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NCERT Summary

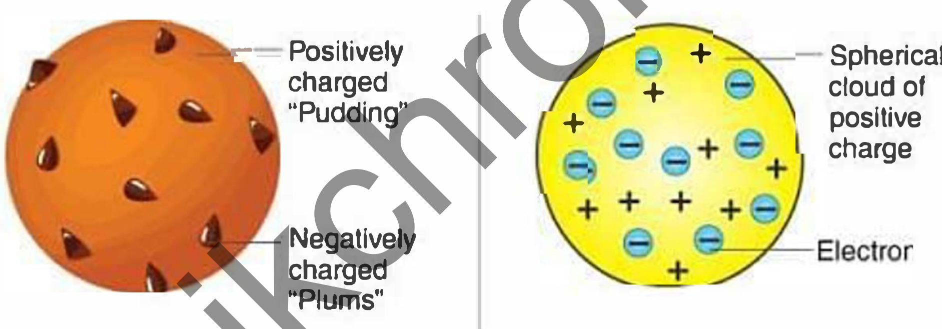
Summary of Physics- 1

Atomic Physics

An atom is the smallest particle of the element that can exist independently and retain all its chemical properties.

1. Dalton's atomic theory: It suggested that the **atom was indivisible and indestructible**. But the discovery of two fundamental particles (electrons and protons) inside the atom, led to the failure of this aspect of Dalton's atomic theory.

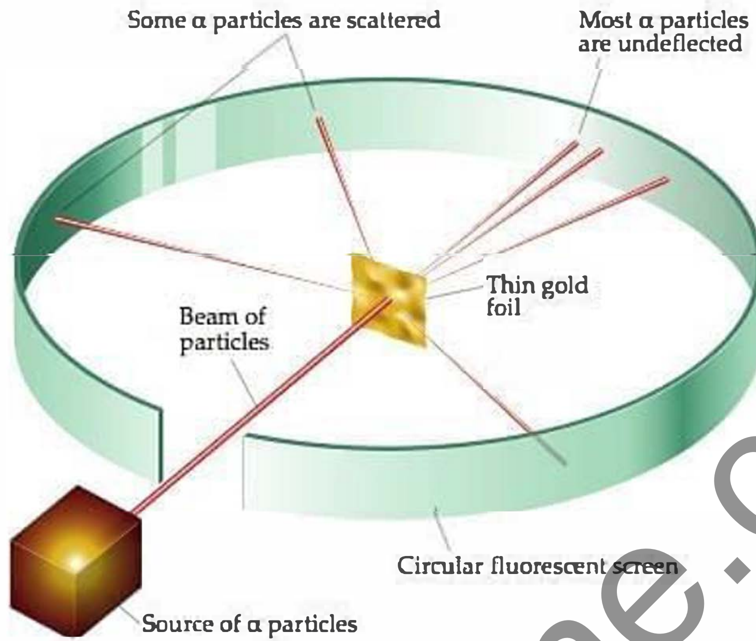
2. Thomson's Atomic Theory



Thomson's model of an atom

Thomson proposed that:
(i) An atom consists of a positively charged sphere and the electrons are embedded in it.
(ii) The negative and positive charges are equal in magnitude. So, the atom as a whole is electrically neutral.

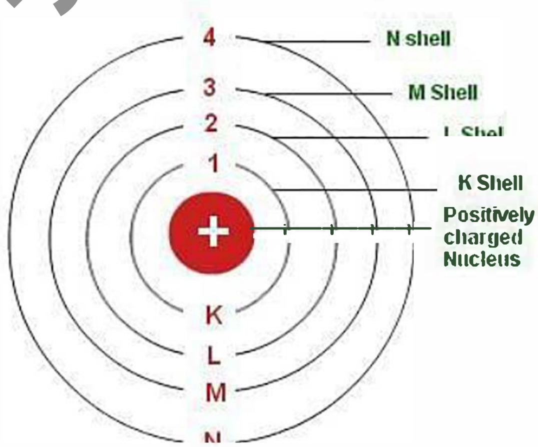
3. Rutherford's model of the atom



Rutherford's Alpha-particle Scattering Experiment

- Rutherford’s alpha-particle scattering experiment led to the discovery of the **atomic nucleus**.
- Rutherford’s model of the atom proposed that a very tiny nucleus is present inside the atom and electrons revolve around this nucleus.
- The stability of the atom could not be explained by this model.

4. Bohr's Model: Neils Bohr’s model of the atom was more successful. He proposed that electrons are distributed in **different shells** with discrete energy around the nucleus. If the atomic shells are complete, then the atom will be stable and less reactive.

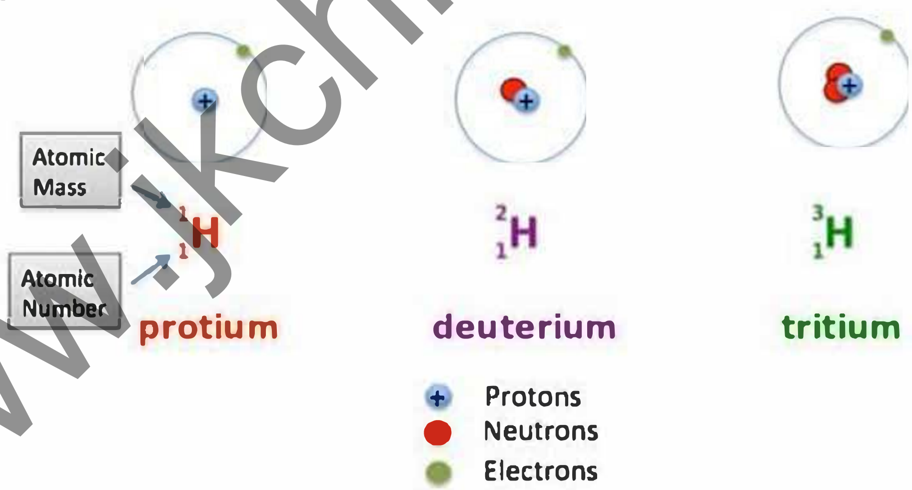


Bohr's Model

5. James Chadwick Discovery: J. Chadwick discovered the presence of **neutrons** in the nucleus of an atom.
The three sub-atomic particles of an atom are:
(i) Electrons
(ii) Protons
(iii) Neutrons
Electrons are negatively charged, protons are positively charged and neutrons have no charges. The mass of an electron is about **1/2000 times** the mass of a hydrogen atom. The mass of a proton and a neutron is taken as one unit each.

- We know that protons are present in the nucleus of an atom. It is the number of protons of an atom, which determines its atomic number. It is denoted by 'Z'. All atoms of an element have the same atomic number, Z. In fact, elements are defined by the number of protons they possess.
- **The mass of an atom** is practically due to protons and **neutrons alone**. These are present in the nucleus of an atom. Hence protons and neutrons are also called **nucleons**. Therefore, the mass of an atom resides in its nucleus.

- **Isotopes** are atoms of the same element, which have different mass numbers



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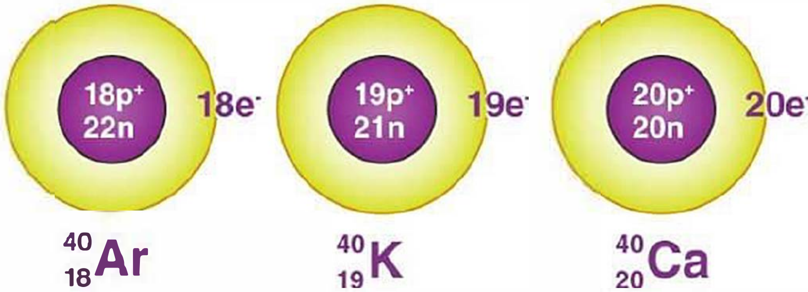
- **Isobars** are atoms having the same mass number but different atomic numbers.



Isobars

Nuclear force

- To bind a **nucleus** together there must be a strong attractive force of a totally different kind. It must be strong enough to overcome the repulsion between the (positively charged) protons and to bind both protons and neutrons into the tiny **nuclear volume**. This force is called the **Nuclear Force.**
- The nuclear force is much stronger than the **Coulomb force** acting between charges or the **gravitational forces** between masses. The nuclear force between neutron-neutron, proton-neutron and proton-proton is approximately the same. The nuclear force does not depend on the **electric charge**.

Radioactivity

- **Radioactivity occurs** when an atomic nucleus breaks down into smaller particles. There are three types of nuclear radiation: **Alpha**, **Beta**, and **Gamma**. Alpha particles are positively charged, beta particles are negatively charged, and gamma particles have no charge. The radiations also have **increased levels of energy**, first Alpha, then Beta, and finally, Gamma, which is the most energetic of all these. Alpha and Beta are particles, but Gamma is a wave.
- When a **radioactive nucleus changes**, the remaining nucleus (and atom) is not the same as it was. It changes its identity. The term half-life describes the time it takes for half of the atoms in a sample to change, and half to remain the same.
- There is even a radioactive isotope of carbon, **carbon-14**. Normal carbon is **carbon-12. C-14** has two extra neutrons and a half-life of **5730 years**. Scientists use **C-14** in a process called carbon dating. This process is not when two carbon atoms go out to the mall one night. Carbon dating is when scientists try to measure the age of very old substances. There are very small amounts of **C-14** in the atmosphere. Every living thing has some

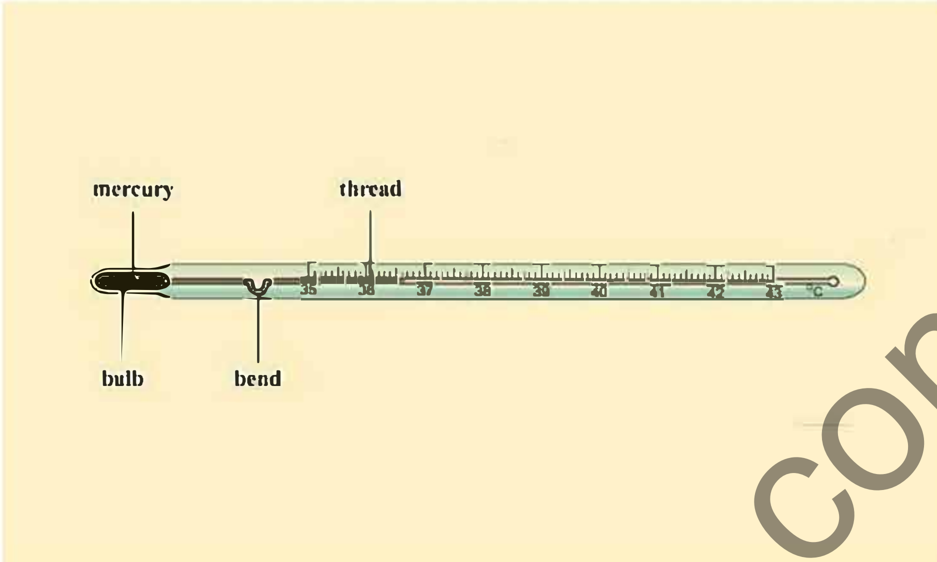
C-14 in it. Scientists measure the number of **C-14** in the things they dig up to estimate how old they are. They rely on the half-life of **5730 years** to date the object.

Fission and Fusion Reactions

- Fission is the splitting of an atom. Not all atoms will go through fission, as a matter of fact, very few do under normal circumstances.
- In a nuclear reaction, scientists shoot a whole bunch of neutrons at uranium- **235 atoms**. When one neutron hits the nucleus, the uranium becomes **U-236**. When it **becomes 236**, the uranium atom wants to split apart. After it splits, it gives off three neutrons and a lot of energy. Those neutrons hit three other U atoms in the area and cause them to become **U-236**. Each cycle, the reaction gets three times bigger. A reaction that, once started, continues by itself, is called a **chain reaction**.
- **Fusion** is the process of two small atomic nuclei coming together to make a larger nucleus that is stable. The simplest nuclei to use are deuterium and tritium (isotopes of hydrogen).

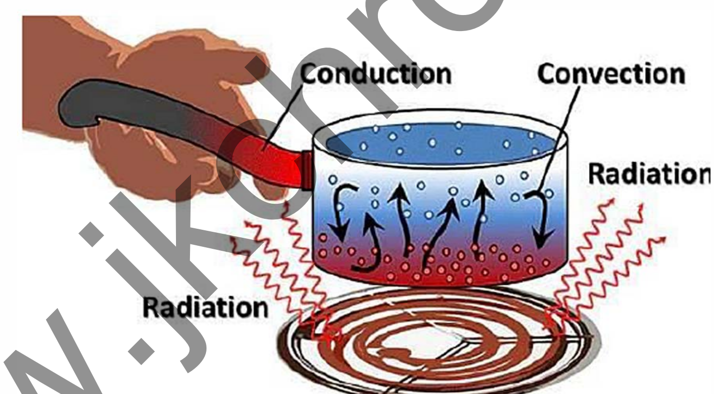
Heat

- **Temperature** is a relative measure or indication of hotness or coldness.
- **Heat** is the form of energy transferred between two (or more) systems or a system and its surroundings by virtue of temperature difference. The SI unit of heat energy transferred is expressed in **joule** (J) while S.I. unit of temperature is **Kelvin** (K), and °C is a commonly used unit of temperature.
- The thermometer is a device used for **measuring temperatures**. The two familiar temperature scales are the **Fahrenheit temperature scale** and the **Celsius temperature scale**.
  The Celsius temperature (T_c) and the Fahrenheit temperature (T_f) are related by:
  $$T_f = (9/5)\ T_c + 32$$
- In principle, there is no upper limit to temperature but there is a definite lower limit- the absolute zero. This limiting temperature is 273.16° below zero on the Celsius scale of temperature.
- **Clinical thermometer** is used to measure our body temperature. The range of this thermometer is from **35°C to 42°C**. For other purposes, we use laboratory thermometers. The range of these thermometers is usually from – **10°C to 110°C**. The normal temperature of the human body is **37°C**.



Clinical Thermometer

- The heat flows from a body at a higher temperature to a body at a lower temperature. There are **three ways** in which heat can flow from one object to another. These are **conduction**, **convection** and **radiation**.



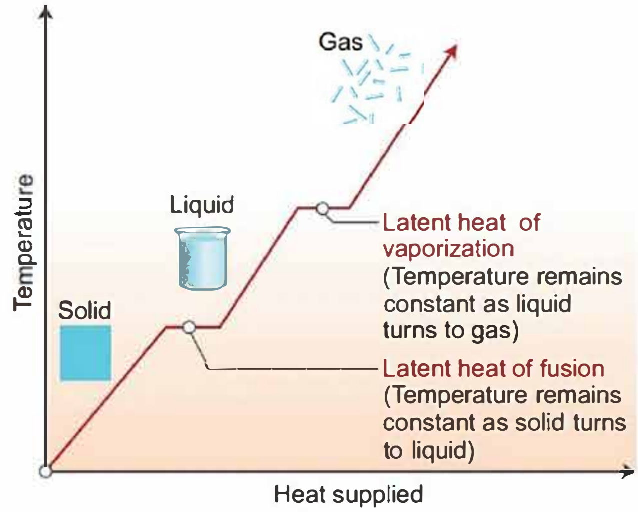
- **(a) Conduction:** The process by which heat is transferred from the hotter end to the colder end of an object is known as conduction.
In **solids**, **generally**, the **heat** is **transferred** by the process of conduction.
The materials which allow heat to pass through them easily are conductors of heat. **Examples:** Aluminium, Iron and Copper.
The materials which do not allow heat to pass through them easily are poor conductors of heat such as plastic and wood. Poor conductors are known as **insulators**.
(b) Convention: Heat is carried from one place to another by the actual movement of liquid and gases. In liquids and gases, the heat is transferred by convection.

The people living in coastal areas experience an interesting phenomenon. During the day, the land gets heated faster than the water. The air over the land becomes hotter and rises up. The cooler air from the sea rushes in towards the land to take its place. The warm air from the land moves towards the sea to complete the cycle. The air from the sea is called the **sea breeze**. At night it is exactly the reverse. The water cools down more slowly than the land. So, the cool air from the land moves towards the sea. This is called the **land breeze**.

(c) Radiation: The transfer of heat by **radiation** does not require any medium. It can take place whether a medium is present or not. **Dark-coloured** objects absorb radiation better than **light-coloured** objects. That is the reason we feel more comfortable in light-coloured clothes in the summer. **Woollen clothes** keep us warm during winter. It is so because wool is a poor conductor of **heat** and it has **air trapped** in between the **fibres**.

- A change in the temperature of a body causes a change in its dimensions. The increase in the dimensions of a body due to the increase in its temperature is called thermal expansion. The expansion in length is called linear expansion. The expansion in area is called **area expansion**. The expansion in volume is called **volume expansion**.
- The amount of heat energy required to raise the temperature of 1g of a substance through 1° is called the specific heat capacity of the substance. The S.I. Unit of specific heat capacity is(J/kg) K. Water has the **highest specific heat capacity** which is equal to **4200 (J/kg)K**.
- The specific heat capacity is the property of the substance which determines the change in the temperature of the substance (undergoing no phase change) when a given quantity of heat is absorbed (or rejected) by it. It is defined as the amount of heat per unit mass absorbed or rejected by the substance to change its temperature by one unit. It **depends on** the nature of the **substance** and its **temperature**.
- The amount of heat energy required to raise the temperature of a given mass of substance through 1° is called **heat capacity** or thermal capacity of the substance. It's **S.I. Unit is (J/K)**.

Latent Heat of Fusion and Vaporization Chart



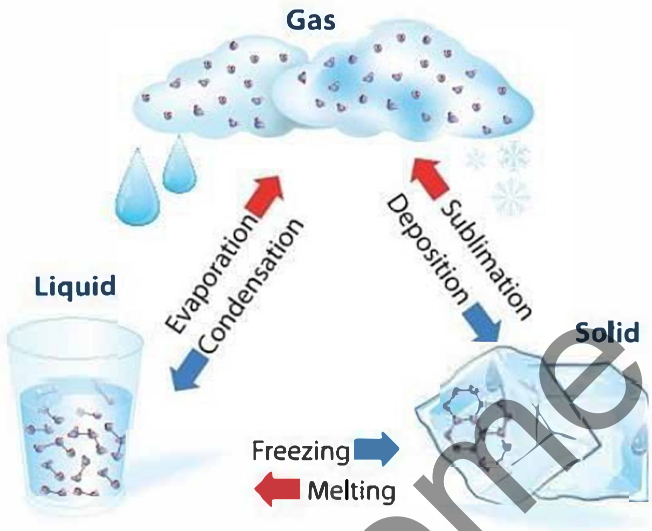
Normal Phase Change Quantities for Selected Materials

Elements	Melting Point (°C)	Boiling Point (°C)	Latent Heat of Fusion (kJ/kg)	Latent Heat of Vaporization (kJ/kg)
Aluminium	660	2519	397	10,900
Argon	189	186	29.5	161
Bismuth	271	1564	54	723
Bromine (Br_2)	7	59	132	375
Chlorine (Cl_2)	102	34	181	576
Copper	1084	2562	209	4730
Gold	1064	2856	63.7	1645
Helium	n/a	269	3.45	20.7
Hydrogen (H_2)	259	253	59.5	445
Iron	1538	2861	247	6090
Krypton	-157	-153	16.3	108
Lead	327	1749	23	866
Lithium	181	1342	432	21,200
Mercury	39	357	11.4	295
Neon	249	246	16.8	84.8
Nickel	1455	2913	298	6430

- **Calorimetry** means a measurement of heat. When a body at higher temperature is brought in contact with another body at lower temperature, the heat lost by the hot body is equal to the heat gained by the colder body, provided no heat is **allowed** to escape to the **surroundings.** A device in which heat measurement can be made is called a **calorimeter**.

Change of State

- Matter normally exists in **three states: Solid, Liquid, and Gas**. A transition from one of these states to another is called a change of state. Two common changes of states are solid to liquid and liquid to gas (and vice versa). These changes can occur when the exchange of heat takes place between the **substance and its surroundings**.



Change of State of Matter

- The change of state from solid to liquid is called melting and from liquid to solid is called **fusion**. It is observed that the temperature remains constant until the entire amount of solid substance melts. That is, both the solid and liquid states of the substance coexist in thermal equilibrium during the change of states from solid to liquid.
- The temperature at which the solid and the liquid states of the substance in **thermal equilibrium** with each other is called its melting point. It is characteristic of the substance. It also depends on pressure. The melting point of a substance at standard atmospheric pressure is called its **normal melting point**.
- The change of state from liquid to vapour (or gas) is called **vaporisation**. It is observed that the temperature remains constant until the entire amount of the liquid is converted into vapour. That is, both the liquid and vapour states of the substance coexist in thermal equilibrium, during the change of state from liquid to vapour.
- The temperature at which the liquid and the vapour states of the substance coexist is called its boiling point. At high altitudes, atmospheric pressure is lower, reducing the boiling point of water as compared to that at sea level. On the other hand, boiling point is

increased inside a pressure cooker by **increasing the pressure**. Hence cooking is faster.

- The boiling point of a substance at standard atmospheric pressure is called its **normal boiling point**.
- However, all substances do not pass through the **three states**: **Solid-Liquid-Gas**. There are certain substances which normally pass from the solid to the vapour state directly and vice versa. The change from solid state to vapour state without passing through the liquid state is called sublimation, and the substance is said to sublime. **Dry ice (solid CO_2) sublimes**, so also iodine. During the **sublimation** process both the solid and vapour states of a substance coexist in thermal equilibrium.
- A certain amount of **heat energy is transferred** between a substance and its surroundings when it undergoes a change of state. The amount of heat per unit mass transferred during change of state of the substance is called **latent heat** of the substance for the process.
- The amount of heat energy supplied to a **solid** at its melting point, such that it changes into liquid state without any rise in temperature is called latent heat of fusion and that for a **liquid-gas** state change is called the latent heat of **vaporisation**.
- **Newton's Law** of Cooling says that the rate of cooling of a body is proportional to the excess temperature of the body over the surroundings.

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NCERT Summary

Summary of Physics- 2

Light

Light or visible light is electromagnetic radiation within the portion of the electromagnetic spectrum that can be perceived by the human eye.

- To understand light you have to know that what we call light is what is visible to us. Visible light is the light that humans can see. Other animals can see different types of light. Dogs can see only shades of gray and some insects can see light from the ultraviolet part of the spectrum.
- As far as we know, all types of light move at one speed when in a vacuum. The speed of light in a vacuum is 299,792,458 meters per second.

Medium of Propagation of Light

- Any medium through which light can travel is an optical medium.
- If this medium is such that light travels with equal speed in all directions, then the medium is called a homogeneous medium.
- The homogeneous media through which light can pass easily, are called transparent media.
- The media through which light cannot pass, are called opaque media. Again the media through which light can pass partly, are called translucent media.

Reflection, Refraction & Dispersion of Light

1. Reflection of Light

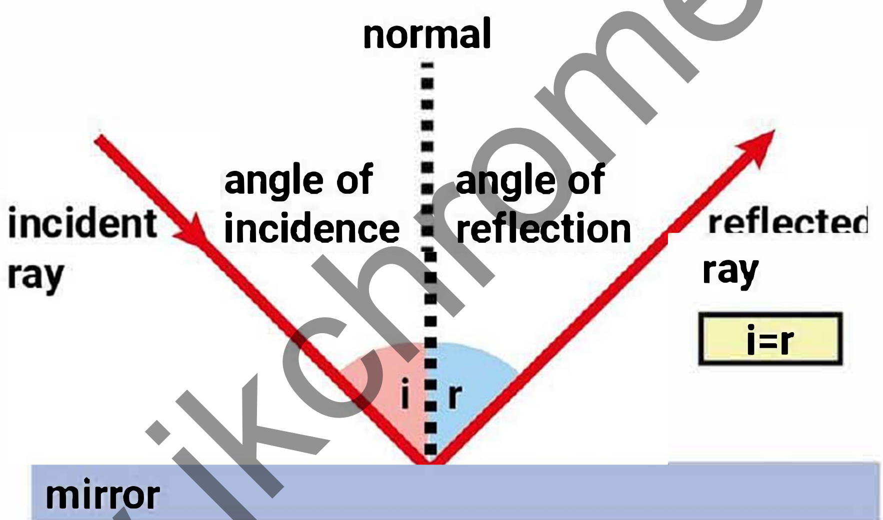
When a ray of light approaches a smooth polished surface and the light ray bounces back, it is called the reflection of light.

- **Light travels along a Straight Line:** Light is reflected from all surfaces. Regular reflection takes place when light is incident on smooth, polished, and regular surfaces.

- **Incident Ray:** After striking the surface, the ray of light is reflected in another direction. The light ray, which strikes any surface, is called the incident ray. The ray that comes back from the surface after reflection is known as the reflected ray.
- **The angle of incidence:** The angle between the normal and incident ray is called the angle of incidence.
- **The angle of reflection:** The angle between the normal and the reflected ray is known as the angle of reflection.

Laws of Reflection of Light

- Two laws of reflection are:
  (i) The angle of incidence is equal to the angle of reflection.
  (ii) Incident ray, reflected ray, and the normal drawn at the point of incidence to the reflecting surface, lie in the same plane.

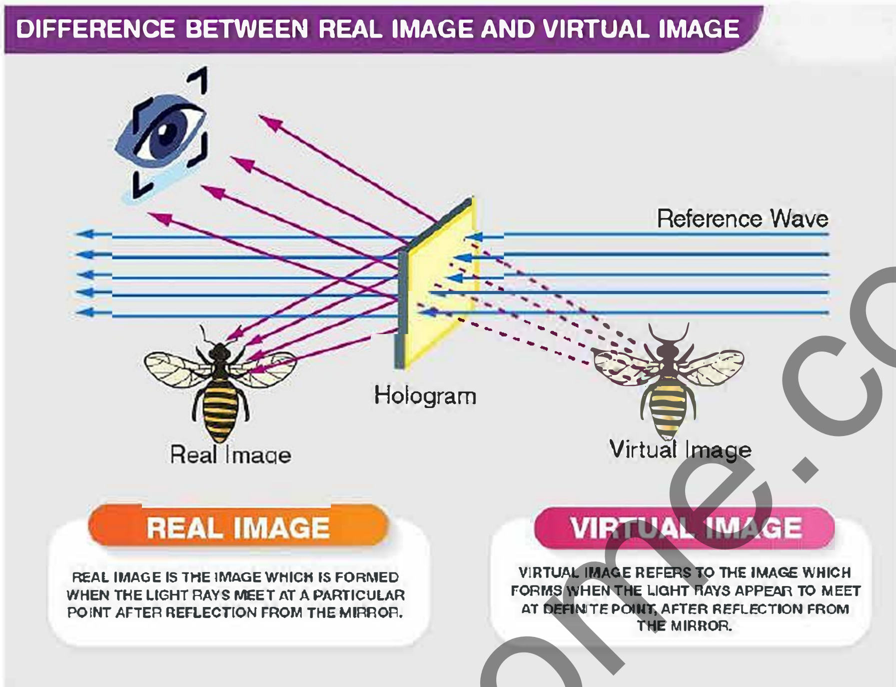


- **Irregular reflection:** When all the parallel rays reflected from a plane surface are not parallel, the reflection is known as diffused or irregular reflection.
- **Regular reflection:** On the other hand reflection from a smooth surface like that of a mirror is called regular reflection.

Types of Images after Reflection

- When rays of light coming from a point of source, after **reflection** or **refraction**, actually meet at another point or appear to diverge from another point, the second point is called the image of the first point.
  Images may be of two types:

(i) Real
(ii) Virtual



- **Real Image:** An image that can be obtained on a screen is called a real image.
- **Virtual Image:** An image that cannot be obtained on a screen is called a virtual image.
- The image formed by a plane mirror is erect. It is virtual and is of the same size as the object. The image is at the same distance behind the mirror as the object is in front of it.

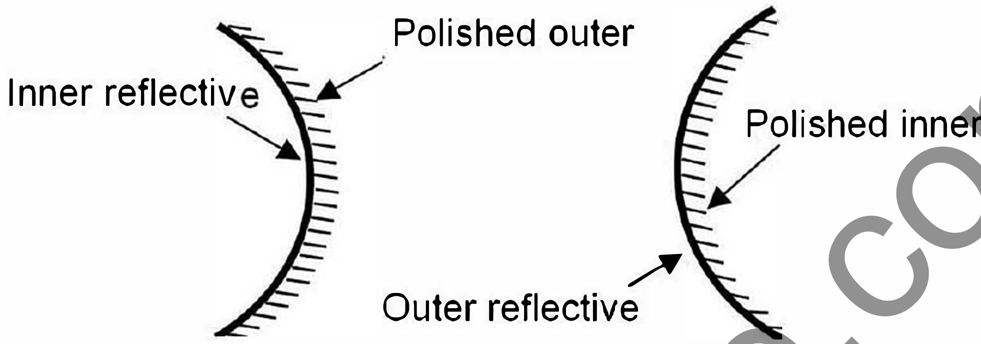
Types of Mirrors

- The reflecting surface of a spherical mirror may be curved inwards or outwards.

Concave Mirror:
A spherical mirror, whose reflecting surface is curved inwards, that is, faces towards the center of the sphere, is called a concave mirror.

- Concave mirrors are commonly used in torches, search-lights, and vehicle headlights to get powerful parallel beams of light.

- They are often used as shaving mirrors to see a larger image of the face. The dentists use concave mirrors to see large images of the teeth of patients.
- Large concave mirrors are used to concentrate sunlight to produce heat in solar furnaces.



(a) A concave mirror (b) A convex mirror

Convex Mirror

A spherical mirror whose reflecting surface is curved outwards is called a convex mirror.

- Convex mirrors are commonly used as rear-view (wing) mirrors in vehicles.
- These mirrors are fitted on the sides of the vehicle, enabling the driver to see traffic behind him/her to facilitate safe driving.
- Convex mirrors are preferred because they always give an erect, though diminished, image.
- Also, they have a wider field of view as they are curved outwards. Thus, convex mirrors enable the driver to view much larger area than would be possible with a plane mirror.

Other Terms Involved

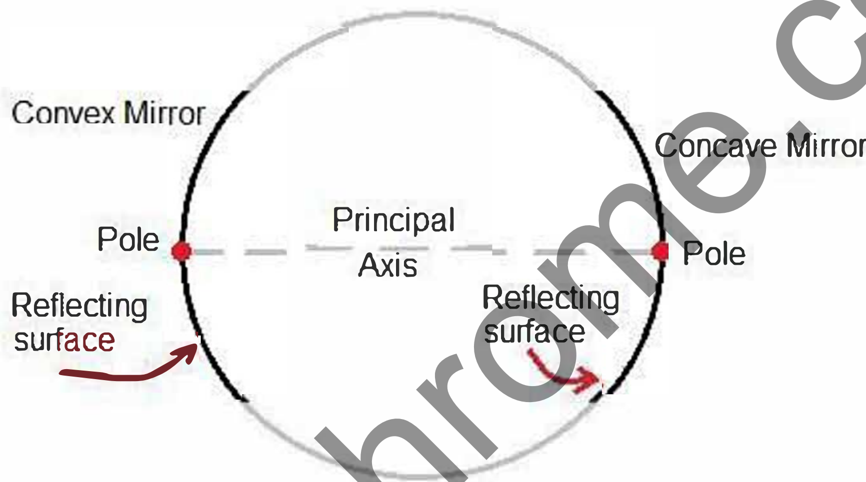
Pole: The center of the reflecting surface of a spherical mirror is a point called the pole. It lies on the surface of the mirror. The pole is usually represented by the letter P.

Center of Curvature: The reflecting surface of a spherical mirror forms a part of a sphere. This sphere has a center. This point is called the center of curvature of the spherical mirror. It is represented by the letter C.

Note: The center of curvature is not a part of the mirror. It lies outside its reflecting surface. The center of curvature of a concave mirror lies in front of it. However, it lies behind the mirror in the case of a convex mirror.

Radius of Curvature (R): The radius of the sphere of which the reflecting surface of a spherical mirror forms a part is called the radius of curvature of the mirror. It is represented by the letter R. You may note that the distance PC is equal to the radius of curvature.

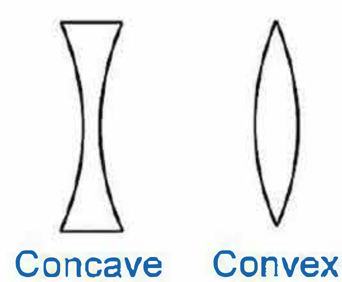
Principal Axis: Imagine a straight line passing through the pole and the center of curvature of a spherical mirror. This line is called the principal axis.



Spherical Mirror

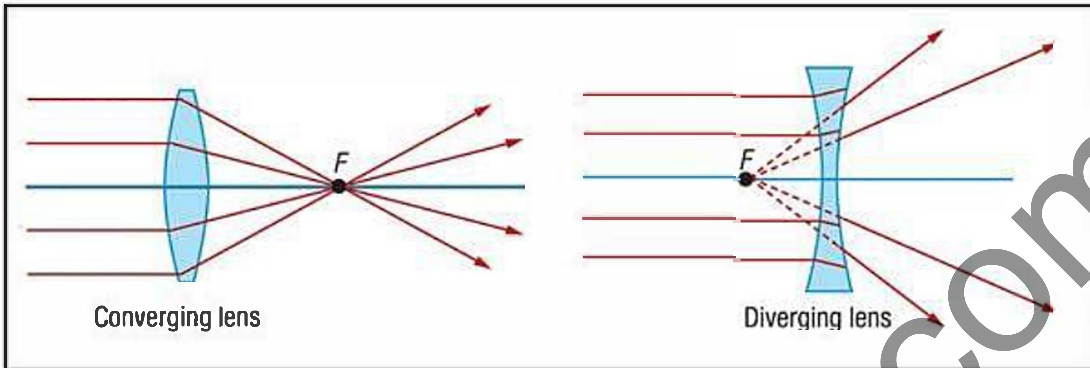
Types of Lenses

- **Concave Lens:** Those lenses which feel thicker in the middle than at the edges are convex lenses. Those which feel thinner in the middle than at the edges are concave lenses. Notice that the lenses are transparent and light can pass through them.



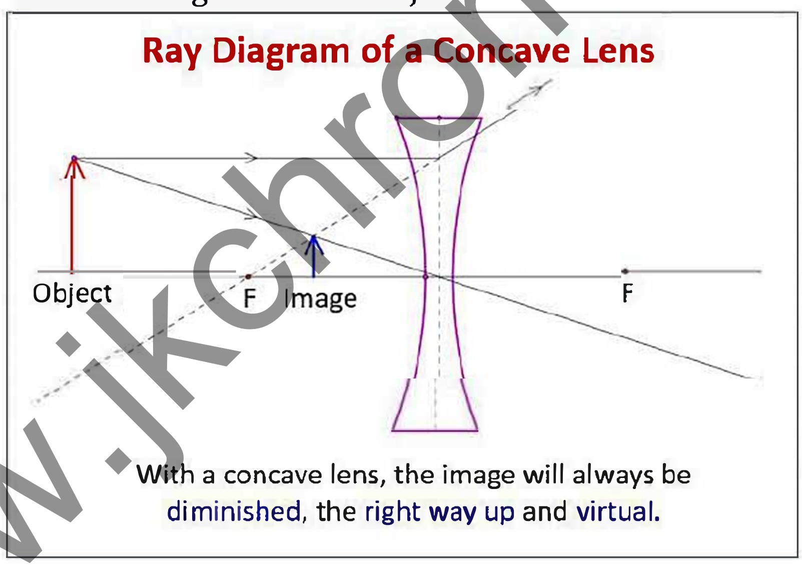
Concave and Convex Lens

Convex Lens: A convex lens converges (bends inward) the light generally falling on it. Therefore, it is called a converging lens. On the other hand, a concave lens divergess (bends outward) the light and is called a diverging lens.

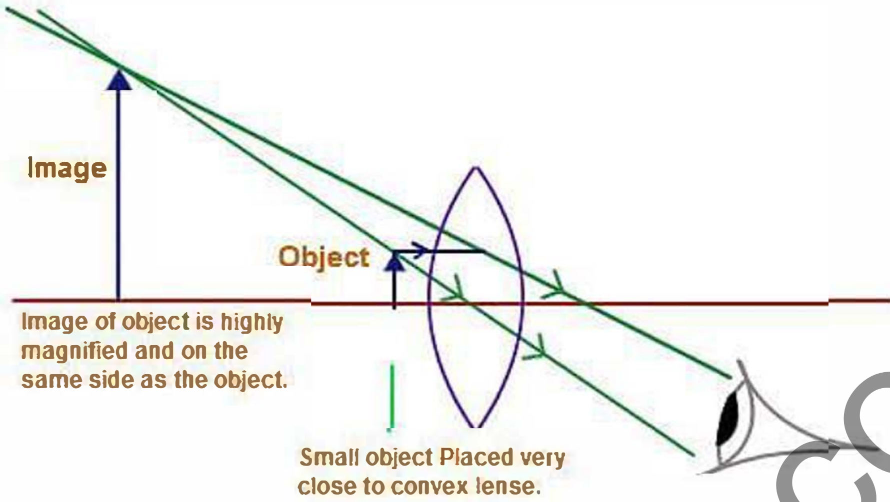


Types of Images formed by Lenses

- **Image formed by Concave Lens:** A concave lens always forms an erect, virtual, and smaller image than the object.



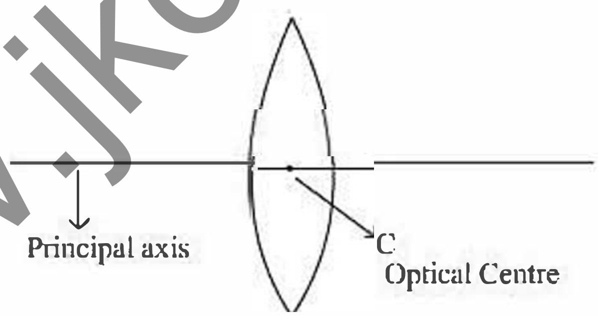
- **Image formed by Convex Lens:** A convex lens can form a real and inverted image. When the object is placed very close to the lens, the image formed is virtual, erect, and magnified. When used to see objects magnified, the convex lens is called a magnifying glass.



The convex lens as a magnifying glass

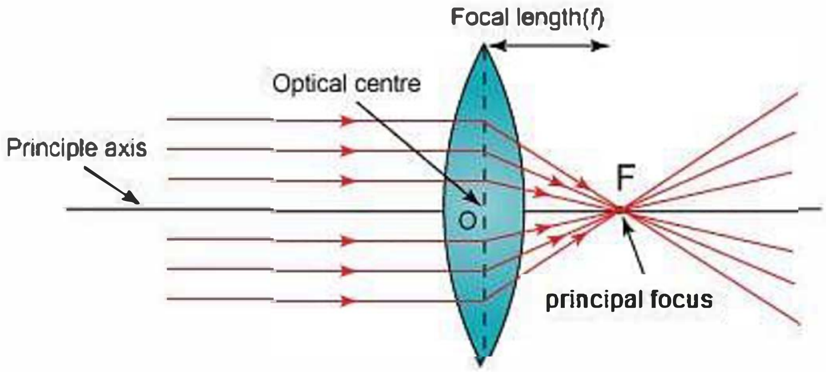
Other Terms Involved

- **Principal Axis:** The two surfaces of the lens are parts of two spheres. The straight line joining obtained by joining two centers of the spheres is called the Principal axis. Generally, we use lenses whose surfaces have equal curvature. In such lenses, if we take a point on the principal axis inside the lens equidistant from the two surfaces, the point is called the optical center of the lens.



Optical center and principal axis of a convex lens

- **Focus of Convex Lens:** If a beam of parallel rays, traveling parallel to the principal axis of a convex lens, is refracted by the lens, the rays become converging and intersect each other at a particular point of the axis. The point is called the focus of the convex lens.
- **Focal Length of Lens:** The focal length of a lens is the distance between the optical center and the focus of the lens.



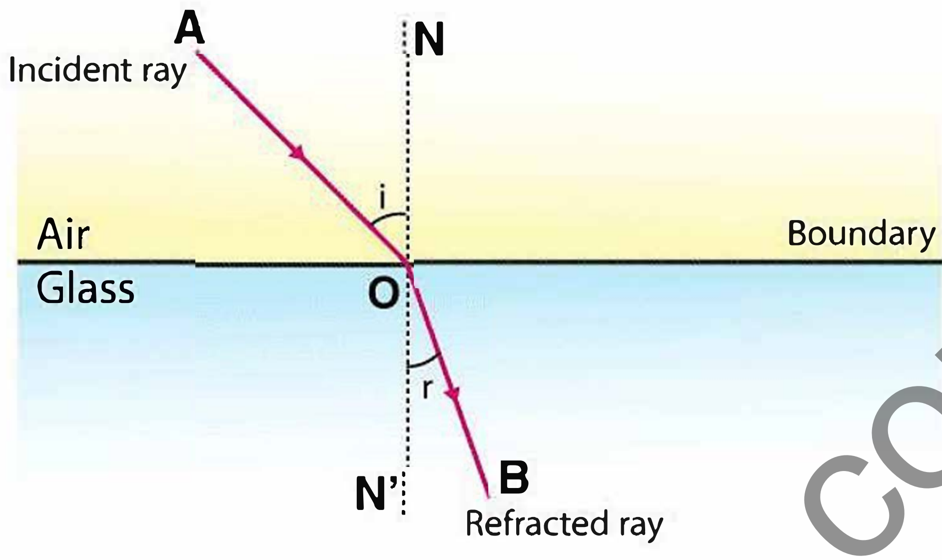
Classification of solids on the basis of electricity conduction

- **Power of Lens**: The power of a lens is a measure of the **degree of convergence** (in the case of a convex lens) or divergence (in the case of a concave lens). It is defined as the reciprocal of its focal length expressed in meters.
- **S.I. Unit of power of a lens:** Dioptre, the symbol being D. Thus, 1 dioptre is the power of a lens whose focal length is 1 meter. $1D = 1m^{-1}$.
- You may note that the power of a convex lens is **positive** and that of a concave lens is **negative**.

2. Refraction of Light

The phenomenon due to which a ray of light deviates from its path, at the surface of separation of two media, when the ray of light is traveling from one optical medium to another optical medium is called refraction of light.

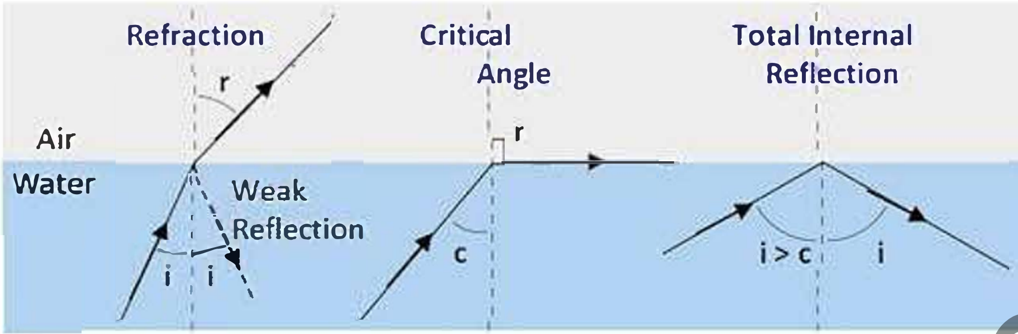
When a ray of light travels from an optically rare medium to an optically denser medium.



Refraction of Light

Phenomenon of Refraction

- When a ray of light travels from an optically denser medium to an optically rare medium, it bends away from the normal at the surface of the separation of two media.
- When a ray of light strikes the surface of separation of two media normally, it does not deviate from its original path. Some indexes of refraction are diamond (2.419), glass (1.523), and water (1.33).
- **Total internal reflection:** It is the phenomenon that involves the reflection of all the incident light off the boundary.
  Total internal reflection only takes place when both of the following two conditions are met:
  (i) The light is in the more dense medium and approaching the less dense medium.
  (ii) The angle of incidence is greater than the so-called critical angle.
- Total internal reflection will not take place unless the incident light is traveling within the more optically dense medium towards the less optically dense medium.



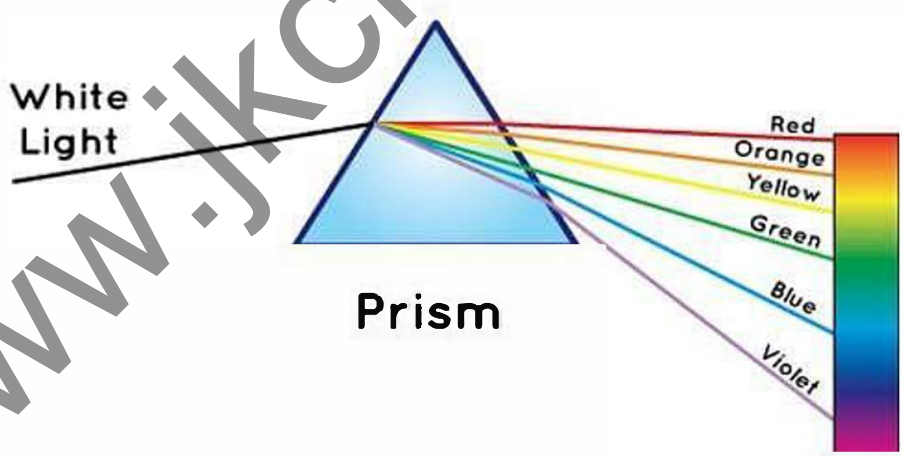
The Phenomenon of Total Internal Reflection

3. Dispersion of Light

It is the phenomenon splitting of a beam of white light into its constituent colors on passing through a prism.

- The order of colors from the lower end are **violet, indigo, blue, green, yellow, orange**, and **red**.
- At one end of the band, there is red and at the other violet.

The sequence of colors can be best remembered by the word **VIBGYOR**' which is formed by taking the initial letter of each color.



Dispersion of Light

- A laser is just a really powerful beam of light. The laser isn't a word but an acronym. It stands for Light Amplification By Stimulated Emission Of Radiation.

Magnetism, Electricity & Electromagnetism

1. Magnetism

Magnetism is aphysical phenomenon produced by the motion of electric charge, which results in attractive and repulsive forces between objects.

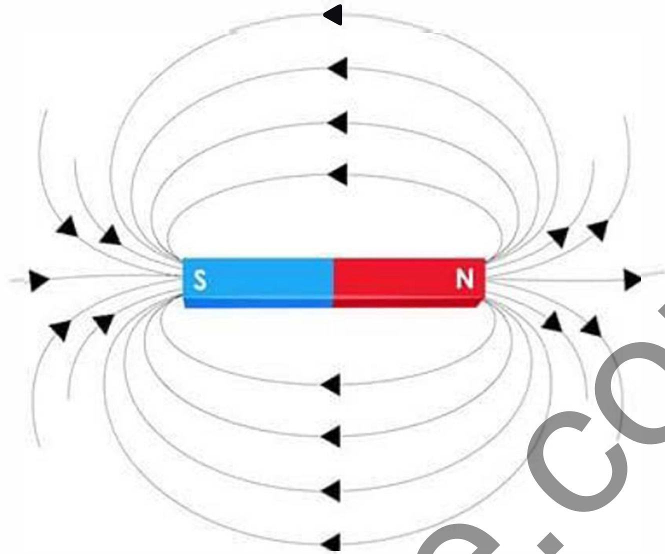
- The word magnet is derived from the name of an island in **Greece** called Magnesia where magnetic ore deposits were found, as early as **600 BC**. Magnetite, an iron ore, is a natural magnet. It is called a **lodestone**.
- When a bar magnet is freely suspended, it points in the north-south direction. The tip which points to the geographic north is called the north pole and the tip which points to the geographic south is called the south pole of the magnet. There is a repulsive force when the north poles (or south poles) of two magnets are brought close together. Conversely, there is an attractive force between the north pole of one magnet and the south pole of the other.
- The properties of a magnet are:
  (i) It attracts a small piece of iron towards it.
  (ii) It always comes to rest in a north-south direction when suspended freely.
  (iii) As poles repel, unlike poles attracts each other
  (iv) Magnetic poles always exist in pairs.
  (v) The strength of a magnet is maximum at poles located near the poles.
- The phenomenon due to which an unmagnetized magnetic substance behaves like a magnet, due to the presence of some other magnet, is called magnetic induction. Magnetic induction takes place first then magnetic attraction.

Magnetic Induction

- Magnetic induction depends upon the nature of the magnetic substance. Magnetic induction is inversely proportional to the distance between the inducing magnet and the magnetic substance. The more powerful the inducing magnet, the more strong will be the magnetism in magnetic substance.

Magnetic Field

- The space around the magnet where its influence can be detected is called the



Magnetic Field Around the Bar Magnet

- A curve in a magnetic field, along with a free north magnetic pole will move, is called the magnetic line of force. The direction of magnetic lines of force is the direction in which the free north pole will move in a magnetic field.
  (i) They travel from north to south pole outside the magnet and from south to north pole inside the magnet.
  (ii) They mutually repel each other.
  (iii) They never intersect with each other.
- The earth behaves as a magnet with the magnetic field pointing approximately from the geographic south to the north. At a particular place on earth, the magnetic north is not usually in the direction of the geographic north. The angle between the two directions called declination.

2. Electricity

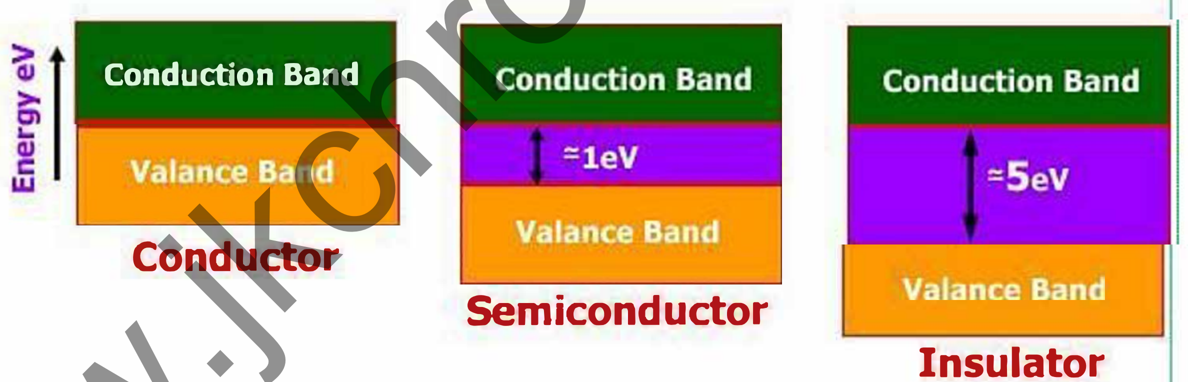
The phenomenon due to which a suitable combination of bodies on rubbing, get electrified is called electricity. If a charge on a body is not allowed to flow, it is called static electricity.

- Matters are made of atoms. An atom is basically composed of three different components — Electrons, Protons, and Neutrons. An electron can be removed easily from an atom. When two objects are rubbed together, some electrons from one object move to another object. **Example:** When a plastic bar is rubbed with fur, electrons will move from the fur to the plastic stick. Therefore, plastic bar will be negatively charged and the fur will be positively charged.

- When two objects are rubbed together, some electrons from one object move to another object.
  Example: When a plastic bar is rubbed with fur, electrons will move from the fur to the plastic stick. Therefore, plastic bar will be negatively charged and the fur will be positively charged.
- When you bring a negatively charged object close to another object, electrons in the second object will be repelled from the first object. Therefore, that end will have a negative charge. This process is called charging by induction.
- When a negatively charged object touches a neutral body, electrons will spread on both objects and make both objects negatively charged. This process is called charging by conduction. The other case, positively charged object touching the neutral body, is just the same in principle.

Types of Substance

- Substances can be classified into **three types — Insulators, Conductors, and Semiconductors.**



Classification of Solids on the basis of Electricity Conduction

- Conductors are materials in which electrical charges and heat energy can be transmitted very easily. Almost all metals such as **gold, silver, copper, iron, and lead are good conductors**.
  (i) Insulators are materials that allow very little electrical charges and heat energy to flow. Plastics, glass, dry air, and wood are examples of insulators.
  (ii) Semiconductors are materials that allow the electrical charges to flow better than insulators, but less than conductors.
  Example: Silicon and Germanium.

Types of Electric Charges

- There are two different types of electric charges namely the positive and negative charges. Like charges repel and unlike charges attract each other.
- Electric current always flows from the point of high potential. The potential difference between two conductors is equal to the work done in conducting a unit positive charges from one conductor to the other conductor through a metallic wire.
- The flow of charge is called the current and it is the rate at which electric charges pass through a conductor. The charged particle can be either positive or negative. In order for a charge to flow, it needs a push (a force) and it is supplied by voltage or potential difference. The charge flows from high potential energy to low potential energy.
- A closed-loop of current is called an electric circuit. The current [I] measures the amount of charge that passes a given point every second. The unit for current is Ampere [A]. 1 A means that 1 C of charge passes every second.
- When current flows through a conductor it offers some obstruction to the flow of current The obstruction offered to flow of current by the conducting wire is called its resistance in the passage of electricity.
- The unit of resistance is Ohm. The resistance varies in different materials. For example gold, silver, and copper have low resistance, which means that current can flow easily through these materials. Glass, plastics, and wood have very high resistance, which means that current can not pass through these materials easily.

3. Electromagnetism

The branch of physics which deals with the relationship between electricity and magnetism is called electromagnetism.

- Whenever current is passed through a straight conductor it behaves like a magnet. The magnitude of magnetic effect increases with the increase in the strength of current.
- **Faraday's law** of induction is one of the important concepts of electricity. It looks at the way changing magnetic fields can cause current to flow in wires. Basically, it is a formula/concept that describes how potential difference (voltage difference) is created and how much is created. It's a huge concept to understand that the changing of a magnetic field can create voltage.

- He discovered that the changes in the magnetic field and the size of the field were related to the amount of current created. Scientists also use the term magnetic flux. **Magnetic flux** is a value that is the strength of the magnetic field multiplied by the surface area of the device.

Coulomb's Law

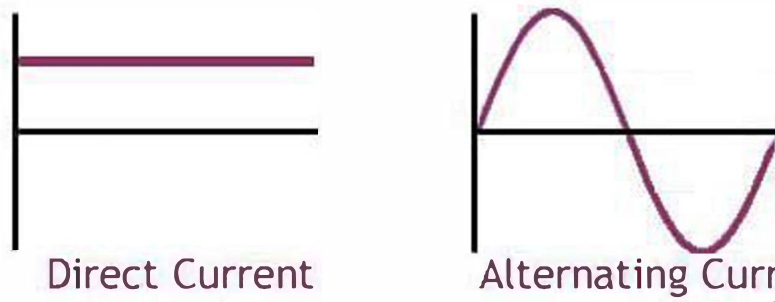
The law states that the magnitude of the electrostatic force of attraction or repulsion between two point charges is directly proportional to the product of the magnitudes of charges and inversely proportional to the square of the distance between them

- Coulomb's Law is one of the basic ideas of electricity in physics. The law looks at the forces created between two charged objects.
- As distance increases, the forces and electric fields decrease. This simple idea was converted into a relatively simple formula. The force between the objects can be positive or negative depending on whether the objects are attracted to each other or repelled.
- When you have two charged particles, an electric force is created. If you have larger charges, the forces will be larger. If you use those two ideas, and add the fact that charges can attract and repel each other you will understand Coulomb's Law.
- It's a formula that measures the electrical forces between two objects.

$F = kq_1q_2 / r^2$
» Where "F" is the resulting force between the two charges.
» The distance between the two charges is "r". The "r" actually stands for "radius of separation" but you just need to know it is a distance.
» The "q_2" and "q_2" values for the amount of charge in each of the particles. Scientists use Coulombs as units to measure charge.
» The constant of the equation is "k"

Types of Current- AC & DC

- There are **two main types of current in our world.** One is direct current (DC) which is a constant stream of charges in one direction. The other is alternating current (AC) that is a stream of charges that reverses



direction.

- The current in DC circuits is moving in a constant direction. The amount of current can change, but it will always flow from one point to another. In alternating current, the charges move in one direction for a very short time, and then they reverse direction. This happens over and over again.

MECHANICS

- **Motion:** In physics, motion is change of location or position of an object with respect to time. Mechanical motion is of two types, transitional (linear) and rotational (spin).
- **SPEED:** The speed of a moving body is the rate at which it covers distance i.e. the distance it covers per unit of time.

Speed: (distance travelled/ time required.) The S.I. Unit of speed is ms.

VELOCITY: The distance covered by an object in a specified direction in unit time interval is called velocity. The S.I. Unit of velocity is m/s.

- Average velocity can be calculated by dividing displacement over time.
- The instantaneous velocity shows the velocity of an object at one point.
- The difference between speed and velocity is: Speed is the distance travelled by an object in a particular time. Velocity is the speed in a particular direction.
- **ACCELERATION**: When an object's velocity changes, it accelerates. Acceleration shows the change in velocity in a unit time. Velocity is measured in meters per second, m/s, so acceleration is measured in (m/s)/ s, or m/s^2, which can be both positive and negative. The symbol for acceleration is a (boldface).
- When the velocity decreases the body is said to undergo retardation or deceleration.
- Acceleration Due to Gravity: Galileo was the first to find out that all objects falling to Earth have a constant acceleration of 9.80

m/s^2 regardless of their mass. Acceleration due to gravity is given a symbol g, which equals to 9.80 m/s^2.

- **FORCE:** Force can be defined as a push or a pull. (Technically, force is something that can accelerate objects.) Force is measured by N (Newton). A force that causes an object with a mass of 1 kg to accelerate at 1 m/s is equivalent to 1 Newton.
- Newton's law of universal gravitation states that every massive particle in the universe attracts every other massive particle with a force which is directly proportional to the product of their masses and inversely proportional to the square of the distance between them.
- In equation form, the gravitational force $F = G(m_1 m_2)/ r_2$ where r is the distance between two bodies of masses m_1 and m_2 and G the universal gravitational constant.
- **Centripetal Force:** For a body to move in a circle there must be a force on it directed towards the centre. This is called the centripetal force and is necessary to produce continuous change of direction in a circular motion.
- The magnitude of the centripetal force on an object of mass m moving at a speed v along a path with radius of curvature r is given by the relation $F = mv^2/r$ The direction of the force is toward the center of the circle in which the object is moving. Centrifugal force is equal and opposite to centripetal force, i.e it acts outwards.
- **WEIGHT:** the weight of a body is the force with which the earth attracts the body towards its centre. The weight of a body should not be confused with its mass, which is a measure of the quantity of matter contained in it. Mass shows the quantity, and weight shows the size of gravity. The weight of a body is maximum at the poles and minimum at equator.
- If you know your mass, you can easily find your weight because W = mg where:

W is weight in Newton (N),
m is mass in kg, and
g is the acceleration of gravity in m/s^2.

- Weight is measured by Newton (N).
- It is now obvious that the value of g is maximum at poles and minimum at equator. At the centre of earth, g would be zero.
- It should be noted here that on the surface of the moon the value of the acceleration due to gravity is neraly one-sixth of that on earth, and therefore, an object on the moon would weigh only one-sixth its weight on earth.

- Newton's Laws of Motion:

1. Newtons First Law of Motion:

- Newton's first law of motion states that "An object at rest tends to stay at rest and an object in motion tends to stay in motion with the same speed and in the same direction unless acted upon by an unbalanced force." . Every object in a state of uniform motion tends to remain in that state of motion unless an external force is applied to it.
- In fact, it is the natural tendency of objects to resist changes in their state of motion. This tendency to resist changes in their state of motion is described as inertia.
- **Inertia:** Inertia is the tendency of an object to resist changes in its state of motion. But what is meant by the phrase state of motion? The state of motion of an object is defined by its velocity - the speed with a direction. Thus, inertia could be redefined as follows: Inertia: tendency of an object to resist changes in its velocity.
- There are many more applications of Newton's first law of motion.
- Blood rushes from your head to your feet while quickly stopping when riding on a descending elevator.
- The head of a hammer can be tightened onto the wooden handle by banging the bottom of the handle against a hard surface.
- While riding a skateboard (or wagon or bicycle), you fly forward off the board when hitting a curb or rock or other object which abruptly halts the motion of the skateboard.

2. Newton's Second Law of Motion:

- The acceleration of an object as produced by a net force is directly proportional to the magnitude of the net force, in the same direction as the net force, and inversely proportional to the mass of the object.
- The relationship between an object's mass m, its acceleration a, and the applied force F is F = ma. Acceleration and force are vectors (as indicated by their symbols being displayed in slant bold font); in this law the direction of the force vector is the same as the direction of the acceleration vector.

3. Newton's Third Law of Motion:

- For every action, there is an equal and opposite reaction.
- The statement means that in every interaction, there is a pair of forces acting on the two interacting objects. The size of the forces on the first object equals the size of the force on the second object. The direction of

the force on the first object is opposite to the direction of the force on the second object. Forces always come in pairs - equal and opposite action-reaction force pairs.

- The rocket's action is to push down on the ground with the force of its powerful engines, and the reaction is that the ground pushes the rocket upwards with an equal force.
- There's also the example of shooting a cannonball. When the cannonball is fired through the air (by the explosion), the cannon is pushed backward. The force pushing the ball out was equal to the force pushing the cannon back, but the effect on the cannon is less noticeable because it has a much larger mass. That example is similar to the kick when a gun fires a bullet forward.
- **Friction:** Friction is a force that resists the movement oof one surface over another. The force acts in the opposite direction to the way an object wants to slide. If a car needs to stop at a stop sign, it slows because of the friction between the brakes and the wheels.
- Measures of friction are based on the type of materials that are in contact. Concrete on concrete has a very high coefficient of friction. That coefficient is a measure of how easily one object moves in relationship to another. When you have a high coefficient of friction, you have a lot of friction between the materials.

PROPERTIES OF MATTERS

- **Properties of matters:** A matter can neither be created nor it can be destroyed but it can be transformed from one state to another. Matter is made of basic building blocks commonly called elements which are 112 in number. The matter is made of only one kind of element then the smallest unit of that element is called an atom. If the matter is made of two or more different elements then the smallest unit of matter is called a molecule.
- Molecule is defined as the smallest unit of matter which has independent existence and can retain complete physical and chemical properties of matters.
- According to kinetic theory of matter:
  (i) molecules are in the state of continuous motion in all possible directions and hence they posses kinetic energy which increases with the gain of heat energy or rise in temperature,
  (ii). the molecules always attract each other,
  (iii). the force of attraction between the molecules decreases with the increase in intermolecular spaces

- The molecules always attract each other. The force of attraction between the similar kind of molecules is called force of cohesion whereas the force of attraction between different kinds of molecules is called force of adhesion.
- In case of solids, the intermolecular space being very small, so intermolecular forces are very large and hence solids have definite size and shape.
- In case of liquids, the intermolecular space being large, so intermolecular forces are small and hence liquids have definite volume but no definite shape.
- In case of gases, the intermolecular space being very large, so intermolecular forces are extremely small and hence gases have neither a definite volume and nor definite shape.
- A solid has definite shape and size. In order to change (or deform) the shape or size of a body, a force is required. If you stretch a helical spring by gently pulling its ends, the length of the spring increases slightly. When you leave the ends of the spring, it regains its original size and shape. The property of a body, by virtue of which it tends to regain its original size and shape when the applied force is removed, is known as elasticity and the deformation caused is known as elastic deformation.
- However, if you apply force to a lump of putty or mud, they have no gross tendency to regain their previous shape, and they get permanently deformed. Such substances are called plastic and this property is called plasticity. Putty and mud are close to ideal plastics.
- When a force is applied on body, it is deformed to a small or large extent depending upon the nature of the material of the body and the magnitude of the deforming force. The deformation may not be noticeable visually in many materials but it is there. When a body is subjected to a deforming force, a restoring force is developed in the body. This restoring force is equal in magnitude but opposite in direction to the applied force. The restoring force per unit area is known as stress. If F is the force applied and A is the area of cross section of the body, Magnitude of the stress = F/A. The SI unit of stress is N m^{-2} or pascal (Pa). Stress is the restoring force per unit area and strain is the fractional change in dimension.
- **HOOKE'S LAW:** Robert Hooke, an English physicist (1635 - 1703 A.D) performed experiments on springs and found that the elongation (change in the length) produced in a body is proportional to the applied force or load. In 1676, he presented his law of elasticity, now called Hooke's law. For small deformations the stress and strain are proportional to each other. This is known as Hooke's law. Thus, stress ””

strain or stress = k X strain , where k is the proportionality constant and is known as modulus of elasticity.

- The basic property of a fluid is that it can flow. The fluid does not have any resistance to change of its shape. Thus, the shape of a fluid is governed by the shape of its container. A liquid is incompressible and has a free surface of its own. A gas is compressible and it expands to occupy all the space available to it.
- **Pascal's Law:** The French scientist Blaise Pascal observed that the pressure in a fluid at rest is the same at all points if they are at the same height, distributed uniformly throughout. We can say whenever external pressure is applied on any part of a fluid contained in a vessel, it is transmitted undiminished and equally in all directions. This is the Pascal's law for transmission of fluid pressure and has many applications in daily life. A number of devices such as hydraulic lift and hydraulic brakes are based on the Pascal's law.
- The flow of the fluid is said to be steady if at any given point, the velocity of each passing fluid particle remains constant in time. The path taken by a fluid particle under a steady flow is a streamline.
- Bernoulli's principle states when a fluid flows from one place to another without friction, its total energy (kinetic + potential + pressure) remains constant.
- You must have noticed that, oil and water do not mix; water wets you and me but not ducks; mercury does not wet glass but water sticks to it, oil rises up a cotton wick, inspite of gravity, Sap and water rise up to the top of the leaves of the tree, hairs of a paint brush do not cling together when dry and even when dipped in water but form a fine tip when taken out of it. All these and many more such experiences are related with the free surfaces of liquids. As liquids have no definite shape but have a definite volume, they acquire a free surface when poured in a container. These surfaces possess some additional energy. This phenomenon is known as surface tension and it is concerned with only liquid as gases do not have free surfaces. Mathematically, surface tension is defined as the force acting per unit length of an imaginary line drawn on the free surface of the liquid. The surface tension is expressed in newton/meter.
- Most of the fluids are not ideal ones and offer some resistance to motion. This resistance to fluid motion is like an internal friction analogous to friction when a solid moves on a surface. It is called viscosity.

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NCERT Summary

Summary of Physics- 3

SOUND

- Sound is a form of energy and like all other energies, sound is not visible to us. It produces a sensation of hearing when it reaches our ears. Sound can not travel through vacuum.
- Sound is produced due to vibration of different objects. The matter or substance through which sound is transmitted is called a medium. It can be solid, liquid or gas. Sound moves through a medium from the point of generation to the listener.
- In longitudinal wave the individual particles of the medium move in a direction parallel to the direction of propagation of the disturbance. The particles do not move from one place to another but they simply oscillate back and forth about their position of rest. This is exactly how a sound wave propagates, hence sound waves are longitudinal waves. Sound travels as successive compressions and rarefactions in the medium. In sound propagation, it is the energy of the sound that travels and not the particles of the medium.
- There is also another type of wave, called a transverse wave. In a transverse wave particles do not oscillate along the line of wave propagation but oscillate up and down about their mean position as the wave travels.Thus a transverse wave is the one in which the individual particles of the medium move about their mean positions in a direction perpendicular to the direction of wave propagation. Light is a transverse wave but for light, the oscillations are not of the medium particles or their pressure or density – it is not a mechanical wave.
- To and fro motion of an object is known as vibration. This motion is also called oscillatory motion.
- Amplitude and frequency are two important properties of any sound.
- The loudness or softness of a sound is determined basically by its amplitude. The amplitude of the sound wave depends upon the force with which an object is made to vibrate.
- The change in density from one maximum value to the minimum value and again to the maximum value makes one complete oscillation.

- The distance between two consecutive compressions or two consecutive rarefaction is called the wavelength, ë.
- The time taken by the wave for one complete oscillation of the density or pressure of the medium is called the time period, T.
- The number of complete oscillations per unit time is called the frequency (í), í =(1/T). The frequency is expressed in hertz (Hz).
- Larger the amplitude of vibration, louder is the sound. Higher the frequency of vibration, the higher is the pitch, and shriller is the sound.

➢ The frequency determines the shrillness or pitch of a sound. If the frequency of vibration is higher, we say that the sound is shrill and has a higher pitch. If the frequency of vibration is lower, we say that the sound has a lower pitch.

➢A sound of single frequency is called a tone whereas a sound of multiple frequencies is called a note. Of the several frequencies present in a note, the sound of the lowest frequency is called the fundamental tone. Besides the fundamental, other tones present in a note are known as overtones. Of the overtones, those which have their frequencies simple multiple of fundamental frequency, are known as harmonics. All harmonics are overtone but all overtones are not harmonics.

- Sound propagates through a medium at a finite speed. The speed of sound depends on the properties of the medium through which it travels. The speed of sound in a medium depends also on temperature and pressure of the medium. The speed of sound decreases when we go from solid to gaseous state. In any medium as we increase the temperature the speed of sound increases. Experiment shows that the velocity of sound in air at 0^0C is about 332 metres per second.
- The velocity of sound through a gas is inversely proportional to the square root of the density of the gas.
- The law of reflection of sound states that the directions in which the sound is incident and reflected make equal angles with the normal to the reflecting surface and the three lie in the same plane.
- If we shout or clap near a suitable reflecting object such as a tall building or a mountain, we will hear the same sound again a little later. This sound which we hear is called an echo. The sensation of sound persists in our brain for about 0.1 second. To hear a distinct echo, the time interval between the original sound and the reflected one must be at least 0.1 second. If we take the speed of sound to be 344 m/s at a given temperature, say at 22 0C in air, the sound must go to the obstacle and reach back the ear of the listener on reflection after 0.1s. Hence, the total distance covered by the sound from the point of generation to the reflecting surface and back should be at least (344 m/s) × 0.1 s = 34.4 m. Thus, for hearing distinct echoes, the minimum distance of the

obstacle from the source of sound must be half of this distance, that is, 17.2 m. This distance will change with the temperature of air. Echoes may be heard more than once due to successive or multiple reflections.

- The phenomenon of prolongation of sound due to successive reflections of sound from surrounding objects is called reverberation.
- Stethoscope is a medical instrument used for listening to sounds produced within the body, chiefly in the heart or lungs. In stethoscopes the sound of the patient's heartbeat reaches the doctor's ears by multiple reflection of sound.
- The audible range of sound for human beings extends from about 20 Hz to 20000 Hz (one Hz = one cycle/s). Children under the age of five and some animals, such as dogs can hear up to 25 kHz (1 kHz = 1000 Hz).
- Sounds of frequencies below 20 Hz are called infrasonic sound or infrasound. Rhinoceroses communicate using infrasound of frequency as low as 5 Hz. Whales and elephants produce sound in the infrasound range. It is observed that some animals get disturbed before earthqu akes. Earthquakes produce low-frequency infrasound before the main shock waves begin which possibly alert the animals.
- Frequencies higher than 20 kHz are called ultrasonic sound or ultrasound. Ultrasound is produced by dolphins, bats and porpoises.
- Ultrasounds can be used to detect cracks and flaws in metal blocks. Metallic components are generally used in construction of big structures like buildings, bridges, machines and also scientific equipment. The cracks or holes inside the metal blocks, which are invisible from outside reduces the strength of the structure. Ultrasonic waves are allowed to pass through the metal block and detectors are used to detect the transmitted waves. If there is even a small defect, the ultrasound gets reflected back indicating the presence of the flaw or defect.
- Ultrasonic waves are made to reflect from various parts of the heart and form the image of the heart. This technique is called 'echocardiography'.
- Ultrasound scanner is an instrument which uses ultrasonic waves for getting images of internal organs of the human body. A doctor may image the patient's organs such as the liver, gall bladder, uterus, kidney, etc. It helps the doctor to detect abnormalities, such as stones in the gall bladder and kidney or tumours in different organs. In this technique the ultrasonic waves travel through the tissues of the body and get reflected from a region where there is a change of tissue density. These waves are then converted into electrical signals that are used to generate images of the organ. These images are then displayed on a monitor or printed on a film. This technique is called 'ultrasonography'.

- The acronym SONAR stands for Sound Navigation And Ranging. Sonar is a device that uses ultrasonic waves to measure the distance, direction and speed of underwater objects. Sonar consists of a transmitter and a detector and is installed in a boat or a ship. The transmitter produces and transmits ultrasonic waves. These waves travel through water and after striking the object on the seabed, get reflected back and are sensed by the detector. The detector converts the ultrasonic waves into electrical signals which are appropriately interpreted. The distance of the object that reflected the sound wave can be calculated by knowing the speed of sound in water and the time interval between transmission and reception of the ultrasound. Let the time interval between transmission and reception of ultrasound signal be t and the speed of sound through seawater be v. The total distance, 2d travelled by the ultrasound is then, $2d = v \times t$. The above method is called echo ranging. The sonar technique is used to determine the depth of the sea and to locate underwater hills, valleys, submarine, icebergs, sunken ship etc.

- Again if the speed of any substance, specially of an air-craft, be more than the speed of sound in air, then the speed of the substance is called supersonic speed. The ratio of the speed of a body and that of sound in air is, however, called the Mach number of the body. If the Mach number of a body is more than 1 , it is clear that the body has supersonic speed.

UNITS AND MEASUREMENT

i. Physics is a quantitative science, based on measurement of physical quantities. Certain physical quantities have been chosen as fundamental or base quantities (such as length, mass, time, electric current, thermodynamic temperature, amount of substance, and luminous intensity).
ii. Each base quantity is defined in terms of a certain basic, arbitrarily chosen but properly standardised reference standard called unit (such as metre, kilogram, second, ampere, kelvin, mole and candela). The units for the fundamental or base quantities are called fundamental or base units.
iii. Other physical quantities, derived from the base quantities, can be expressed as a combination of the base units and are called derived units. A complete set of units, both fundamental and derived, is called a system of units.
iv. The International System of Units (SI) based on seven base units is at present internationally accepted unit system and is widely used throughout the world. The SI units are used in all physical measurements, for both the base quantities and the derived quantities obtained from them. Certain derived units are expressed by means of SI units with special names (such as joule, newton, watt, etc).

v. The SI units have well defined and internationally accepted unit symbols (such as m for metre, kg for kilogram, s for second, A for ampere, N for newton etc.). Physical measurements are usually expressed for small and large quantities in scientific notation, with powers of 10. Scientific notation and the prefixes are used to simplify measurement notation and numerical computation, giving indication to the precision of the numbers.

vi. Unit of Length: The SI Unit of length is metre(m). Various other metric units used for measuring length are related to the metre by either multiples or submultiples of 10. Thus,

- 1 kilo metre = 1000 (or 10^3) m
- 1 centi metre= 1/100 (or 0^{-2}) m
- 1 mili metre=1/1000 (or 10^{-3}) m

Very small distance are measured in micrometre or microns (μm), angstroms(Å), nanometre (nm) and femtometre (fm).

- 1m = 10^6 μm
- 1m = 10^9 nm
- 1m =10^{10} Å
- 1m = 10^{15} fm

For really large distances, the light year is the unit of choice. A light year is the distance light would travel in a vacuum after one year. It is equal to some nine quadrillion meters (six trillion miles). 1 light year = 9.46×10^{15}m.
vii. Unit of Mass: The SI Unit of mass is kilogram(kg). Various other metric units used for measuring mass are related to the kilogram by either multiples or submultiples of 10. Thus,

- 1 tonne(t) = 1000 (or 10^3) kg
- 1 gram(g) = 1/1000 (or 0^{-32}) kg
- 1 miligram(mg) = 10^{-6}Kg

viii. Unit of Time: The SI unit of time is the second (s).

SI Base Quantities and Units:

Base Quantity	SI Name	Units Symbol
Length	metre	m
Mass	kilogram	kg
Time	second	s
Electric current	ampere	A
Thermo dynamic	kelvin	K
Temperature		
Amount of substance	mole	mole
Luminous	candela	cd

Important Units of Measurement:

Used to Measure	Name of the Unit
Electric Current	Ampere
Wave length of light	Angstrom
Electric charge	Faraday
Magnetic induction	Gauss
Magnetic Flux	Maxwell
Electric Charge	Coulomb
Electric Resistance	Ohm
Electric Tension	Volt
Power	Watt
Intensity of Sound	Bel
Temperature	Celsius, Kelvin, Fahrenheit
Atmospheric Pressure	Bar
Quantity of heat	Calorie
Force	Dyne
Work or Energy	Joule
Work	Newton
Pressure	Pascal
Luminious Flux	Lumen

- A nautical mile is now 1852 m (6080 feet), but was originally defined as one minute of arc of a great circle, or 1/60 of 1/360 of the earth's circumference. Every sixty nautical miles is then one degree of latitude anywhere on earth or one degree of longitude on the equator. This was considered a reasonable unit for use in navigation, which is why this mile is called the nautical mile. The ordinary mile is more precisely known as the statute mile; that is, the mile as defined by statute or law. Use of the nautical mile persists today in shipping, aviation, and aerospace.

- Distances in near outer space are sometimes compared to the radius of the earth: 6.4×10^6 m. Some examples: the planet Mars has ½ the radius of the earth, the size of a geosynchronous orbit is 6.5 earth radii, and the earth-moon separation is about 60 earth radii.
- The mean distance from the earth to the sun is called an astronomical unit: approximately 1.5×10^{11}m. The distance from the Sun to Mars is 1.5 AU; from the Sun to Jupiter, 5.2 AU; and from the Sun to Pluto, 40 AU. The star nearest the Sun, Proxima Centauri, is about 270,000 AU away.

WAVES

WAVES: There are three types of waves:
1. Mechanical waves require a material medium to travel (air, water, ropes). These waves are divided into three different types.
(i) Transverse waves cause the medium to move perpendicular to the direction of the wave.
(ii) Longitudinal waves cause the medium to move parallel to the direction of the wave.
(iii) Surface waves are both transverse waves and longitudinal waves mixed in one medium.

2. Electromagnetic waves do not require a medium to travel (light, radio).
3. Matter waves are produced by electrons and particles.

- A point of maximum positive displacement in a wave, is called crest, and a point of maximum negative displacement is called trough.
- **Measuring Waves:** Any point on a transverse wave moves up and down in a repeating pattern. The shortest time that a point takes to return to the initial position (one vibration) is called period, T.
- The number of vibrations per second is called frequency and is measured in hertz (Hz). Here's the equation for frequency: $f = 1 / T$.
- The shortest distance between peaks, the highest points, and troughs, the lowest points, is the wavelength, λ.
- By knowing the frequency of a wave and its wavelength, we can find its speed. Here is the equation for the velocity of a wave: $v = \lambda f$.
- However, the velocity of a wave is only affected by the properties of the medium. It is not possible to increase the speed of a wave by increasing

its wavelength. By doing this, the number of vibrations per second decreases and therefore the velocity remains the same.
- The amplitude of a wave is the distance from a crest to where the wave is at equilibrium. The amplitude is used to measure the energy transferred by the wave. The bigger the distance, the greater the energy transferred.

WORK, POWER AND ENERGY

- When a force acting on a body produces a change in the position of the body, work is said to be done by the force. Work done on an object is defined as the magnitude of the force multiplied by the distance moved by the object in the direction of the applied force. The unit of work is joule: 1 joule = 1 newton × 1 metre. Work done on an object by a force would be zero if the displacement of the object is zero.
- Power is defined as the rate of doing work. Power = (work done) / (time taken). The SI unit of power is watt. 1 W = 1 Joule/second. The unit of power is also horse power. It is the power of an agent which can work at the rate of 550 foot pounds per second or 33,000 foot pounds pwe minute.
- An object having capability to do work is said to possess energy. Energy has the same unit as that of work.
- An object in motion possesses what is known as the kinetic energy of the object. An object of mass, m moving with velocity v has a kinetic energy of $(1/2)\ mv^2$.
- The energy possessed by a body due to its change in position or shape is called the potential energy. The gravitational potential energy of an object of mass, m raised through a height, h from the earth's surface is given by mgh.
- According to the law of conservation of energy, energy can only be transformed from one form to another; it can neither be created nor destroyed. The total energy before and after the transformation always remains constant.
- Energy exists in nature in several forms such as kinetic energy, potential energy, heat energy, chemical energy etc. The sum of the kinetic and potential energies of an object is called its mechanical energy.
- **Pressure:** Pressure is defined as force acting per unit area. Pressure = force/ area. The SI unit of pressure is newton per meter squared or Pascal.
- The same force acting on a smaller area exerts a larger pressure, and a smaller pressure on a larger area. This is the reason why a nail has a pointed tip, knives have sharp edges and buildings have wide foundations.
- All liquids and gases are fluids. A solid exerts pressure on a surface due to its weight. Similarly, fluids have weight, and they also exert pressure on the base and walls of the container in which they are enclosed. Pressure

exerted in any confined mass of fluid is transmitted undiminished in all directions.

- All objects experience a force of buoyancy when they are immersed in a fluid. Objects having density less than that of the liquid in which they are immersed, float on the surface of the liquid. If the density of the object is more than the density of the liquid in which it is immersed then it sinks in the liquid.
- **Archimedes' Principle:** When a body is immersed fully or partially in a fluid, it experiences an upward force that is equal to the weight of the fluid displaced by it.
- Archimedes' principle has many applications. It is used in designing ships and submarines. Lactometers, which are used to determine the purity of a sample of milk and hydrometers used for determining density of liquids, are based on this principle.
- **Density and Relative Density:** The mass per unit volume of a substance is called its density. The SI unit of density is kilogram per meter cubed. Density= mass/volume.
- The relative density of a substance is the ratio of its density to that of water: Relative density = Density of a substance/Density of water. Since the relative density is a ratio of similar.