CHAPTER 10 : Light-Reflection and Refraction

Key Points and Concepts

- **Reflection of light :** When light ray falls on a highly polished surface, it bounces back in certain direction. This phenomenon is called reflection of light.
- **Laws of reflection of light :**
  - The incident ray, the reflected ray, and the normal all lie in the same plane at the point of incidence.
  - Angle of incident is always equal to angle of reflection *i.e.* angle i = angle r.
- **Real image :** Image which can be obtained on screen. Real image is formed when light rays falling on the surface actually meet at a point after reflection. Real image is inverted.
- **Virtual image :** Image which cannot be obtained on screen. Virtual image is erect. It is formed when light rays after reflection appears to pass through the point.
- **Image formed by plane mirror :**
  - Virtual, and erect. The image do not form on screen.
  - The image is laterally inverted.
  - Size of image is equal to that of object.
  - Image formed is far behind the mirror as the object is in front of it.
- **Spherical mirror :** Mirror who's reflecting surfaces are curved inward or outward spherically are called spherical mirror.
- Spherical mirror are of two types : concave (converging mirror) and convex (diverging mirror).
- Relation between radius of curvature (R) and focal length (f) is $f = R/2$.

- **Uses of concave mirror :**
  - Used in torch, search light, and in vehicle head lights to get powerful parallel beams of light.
  - Used as shaving mirror to see a larger image of the face.
  - Used by dentists to examine the larger images of the teeth of the patient.
  - Used in solar furnaces to concentrate sunlight to produce heat.
- **Uses of convex mirror :**
  - Convex mirror is used as rear view mirror in vehicles, because, they always give an erect image. It also enables the driver to view much larger area.
- **Magnification :** It is expressed as ratio of the height of the image to height of the object.
- **Refraction of light :** When light travel obliquely from one medium to another, the direction of propagation in the second medium changes. This phenomenon is known as refraction of light. Refraction is due to the change in speed of light when it travel from one transparent medium to another.
  - Speed of light decreases as the beam of light travel from rarer medium to the denser medium.

- **Laws of refraction of light :**
  - The incident ray, the refracted ray and the normal at the point of incidence all lie in the same plane.
  - The ratio of sine of angle of incidence to the sine of angle of refraction is constant for a given pair of media. This law is also known as Snell's law of refraction.

$$\frac{\sin i}{\sin r} = \text{constant}$$

  - The constant value is the refractive index for a given pair of medium. It is the refractive index of the second medium with respect to first medium.
- **Refractive index :** The refractive index of glass with respect to air is given by ratio of speed of light in air to the speed of light in glass.
  - Spherical lens is a transparent material bound by two surfaces, of which one or both surfaces are spherical.

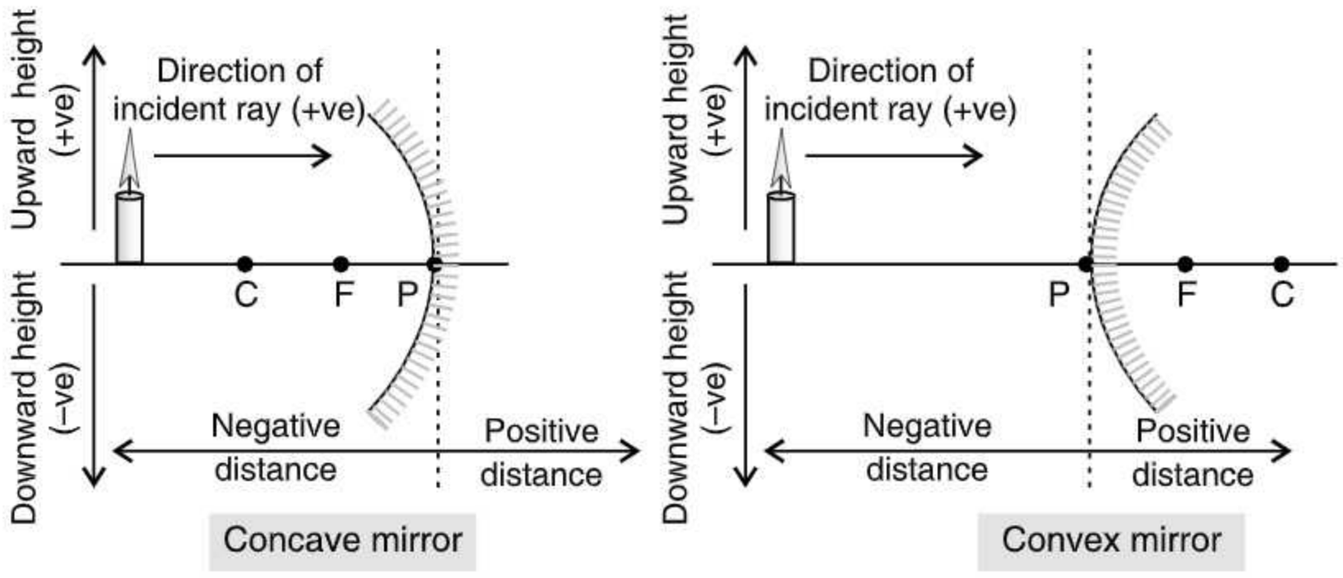
- **Convex lens** is a lens bounded by two spherical surfaces, curved outwards. It is thicker at the middle. These are converging lens as it converges the light.
- **Concave lens** is a lens in which both the spherical surfaces are curved inward. Concave lens is diverging lens as it diverges the light.
- **Power of Lens :** It is defined as the reciprocal of its focal length $P = \frac{1}{f}$.
- SI unit of power of a lens is "dioptre", denoted by 'D'.
- **Important Formulae and ray diagrams :**
  - **Mirror Formula :** $\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$
  - **Lens Formula :** $\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$
  - **Linear Magnification :**

$$m = \frac{v}{u} = \frac{h'}{h} \text{ (in lens)}$$

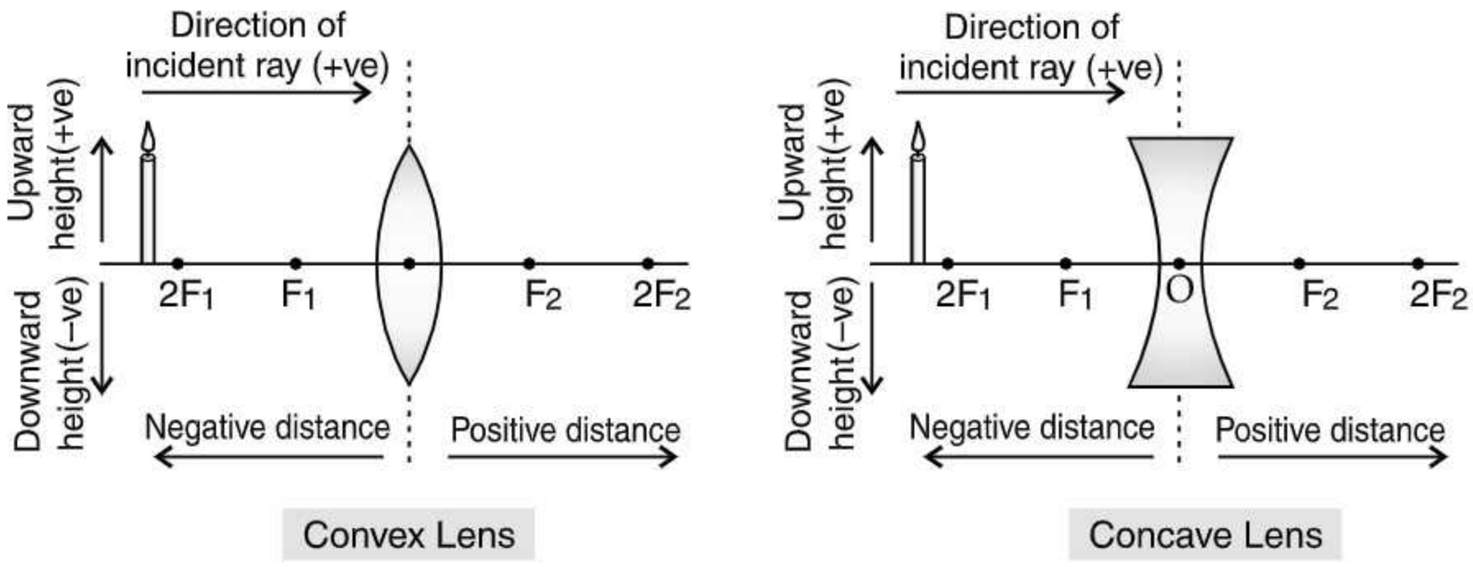
$$m = -\frac{v}{u} = \frac{h'}{h} \text{ (in mirror)}$$

Here, h = Height of object, h' = Height of image, v = Image distance, u = Object distance

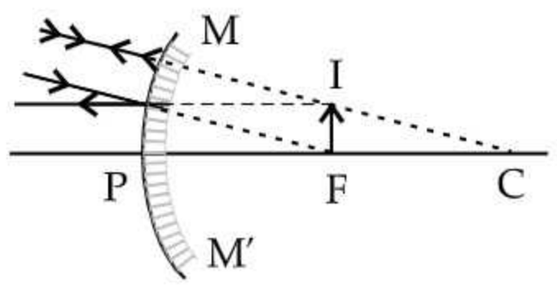
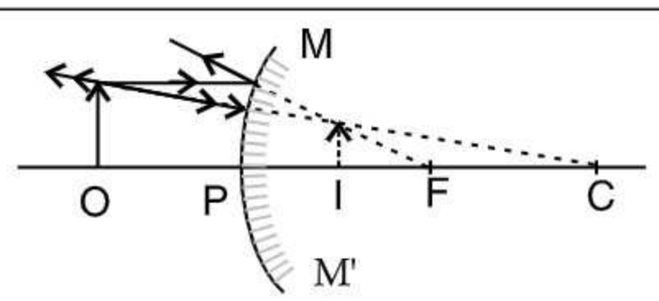
- **Sign Convention in Mirror :**



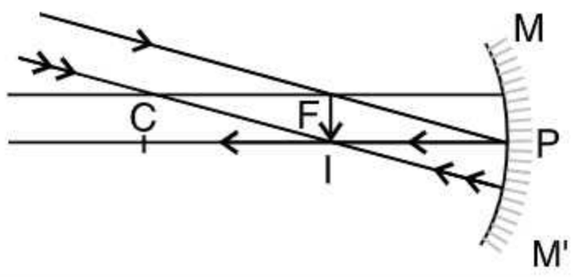
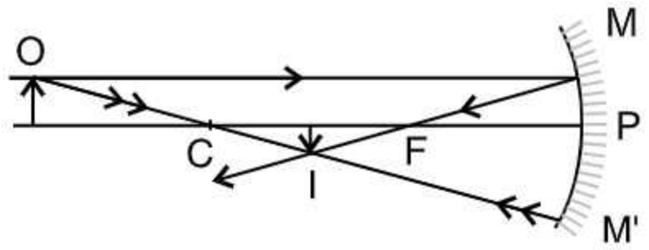
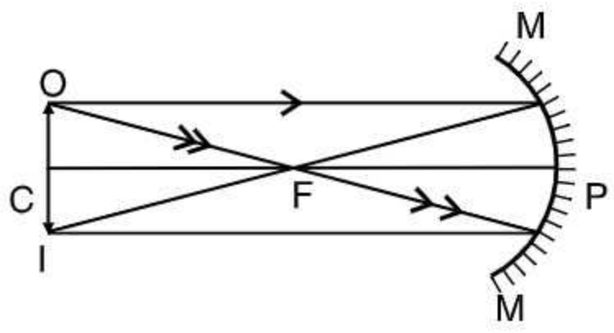
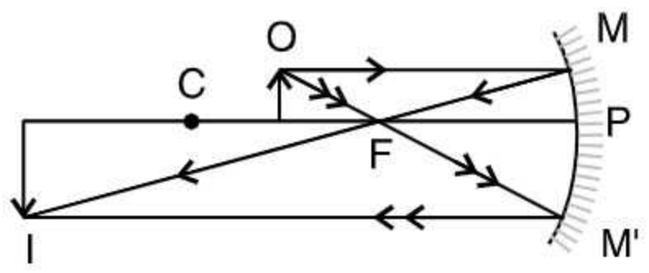
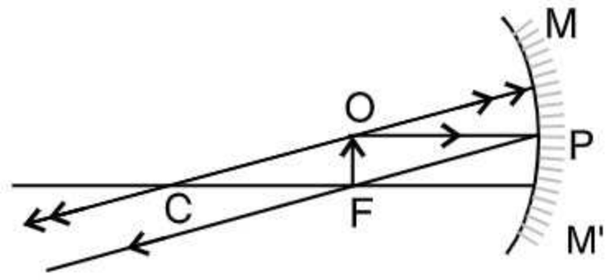
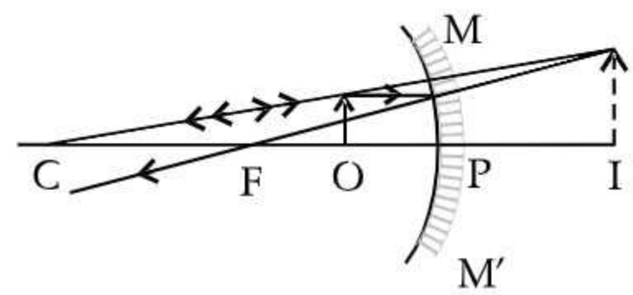
- **Sign Convention in Lens :**



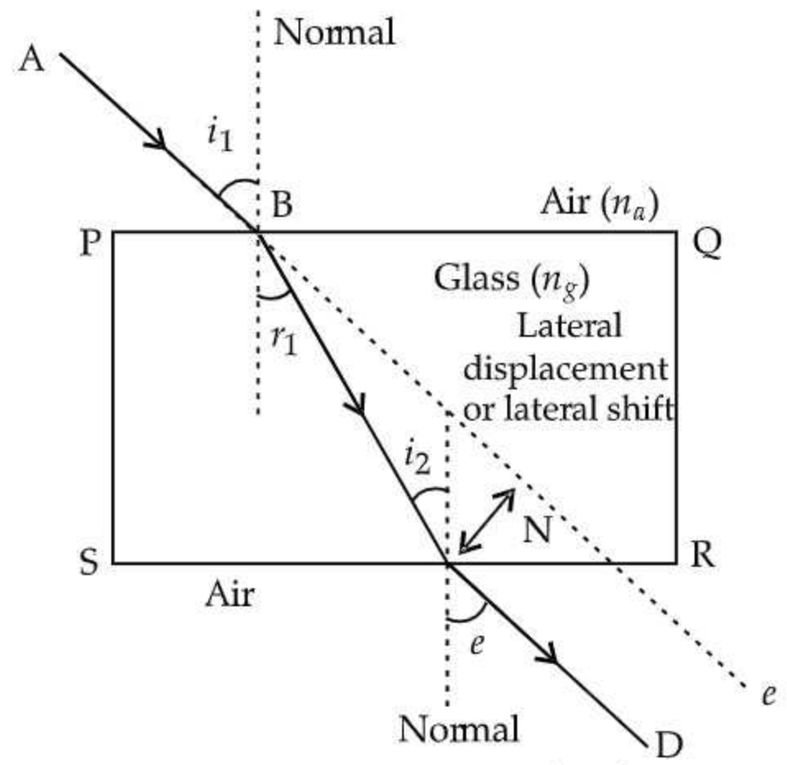
➢ **Image formation by convex mirror :**

S.No.	Position of object	Ray-diagram	Details of image
1.	At infinity		Virtual, erect, very small ($m << +1$), at F.
2.	In front of mirror		Virtual, erect, diminished ($m < +1$), between P and F.

➢ **Image formation by concave mirror :**

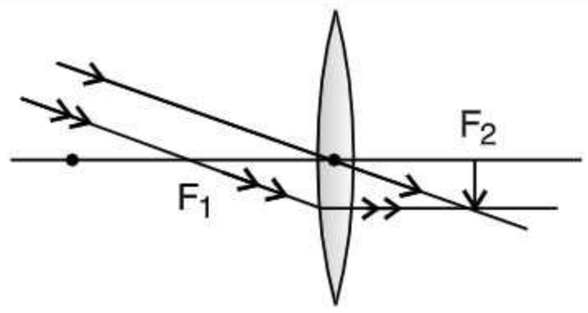
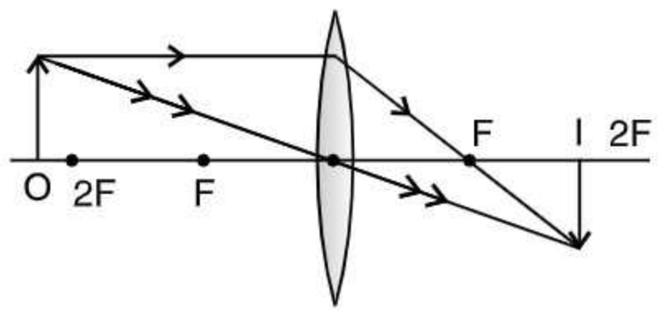
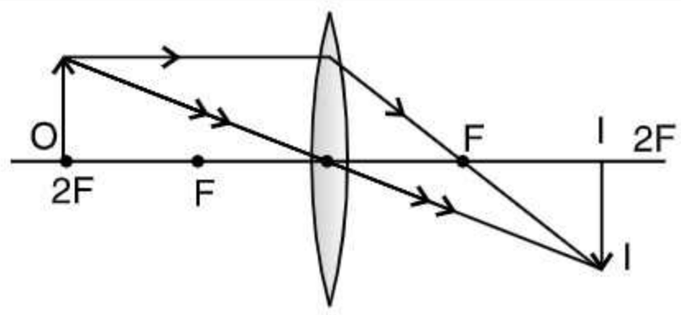
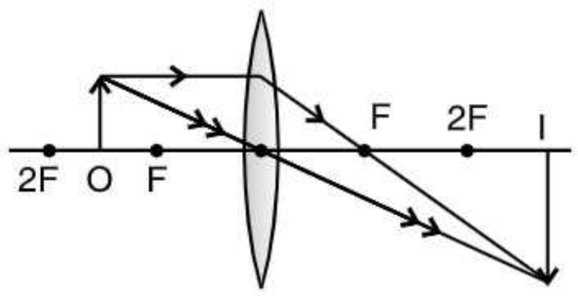
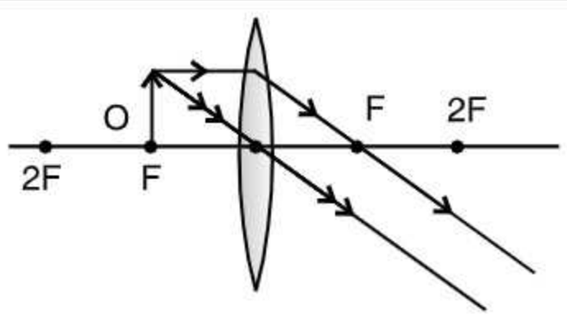
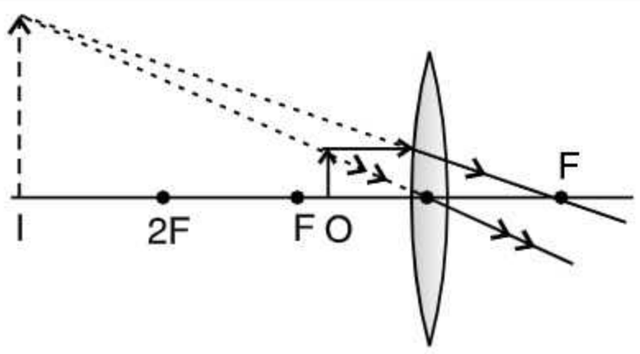
S.No.	Position of object	Ray-diagram	Details of image
1.	At infinity		Real, inverted, very small ($m << -1$), at F.
2.	Beyond C		Real, inverted diminished ($m < -1$), between F and C.
3.	At C		Real, inverted, equal ($m = -1$), at C.
4.	Between F and C		Real, inverted, enlarged ($m > -1$), between C and ∞.
5.	At F		Real, inverted, very large ($m >> -1$), at infinity.
6.	Between F and P		Virtual, erect, enlarged ($m > +1$), behind the mirror.

➢ Refraction through glass slab :

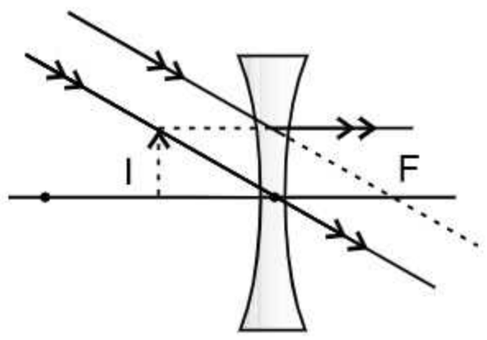
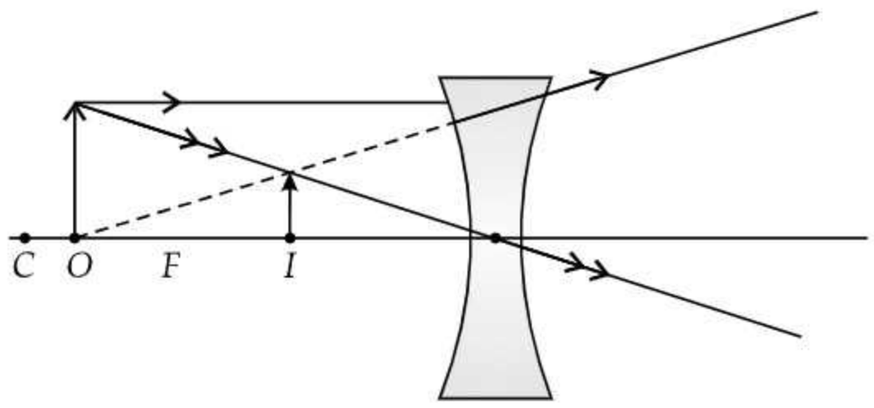


e = angle of emergence

➢ Image formation by convex lens :

S.No.	Position of object	Ray-diagram	Details of image
1.	At infinity		Real, inverted, diminished ($m << -1$), at F.
2.	Beyond 2F		Real, inverted, diminished ($m < -1$), between F and 2 F.
3.	At 2F		Real, inverted, equal ($m = -1$), at 2F.
4.	Between 2F and F		Real, inverted, enlarged ($m > -1$), between 2F and ∞.
5.	At F		Real, inverted, enlarged, ($m >> -1$) at infinity.
6.	Between F and O		Virtual, erect, enlarged ($m > +1$), between ∞ and object on the same side as that of object.

➢ **Image formation by concave lens :**

S.No.	Position of object	Ray-diagram	Details of image
1.	At infinity		Virtual, erect, diminished ($m << +1$), at F.
2.	In front of lens		Virtual, erect , diminished ($m < +1$), between F and optical centre.

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CHAPTER 11 : Human Eye and Colourful World

Key Points and Concepts

- The ability or the property of the eye lens to adjust its focal length in order to be able to focus both near and distant objects is known as the power of accommodation.
- The minimum distance at which objects can be seen most distinctly without strain is called the least distance of distinct vision.
- Retina contains light sensitive cells known as rod and cones. These cells get activated upon illumination and generate electrical signals or pulses. The electrical signals are sent to the brain through optic nerves. In the brain, the signals are processed, interpreted and the objects in front of the eye are perceived.
- Rods are sensitive to the brightness of light and cones tells us the colour of the object.
- **Defects of vision and their corrections :**

(a) Myopia (Near sightedness) :

Reason of the defect :

- Excessive curvature of eye lens *i.e.,* eye lens becomes thick and its focal length decreases.
- Elongation of the eye ball.

Correction : This defect is corrected by using concave lens of suitable power.

(b) Hypermetropia (Far sightedness) :

Reason of the defect :

- Increase in focal length of the eye lens.
- Eye ball has become too small.

Correction : Corrected by using convex lens of suitable power.

(c) Presbyopia :

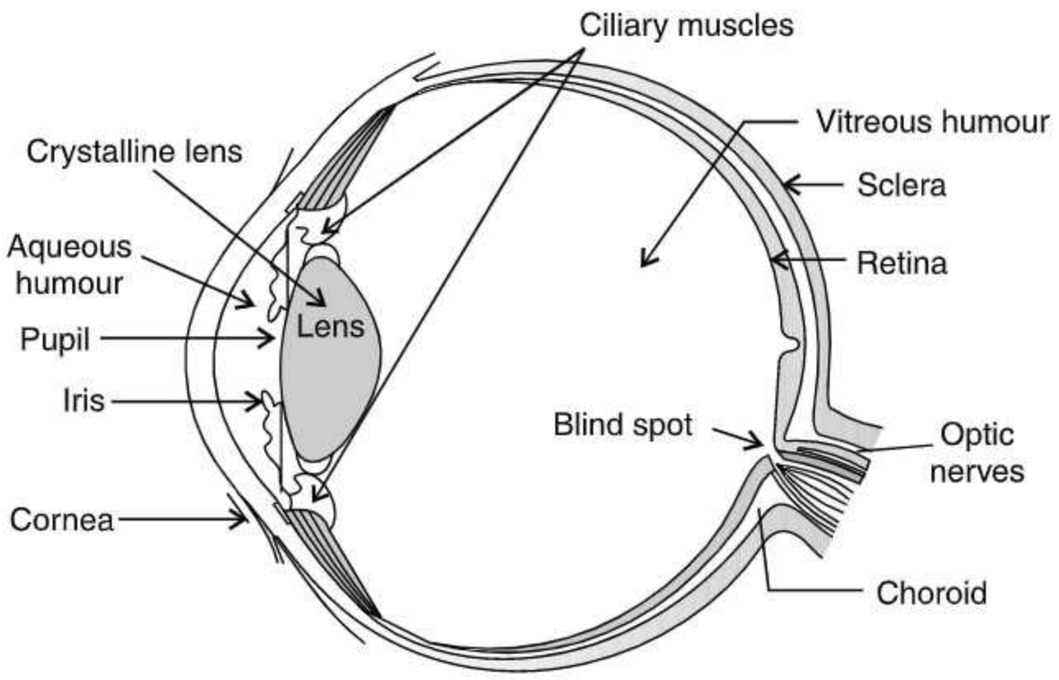
Reason of defect : Gradual weakening of ciliary muscles, thereby decreasing the flexibility of the eye lens.

Correction : Using Bifocal lens with appropriate power.

(d) Cataract : The image cannot be seen distinctly because eye lens become milky and cloudy. This condition is known as cataract, it can cause complete or partial loss of vision. This can be corrected by surgical removal of extra growth (cataract surgery).

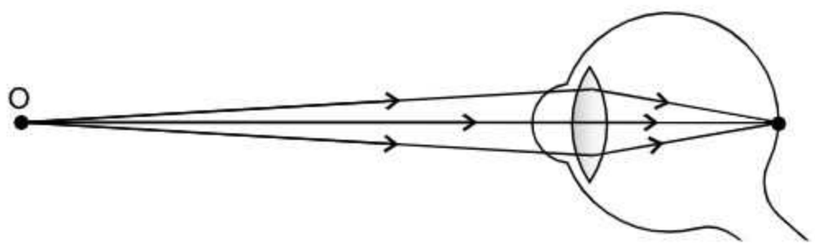
- **Refraction of light through glass prism :**
  - A glass prism has two triangular bases and three rectangular lateral surfaces which are inclined to each other.
  - The angle between two lateral surfaces of a prism is called angle of the prism.
  - **Angle of deviation :** It is the angle between the incident ray and emergent ray.
- The process of splitting up of white light into its constituent colour as it passes through a refracting medium is known as dispersion of light.
- The phenomenon of scattering of white light by colloidal particles is known as Tyndall effect.
- The sky appears blue due to atmospheric refraction and scattering of light.
- Rainbow is formed due to dispersion, refraction and total internal reflection of light.
- In the morning, the sunlight covers a larger distance from thick layers of atmosphere, so except the red colour light, most of the other colours are scattered into the atmosphere. As only red colour light reaches our eye, the morning Sun appears to be red.

- **Important Graphs and Diagrams :**
  - **The Human Eye :**

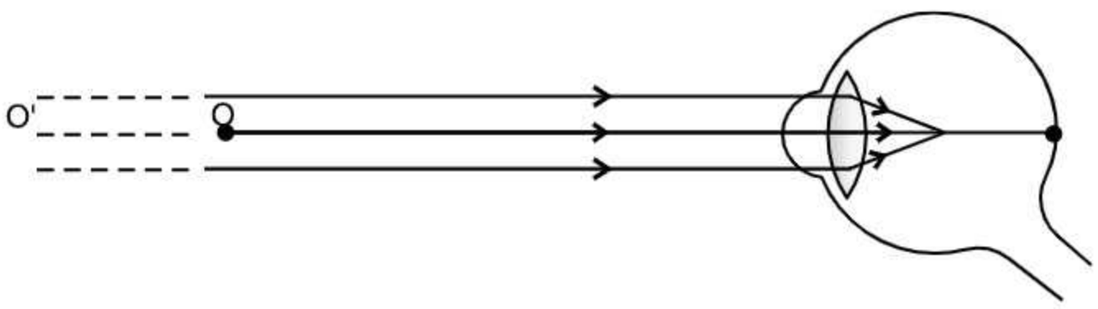


- **Myopia and its correction :**

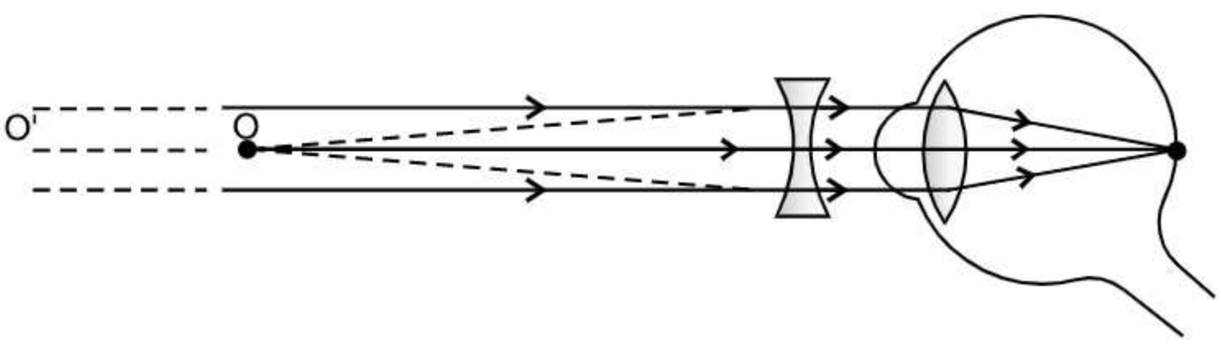
(a) Far point of a myopic eye :



(b) Myopic Eye :

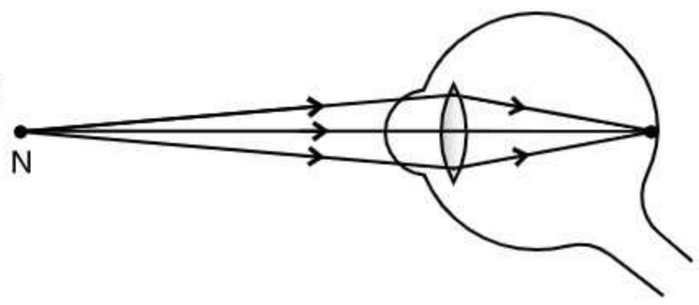


(c) Correction for myopia :

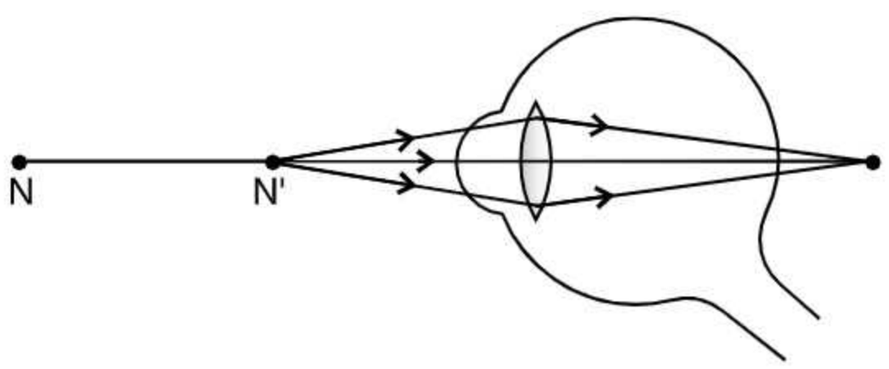


- **Hypermetropia and its correction :**

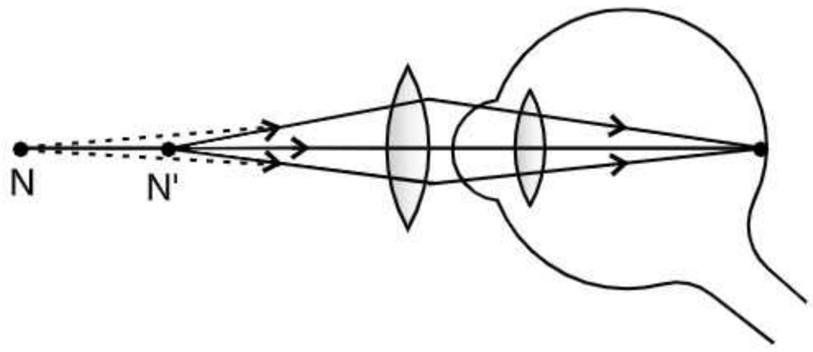
(a) Near point of a hypermetropic eye :



(b) Hypermetropic eye :

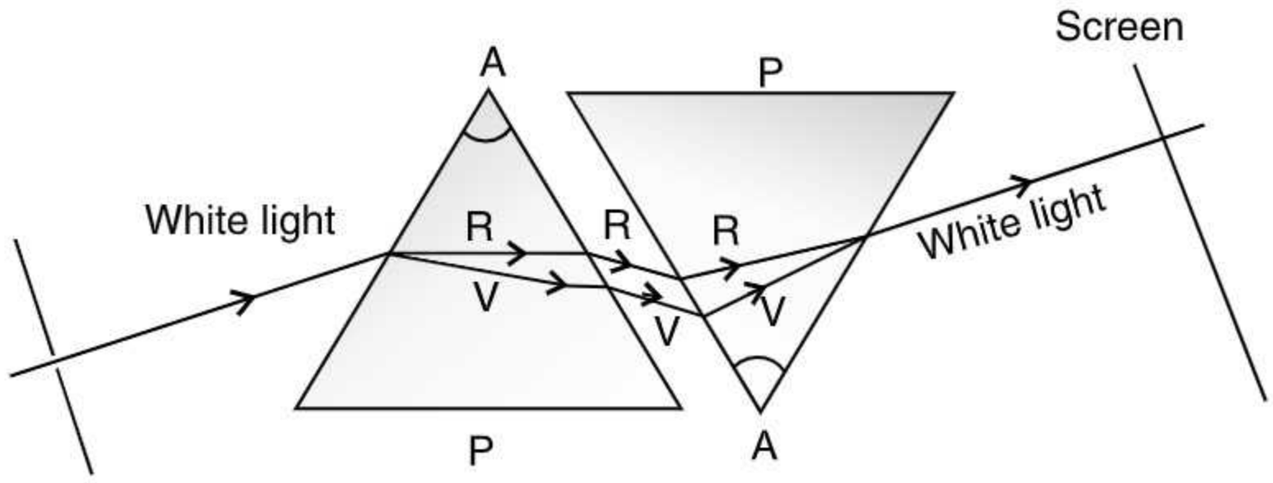


(c) Correction for hypermetropic eye :

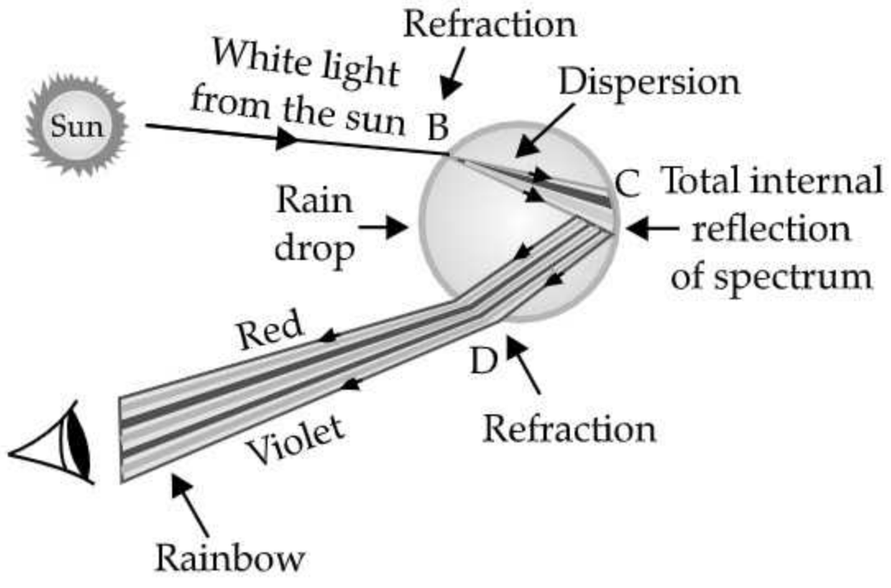


- **Refraction through a glass prism :**

- **Recombination of the spectrum of white light :**



- **Rainbow Formation :**



CHAPTER 12 : Electricity

Key Points and Concepts

- Electric current $= \dfrac{\text{Charge}}{\text{Time}}$ or $I = \dfrac{Q}{t}$
- Potential difference $= \dfrac{\text{Work done}}{\text{Charge}}$ or $V = \dfrac{W}{Q}$
- 1 volt $= \dfrac{1 \text{ Joule}}{1 \text{ Coulomb}}$ or $1\ V = \dfrac{1\ J}{1\ C}$
- **Ohm's law :** This law states that the current passing through a conductor is directly proportional to the potential difference across its ends, provided the physical conditions like temperature, density etc., remain unchanged.

  $$I \propto V \text{ or } I = \frac{1}{R} \times V \quad \text{or} \quad V = I\,R$$

  R is called resistance of the conductor.
- Resistance $= \dfrac{\text{Potential difference}}{\text{Current}}$ or $R = \dfrac{V}{I}$
- 1 ohm $= \dfrac{1 \text{ Volt}}{1 \text{ Ampere}}$ or $1\ \Omega = \dfrac{1\ V}{1\ A}$
- **Factors on which resistance of a conductor depends :** The resistance R of a conductor depends on its length L, area of cross-section A and the nature of its material. It is given by

  $$R = \rho \frac{L}{A}$$

  The proportionality constant ρ is called resistivity of the conductor.
- **Joule's law of Heating :** It states that the heat produced in a conductor is directly proportional to **(i)** the square of the current I through it, **(ii)** its resistance R and **(iii)** the time *t*, for which current is passed.

  Mathematically, it can be expressed as

  $$H = I^2Rt \text{ Joule} = \frac{I^2Rt}{4.18} \text{ cal}$$

  or
  $$H = VIt \text{ Joule} = \frac{VIt}{4.18} \text{ cal}$$

  $$P = \frac{W}{t} = VI = I^2R = \frac{V^2}{R}$$
- Electric Power Efficiency, $\eta = \dfrac{\text{Output power}}{\text{Input power}}$
- **Quantities and Units :**

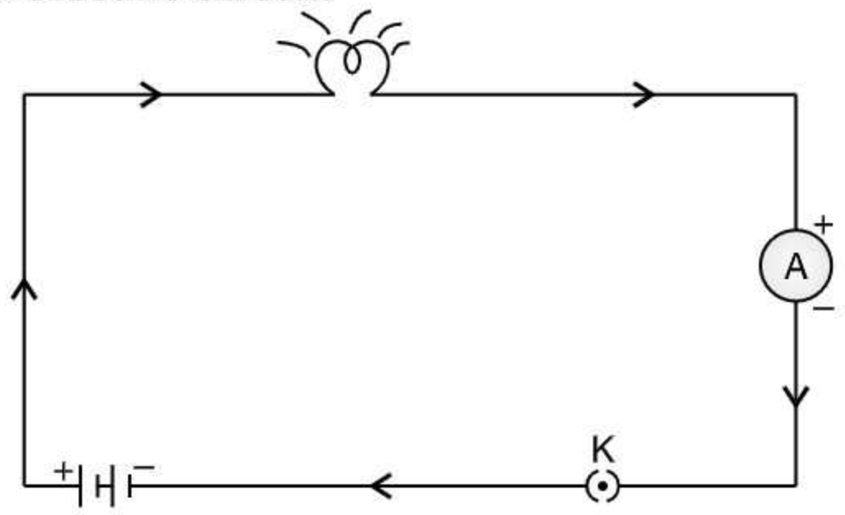
Quantities	S. I. Units
Charge	Coulomb
Electric Current	Ampere
Potential Difference	Volt
Resistance	Ohm
Resistivity	Ohm metre
Heat	Joule
Electric Power	Watt

➢ **Important Equations :**

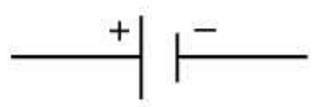
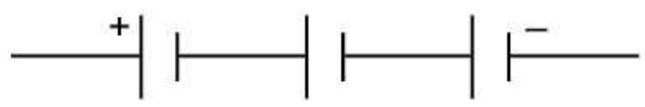
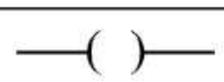
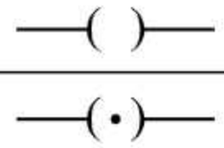
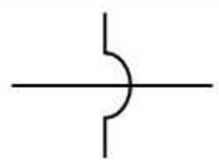
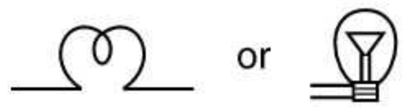
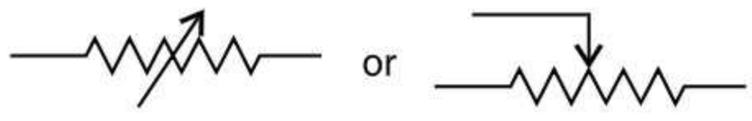
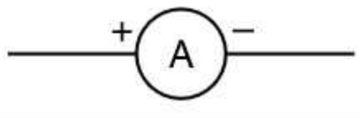
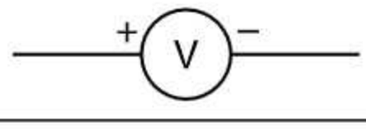
- Resistance in Series, $R_s = R_1 + R_2 + R_3 + ...$
- Resistance in parallel, $\frac{1}{R_P} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + ...$

➢ **Important Graphs and Diagrams :**

- **Schematic Diagram of an electric circuit**



➢ **Components of an electric circuit :**

S. No.	Components	Symbols
1.	An electric cell	
2.	A battery or a combination of cells	
3.	Plug key or switch (open)	
4.	Plug key or switch (closed)	
5.	A wire joint	
6.	Wires crossing without joining	
7.	Electric bulb	
8.	A resistor of resistance	
9.	Variable resistance or rheostat	
10.	Ammeter	
11.	Voltmeter	

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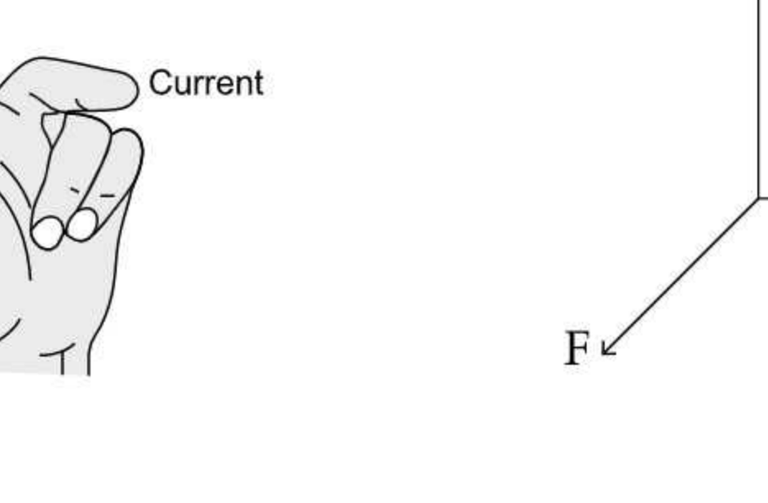
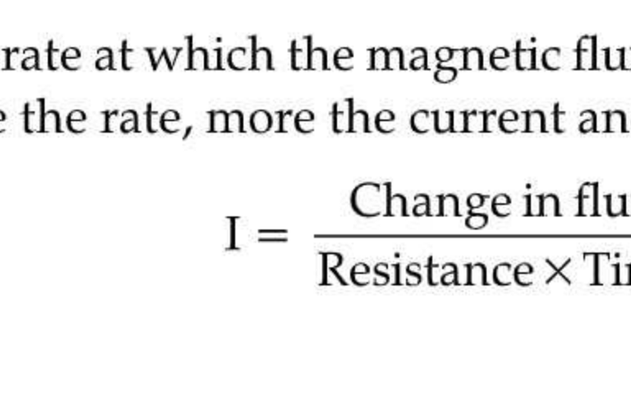
CHAPTER 13 : Magnetic Effects of Electric Current

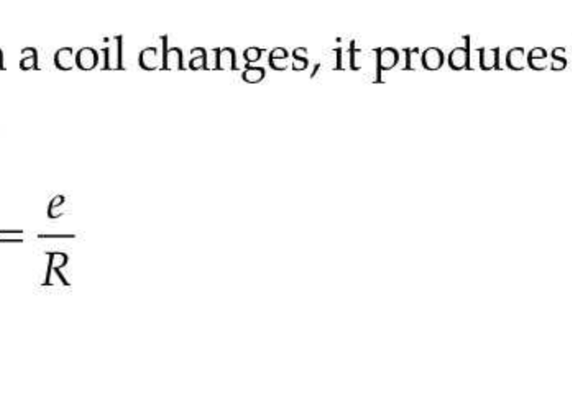
Key Points and Concepts

- **Magnetic field** is the region surrounding the magnet in which the force of the magnet can be detected.
- Magnetic field has both direction as well as magnitude.
- The direction of the magnetic field is taken to be the direction in which a north pole of the compass needle moves inside it.
- **Magnetic field line** is a path along which a hypothetical free north pole tend to move towards South Pole.
- When iron fillings are brought near the bar magnet, it gets influenced by the magnetic field of the bar magnet and arrange themselves in a pattern of curved lines called magnetic field lines.
- **Properties of magnetic field lines :**
  - Magnetic field lines are closed curves.
  - They emerges from North and merge into South Pole.
  - Inside the magnet, the direction of the field lines are from South to North Pole.
  - Magnetic field lines never intersect each other.
- **Electromagnet :** A strong magnetic field produced inside a solenoid can be used to magnetize a piece of magnetic material like soft iron. The magnet so formed is called an electromagnet. It is a temporary magnet.
- **Right Hand Thumb Rule :** Hold the wire carrying current in your right hand, such that the thumb indicates the direction of current, then the folded fingers will indicate the presence of magnetic field (lines) surrounding the wire.



- **Fleming's Left Hand Rule :** i, B and F are mutualy perpendicular





- **Faraday's Law :** The rate at which the magnetic flux linked with a coil changes, it produces the induced emf or current. More the rate, more the current and vice-versa.

$$I = \frac{\text{Change in flux}}{\text{Resistance} \times \text{Time}} = \frac{d\phi}{dt} \times \frac{1}{R} = \frac{e}{R}$$

➢ **Electric Motor and Generator :**

S. No.	Electric Motor	Generator
1.	Motor converts electrical energy into mechanical energy.	Converts mechanical energy to electrical energy.
2.	Works on the principle of Fleming's left hand rule.	Works on the principle of Fleming's right hand rule.

➢ **Galvanometer :** It is an instrument that can detect the presence of a current in a circuit. If pointer is at zero (the centre of scale), then there will be no flow of current. If the pointer deflect on either side right or left, this will show the direction of current.

➢ **Electric generator :** Electric generator works on the phenomenon of electromagnetic induction.

➢ There are two types of current : Alternating current (AC) and Direct current (DC).

➢ The difference between the direct and alternating current is that the direct current always flows in one direction, whereas the alternating current reverses its direction periodically.

➢ In India, the AC changes direction after every 1/100 second, that is, the frequency of AC is 50 Hz.

➢ **Advantages of Alternate Current (AC) over Direct Current (DC) :** Electric power can be transmitted to longer distances without much loss of energy. Therefore, cost of transmission is low.

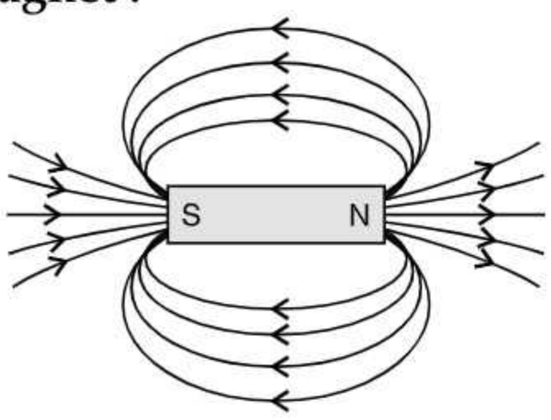
➢ **Domestic Electric Circuits :** In our homes, the electric power supplied is of potential difference V = 220 V and frequency 50 Hz.

➢ **Earth wire :** It provide a low resistance to the current hence any leakage of current to the metallic body of the appliances, keep its potential equal to that of Earth that means zero potential. Thus, the user is saved from severe electric shock.

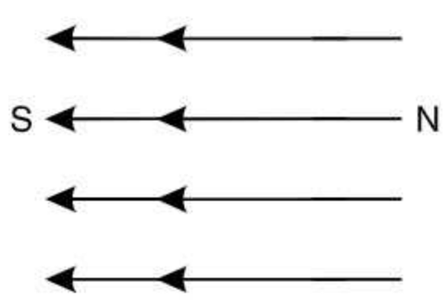
➢ **Fuse :** It is a safety device that can prevent the circuit from overloading and short circuiting.

➢ **Important Graphs and Diagrams :**

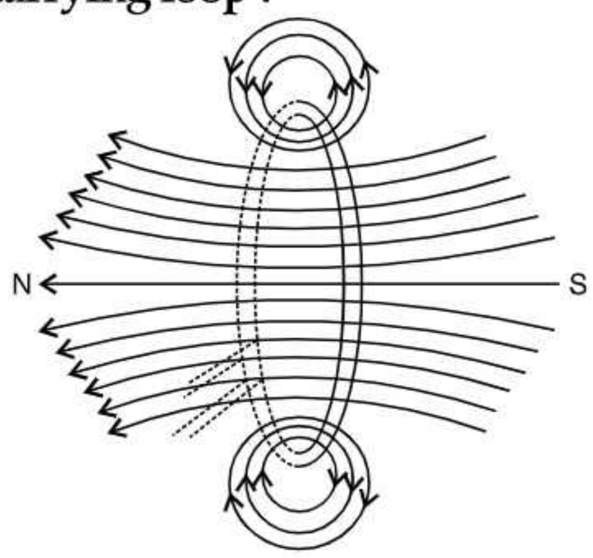
- **Magnetic Lines around a bar magnet :**



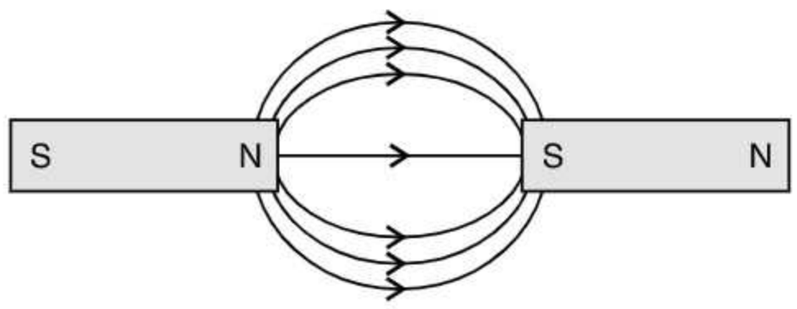
- **Uniform Magnetic Field :**



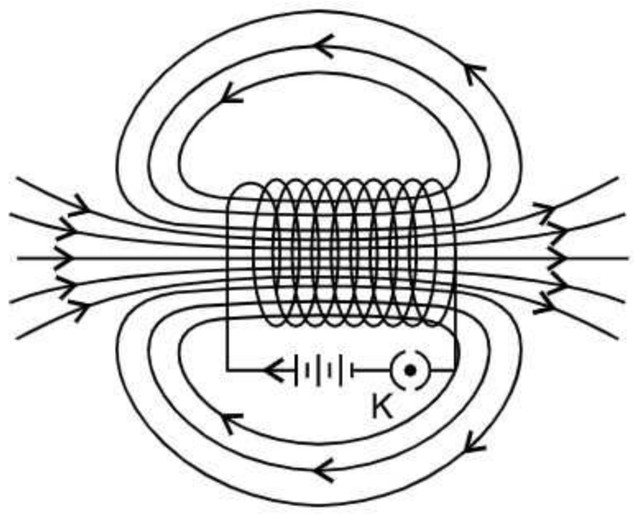
- **Magnetic Lines due to a current carrying loop :**



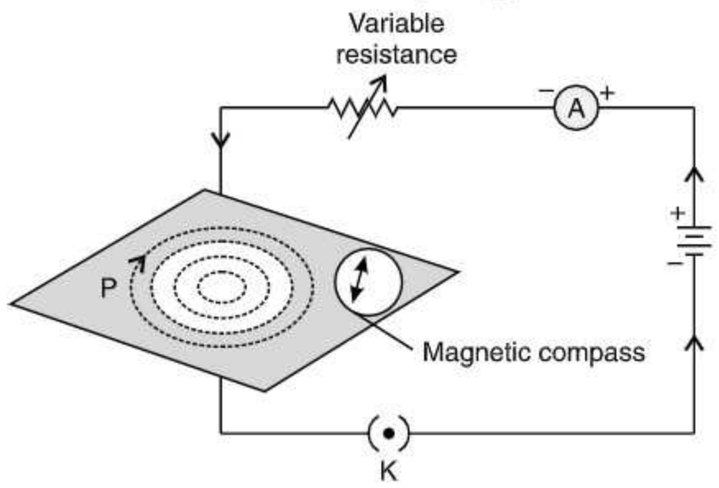
- **Magnetic Lines around two magnets :**



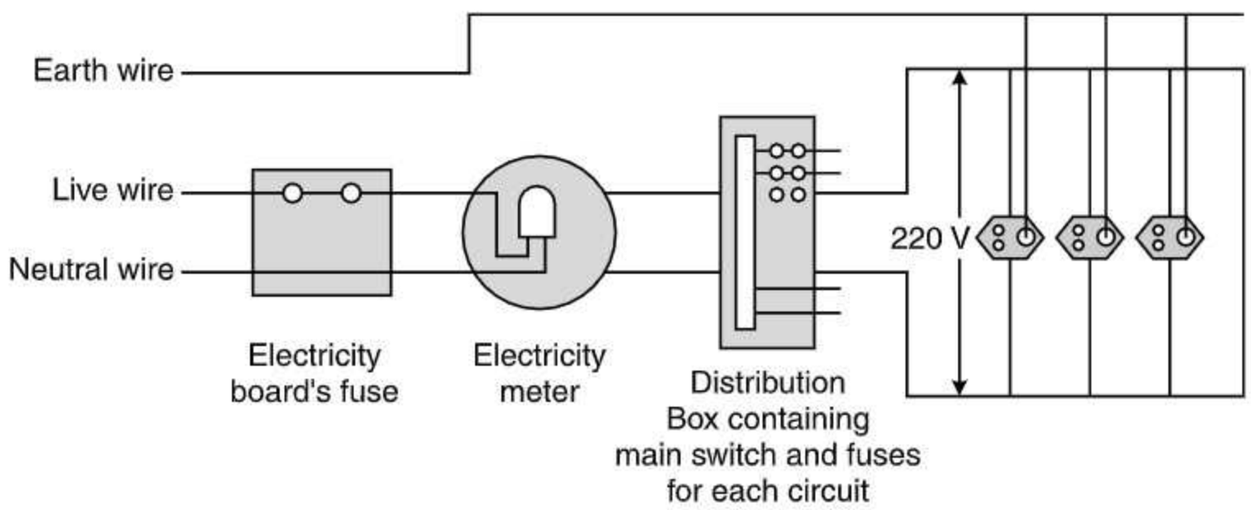
- **Magnetic field in a solenoid :**



- **Magnetic lines produced around a current carrying conductor :**



- Common Domestic Circuit :

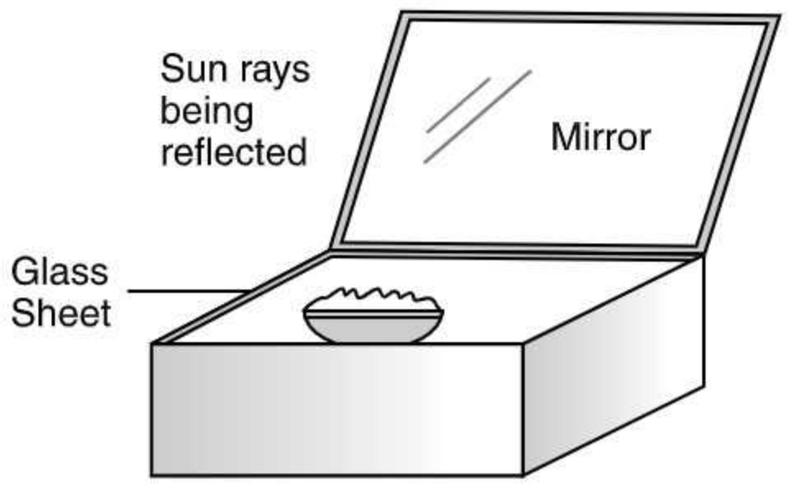


CHAPTER 14 : Sources of Energy

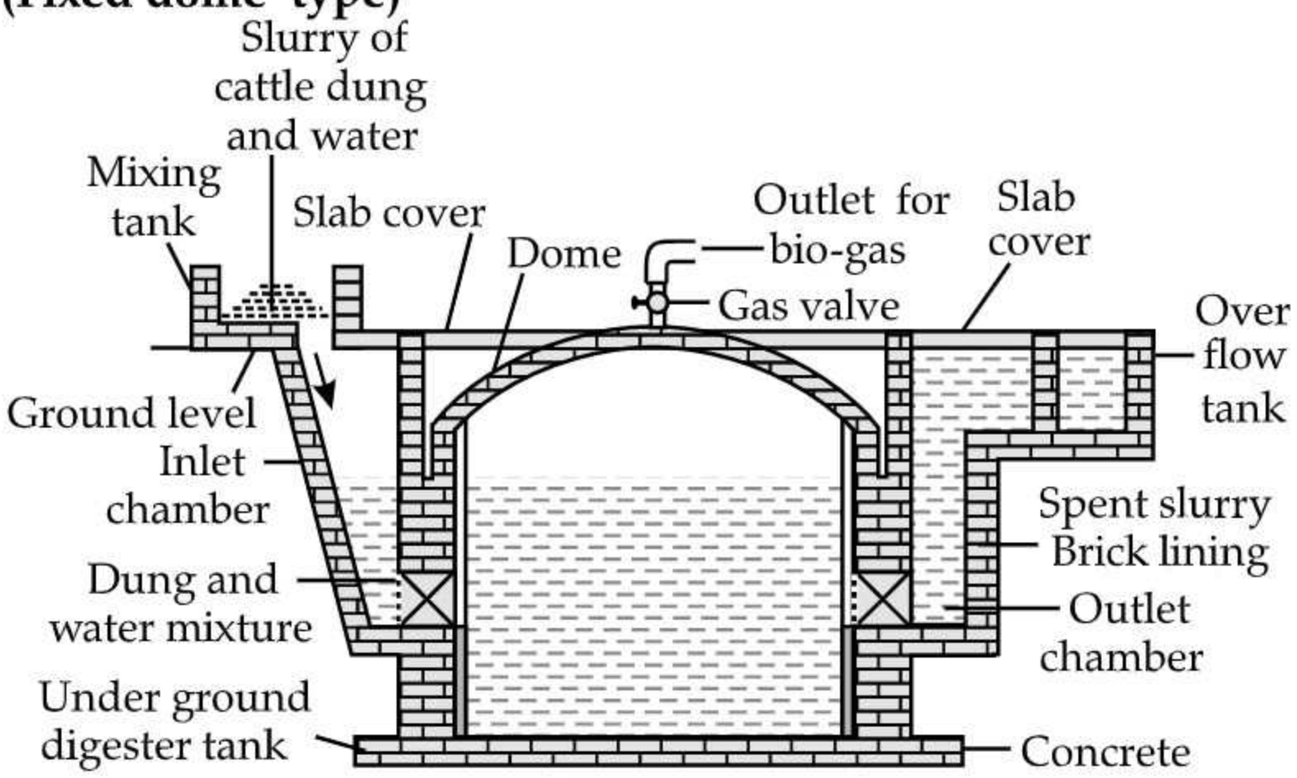
Key Points and Concepts

- **Law of conservation of energy :** Energy can neither be created nor be destroyed, but can be transformed from one form to another.
- Energy sources which are used traditionally from many years and are about to deplete over a period of time are called conventional or non-renewable sources. *e.g.*, Coal, Petroleum, Natural gas etc.
- Energy sources which do not deplete and are scarcely used by the population are called non-conventional or renewable sources of energy, *e.g.* Solar energy, Wind energy etc.
- A good source of energy will have high calorific value, is easily accessible, is easy to store and transport, and is economical and eco-friendly.
- **Biomass :** It is agricultural and animal wastes that can be used as a fuel. For example, firewood, cattle dung, sewage, dry leaves, stems.
- Charcoal is better fuel than wood because it does not contain water and other volatile material which are present in wood. Charcoal burns without smoke, flames and has high calorific value.
- Bio-gas is produced by anaerobic decomposition of the slurry (cow dung + water mixture) by microbes.
- Bio-gas is an excellent fuel and contains 75% of methane. It burns without smoke, leaves no residues like ash, with high heat capacity.
- Wind energy is eco-friendly, renewable source of energy. Wind mills can be established only at those places where wind speed is above 15 km/h.
- The energy emitted by the Sun in the form of heat and light is called solar energy. It is a renewable source of energy.
- A large number of devices like solar cooker, solar furnaces, solar cells and solar water heaters utilizes solar energy directly.
- Solar heating devices use black painted surface because black surface absorbs more heat as compared to white or other surface.
- **Solar cooker :** Solar cooker converts solar energy into heat.
- **Solar cell :** A solar cell is a device that converts solar energy into electrical energy. A large number of solar cells are combined in an arrangement called solar cell panel.
- Gallium and silicon are used to make solar cells. Silver is used for inter connection of cells.
- **Tidal energy :** It is the energy possessed by water during tides. Tidal energy is converted into electricity at the dam.
- **Ocean thermal energy :** The power plants used to harness the ocean thermal energy is known as "Ocean Thermal Energy Conversion Plant" (OTEC).
- **Geothermal energy :** Energy stored as heat inside the Earth is known as geothermal energy.
- **Nuclear energy :** Nuclear energy is the energy which is stored in the nucleus of an atom. It is obtained by two types of reactions : Nuclear fission and nuclear fusion.
- **Important Equations :**
  - **The flow of energy to run a turbine in power station is :**

    Fossil Fuels → Heat Energy → Mechanical Energy → Electrical Energy.
- **Important Diagrams :**
  - **Solar Cooker :**



- **Biogas Plant : (Fixed dome type)**



- **Hydroelectricity Generation :**