CHAPTER-1
MEASUREMENTS AND EXPERIMENTATION

Topic-1 International System of Units

Revision Notes

➢ **SI Units:** Internationally accepted system of physical units based on the metre, kilogram, second, ampere, candela, kelvin and mole.

➢ Measurement is the process of comparison of the given physical quantity with the known standard quantity of the same nature.

- ➢ Unit is the quantity of a constant magnitude which is used to measure the magnitudes of other quantities of the same nature.
- ➢ Physical quantity = (numerical value) × (unit)
- ➢ **Fundamental or basic units :** A fundamental (or basic) unit is that which is independent of any other unit or which can neither be changed nor can be related to any other fundamental unit.
- ➢ **Derived units :** These are those units which depend on the fundamental units or which can be expressed in terms of the fundamental units.
- ➢ **System of units :**
  - **(i)** CGS system (or French system)
  - **(ii)** FPS system (or British system)
  - **(iii)** MKS system (or Metric system)
  - **(iv)** S.I. (or International system)

Fundamental quantities, units and symbols in SI system

➢ **Fundamental Units**

Quantity	Unit	Symbol
Length	metre	m
Mass	kilogram	kg
Time	second	s
Temperature	kelvin	K
Luminous Intensity	candela	cd
Electric Current	ampere	A
Amount of substance	mole	mol
Angle	radian	rd
Solid angle	steradian	st-rd

Prefix used for big measurements

Prefix	Symbol	Meaning
deca	Da	10^1
hecto	h	10^2

kilo	k	10^{3}
mega	M	10^{6}
giga	G	10^{9}
tera	T	10^{12}
peta	P	10^{15}
exa	E	10^{18}
zetta	Z	10^{21}
yotta	Y	10^{24}

Prefixes used for small measurements

Prefix	Symbol	Meaning
deci	d	10^{-1}
centi	c	10^{-2}
milli	m	10^{-3}
micro	μ	10^{-6}
nano	n	10^{-9}
pico	p	10^{-12}
femto	f	10^{-15}
atto	a	10^{-18}
zepto	z	10^{-21}
yotto	y	10^{-24}

➢ **Non metric unit of length**

- **Astronomical unit (AU):** One astronomical unit is equal to the mean distance between the earth and sun *i.e.*,

$$1 \text{ AU} = 1.496 \times 10^{11} \text{ metre}$$

- **Light year** : A light year is the distance travelled by light in vacuum in one year *i.e.*,

$$1 \text{ light year} = \text{speed of light} \times \text{time (1 year)}$$

$$1 \text{ ly} = 9.46 \times 10^{12} \text{ km}$$

- **Parsec** : One parsec is the distance from where the semi major axis of orbit or earth subtends an angle of one second. 1 parsec= 3.26 ly

➢ **Non metric unit of mass**

- The mass of atomic particles such as proton, neutron and electron is expressed is a unit called the atomic mass unit or the unified atomic mass unit.

  It is defined as 1 amu (or *u*) is $\frac{1}{12}$*th* the mass of one Carbon-12 atom.

  The mass of large heavenly bodies is measured in terms of solar mass where 1 solar mass is the mass of the sun *i.e.*, 1 solar mass = 2×10^{30} kg

➢ **Units of Time**

- SI unit of time is second (s)
- smaller units of time

  1 ms = 10^{-3}s; 1 μs = 10^{-6}s

  1 shake = 10^{-8}s ; 1 ns = 10^{-9}s
- bigger units of time
  - **minute:** one minute is the duration of 60 seconds.
  - **hour:** one hour in the duration of 60 minutes.
  - **day:** the time taken by the earth to rotate once on its own axis is called a day.
  - **lunar month:** the time of one lunar cycle is 29.5 days.
  - **month:** a month considered to be of 30 days.

- **year:** one year is defined as the time in which the earth completes one revolution around the sun.
- **leap year:** a leap year is the year in which the month of February is of 29 days.
- **decade:** a decade is of 10 years.
- **century:** a century is of 100 years.
- **millennium:** a millennium is of 1000 years.

Derived Units of physical quantities

Quantity	Derived unit	Symbol
Volume	metre × metre × metre	m^3
Force	mass × acceleration	$kgms^{-2}$ or N
Energy	kilogram × $\frac{(\text{metre})^2}{\text{second}^2}$	kgm^2s^{-2} or J
Frequency	$\frac{1}{\text{second}}$ or second^{-1}	s^{-1} or Hz

Mnemonics

- **Concept Name:** S.I. units
- **Mnemonics:** Keka, Calls Mimo
- **Interpretations:** Kilogram, Kelvin, Ampere, Candela, Second, Meter, Mol

Topic-2 Simple Pendulum

Revision Notes

- A simple pendulum is a heavy point mass (known as bob) suspended from a rigid support by a massless and inextensible string.
- Relationship between time period and frequency

$$f = \frac{1}{T} \quad Or \quad T = \frac{1}{f}$$

- The time taken for one oscillation is known as the Time period (T)

$$T = 2\pi\sqrt{\frac{l}{g}}$$

- Here l is the effective length and g is the acceleration due to gravity at that place where time period is defined.
- Factors affecting the time period of a simple pendulum:
  – The time period of oscillation is directly proportional to the square root of its effective length.
  – The time period of oscillation inversely proportional to the square root of acceleration due to gravity.
  – The time period of oscillation does not depend on the mass or material or the body suspended.
  – The time period of oscillation does not depend on the extent of swing or either side side (i.e., amplitude)
- Second's pendulum
  A pendulum with a time period of oscillation equal to two seconds is known as a second's pendulum.

Key Words

- The time period of oscillation does not depend on the mass or material of the body suspended (*i.e.*, bob)
- The time period of oscillation does not depend on the extent of swing on either side (*i.e.*, amplitude)

Topic-3 Measurement Using Common Instruments

Revision Notes

- The least count of an instrument is the smallest measurement that can be taken accurately with it.
- The smaller the least count of an instrument, the more precise is the measurement made by using it.
- A Vernier caliper is a device used to measure the length or width of any small object with greater precision.
- Pierre Vernier invented the vernier caliper.
- Vernier Caliper uses two scales for measurements.
  - The fixed scale also called the main scale.
  - The Vernier scale which slides along the main scale.
- The Least Count of Vernier is also called the Vernier Constant.
- L.C. Vernier Calliper = Value of 1 main scale division – Value of 1 Vernier scale division
- The Least Count of a Vernier Calliper is normally 0.1 mm.
- Length of the object = Total reading = Main scale reading + Vernier reading
- L.C. of Vernier Caliper = Value of 1 main scale division / Total number of divisions on Vernier scale
- The distance between the zero of the main scale and the vernier scale is called Zero Error.
- **Two Kinds of Zero Error:**
  - Positive Zero Error
  - Negative Zero Error
- On bringing both jaws together, if zero of Vernier Scale is in right of the zero of the main scale then it is called Positive Zero Error.
- On bringing both jaws together, if zero of Vernier Scale is in left of the zero of the main scale then it is called Negative Zero Error.
- Correct Reading = Observed reading – Zero Reading (With Sign)
- A screw gauge is an instrument used for measuring the diameter of a thin wire or the thickness of a sheet of metal.
- The pitch of a screw gauge is the distance moved by the screw along its axis in one complete rotation of its head.
- Pitch of Screw Gauge = Unit length on main scale/Number of divisions in a unit length
- Generally, the pitch of a screw is 1 mm or 0.5 mm.
- The least count of a screw gauge is the smallest distance moved by the tip of the screw gauge, when the circular scale of it moves by one division.
- Least Count of Screw Gauge = Pitch of screw/Total number of divisions on the circular scale
- Error due to wear and tear of the screw is called Backlash Error.

Key Words

- Less the least count of an instrument, more the accuracy of the Instrument.
- Positive Zero Error is subtracted from final reading.
- Negative Zero Error is added in final reading.
- Backlash error can be avoided by rotating the screw in only one direction.

CHAPTER-2
MOTION IN ONE DIMENSION

Topic-1 Scalar and Vector quantities Distance, Displacement.

Revision Notes

- Scalar quantities are the physical quantities which are expressed only by their magnitudes – mass distance, time, speed, volume, density, pressure, work, energy, temperature, power, charge, current, etc.

- Vector quantities are the physical quantities require the magnitude as well as the direction to express them – displacement, velocity, acceleration, force, weight, electric field, magnetic field, etc.
- A body in said to be at rest if it does not change its position with respect to its immediate surroundings.
- A body is said to be in motion if it changes its position with respect to its immediate surroundings.
- **Representation of one dimensional motion:**
  The path of one dimensional motion can be represented by a straight line parallel to the X-axis. If X-axis is taken in the direction of motion, then each point on the straight line represents the position of the particle at different instants of time.
  - **Distance:** The actual length of path traversed by a body during its course of motion is called distance. The distance travelled by a body depends on the path followed by the body. It is a scalar quantity.
  - The SI unit of distance is metre (m) and C.G.S unit is centimetre (cm).
  - **Displacement:** The shortest distance between the initial and the final position of the body, is the magnitude of displacement and its direction is from the initial position to the final position. It is a vector quantity.
  - Displacement is a vector quantity. It is represented by a symbol $\vec{s}$.
  - The SI unit of displacement is metre (m) and C.G.S unit is centimetre (cm)
- **Representation of displacement:**
  The displacement being a vector, is represented by a straight line with an arrow over head, using a convenient scale.
- **Difference between distance and displacement:**
  (i) The magnitude of displacement is either equal to or less than the distance.
  (ii) The distance is the actual length of path travelled by the body so it is always positive but displacement is the shortest length in direction from initial position to final position so it may be positive, or negative depending on its direction.
  (iii) The displacement may be zero even if the distance is not zero.
  (iv) Displacement is a vector quantity, but distance is a scalar quantity.

Topic-2 Speed, Velocity, Acceleration, Equations of motion

Revision Notes

- The speed of a body is the rate of change of distance with time. It is a scalar quantity. It is represented by u or v.
- SI units of speed is metre per second (ms^{-1}) and its C.G.S unit is centimetre per second (cms^{-1}).
- **Uniform speed :** A body is said to be moving with uniform speed if it covers equal distances in equal intervals of time throughout its motion.
- **Non uniform or variable speed :** A body is said to be moving with non – uniform (or variable) speed if it covers unequal distances in equal intervals of time or it covers equal distances in unequal intervals of time
- **Instantaneous speed :** The speed of a body at a particular instant of time during its course of motion is called instantaneous speed.
- The speedometer of a vehicle measures the instantaneous speed.
- **Average speed :** The ratio of the total distance travelled by a body to the total time of journey in called its average speed.
- **Velocity :** The velocity of a body is the distance travelled by the body per unit time in a specified direction.
- Velocity is a vector quantity and represented by $\vec{u}$ or $\vec{v}$.
- The unit of velocity is same as the unit of speed i.e., the SI unit of velocity is metre per second (ms^{-1}) the C.G.S unit is centimetre per second (cms^{-1})
- **Uniform velocity :** If a body travels equal distances in a particular direction, in equal intervals of time, the body is said to be moving with a uniform velocity.
- If a body moving with a uniform velocity $\vec{v}$, has displacement $\vec{s}$ in a time interval t, then by definition, $\vec{v} = \frac{\vec{s}}{t}$

  $\therefore$ Displacement $= \vec{s} = \vec{v}t$
- **Non-uniform or variable velocity :** If a body moves equal distances in equal intervals of time but its direction of motion does not remain the same, or travels unequal distances in equal intervals of time with change in direction of motion of a body then the velocity of the body is said to be variable (or non – uniform)

- **Instantaneous velocity :** When a body moving with variable velocity, the velocity of the body at any instant is called its instantaneous velocity.
- **Average velocity :** The ratio of total distance travelled by a body in a particular direction to the total time taken for the entire journey is called as the average velocity of the body.
- **Acceleration and Retardation :** If the velocity of a body increases with time, the motion is said to be accelerated. If the velocity of body decreases with time, the motion is said to the decelerated (or retarded) . Thus retardation is the negative acceleration.
- SI unit of acceleration is metre per second square or ms^{-2} and C.G.S. unit of acceleration is cms^{-2}.
- **Uniform acceleration :** The acceleration is said to be uniform (or constant) when equal changes in velocity takes place in equal intervals of time. The motion of a body under gravity in an example of uniformly accelerated motion.
- **Variable acceleration :** If change in velocity is not constant in the same intervals of time, the acceleration is said to be variable. The motion of a vehicle on a crowded (or hilly) road is an example of variable acceleration.
- **Acceleration due to gravity :** When a body falls freely under gravity, the acceleration produced in the body due to earth's gravitational attraction is called the acceleration due to gravity.
- **Equation of uniformly accelerated motion :**

(i) $v = u + at$

(ii) $s = ut + \frac{1}{2}at^2$

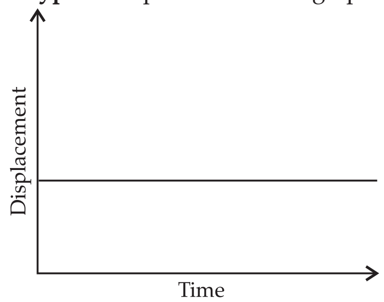
(iii) $v^2 = u^2 + 2as$

Where, u = initial velocity
v = final velocity
S = displacement
a = acceleration
t = time.

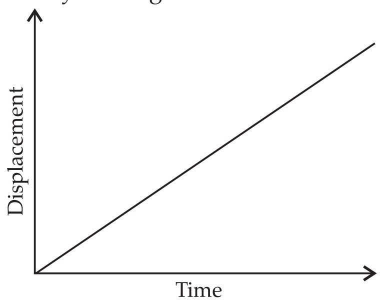
Topic-3 Graphical Analysis of One-Dimensional Motion

Revision Notes

- A graph is a pictorial representation of the relation between two sets of data of which one set is of dependent variables and the other set is of independent variables.
- A line graph is used to represent the motion of any object.
- A distance-time graph shows the distance travelled by an object in a given time.
- The slope of a distance-time graph represents the speed of the object.
- **There are three types distance – time graph:**
  - **Type a:** Distance time graph of a stationary object which is a straight line parallel to the time axis.
  - **Type b:** Displacement time graph of a body moving with uniform velocity which is a straight line inclined to the time axis.
  - **Type c:** Displacement time graph of a body moving with variable velocity which is a curve.



Type a



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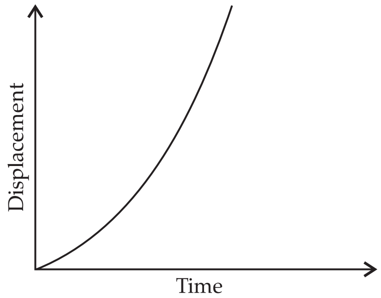

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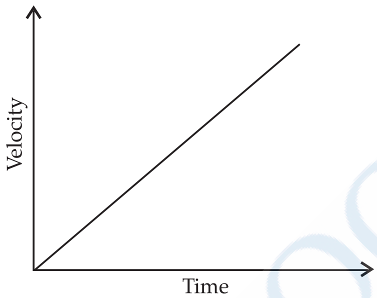
- The variation in velocity with time for an object moving in a straight line can be represented by a velocity-time graph.
- In this graph, time is represented along the X-axis, and velocity is represented along the Y-axis.
- Positive slope of Velocity-Time graph represents the acceleration of the body.
- Negative slope of Velocity-Time graph represents the retardation of the body.
- **There are three types for a Velocity-Time graph:**
  - **Type a:** Velocity-Time Graph of a body moving with uniform velocity which is a straight line parallel to the time axis.
  - **Type b:** Velocity-Time Graph of a body moving with uniform acceleration which is a straight line inclined to the time axis.
  - **Type c:** Velocity-Time Graph of a body moving with variable acceleration which is a curve.

Type a



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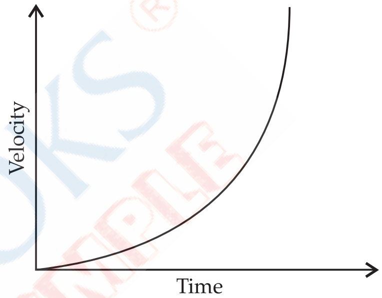


Type c

- Area under the Speed – Time graph represents the distance moved by the object.

Mnemonics

- **Mnemonics:** Sunday, Vijay Takes Apple, Danny Takes Strawberry
- **Interpretations:** Slope, Velocity, Time (Slope of velocity-time graph is acceleration), Acceleration, Displacement (Slope of displacement-time graph is acceleration), Time, Speed

Key Words

- Higher the speed of the body, steeper the slope of the Distance – Time Graph.
- Higher the acceleration of the body, steeper the slope of the Velocity – Time Graph.
- The graph can be segregated into several regular shapes to find the area under the curve.
- Slope of a curve can be obtained by drawing a tangent to a point.

CHAPTER-3
LAWS OF MOTION

Topic-1 Contact and non-contact forces

Revision Notes

- **Effects of force**
  - It can change the state of rest or of motion of the body, i.e. it can produce motion in the body.
  - It can change the size or shape of the body i.e. it can change the dimensions of the body.
- **Contact forces:** The forces which are applied on bodies by making a physical contact, are called the contact forces.

  Examples of contact forces:

- Frictional forces
- Normal reaction forces
- Tension force as applied through strings
- Force exerted by a spring
- Force exerted during collision

➢ **Non-contact forces :** The force experienced by body even without being physically touched, are called the non-contact forces.

Examples of non-contact forces:

- Gravitational force
- Electrostatic force
- Magnetic force

➢ **General character of non-contact forces :**

- The gravitational force is always of attractive nature, while the electrostatic force and magnetic force can be either attractive or repulsive.
- The magnitude of non-contact forces on the two bodies depends on the distance of separation between them. It decreases with the increase in separation and increases as the separation decreases. Non-contact forces follow inverse square law

Topic-2 Newton's laws of Motion

Revision Notes

➢ The property of a body by virtue of which it neither changes nor tends to change the present state of motion or rest, is known as inertia. It is the inherent property of the body.

➢ The property of inertia is because of the mass of the body. Thus, a lighter body has less inertia than heavier body.

➢ According to Newton's first law of motion, if a body is in a state of rest, it will remain in the state of rest and if it is in the state of motion, it will remain moving in the same direction with the same speed unless an external force is applied on it.

➢ Linear momentum of a body is the product of its mass and velocity.

For a body of mass m moving with velocity v, linear momentum p is expressed as

$$p = mv$$

It is a vector quantity in the direction of motion of the body.

➢ The SI unit of momentum is $kgms^{-1}$ and the CGS unit is $gcms^{-1}$.

➢ Rate of change of momentum $= ma$

$$= \text{mass} \times \text{acceleration}$$

➢ According to Newton's second law of motion, the rate of change of momentum of a body is directly proportional to the force applied on it and the change in momentum takes place in the direction in which the force is applied.

➢ The SI unit of force is Newton and C.G.S. unit of force is dyne.

➢ Relationship between Newton and dyne:

$$\begin{aligned} 1 \text{ Newton} &= 1 \text{ kg} \times 1 \text{ ms}^{-2} \\ &= 1000 \text{ g} \times 100 \text{ cms}^{-2} = 10^5 \text{ g} \times \text{cms}^{-2} \\ &= 10^5 \text{ dyne} \end{aligned}$$

➢ According to Newton's third law of motion to every action there is always an equal and opposite reaction.

➢ Equation of motion with constant translational acceleration in a straight line:

- $v = u + at$
- $s = ut + \frac{1}{2}at^2$
- $v^2 = u^2 + 2as$

where, u = initial velocity

v = final velocity

t = time

s = distance traversed

a = acceleration

Topic-3 Gravitation

Revision Notes

- **Universal law of gravitation:**
  - Every body attracts every other body in the universe with a force that is directly proportional to the product of their masses and inversely proportional to the square of the distance between their centres.

    $$F = G\frac{m_1 m_2}{r^2}$$

    Where F = force of attraction

    m_1 and m_2 are the masses of the two bodies

    r = distance between the bodies

    G = Universal gravitational constant = 6.674×10^{-11} N m_2 kg^{-2}
- **Gravity:** Gravity is the force by which a planet or other body draws objects towards its centre.
  - **Acceleration due to gravity:**

    Considering the force of attraction between the earth and a body on it:

    From Universal law of gravitation, $F = G\frac{m_1 m_2}{r^2}$

    Where m_1 = mass of earth

    m_2 = mass of a body on the earth

    From Newton's second law of motion, $F = m_2 g$

    Where F is the force acting

    g = acceleration of the body when falling freely on earth from a height

    From the two expressions of force,

    $g = \frac{Gm_1}{r^2}$ =Acceleration due to gravity.
  - Value of g at sea level = 9.81 ms^{-2}
  - Value of g varies from place to place.
- **Free fall of a body:**
  - A freely falling object is an object that is falling from a height to the surface of the earth under the sole influence of gravity
  - Free falling objects do not encounter air-resistance.
  - All free falling objects accelerate downward at the rate of 9.8 ms^{-2}.
- **Mass and weight:**
  - Mass is the amount of matter contained in an object.
  - Weight is the measure of the amount of force acting on the mass due to acceleration due to gravity. It is calculated as mass times of the acceleration due to gravity.

    $W = mg$

    Where, W = weight of an object.

    m = mass of an object

    g = acceleration due to gravity
  - S.I. Unit of mass: Kilogram
  - S.I. unit of weight: Newton
- **Unit of force:**
  - S.I. unit of force: Newton
  - Gravitational unit of force: kgf
  - 1 kgf is the amount of force exerted by the earth on a body of mass 1 kg.
  - 1 kgf = 1kg × 9.8 ms^{-2} = 9.8 N

➢ **Equations for vertical motion under gravity:**

Equations of motion	Ascending (Upwards)	Descending (Downwards)
I	$v = u - gt$	$v = u + gt$
II	$h = ut - \frac{1}{2} gt^2$	$h = ut + \frac{1}{2} gt^2$
III	$v^2 = u^2 - 2gh$	$v^2 = u^2 + 2gh$

[u = initial velocity, v = final velocity, h = height traversed, t = time, g = acceleration due to gravity]

➢ For maximum height traversed, $v = 0$ and $h_{max} = u^2/2g$

➢ Time to ascent maximum height = time to descent to ground = u/g

Mnemonics

➢ **Concept Name:** Fundamental units

➢ **Mnemonics:** SILA NAIR HAD 1 KG FISH AND THEN COLD DRINKS 1 GLASS FULL

➢ **Interpretations:** SI system, Newton, kgf, CGS system, Dyne, gf

CHAPTER-4
FLUIDS

Topic-1 Pressure in fluids and its Transmission

Revision Notes

➢ Thrust is the force acting normal on a surface

➢ Thrust exerted by a body on a surface= weight of the body

➢ SI unit of thrust is newton (N) and CGS unit of thrust in dyne.

➢ The thrust on the unit area of a surface is called pressure.

$$\text{Pressure} = \frac{\text{Thrust}}{\text{Area}}$$

➢ SI unit of pressure is Nm^{-2}

➢ Pascal in another unit of pressure. One pascal is defined as the pressure exerted on a surface of area 1 m^2 by a force of I N acting normally on the surface

$$1 \text{ pa} = 1 \text{ Nm}^{-2}$$

➢ **The pressure exerted an a surface depends on two factors :**

(i) The area on which the thrust in applied

(ii) The thrust

➢ **Way of increasing pressure:** For the given thrust, the pressure on the surface in increased by reducing the area of surface an which it is acting.

➢ **Way of decreasing pressure:** For the given thrust, the pressure on a surface in reduced by increasing the area of surface.

➢ A substance which can flow in called a fluid. All liquids and gases are thus fluids.

➢ A fluid contained in a vessel exerts pressure at all points and in all direction.

➢ The pressure at a point in a liquid depends directly on the following three factors :

(i) Depth of the point below the free surface (h)

(ii) Density of liquid (ρ) and

(iii) Acceleration due to gravity (g)

- **Pressure exerted by a liquid column (p)** = depth × density of the liquid × acceleration due to gravity = ρhg

  Total pressure inside a liquid at depth = Atmospheric pressure + pressure due to liquid column

  $= P_0 + h\rho g$

  Here, P_0 in atmospheric pressure acting on the free surface of liquid.
- **Laws of liquid pressure:**
  - Inside the liquid, pressure increases with the increase in depth from its free surface.
  - In a stationary liquid, pressure is same at all points on a horizontal level.
  - Pressure in same in all directions about a point inside a liquid
  - Pressure at same depth is different in different liquids. It increases with the increase in density of liquid.
  - The hydrostatic paradox: Same liquid in different shaped containers, with the same base area, applies same pressure on the base of the containers if the height of liquid is same.
- **Consequences of liquid pressure :**
  - The pressure at a certain depth in sea water in more that at the same depth in river water.
  - The wall of dam in made thicker at the bottom.
  - Water supply tank is placed high.
  - Size of gas bubble increases inside the water as it rises upward.
- **Transmission of pressure in liquids:**
  - Pascal's law states that the pressure exerted anywhere in a confined liquid in transmitted equally and undiminished in all directions throughout the liquid.
  - Hydraulic machines such as hydraulic press, hydraulic brakes, hydraulic jack are based on Pascal's law.
  - Our earth and everything on its surface in submerged in a great sea of air. The air envelope surrounding the earth is called atmosphere of the earth.
  - The atmospheric pressure at any point in air at rest is equal to the weight of a vertical column of air on unit area surrounding the point, extending to the top of the atmosphere.
  - The thrust exerted per unit area on the earth surface due to column of air, is called the atmosphere pressure on the surface of earth.
- **Consequence of the atmosphere pressure :**
  - Sucking a drink with a straw.
  - Filling a surface with a liquid.
  - Filling of ink into a fountain pen.
  - Action of rubber suckers.
  - Action of a siphon system.
  - Taking out oil from a sealed oil can.
- **A barometer is an instrument which in used to measure the atmospheric pressure.**
  - The barometric height at normal temperature and pressure at sea level in 0.76 m (or 76 cm or 760 mm) of mercury.
- **Factors affecting the barometric height :**
  - The barometric height at a place changes only when the atmospheric pressure at that place changes.
- **Advantage of using mercury as a barometric liquid :**
  - The vapour pressure of mercury is negligible. So vapours in the Torricellian vacuum does not affect the barometric height.
  - The mercury neither wets nor sticks to the glass tube therefore it gives accurate reading.
  - The surface of mercury is shining and opaque. Therefore it can be easily seen while taking the observation.
  - It can easily be obtained in a pure state.
- **Unit of pressure related to barometric height :**
  - 1 torr = 1 mm of mercury
  - 1 torr = 133.3 Pa
- **Disadvantage of using water as a barometric liquid:**
  - The vapour pressure of water is high. So its vapours in the vacuum space makes the reading inaccurate.
  - Water sticks with the glass tube and wets it. So the reading becomes inaccurate.
  - Water is transparent. So its surface in not easily seen while taking the observation.
- **Demerits of a simple barometer :**
  - There is no protection for the glass tube.

- The surface of mercury in the trough is open therefore there are chances of impurities to fall in and to get mixed with the mercury of the trough.
- It is inconvenient to move the barometer from one place to another. It is not portable.

- **Weather forecast by the use of Barometer:**
  - It the barometer height at a place suddenly falls, it means that the pressure at that place has suddenly decreased which indicates the coming of a storm or cyclone.
  - If the barometric height gradually falls, it indicate that the moisture in air is increasing and there is a possibility of rain.
  - A gradual increase in the barometric height means that the moisture in air to decreasing. This indicates the coming of a dry weather.
  - A sudden rise in the barometric height means the flow of air from the place to other surrounding low pressure areas. This indicates the coming of an extremely dry weather.
  - If there is no abrupt change in barometric height, it indicates that the atmospheric pressure is normal and the weather will remain unchanged.

Topic-2 Archimedes' principle and law of floatation

Revision Notes

- The upward force exerted on the body by the fluid in which it is submerged, is called the upthrust or buoyant force.
- When a body is immersed in a fluid, upthrust on it due to fluid is equal to weight of the fluid displaced by the submerged part of the body.
- **Characteristic properties of upthrust :**
  - Larger the volume of body submerged in fluid, greater is the upthrust.
  - For same volume inside the fluid more the density of fluid greater is the upthrust.
- **Factors affecting the upthrust :**

  (i) Volume of the body submerged in fluid.

  (ii) Density of the (the fluid) in which the body is submerged.
- **Archimedes' principle :** When a body is immersed partially or completely in a fluid it experiences an upthrust, which is equal to the weight of the fluid displaced by it.
- **Density :** The density of a substance is its mass per unit volume *i.e.*,

$$\text{Density of substance} = \frac{\text{Mass of the substance}}{\text{Volume of the substance}}$$

  - It is a a scalar quantity and represented by ρ. SI unit of density in kg m^{-3} and C.G.S. unit is g cm^{-3}
- **Relationship between SI and C.G.S units of density :**

$$1 \text{ kg m}^{-3} = \frac{1 \text{ Kg}}{1 \text{ m}^3} = \frac{1000\text{g}}{1000000 \text{ cm}^3}$$
$$= \frac{1}{1000} \text{g cm}^{-3}$$

Thus,

$1 \text{ kg m}^{-3} = 10^{-3} \text{gcm}^{-3}$

$1 \text{ gcm}^{-3} = 1000 \text{ kg m}^{-3}$

- **Relative density**
  - It is defined as the ratio of the mass of a certain volume of a substance to the mass of an equal volume of water at 4°C.
  - It is a scalar quantity and this has no unit.
- Relationship between density and relative density.

  Density = Relative Density × Density of water at 4°C.

$$\text{Relative density of a body} = \frac{\text{weight of body in air}}{\text{Loss of weight of the body when fully immersed in water}}$$

- **Law of floatation :** The weight of a floating body is equal to the weight of the liquid displaced by submerged part.

Mnemonics

- **Concept Name:** Relation between distance, velocity and acceleration
- **Mnemonics:** BEST EDUCATION OPENS MORE WINGS FOR BETTER FUTURE
- **Interpretations:** Buoyancy, Equal, or, more than, weight of, body, floats

CHAPTER-5
HEAT AND ENERGY

Topic-1 Concepts of Heat and Temperature

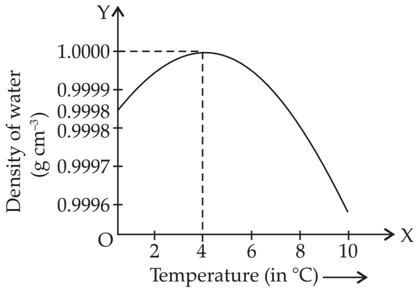
Revision Notes

- Total internal energy in equal to be sum of internal kinetic energy due to molecular motion and internal potential energy due to molecular attractive forces.
- Heat is the internal energy of molecules constituting the body. It flows from a hot body to cold body.
- Unit of heat
  - S.I. Unit of heat : Joule
  - 4.186 Joule of heat energy is required to raise the temperature of l g of water from 0 °C to 1 °C or from 32 °F to 33.8 °F
  - Other unit of heat : calorie
  - 1 calorie heat is required to raise the temperature of 1 g of water by 1 °C.
  - 1 calorie = 4.186 Joule
- Temperature is a quantity which tells the thermal state of a body (i.e., the degree of hotness or coldness of the body). It determines the direction of flow of heat when two bodies at different temperatures are placed in contact.
- The SI unit of temperature is Kelvin (K). The other most common units of temperature are degree Celsius (°C) and degree Fahrenheit (°F).
- Relation between various Temperature scales:

$$\mathbf{K = 273 + t\,°C}$$

$$\mathbf{C = \frac{5}{9}(F-32)}$$

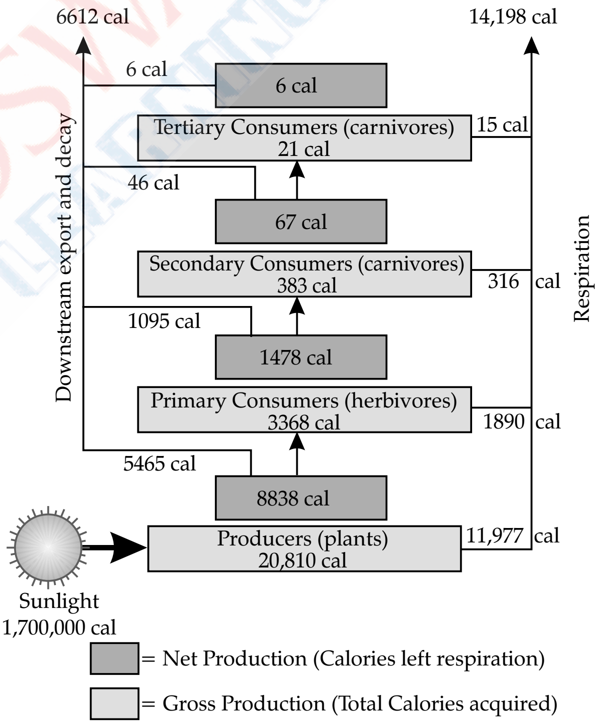
- The expansion of water when it in cooled from 4 °C to 0 °C in known as anomalous expansion of water.
- Variation in density of water with temperature in range 0 °C to 10 °C
- Consequences of anomalous expansion of water:
  – The anomalous expansion of water helps in preserving the aquatic life during very cold weather.
  – The anomalous expansion of water is responsible for the burst of water pipe lines, and destruction of crop during the very cold night.



Topic-2 Energy Flow and its Importance

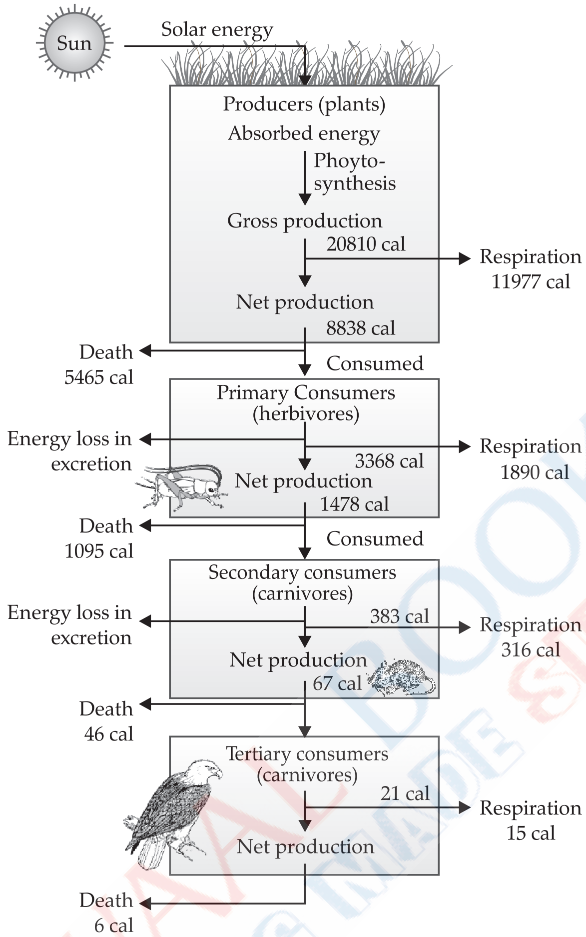
Revision Notes

- The capability to do work is called energy.
- Every biological activity requires the consumption of energy.
- The energy for biological activities is received from the Sun ultimately.
- Approximately 1% of solar energy is absorbed by plants.
- Out of which approx. 0.02% is utilized in Photosynthesis.
- In photosynthesis, the energy from the Sun is converted into chemical energy.
- The chemical energy stored in the plants is called the gross primary production.
- The plants use some of them in development and metabolic process and growth, the rest of the remaining energy is called net primary production.
- Plants are called Producers.
- Primary Consumers herbivores obtain food from plants.
- They obtain a small portion of energy from the Plants, as the rest of the energy is wasted as the plant remains.
- Secondary Consumers carnivores obtain food from Primary Consumers.
- They obtain a small portion of energy from the Primary Consumers, as the rest of the energy is wasted as remains and decay of primary consumers.
- Tertiary Consumers carnivores obtain food from Secondary Consumers.
- They also obtain a small portion of energy from the secondary Consumers, as the rest of the energy is wasted as remains and decay of secondary consumers.
- Following is the energy flow diagram which represents Energy Flow in the food chain.



Energy flow Diagram

➢ Energy Flow in food chain.



Energy Flow in Food Chain

➢ Thus, the energy flow in ecosystem is linear.

➢ According to the first law of thermodynamics, the energy can neither be created nor destroyed, it can be transformed from one form of energy to the other form of energy.

➢ The First law of thermodynamics is also known as Law of conservation of energy.

➢ According to the second law of thermodynamics, during the process of transformation of energy, a part is converted in a wasteful form such as heat.

➢ Thus, no energy transfer is 100% efficient.

Key Words

➢ Most of the energy is spent during the decay and decomposition of the bodies.

➢ Small portion of energy is used in respiration.

Topic-3 Energy Sources

Revision Notes

➢ Any substance which is useful and essential for survival is called a resource.

➢ Resources through which we can receive energy are called Energy Sources.

➢ There are two classes of Energy Resources:

- Renewable Resources
- Non-Renewable Resources

➢ The resources which can be renewed along with their use and replenish are called Renewable resources.
➢ Examples of Renewable resources: Sun, Air, Water, etc.
➢ Renewable resources are also called non-conventional resources.
➢ Renewable resources don't produce pollution.
➢ The resources which cannot be renewed with their use and replenish with time are called Non-Renewable resources.
➢ Examples of Non-Renewable resources: Coal, Petroleum, etc.
➢ Non-Renewable resources are also called Conventional Resources.
➢ Non-Renewable resources can't be restored after being replenished.
➢ Non-Renewable resources produce pollution.
➢ There are six Principal energy resources:

- Soil
- Forest
- Marine or oceans
- Water
- Minerals
- Sun

➢ The top layer of ground is called soil, using soil we can get food, fuel, and fiber.
➢ Soil can be conserved by planting trees.
➢ Nearly 75% part of the Earth is covered with water, but less than 1% of water is drinkable or usable by humans.
➢ Water can be conserved by making dams and rain harvesting.
➢ The surface of Earth covered by trees and shrubs is called a forest.
➢ Forests help in reducing factors of global warming and pollution.
➢ Forests also provide us oxygen.
➢ Afforestation can help in conserving the forests.
➢ The core of Earth is composed of minerals.
➢ Some minerals are required as nutrients for living organisms.
➢ Minerals can be conserved by recycling the products made by them.
➢ About 71% of Earth's surface is covered with oceans.
➢ They are resources of seafood, and various minerals required by humans.
➢ Energy is required by humans and all other organisms in every activity.
➢ Natural sources which provide us energy continuously are known as renewable sources of energy.
➢ The sources of energy which have been accumulated in nature over a very long period and cannot be easily replenished when exhausted are known as non-renewable sources of energy. Example: coal, petroleum and natural gas. These are also known as fossil fuel.
➢ Energy resources can be conserved by switching to renewable resources.
➢ The main renewable resources are as follows:

- Solar Energy
- Wind energy
- Geothermal Energy
- Hydro-electric Energy
- Tidal energy

➢ The energy received from the Sun is called Solar Energy.
➢ Solar cells are used to convert Sun's heat energy to electricity.
➢ Solar Panels are used to collect heat from Sun which can be used for various purposes.
➢ A solar cooker is used to cook food.
➢ Biomass is the source of indirect solar energy.
➢ Hydroelectric power systems convert the kinetic energy of flowing water into electric energy.
➢ Nearly 25% of the world's electricity is produced by hydroelectric sources.
➢ The kinetic energy of wind is converted to electric energy by windmill.
➢ Wind energy is used in water pumping as well.
➢ Two forms of ocean energy:

- Ocean Tidal Energy
- Ocean Thermal Energy

➢ Tides of sea rotate the turbine to produce electricity.

- The heat energy stored in rocks inside the Earth is called Geothermal energy.
- Hot water from Earth is used for the generation of electricity.
- Disadvantages of building large dams for generating hydro-electric power:
  - It disturbs the natural ecosystem.
  - Human, animal and plant life gets disturbed as it leads to deforestation.
  - Disrupts aquatic ecosystem.
- Reducing the amount of energy required by us in various work and services is called efficient use of energy.
- It can be achieved by using fuel-efficient electrical appliances and vehicles.

Key Words

- The world currently receives 80% of energy from fossil fuels because it provides energy at the lowest cost.
- But since it is not being replenished, the cost is rising, so countries are switching to renewable sources very fast.

Topic-4 Global warming and Green house effect.

Revision Notes

- **Green house effect :** It is the process of warming of planet's surface and its lower atmosphere by absorption of infrared radiations of long wavelength emitted out from the surface of planet.
- **Global warming :** It means the increase in average effective temperature near the earth's surface due to an increase in the amount of green house gases in its atmosphere.
  - **Causes of global warming :**
    - **(i)** Increment of concentration of carbon dioxide up to 25% due to industrial growth, combustion of fossil fuels and clearing of forests.
    - **(ii)** Increment of concentration of chlorofluorocarbons at the rate of 5% per year.
  - **Impacts of global warming on life on the earth:**
    - **(i)** The change in blooming season of different planets.
    - **(ii)** The change in regional climate which has an immediate effect on simple organism and plants.
    - **(iii)** The change in the world's ecology.
    - **(iv)** The increase in the heat stroke deaths.
  - **Ways to minimize the impact of global warming :**
    - **(a)** Use of renewable sources of energy for generation of electricity in place of electricity from the fossil fuel based power plants.
    - **(b)** Change of transportation vehicles.
    - **(c)** Reforestation and sustainable use of land.
    - **(d)** Industries to pay carbon tax.
    - **(e)** Educating children to live sustainable life style.
    - **(f)** Controlling population through family planning, welfare reforms and the empowerment of women.

Mnemonics

Concept Name: Green house gases

Mnemonics: **M**ONDAY TO **W**EDNESDAY **C**OLLEGE IS **C**LOSED.

Interpretations:

Methane, Water vapour, Carbon-di-oxide, Chlorofluorocarbon

CHAPTER-6
LIGHT

Topic-1 Reflection of Light

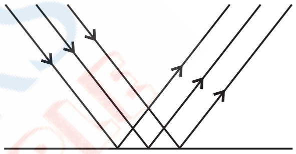
Revision Notes

➢ Light may be defined as the radiant energy which produces a sensation of sight. Light itself is invisible but makes often objects visible.

➢ A body which emits light by itself is called a luminous body, e.g., stars, sun, firefly etc.

➢ A body which does not emit light by itself is a non-luminous body. A non-luminous body is seen by the light reflected by it. Examples of non-luminous bodies are planets, moon, buildings, trees etc.

➢ The return of light into the same medium after striking a surface is called reflection.



Regular reflection

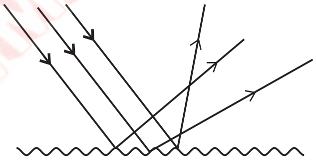
➢ **Kinds of Reflection**

(i) Regular reflection

(ii) Irregular reflection

(i) Regular Reflection

➢ It occurs when a beam of light falls on a smooth and polished surface, such as a plane mirror.



Irregular reflection

(ii) Irregular Reflection

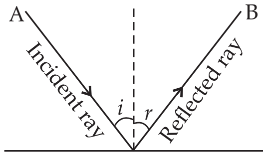
➢ It occurs when a beam of light falls on a rough surface such as wall of a room, the page of a book or any other object.

➢ Diffused light obtained by irregular reflection from various uneven surfaces which enables us to see the objects around us.

➢ **Terms related with Reflection:**

➢ **Incident ray:** The light ray striking a reflecting surface is called the incident ray.

➢ **Point of incidence:** The point at which the incident ray strikes the reflecting surface is called the point of incidence.



Reflection at a plane surface

➢ **Reflected ray:** The light ray obtained after reflection from the surface in the same medium in which the incident ray is travelling is called the reflected ray.

➢ **Normal:** The perpendicular drawn to the surface at the point of incidence is called the normal.

➢ **Angle of incidence:** The angle which the incident ray makes with the normal at the point of incidence, is called the angle of incidence. It is denoted by the letter i.

➢ **Angle of Reflection:** The angle which the reflected ray makes with the normal at the point of incidence, is called the angle of reflection. It is denoted by the letter r.

➢ **Plane of incidence:** The plane containing the incident ray and the normal is called the plane of incidence.

➢ **Plane of Reflection:** The plane containing the reflected ray and the normal is called the plane of reflection.

➢ **Laws of Reflection**

➢ The angle of incidence i is equal to the angle of reflection r (*i.e.*, $\angle i = \angle r$).

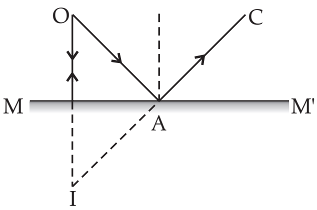
➢ The incident ray, the reflected ray and the normal at the point of incidence all lie on the same plane.

➢ **Types of Images**

➢ **Real image:** The image which can be obtained on a screen, is called a real image. It is formed when light rays after reflection actually intersect. It is inverted. For example ,for a distant object, the image formed by a concave mirror is real.

➢ **Virtual image:** The image which cannot be obtained on a screen, is called a virtual image. It is formed when light rays after reflection do not actually intersect, but they appear to diverge from the image. For example, the image of an object formed by a plane mirror or by a convex mirror is virtual.

➢ Position of image by a plane mirror

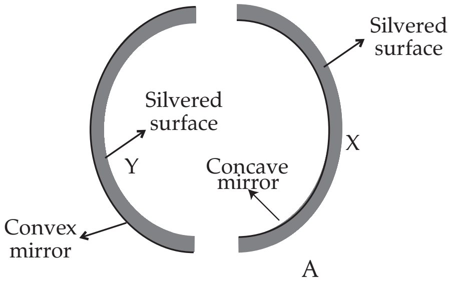


- The image is situated on the normal drawn from the object on the mirror and it is as far behind the mirror as the object is in front of it.
- **Lateral Inversion**
  The interchange of the left and right sides in the image of an object in a plane mirror is called lateral inversion.
- Characteristics of the image formed by a plane mirror:
  (i) Upright (or erect)
  (ii) Virtual
  (iii) same size as that of object
  (iv) Laterally inverted

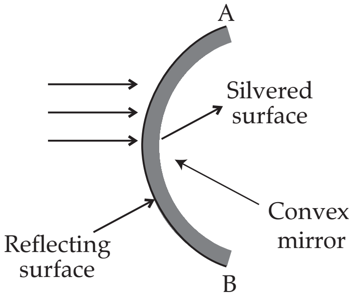
- **Number of images produced by two mirrors at an angle θ :**
  (i) If $360^\circ/\theta$ is even, then number of images = $(360^\circ/\theta) - 1$
  (i) If $360^\circ/\theta$ is odd, then
  (a) for symmetrical position of object, number of images is $360^\circ/\theta - 1$.
  (b) For asymmetrical position of object, the number of images is $360^\circ/\theta$.

Topic-2 Spherical Mirrors

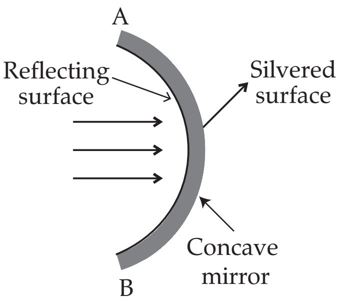
Revision Notes

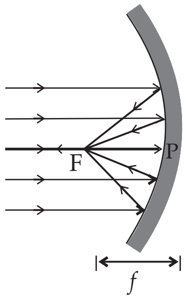


- **A reflecting surface which is a part of a sphere, is called a spherical mirror.**
- **Concave Mirror**
  - A concave mirror is made by silvering the outer (or bulging) surface of the piece of a hollow sphere such that the reflection takes place from the inner surface.
- **Convex Mirror**
  - A convex mirror is made by silvering the inner surface of the piece of a hollow sphere such that the reflection takes place from the outer (or bulging) surface.

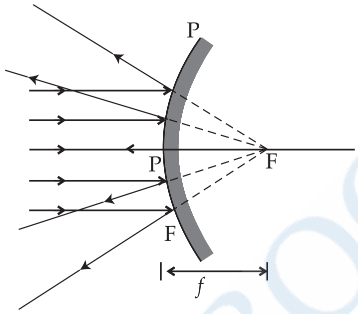


- **Terms related to a spherical mirror**
  - **Centre of Curvature:** The centre of curvature of a mirror is the centre of the sphere of which the mirror is a part.
  - **Radius of Curvature:** The radius of a sphere of which the spherical mirror is a part, is called the radius of curvature of the mirror.
  - **Pole:** The geometrical centre of the spherical mirror is called the pole of mirror.
  - **Aperture:** The plane surface area of the mirror through which the light rays enter and fall on the mirror is called its aperture.
  - **Principal axis:** It is the straight line joining the pole of the mirror to its centre of curvature.
  - **Focus of Concave Mirror:** The focus of a concave mirror is a point on the principal axis at which the light rays incident parallel to the principal axis after reflection from the mirror meet.





- **Focus of Convex Mirror:** The focus of a convex mirror is a point on the principal axis from which the light rays incident parallel to the principal axis, appear to diverge, after reflection from the mirror.



- Position, size and nature of the images formed by a concave mirror for different positions of the object:

Position of the object	Position of the image	Size of the image	Nature of the image
At infinity	At the focus	Diminished to a point	Real and inverted
At very far distance	In focal plane	Highly diminished	Real and inverted
Beyond centre of curvature	Between the centre of curvature and focus	Diminished	Real and inverted
At the centre of curvature	At the centre of curvature	Same size	Real and inverted
Between the centre of curvature and focus	Beyond the centre of curvature	Magnified	Real and inverted
At focus	At infinity	Highly magnified	Real and inverted
Between the focus and pole	Behind the mirror	Magnified	Virtual and upright

- Position, size and nature of image formed by a convex mirror:

Position of the object	Position of the image	Size of the image	Nature of the image
At infinity	At focus	Diminished to a point	Virtual and upright
At any other point	Between focus and pole	Diminished	Virtual and upright

- **Relationship between the focal length and radius of curvature:**

The focal length of a spherical mirror is equal to half of its radius of curvature. *i.e.*,

$$f = \frac{1}{2}R$$

- **Sign conventions for the measurement of distances:**

(i) All the distances are measured taking pole as origin.

(ii) The distances are measured along the principal axis in the direction of incident light are positive while those opposite to the incident light are negative.

(iii) The distances above the principal axis are taken positive and those below the principal axis are taken negative.

- **Formulae for the spherical mirror:**

Mirror formula

$$\frac{1}{f} = \frac{1}{u} + \frac{1}{v}$$

where, f = focal length of the spherical mirror
u = object distance
v = image distance

Magnification $(m) = -\frac{v}{u}$

CHAPTER-7
SOUND

Topic-1 Nature of Sound Waves

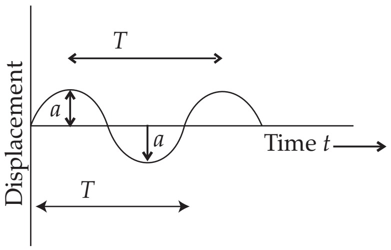
Revision Notes

- Sound is a form of energy that produces sensation of hearing in our ears. Sound is produced when a body vibrates. Sound is produced by vibrations in a body. When the body stops vibrating, the sound produced by it also stops.
- A material medium is necessary for the propagation of sound from one place to another.
- **Requisites of the medium :**
  - The medium must be elastic so that its particles may come back to their initial position after displacement on either side *i.e.*, the particles are capable of vibrating about their mean position.
  - The medium must have inertia so that its particles may store mechanical energy.
  - The medium should be frictionless so that there is no loss of energy in propagation of sound through it.
- **Characteristics of wave motion :**
  - A wave is produced by the periodic disturbance at a point in the medium.
  - Due to propagation of wave in a medium, the particles of medium vibrate about their mean positions and energy is transferred with a constant speed from one place of medium to the other place.
- **Some terms related to wave motion :**
  - **Amplitude :** When a wave passes through a medium, the maximum displacement of the particle of medium on either side of its mean position is called its amplitude. It is denoted by a. Its SI unit is metre (m).
  - **Time period :** The time taken by a particle of medium to complete its one vibration is called the time period of wave. It is denoted by T. Its SI unit is second (s).
  - **Frequency :** The number of vibrations made by a particle of medium in one second is called the frequency of wave. It is denoted by f. Its SI unit is Hz or second^{-1}.
  - The frequency f and time period T are related as

    $$f = \frac{1}{T}$$

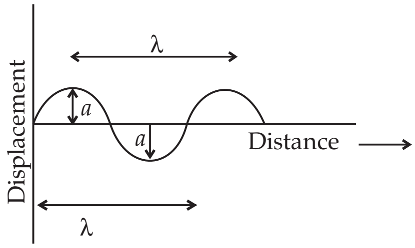
  - **Wavelength :** The distance travelled by the wave in one time period of vibration of particle of the medium is called its wavelength. It is denoted by λ. Its SI unit is metre (m).
- **Wave Velocity**

  The distance travelled by a wave in one second is called its wave velocity or wave speed. It is denoted by v. Its SI unit is metre per second.
  - Displacement – time graph:



The above graph shows the variation of displacement with time for a particle of the medium at a given position, when a wave propagates through the medium.

- Displacement – distance graph:



The above graph shows the displacement distance-graph of a transverse wave at an instant.

- **Relationship between the wavelength, wave velocity and frequency :**

  wave velocity = frequency × wavelength

  - Speed of sound is different in different media. The speed of sound is more in solids, less in liquids and least in gases (since solids are much more elastic than the liquids and gases). The speed of sound is nearly 5100 ms^{-1} in steel, 1450 ms^{-1} in water and 330 ms^{-1} in air at 0°C.

- **Factors affecting the speed of a sound in a gas:**

  (i) Effect of temperature: The speed of sound in a gas increases with the increase in temperature of the gas.

  (ii) Effect of humidity: The speed of sound in air increases with the increase in humidity in air.

  (iii) Effect of direction of wind: The speed of sound increases or decreases according to the direction of wind.

- **Factors not affecting the speed of sound in a gas:**

  (i) Effect of pressure: The speed of sound in a gas is independent of pressure.

  (ii) Effect of amplitude of wave: The speed of sound does not depend on the amplitude of sound wave.

  (iii) Effect of wavelength (or frequency) of wave: The speed of sound does not depend on the wavelength (or frequency) of sound wave.

Mnemonics

- **Concept:** Relation between Velocity, Frequency and Wavelength
- **Mnemonics:** For growth
- VERY ESSENTIAL IS PROPER FOOD AND WATER.
- **Interpretations:** Velocity of Sound, equals to, product of, frequency and wavelength

Topic-2 Infrasonic and Ultrasonic Waves

Revision Notes

- The sound of frequencies in the range 20 Hz to 20 kHz is called the sonic or audible sound, the sound of frequency less than 20 Hz is known as infrasonic sound while the sound of frequency greater than 20 kHz is known as ultrasound (or ultrasonic).
- **Frequency ranges for hearing by humans and animals:**

Animal	Frequency range of hearing in Hz
Bat	2,000-110,000
Cat	45-64,000
Dog	67-45,000
Dolphin	75-150,000
Human	20 Hz – 20 kHz

- **Properties of ultrasound:**
  - The energy carried by ultrasound is very high.

- The ultrasound can travel along a well defined straight path. It does not bend appreciably at the edges of an obstacle because of its small wavelength, they have high directivity.

- **Applications of ultrasound:**
  - Ultrasound is used for drilling holes, on making cuts of desired shape in materials like glass.
  - Ultrasound is used in surgery to remove cataract and in kidneys to break the small stones into fine grains.
  - For detection of defects in metals, ultrasound is used. Ultrasound passes through the object if there is no defect in the object.
  - In SONAR, to detect and find the distance of objects under water, ultrasound is used.
- **Difference between ultrasonic and supersonic:**
  - The word ultrasonic is used for ultrasound (*i.e.*, sound of frequency above 20 kHz), while supersonic is used for object which travels with a speed greater than the speed of sound in air (*i.e.*, 330 ms^{-1}). e.g., – concord jet planes and fighter planes.

CHAPTER-8
ELECTRICITY AND MAGNETISM

Topic-1 Electric Circuit

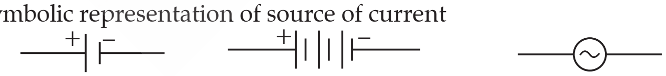
Revision Notes

- Direct current is a current of constant magnitude flowing in one direction.
- **Kinds of cells**
  - **Primary cells :** These cells provide current as a result of irreversible chemical reaction.
  - **Secondary cells :** These cells provide current as a result of reversible reaction and can be recharged after use.
- **Current :**
  - Current is the rate of flow of electric charges across a cross section of a conductor.
  - If charge Q flows through the cross section of a conductor in time t, then

$$\text{Current } (I) = \frac{\text{Charge } (Q)}{\text{time } (t)}$$

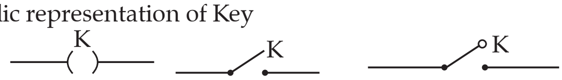
$$1 \text{ ampere} = \frac{1 \text{ Coulomb}}{1 \text{ second}}$$

  - The current in a scalar quantity.
  - Conventional direction of electric current is the direction in which a positive charge flows. That is why in the circuit current is directed from positive to negative terminal of a battery. Electrons actually move in opposite direction of conventional direction of current.
- Symbolic representation of source of current



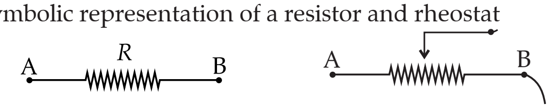
Cell Battery A.C. Source

- Symbolic representation of Key



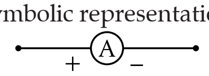
Plug key Switch Tapping key

- Symbolic representation of a resistor and rheostat

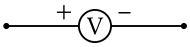


Resistor Rheostat

- Symbolic representation of Ammeter



➢ Symbolic representation of Voltmeter

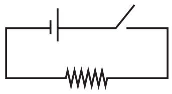


➢ Symbolic representation of Galvanometer

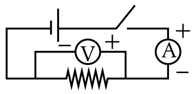
➢ **Detection of current and potential difference :**
  - **Galvanometer :** Detects the presence of small electric current in a circuit.
  - **Ammeter :** Detects and measures the electric current in a circuit.
  - **Voltmeter :** Measures the potential difference across a component in a circuit.

➢ **Insulators and conductors :**
  - **Insulators :** The substances which do not allow electric current to flow through them, are called insulators. They almost have no free electrons and they offer a very high resistance in the path of electric current. Examples of insulators are cotton, rubber, plastic.
  - **Conductors :** The substances which allow the electric current to flow through them easily are called the conductors. All metals such as copper and aluminium are conductors.

➢ **Closed and open circuit :**
  - For an electric circuit to be complete, each component of it must passes current through it *i.e.*, it should be conducting. If there is an insulator in the path (or if the circuit is broken), the circuit in incomplete (or open) and the current does not flows through it.
  - Simple electric circuit using cell, key and resistor :



  - Use of ammeter and voltmeter in a circuit :



➢ **Flow of electrons between the conductors :**
  - When two charged conductors are joined by a metallic wire (or they are placed in contact), free electrons flow from a conductor having high concentration of electrons to the conductor having lower concentration of electrons.
  - A conductor having an excess of electrons in said to be at negative (or lower) potential while the one having a deficit of electrons is said to be at positive (or higher) potential.

➢ The potential difference between two conductors is equal to the work done in transferring a unit positive charge from one conductor to the other conductor.

➢ **Unit of potential difference :**
  - Potential difference between two points is said to be 1 Volt if work done in transferring 1 Coulomb of charge from one point to the other point is 1 Joule.
  - $V = W/Q$, where V = potential difference, W = Work done, Q = Quantity of charge.
  - The obstruction offered to the flow of current by a conductor in called its electrical resistance.

➢ **Ohm's Law :** If a current I flows through a wire when potential difference across the ends of the wire is V, the resistance offered by the wire to the flow of current is the ratio of potential difference across it to the current flowing in it *i.e.*,

$$\text{Resistance of wire}(R) = \frac{\text{Potential difference aross the wire } (V)}{\text{Current flowing in the wire } (I)}$$

$$R = \frac{V}{I} \quad \text{or} \quad V = IR$$

➢ The resistance of a conductor is said to be 1 ohm if a current of 1 ampere flows through it when the potential difference across its ends is 1 volt.

- **Factors affecting the resistance of a conductor :**
  - **The material of wire :** The resistance of wire of same length, same area of cross section but of different materials differs depending on their material.
  - **The length of wire :** A long wire offers more resistance than a short wire
  - **The area of cross section of wire :** A thick wire offers a less resistance.
  - **The temperature of the wire :** The resistance of wire increases with the increase in its temperature in case of metals.
- **Efficient use of energy**
  - The use of compact fluorescent lamps (CFLs) saves 67% energy and they last 6 to 10 times longer than the incandescent lights.
  - By properly insulating a home it is possible to maintain a comfortable temperature inside. It will reduce the cost of heating devices in winter and cooling devices in summer.

Topic-2 Magnetism

Revision Notes

- **Magnet :** Magnet is defined as a material which is capable of attracting small pieces of iron and it sets itself along a definite direction when suspended freely.
- **Properties of magnet**
  - Two like poles (both north poles or both south poles) repel each other while two unlike poles (one north pole and other south pole) attract each other.
  - The temporary magnetism acquired by a magnetic material when it is kept near (or in contact) with a magnet, is called induced magnetism.
  - A magnetic pole induces an opposite polarity on the near end and a similar polarity on the farther end of the iron bar.
  - The space around a magnet in which the needle of a compass rests in a direction other than the geographical north-south direction is called magnetic field of the magnet.
  - A magnetic field line is a continuous curve in a magnetic field such that tangent at any point of it gives the direction of the magnetic field at that point.
- **Properties of magnetic field lines :** The magnetic field lines have following properties.
  - These are closed and continuous curves.
  - Outside the magnet, they are directed from the north pole to the south pole of the magnet.
  - The tangent at any point on a field line gives the direction of magnetic field at that point.
  - They never intersect one another. It two field lines intersect, there would be two directions of the magnetic field at that point which is not possible.
  - They are crowded near the poles of the magnet where the magnetic field is strong and are separated near the middle of the magnet , where the magnetic field is weak.
  - Parallel and equi-distant field lines represent a uniform magnetic field. The earth's magnetic field in a limited space is uniform.
  - They behave like the stretched elastic rubber strings.
  - Two places where the magnetic needle becomes vertical are called the magnetic poles.
  - The line joining the places where the magnetic needle becomes horizontal, is called the magnetic equator.
  - Neutral point is the point at which two magnetic fields are equal in magnitude, but opposite in direction. The net magnetic field at a neutral point is zero. A compass needle if placed at the neutral points will rest in any direction.

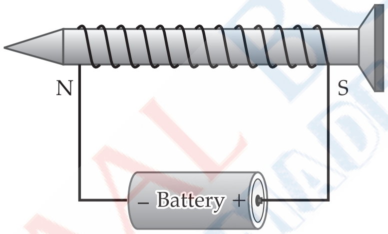
Mnemonics

- **Concept Name:** Magnetic field lines
- **Mnemonics:** NISA AND ISHA, LEFT BY CYCLE, FOR EXTENDED EXPEDITION FROM NORTH TO SOUTH, VIA TANAKPUR, INDORE, DELHI, MYSORE.
- **Interpretations:** Never Intersect, Loop closed, Extends externally from north to south, Tangent indicates direction of Magnetic field

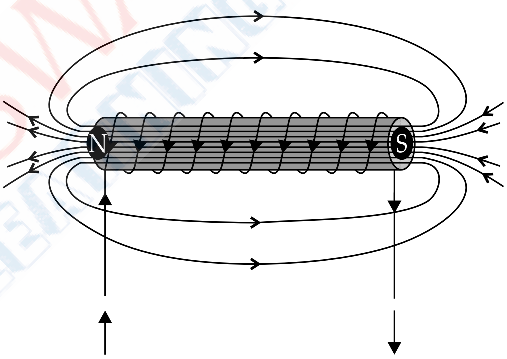
Topic-3 Introduction to Electromagnet and its Uses

Revision Notes

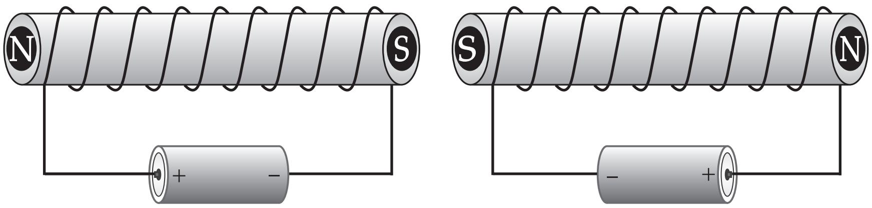
- When current flows through a conductor, a magnetic field is generated around the conductor.
- A cylindrical coil of wire acting as a magnet when carrying an electric current is called a solenoid.
- An electromagnet is a temporary magnet created by coiling a wire around a metal core, and passing a current through the wire.



- The magnetic field around an electromagnet is just the same as the one around a bar magnet.

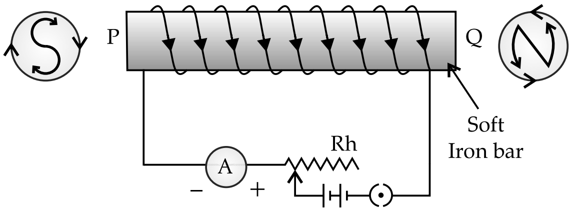


- Unlike bar magnets, which are permanent magnets, the magnetism of electromagnets can be turned on and off just by closing or opening the switch.
- They still have a north and a south pole.
- Poles can be reversed by changing the direction of the electric current.

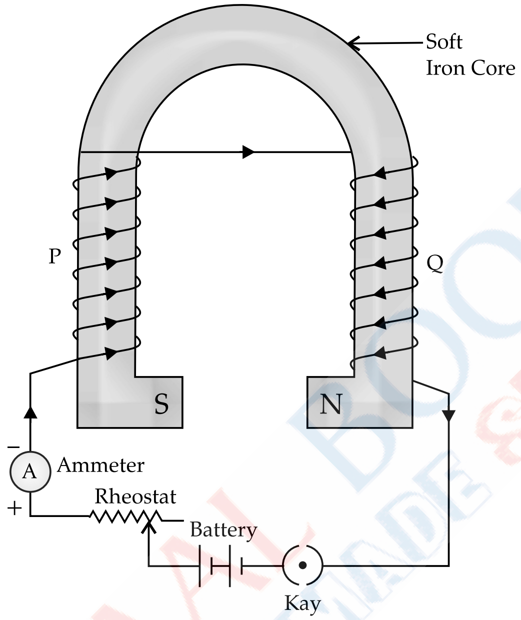


- **There are two shapes of electromagnets:**
  - I – Shaped magnet
  - U – Shaped magnet

➢ I – Shaped magnet



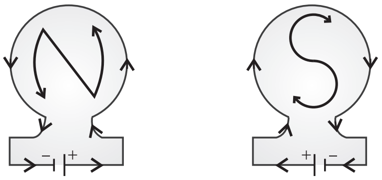
➢ U – Shaped magnet



➢ U – Shaped electromagnet is also known as a horseshoe magnet.

➢ **Clock Face Rule:**

- ➢ While looking at the face of the coil, if the current is flowing in the anti-clockwise direction, then the face of the coil will behave like the North Pole.
- ➢ While if the current is in the clockwise direction, the face of the coil will behave like the South Pole.



Anticlockwise Current (A) | Clockwise Current (B)

➢ **Factors affecting strengths of electromagnets:**
- o The type of core used
- o Magnitude of the current
- o Number of turns

➢ Generally, soft iron is used as the core of an electromagnet.

➢ **Ways to increase the magnetic field of electromagnets:**
- o by increasing the number of turns of winding in the solenoid
- o by increasing the magnitude of the current flow

➢ **Application of electromagnets:**
- o They are used in cranes to lift heavy objects like cars, etc.
- o Used in scrap management.
- o Used in electrical devices, such as:
  - ▪ Electrical bells
  - ▪ Motors
  - ▪ Generators
  - ▪ Relays
  - ▪ Speakers
  - ▪ Hard disks
  - ▪ MRI machines
  - ▪ Scientific equipment
- o Electromagnetic Suspension EMS are used in MAGLEV (trains).
- o It is used in removing iron pieces from a wound.

- Separating iron pieces from debris.
- In loading the furnace with iron.

Key Words

- MRI stands for Magnetic Resonance Imaging; it uses an electromagnet to scan the magnetic field and radio waves produced by the brain and other organs.
- An electromagnet can produce a very strong magnetic field.

❑❑❑