit is newton / ampere-meter or weber/meter2 or tesla (T).

Magnetic lines of force : The magnetic lines of force are imaginary curves which represent a magnetic field graphically. The tangent drawn at any point on the magnetic liens of force gives the direction of magnetic field at that point.

Properties of magnetic liens of force :

(i) Magnetic lines of force are closed curves. Outside the magnet they are from north to south pole and inside the magnet they are from south to north pole.

(ii) Two lines of force near intersect each other.

(iii) If the lines of force are crowded, the field is strong.

(iv) If the liens of force are parallel and equidistant, the field is uniform.

Magnetic Substance : On the basis of magnetic behaviour, substances can be divided into three categories.

(i) Diamagnetic substances : Diamagnetic substances are such substances which when placed in a magnetic field, acquire feeble magnetism opposite to the direction of magnetic field.

Examples : Bismuth, Zinc, Copper, Silver, Gold, Diamond, Water, Mercury, Water etc.

(ii) Paramagnetic Substance : Paramagnetic substances are such substances which when placed in a magnetic field acquire a feeble magnetism in the direction of the field.

Examples : Aluminum, Platinum, Manganese, Sodium, Oxygen etc.

(iii) Ferromagnetic substance : Ferromagnetic substances are those substance, which when placed in a magnetic field, are strongly magnetised in the direction of field.

Examples : Iron, Cobalt, Nickel etc.

Domain : Atoms of ferromagnetic substance have a permanent dipole moment i.e. they behave like a very small magnet. The atoms form a large no. of effective regions called domain in which 1018 to 1021 atoms have their dipole moment aligned in the same direction. The magnetism in ferromagnetic substance, when placed in a magnetic field, is developed due to these domain by (i) the displacements of boundaries of the domains (ii) the rotation of the domains.

Curie Temperature : As temperature increases, the magnetic property of ferromagnetic substance decreases and above a certain temperature the substance changes into paramagnetic substance. This temperature is called Curie temperature.

---> Permanent magnets are made of steel, cobalt steel, ticonal, alcomax and alnico.

---> Electromagnets, cores of transformers, telephone diaphragms, armatures of dynamos and motors are made of soft iron, mu-metal and stalloy.

Terrestrial Magnetism: Our earth behaves as a powerful magnet whose south pole is near the geographical north pole and whose north pole is near the geographical south pole. The magnetic field of earth of a place is described in the terms of following three elements.

(i) Declination : The acute angle between magnetic meridian and geographical meridian at a place is called the angle of declination at that place.

(ii) Dip or Inclination : Dip is the angle which the resultant earth's magnetic field at a place makes with the horizontal. At poles and equator, dip is 90° and 0° respectively.

(iii) Horizontal component of earth's magnetic field : At a place it is defined as the component of earth's magnetic field along the horizontal in the magnetic meridian.

Its valve is different at different places, (approximately 0.4 gauss or 0.4 x 10-4 tesla).

Atomic & Nuclear Physics

Atomic Physics

1. Atom is the smallest part of matter which takes part in chemical reactions. Atoms of the same element are similar in mass, size and characteristics. Atom consists of three fundamental particles electron, proton and neutron. All the protons and neutrons are present in the central core of atom called nucleus. Electrons revolve around the nucleus.

2. In an atom, electrons and protons are equal in number and have equal and opposite charge. Hence atom is neutral.

Note : Proton was discovered by Golastin and named by Rutherford.

---> Till today, several subatomic particles have been discovered. Some important of them are as follows.

Cathode Rays : If the gas pressure in a discharge tube is 102 to 10-3 mm of Hg and a potential difference of 104 volt is applied between the electrode, then a beam of electrons emerges from the cathode which is called cathode rays. Hence cathode rays are beam of high energy electrons. Cathode is an electrode with a negative charge.

Properties of cathode rays :

(i) Cathode rays are invisible and travel in straight line.

(ii) These rays carry negative charge and travel from cathode to anode.

(iii) These rays emerge perpendicular to the cathode surface and are not affected by the position of anode.

(iv) Cathode rays travel with very high velocity (1 / 10th the velocity of light).

(v) These rays are deflected by electric and magnetic fields.

(vi) These rays can ionise gases.

(vii) These rays heat the material on which they fall.

(viii) They can produce chemical change and thus affect a photographic plate.

(ix) These rays can penetrate through thin metal foils.

(x) The source of emf used in the production of cathode rays is induction coil.

(xi) When they strike a target of heavy metals such as tungsten, they produce x-rays.(xii)The nature of cathode rays is independent of nature of cathode and the gas in the discharge tube.

Positive or Canal rays :

If perforated cathode is used in a discharge tube, it is observed that a new type of rays are produced from anode moving towards the cathode and passed through the holes of cathode. These rays are positively charged and are called positive rays or canal rays or anode rays. These rays were discovered by Goldstein.

Properties of Canal rays :

(i) The positive rays consists of positively charged particles.

(ii) These rays travel in straight line.

(iii) These rays can exert pressure and thus possess kinetic energy.

(iv) These rays are deflected by electric and magnetic fields.

(v) These rays are capable of producing physical and chemical changes.

(vi) These rays can produce ionisation in gases.

Radioactivity

1. Radioactivity is the sending out of harmful radiation or particles, caused when atomic nuclei breakup spontaneously.

2. Radioactivity was discovered by Henry Becquerel, Madame Curie and Pierre Curie for which they jointly win Noble prize.

3. The nucleus having protons 83 or more are unstable. They emit a, ß and ? particles and become stable. The elements of such nucleus are called radioactive elements and the phenomenon of emission of a, ß and ? particles is called radioactivity.

4. ? rays are emitted after the emission of a and ß rays.

5. Robert Pierre and his wife Madame Curie discovered a new radioactive element radium.

6. The rays emitted by radioactivity were first recognised by Rutherford.

7. The end product of all natural radioactive element after emission of radioactive rays is lead.

Properties of a, ß and ? particles

1. With the emission an a-particle, atomic number is decreased by 2 and mass member is decreased by 4.

2. With the emission of a (ß-particle atomic number is increased by one and mass number does not change.

3. The effect on the mass number and atomic number with the emission of a, ß and ? rays is decided by Group-displacement law or Soddy-Fajan Law.

4. Radioactivity is detected by G.M. Counter.

5. The time in which half nuclei of the element is decayed is called half life of the radioactive substance.

6. Cloud chamber : Cloud chamber is used to detect the presence and kinetic energy of radioactive particles. It was discovered by C.R.T. Wilson.

7. Radioactive carbon-14 is used to measure the age of fossils and plants. (Carbon dating) In this method age is decided by measuring the ratio of 6C12 and 6C14.

Nuclear Fission and Fusion

Nuclear Fission : The nuclear reaction in which a heavy nucleus splits into two nuclei of nearly equal mass is nuclear fission. The energy released in the nuclear fission is called nuclear energy.

---> Nuclear fission was first demonstrated by Strassmann and O. Hahn. They found that when U235 nucleus is excited by the capture of a neutron, it splits into two nuclei Ba142 & K92.

Chain Reaction : When uranium atom is bombarded with slow neutrons, fission takes place. With the fission of each uranium nucleus, on the average 3 neutrons and large energy is released. These neutrons cause further fission. Clearly a

chain of fission of uranium nucleus starts which continues till whole of uranium is exhausted. This is called chain reaction.
Chain reaction is of the following two types (i) Uncontrolled chain reaction (ii) Controlled chain reaction.

Uncontrolled Chain Reaction : In each fission reaction, three more neutrons are produced. These three neutrons may cause the fission of three other U235 nuclei producing 9 neutrons and so on. As a result the number of neutron goes on increasing till the whole of fissionable material is consumed. This chain reaction is called uncontrolled or explosive chain reaction. This reaction proceeds very quickly and a huge amount of energy is liberated in a short time.

Atom bomb : Atom bomb is based on nuclear fission. U235 and Pu239 are used as fissionable material. This bomb was first used by USA against Japan in second world war (6th August, 1945 at Hiroshima & 9th August, 1945 at Nagashaki).

Controlled Chain Reaction : A fission chain reaction which proceeds slowly without any explosion and in which the energy released can be controlled is known as controlled reaction. Actually in this situation only one of the neutrons produced in each fission is able to cause further fission. The rate of reaction remains constant.

Nuclear Reactor or Atomic Pile : Nuclear reactor is an arrangement in which controlled nuclear fission reaction takes place.

-----> First nuclear reactor was established in Chicago University under the supervision of Prof. Fermi.

-----> There are several components of nuclear reactor which are as follows :

(i) Fissionable Fuel : U235 or U239 is used.

(ii) Moderator : Moderator decreases the energy of neutrons so that they can be further used for fission reaction. Heavy water and graphite are used as moderator.

(iii) Control rod : Rods of cadmium or boron are used to absorb the excess neutrons produced in fission of uranium nucleus so that the chain reaction continues to be controlled.

(iv) Coolant : A large amount of heat is produced during fission. Coolant absorbs that heat and prevents excessive rise in the temperature. The coolant may be water, heavy water, or a gas like He or C02.

Uses of nuclear reactor

(i) To produce electrical energy from the energy released during fission.

(ii) To produce different isotopes which can be used in medical, physical and agriculture science.

Fast Breeder Reactor : A nuclear reactor which can produce more missile fuel than it consumes is called a fast breeder reactor.

Nuclear Fusion : When two or more light nuclei combined together to form a heavier nucleus, tremendous energy is released. This phenomenon is called nuclear fusion. A typical example of nuclear fission is 1H2 + 1H3 2He4 + 0n1 + 17.6 Mev.

-----> The energy released by sun and other stars is by nuclear fusion.

-----> For the nuclear fusion, a temperature of the order of 108 K is required.

Hydrogen bomb : Hydrogen bomb was made by American scientists in 1952. This is based on nuclear fusion. It is 1000 times more powerful than atom bomb.

Mass Energy Relation : In 1905 Einstein established a relation between mass and energy on the basis of special theory of relativity. According to this relation, mass can be converted into energy and vice versa, according to the relation E = me2 where c is the velocity of light and E is the energy equivalent of mass m.

-----> Albert Einstein was an American scientist. He was born in Germany. He was given Nobel Prize of Physics in 1921.

-----> Sun is continuously emitting energy. Earth is continuously receiving 4 x 1026 joule of energy per second from sun. As a result mass of sun is decreasing at the rate of approximately 4 x 109 kg per second. But mass of sun is so large that it is estimated that the sun will continuously supply energy for next 109 years.

Electronics

Electronics : Electronics is the branch of physics and technology concerned with the behaviour and movement of electrons.

Diode Valve : Designed by J. A. Fleming in 1904, diode valve consists of two electrodes placed inside an evacuated glass envelope. One electrode is called cathode which is made up of tungsten on which there is a thin layer of barium oxide. When heated, cathode emits electrons. These electron flow towards the other electrode called anode or plate, which is at positive potential. As a result an electric current is established in the circuit.

---> The electrons emitted from the cathode are collected in the evaluated space around it. This collection of electrons is called space charge which is obviously negative.

---> Diode valve acts a rectifier. Rectifier is a device which converts alternating voltage (current) into direct voltage (current).

Triode Valve : Designed by Lee de Forest in 1907, triode valve is a modified form of usual diode. It consists of a usual anode - cathode pair and one more electrode called control grid.

---> Triode valve can be used as amplifier, oscillator, transmitter and detector.

Semi-conductor : Semi conductor are those materials whose electrical conductivity, at room temperature, lies in between that of insulator and conductor. Germenium and Silicon are two important semiconductor. In a crystal lattice of semi-conductor, some of the electrons become free from bond formation. At the sites of these electrons a deficiency of electron exists which acts as a virtual positive charge. These virtual positive charges are called holes. Semi-conductors are used in electronics industry.

Semi-conductors are of two types :

(i) Intrinsic Semi -Conductor : A semi conductor in an extremely pure form is known as intrinsic semi conductor.

(ii) Extrinsic Semi-Conductor : If a measured and small amount of chemical impurity is added to intrinsic semi-conductor, it is called extrinsic semi-conductor or doped semi conductor. As a result of doping, there is large increase in its conductivity.

---> Extrinsic semi conductor are of two types :

(a) N type semi conductor : An extrionic semi conductor in which electrons are-majority charge carrier is called N type semi conductor. Such a semi conductor is made by doping a pure semi conductor with pentavalent impurity like Arsenic, Antimony & Phosphorus.

(b) P type semi conductor : An extrinsic semi conductor in which holes are the majority charge carrier is called a P type semi conductor. Such a semi conductor is made by doping a pure semi conductor with trivalent impurity like Gallium, Indium, Boron and Aluminium.

Doping : Adding of chemical impurity to a pure semi conductor is called doping. The amount and type of impurity is closely controlled.

Donor : Pentavalent impurities are called donor.

Acceptor : Trivalent impurities are called acceptor.

---> The electrical conductivity of a semi conductor increases with the increase in temperature.

Scientific Instruments

S. No	Instrument	Use
1.	Altimeter	Measures altitudes (used in aircraft)
2.	Ammeter	Measures strength of electric current
3.	Anemometer	Measures force and velocity of wind and directions
4.	Audiometer	Measures intensity of sound
5.	Barograph	Continuous recording of atmospheric pressure
6.	Barometer	Measures atmospheric pressure
7.	Binoculars	To view distant objects
8.	Bolometer	To measure heat radiation
9.	Callipers	Measure inner and outer diameters of bodies
10.	Calorimeter	Measures quantities of heat
11.	Cardiogram (ECG)	Traces movements of the heart; recorded on a Cardiograph
12.	Cathetometer	Determines heights, measurement of levels, etc., in scientific experiments
13.	Chronometer	Determines longitude of a vessel at sea.
14.	Colorimeter	Compares intensity of colours
15.	Commutator	To change/reverse the direction of electric current; Also used to convert AC into DC
16.	Cryometer	A type of thermometer used to measure very low temperatures, usually close to 0°C
17.	Cyclotron	A charged particle accelerator which can accelerate charged particles to high energies
18.	Dilatometer	Measures changes in volume of substances
19.	Dyanamo	To convert mechanical energy into electrical energy
20.	Dynamometer	Measures electrical power
21.	Electronecephalo	Records and interprets the electrical waves of the brain.
22.	graph (EEC)	(waves) recorded on electroence-phalograms
23.	Electrometer	Measures very small but potential difference in electric currents
24.	Electroscope	Detects presence of an electric charge

25.	Electromicroscope	To obtain a magnifying view of very small objects Capable of magnifying up to 20,000 times
26.	Endoscope	To examine internal parts of the body
27.	Fathometer	Measures depth of the ocean
28.	Fluxmeter	Measures magnetic flux
29.	Galvanometer	Measures electric current
30.	Hydrometer	Measures the relative density of liquids
31.	Hygrometer	Measures level of humidity
32.	Hydrophone	Measures sound under water
33.	Hygroscope	Shows the changes in atmospheric humidity
34.	Hypsometer	To determine boiling point of liquids
35.	Kymograph	Graphically records physiological movement, (e.g., blood pressure / heartbeat)
36.	Lactometer	Measures the relative density of milk to determine purity
37.	Machmeter	Determines the speed of an aircraft in terms of the speed of sound
38.	Magnetometer	Compares magnetic movements and fields
39.	Manometer	Measures the pressure of gases
40.	Micrometer	Converts sound waves into electrical vibrations
41.	Microphone	Measures distances/angles
42.	Microscope	To obtain a magnified view of small objects
43.	Nephetometer	Measures the scattering of light by particles suspended in a liquid
44.	Ohmmeter	To measure electrical resistance in ohms
45.	Ondometer	Measures the frequency of electromagnetic waves, especially in the radio-frequency band
46.	Periscope	To view objects above sea level (used in submarines)
47.	Photometer	Compares the luminous intensity of the source of light
48.	Polygraph	Instrument that simultaneously records changes in physiological processes such as heartbeat, blood-pressure and respiration; used as a lie detector
49.	Pyknometer	Determines the density and coefficient of expansion of liquids

50.	Pyrheliometer	Measures components of solar radiation
51.	Pyrometer	Measures Very high temperature
52.	Quadrant	Measures altitudes and angles in navigation and astronomy
53.	Radar	To detect the direction and range of an approaching aeroplane by means of radiowaves, (Radio, Angle, Detection and Range)
54.	Radio micrometer	Measures heat radiation
55.	Refractometer	Measures refractive indices
56.	Salinometer	Determines salinity of solutions
57.	Sextant	Used by navigators to find the latitude of a place by measuring the elevation above the horizon of the sun or another star; also used to measure the height of very distant objects.
58.	Spectroscope	To observe or record spectra
59.	Spectrometer	Spectroscope equipped with calibrated scale to measure the position of spectral lines (Measurement of refractive indices)
60.	Spherometer	Measures curvature of spherical objects
61.	Sphygmometer	Measures blood pressure
62.	Stereoscope	To view two-dimensional pictures

Inventions

S. No	Invention	Inventor	Country	Year
1.	Adding machine	Pascal	France	1642
2.	Aeroplane	Wright brothers	USA	1903
3.	Balloon	Jacques and Joseph Montgolfier	France	1783
4.	Ball-point pen	C. Biro	Hungary	1938
5.	Barometer	E. Torricelli	Italy	1644
6.	Bicycle	K. Macmilla	Scotland	1839
7.	Bicycle Tyre	J.B. Dunlop	Scotland	1888
8.	Calculating machine	Pascal	France	1642
9.	Centrigrade scale	A. Celsius	France	1742
10.	Cinematograph	Thomas Alva Edison	USA	1891
11.	Neon-lamp	G. Claude	France	1915
12.	Nylon D	r W.H. Carothers	USA	1937
13.	Photography (paper)	W.H. Fox Tablot	England	1835
14.	Printing press	J. Gutenberg	Germany	1455
15.	Radar	Dr A.H. Taylor and L.C. Young	USA	1922
16.	Radium	Marie and Pierre Curie	France	1898
17.	Radio	G. Marconi	England	1901
18.	Rayon	American Viscose Co.	USA	1910
19.	Razor (safety)	K.G. Gillette	USA	1895
20.	Razor (electric)	Col. J. Schick	USA	1931
21.	Refrigerator	J. Harrison and A. Catlin	Britain	1834
22.	Revolver	Samuel Colt	USA	1835
23.	Rubber (vulcanized)	Charles Goodyear	USA	1841
24.	Rubber (waterproof)	Charles Macintosh	Scotland	1819
25.	Safety lamp	Sir Humphrey Davy	England	1816
26.	Safety pin	William Hurst	USA	1849
27.	Sewing machine	B. Thimmonnier	France	1830

28.	Scooter	G. Bradshaw	England	1919
29.	Ship (steam)	J.C. Perier	France	1775
30.	Ship (turbine)	Sir Charles Parsons	Britain	1894
31.	Shorthand (modem)	Sir Issac Pitman	Britain	1837
32.	Spinning frame	Sir Richard Arkwight	England	1769
33.	Spinning jenny	James Hargreaves	England	1764
34.	Steam engine (piston)	Thomas Newcome	Britain	1712
35.	Steam engine (condenser)	James Watt	Scotland	1765
36.	Steel production	Henry Bessemer	England	1855
37.	Stainless Steel	Harry Brearley	England	1913
38.	Tank	Sir Ernest Swington	England	1914
39.	Telegraph code	Samuel F.B. Morse	USA	1837
40.	Telephone	Alexander Graham Bell	USA	1876
41.	Telescope	Hans Lippershey	Netherlands	1608
42.	Television	John Logie Bared	Scotland	1926
43.	Terylene	J. Whinfield and H. Dickson	England	1941
44.	Thermometer	Daniel Gabriel Fahrenheit	Germany	1714
45.	Tractor	J. Froelich	USA	1892
46.	Transistor	Bardeen, Shockley	USA & UK	1949
47.	Typewriter	C. Sholes	USA	1868
48.	Valve of radio	Sir J.A. Fleming	Britain	1904
49.	Watch	A.L. Breguet	France	1791
50.	X-ray	Wilhelm Roentgen	Germany	1895
51.	Zip fastener	W.L. Judson	USA	1891

Important Discoveries in Physics

S. No	Discovery	Scientist	Year
1.	Laws of motion	Newton	1687
2.	Law of electrostatic attraction	Coulomb	1779
3.	Atom	John Dalton	1808
4.	Photography (On metal)	J. Neepse	1826
5.	Law of Electric resistance	G.S. Ohm 1	1827
6.	Law of floatation	Archemedes	1827
7.	Electromagnetic Induction	Michael Faraday	1831
8.	Photography (On paper)	W.Fox Talbot	1835
9.	Dynamite	Alfred Nobel	1867
10.	Periodic table	Mandeleev	1888
11.	X-Rays	Roentgen	1895
12.	Radioactivity	Henry Becquerel	1896
13.	Electron	J.J. Thomson	1897
14.	Radium	Madam Curie	1898
15.	Quantum theory	Max Plank	1900
16.	Wireless Telegram	Marconi	1901
17.	Diode Bulb	Sir J. S. Fleming	1904
18.	Photo electric effect	Albert Einstein	1905
19.	Principle of Relativity	Albert Einstein	1905
20.	Triode Bulb	Lee de Forest	1906
21.	Atomic Structure	Neil Bohr & Rutherford	1913
22.	Proton	Rutherford	1919
23.	Raman Effect	C.V. Raman	1928
24.	Neutron	James Chadwick	1932
25.	Nuclear Reactor	Anrico Fermi	1942

S.I. Units of Physical Quantity

S. No	Quantity	SI	Symbol
1.	Length	meter	M
2.	Mass	kilogram	Kg
3.	Time	second	S
4.	Work and Energy	joule	J
5.	Electric current	ampere	A
6.	Temperature	kelvin	K
7.	Intensity of flame	candela	Cd
8.	Angle	radian	Rad
9.	Solid angle	steredian	Sr
10.	Force	newton	N
11.	Area	square meter	V
12.	Volume	Cubic meter	m3
13.	Speed	meter per second	ms-1
14.	Angle Velocity	radian per second	rad s-1
15.	Frequency	Hertz	Hz
16.	Moment of inertia	kilogram Square meter	kgm2
17.	Momentum	kilogram meter per second	Kg ms-1
18.	impulse	newton second	Pa
19.	Angular Momentum	kilogram square meter per second	Kgm2s-1
20.	Pressure	pascal	Pa
21.	Power	watt	W
22.	Surface tension	newton per meter	Nm-1
23.	Viscosity	newton second per square m	N.s.m-2
24.	Thermal Conductivity	watt per meter per degree celdus	Wm -1C1
25.	Specific Heat capacity	joule per kilogram per Kelvin	Jkg-1k-1
26.	Quantity	SI	Symbol
27.	Electric charge	coulomb	C
28.	Potential Difference	volt	V
29.	Electric	Resistance	Ohm
30.	Electrical Capacity	farad	F
31.	Magnetic Induction	henry	H
32.	Magnetic Flux	weber	Wb
33.	Luminous Flux or photometric power	lumen	lm

Conversion of Units from One System to Another System

1 Inch	2.54 centimeter
1 grain	64.8 miligram
1 Feet	0.3 meter
1 dram	1.77 gm
1 Yard	0.91 meter
1 ounce	28.35 gm
1 Mile	1.60 kilometer
1 pound	0.4537 kilogram
1 Fathom	1.8 meter
1 dyne	I0-5 Newton
1 Chain	20.11 meter
1 poundal	0.1383 Newton
1 Nautical mile	1.85 kilometer
1 erg	10-7 Joule
1 Angstrom	10-10 meter
1 horse power	747 Watt
1 Square inch	6.45 sq. centimeter
1 fathom	6 feet
1 Square feet	0.09 square meter
1 mile	8 furlong