# 1.Effects of Electric Current

## FOCUS AREA

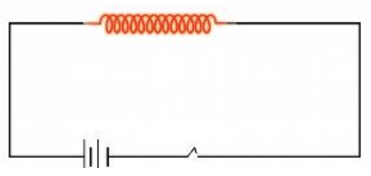
- Energy change in electrical devices
- Heating effect of electric current.
- Joule's Law & Mathematical problems related to these.
- Arrangement of Resistors in Circuits-Series Connection and Parallel Connection - Mathematical problems related to these.
- Electric heating appliances.
- Peculiarities of substances used as heating coil.
- Short circuit, Overloading.
- Working of Safety fuse.
- Peculiarities of substances used as fuse wire.
- Electric power & Mathematical problems related to these.

## 1. Energy change in electrical devices

| Device | Use | Energy change |
|---|---|---|
| Electric bulb | To get light | Electrical energy → Light energy |
| Induction cooker | To get heat | Electrical energy → Heat energy |
| Storage battery (while charging) | To store current | Electrical energy → Chemical energy |
| Mixer grinder | For grinding | Electrical energy → Mechanical energy |
| Electric Fan | To get breeze | Electrical energy → Mechanical energy |

## 2. Heating effect of electric current

* When electricity passes through any conductor, it generates heat energy.



### One volt

* The potential difference between two points will be one volt if one joule of work is done in moving one coulomb of charge from one point to the other.

### Joule Heating or Ohmic Heating.

* Heat is developed in a circuit on passing current through it is known as the Joule Heating or Ohmic Heating.

* What are the factors influencing the heat developed when a current passes through a conductor?

1. Intensity of electric current (I)
2. Resistance of the conductor (R)
3. The time of flow of current (t)

## 3. Joule's Law & Mathematical problems related to these.

The heat generated (H) in a current carrying conductor is directly proportional to the product of the square of the current (I) in the conductor, the resistance of the conductor (R) and the time (t) of flow of current.

$H \propto I^2 Rt$ $\therefore H = I^2 Rt$ joule

I is the current in ampere, R is the resistance in ohm and t is the time in second.

$H = I^2Rt$
$H = VIt$
$H = (V^2/R)\,t$

H - Heat energy
R - Resistance
V - Potential difference
I - Current
t - Time

Mathematical problems which are related to Joules Law.

1. How much will be the heat developed if 0.2 A current flows through a conductor of resistance 200 Ω for 5 minute?

Current I = 0.2 A
Resistance R = 200 Ω
Time t = 5 x 60 = 300 s
Heat H = ?

$H = I^2Rt$
$= (0.2)^2 \times 200 \times 300$
$= 2400$ J

* If 4.2 J is one calorie then H = 2400 / 4.2 = 571.4 calorie

2. Find out the heat developed in 3 minute by a device of resistance 920 Ω working under 230 V

Resistance R = 920 Ω
Voltage V = 230 V
Time t = 3 x 60 = 180 s
Heat H = ?

$H = (V^2/R)t$
$= (230^2/920) \times 180$
$= 10350$ J

Ohm's law R = V/I
I = V / R
= 230 / 920 = 0.25 A
H = ?

$H = I^2Rt$
$= (0.25)^2 \times 920 \times 180$
$= 10350$ J

3. Let's calculate the heat developed when 3 A current flows through an electric iron box designed to work under 230 V for half an hour?

Current $I = 3$ A
Voltage $V = 230$ V
Time $t = 30 \times 60 = 1800$ s

Heat $H = ?$

$$H = Vit$$
$$= 230 \times 3 \times 1800$$
$$= 1242000 \text{ J}$$

## 4. Arrangement of Resistors in Circuits-Series Connection and Parallel Connection - Mathematical problems related to these

### 1. Series Connection

When a circuit is completed by connecting the resistors one after the other, it is called series connection.

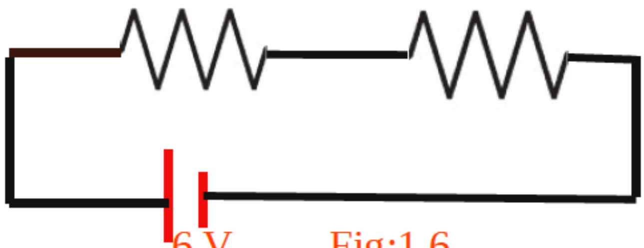


Fig:1.6

**Effective resistance, $R = R_1 + R_2$**

Effective resistance is the sum of the resistance of all the resistors when they are connected in series.

Ex. 1 ( Fig.1.6 )

$R_1 = 3\ \Omega$

$R_2 = 6\ \Omega$

Effective resistance, $R = R_1 + R_2$

$R = 3\ \Omega + 6\ \Omega$

$R = \underline{9\ \Omega}$

## When resistors are connected in series,

* The potential difference gets divided
* The current through each resistor will be the same.
* The effective resistance increases.

## 2. Parallel Connection

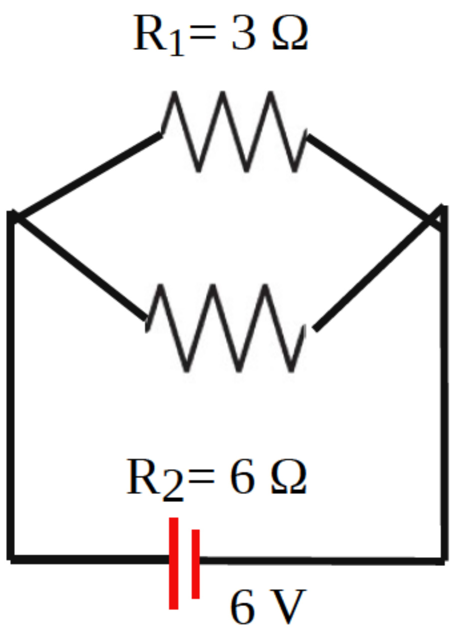



fig1.7

Effective resistance, $1/R = 1/R_1 + 1/R_2$

$$R = \frac{R_1 \times R_2}{R_1 + R_2}$$

Ex. 2 ( Fig.1.7 )

$R_1 = 3\ \Omega$

$R_2 = 6\ \Omega$

Effective resistance, $R = \frac{R_1 \times R_2}{R_1 + R_2}$

$$R = \frac{3\ \Omega \times 6\ \Omega}{3\ \Omega + 6\ \Omega}$$

$R = 2\ \Omega$

## When resistors are connected in Parallel,

* The potential difference in each resistors are same.
* Current through each resistors are different.
* The effective resistance decreases.

If resistors of the same value are connected in parallel, then $R = \frac{r}{n}$ , where n is the number of resistors and r is the resistance of one resistor.

## 5.Electric heating appliances

* Name the part in which electrical energy changes into heat energy.
  - Heating coils
* Which material is used to make this part?
- Nichrome(Nichrome is an alloy of nickel, chromium and iron)

## 6. Peculiarities of substances used as heating coil.

* What are the peculiarities of heating coil?
  - High resistivity
  - Ability to remain in red hot condition for a long time without getting oxidised
  - High melting point

## 7. Short circuit, Overloading.

### Short Circuit

If the positive and the negative terminals of a battery or the two wires from the mains come into contact without the presence of a resistance in between, they are said to be short-circuited.

### Overloading

A circuit is said to be overloaded if the total power of all the appliances connected to it is more than what the circuit can withstand.

## 8. Working of Safety fuse

Safety fuse is a device that works on the heating effect of electric current.

* Which material is used to make fuse wire?

- Fuse wire, an alloy of tin and lead,

* Which are the circumstances that cause high electric current, leading to the melting of fuse wire?

-Short Circuit and Overloading

* How is the fuse wire connected to a circuit?

- In series.

* How dose a fuse wire working?

When there is an overloading or short-circuit in the circuit.

↓

When electric current is increased.

↓

According to Joule s Law, more heat will be produced.

↓

The fuse wire melts.

↓

The circuit is broken

## 9. Peculiarities of substances used as fuse wire.

* What are the peculiarities of fuse wire?

-low melting point, More ductility.

* When a fuse wire is included in a household wiring, what are the precautions to be taken?

• The ends of the fuse wire must be connected firmly at appropriate points.

• The fuse wire should not project out of the carrier base.

## 10. Electric power & Mathematical problems related to these

* The amount of energy consumed by an electrical appliance in unit time is its power.
* The unit of power is watt (W)

$$\text{Power, } P = \frac{\text{Work}}{\text{time}} = \frac{H}{t}$$

$P = VI$

$P = I^2R$

$P = V^2/R$

## Amperage

* Amperage (A) is the ratio of the power of an equipment to the voltage applied. Amperage increases with the thickness of the conductor.

$$\text{Amperage} = \frac{\text{Wattage}}{\text{Voltage}} = \frac{W}{V}$$

1. An appliance of power 540 W is used in a branch circuit. If the voltage is 230 V, what is its amperage?

Power P = 540 W
Voltage V = 230 V
Amperage = Wattage / Voltage = W / V
Amperage = 540 / 230 = 2.34 A ≈ 2.4 A

2. A heating appliance has a resistance of 115 Ω. If 2 A current flows through it, what is the power of the appliance?

Resistance R = 115 Ω
Current I = 2 A
Power $P = I^2 R$
$= 2^2 \times 115 = 460$ W

3. A current of 0.4 A flows through an electric bulb working at 230 V. What is the power of the bulb?

Voltage V = 230 V
Current I = 0.4 A
Power P =VI
= 230 x 0.4 =92 W

4. Power of an electrical appliance is 1600 W. The device works at 400 V. If we give 200 V instead of 400 V. what is its power?

Power $P = 1600$ W
Voltage $V = 400$ V
Power $P = V^2 / R$
$R = V^2 / P = (400)^2 / 1600 = 100\ \Omega$

Power at 200V $= (200)^2 / 100 = 400$ W

* If voltage is decreased to half then power decreases to one fourth.

# 2.Magnetic Effects of Electric Current

## FOCUS AREA

- **The magnetic field around a current carrying conductor.**
- **Right Hand Thumb Rule**
- **The magnetic field around a Solenoid- Magnetic polarity.**
- **Factors affecting the strength of the magnetic field of a solenoid.**
- **Motor principle**
- **DC motor - Structure and working**
- **Moving coil loud speaker – Structure and working**

## 1. The magnetic field around a current carrying conductor.

### a. Conductor above the magnetic needle

| No. | Conductor above the magnetic needle | Direction of motion of North Pole (N) of the magnetic needle clockwise/anticlockwise |
|---|---|---|
| 1 | Direction of current from A to B | Anticlockwise |
| 2 | Direction of current from B to A | Clockwise |

### b. Conductor below the magnetic needle

| No. | Conductor below the magnetic needle | Direction of motion of North Pole (N) of the magnetic needle clockwise/anticlockwise |
|---|---|---|
| 1 | Direction of current from A to B | Clockwise |
| 2 | Direction of current from B to A | Anticlockwise |

1. What might be the reason for the deflection of the magnetic needle?
* A magnetic field is developed around a current carrying conductor. The magnetic needle is deflected as a result of the mutual action of this magnetic field and that around the magnetic needle.

2.What are the factors influencing the deflection of the magnetic needle?
* The direction of the current.
* The position of the conductor.

A magnetic field around a straight conductor

* A magnetic field is developed around a current carrying conductor.
* The shape of the magnetic field around it is circular.
* The direction of the magnetic field can be found out using
* The Right Hand Thumb Rule & * The Right Hand Screw Rule

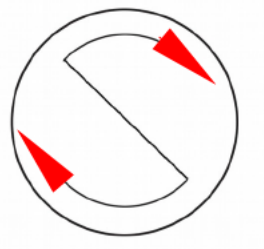
## 2. Right Hand Thumb Rule

* Imagine you are holding a current carrying conductor with the right hand in such a way, that the thumb points in the direction of the current. The direction in which the other fingers encircle the conductor gives the direction of the magnetic field.

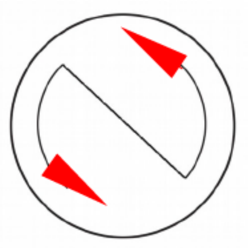
## 3. The magnetic field around a Solenoid- Magnetic polarity.

How we can recognise the direction of magnetic field and the polarity of a current carrying solenoid.

The end of the solenoid at which current flows in the clockwise direction will be the South Pole.



The end of the solenoid at which current flows in the anticlockwise direction will be the North Pole.



## 4. The factors affecting the strength of the magnetic field of a solenoid carrying current.

- Intensity of electric current.
- The number of turns of the solenoid.
- The area of cross section of the solenoid.
- The area of cross section of the soft iron core.

## 5. Motor principle

A conductor, which can move freely and which is kept in a magnetic field, experiences a force when current passes through it and it moves.

## 6. DC motor - Structure and working

Working principle : Motor principle

*The parts of an electric motor*

- *N,S - Magnetic poles*
- *XY - Axis of rotation of the motor*
- *ABCD - Armature*
- *B 1 , B 2 - Graphite brushes*
- *R 1 , R 2 - Split rings*

*Armature*

- *Armature is the metallic coil wound round a soft iron core so that it is free to rotate.*
- *It is fixed firmly on the axis XY.*
- *In the figure, are the forces acting on sides AB and CD in the same direction?*
  ** No*
- *Find out on the basis of Fleming's Left Hand Rule and write it down.*
  ** AB moves forward and CD moves backwards.*
- *What are the effects on the armature produced by forces thus developed?*
  ** Force produced are in the opposite direction. They are experiences on the different positions of same object. So it rotates.*

*Split ring Commutator*

- *If the rotation of the armature is to be sustained the direction of current through the armature should continuously keep on changing.*
- *The split rings help to change the direction of current through the coil after every half rotation.*
- *It is also called split ring commutator.*

*Working*

* A freely suspended, current carrying armature when kept in a magnetic field starts to move when current flow through it.
* What is the energy change in Electric Motor?

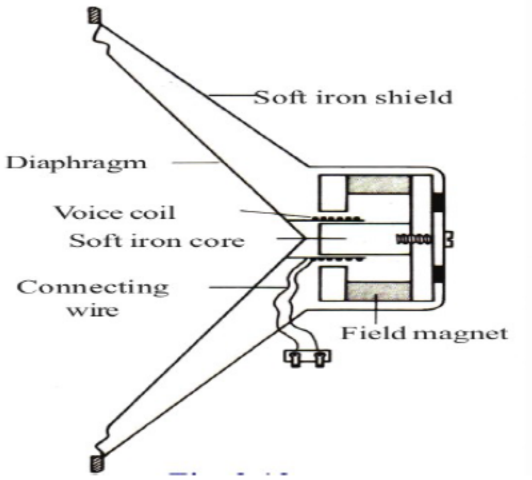
Electrical energy ⟶ Mechanical energy

## 7. Moving coil loud speaker – Structure and working

Working principle : Motor principle

The parts of a Moving coil loud speaker

- Voice coil
- Field magnet
- Diaphragm
- Soft iron core
- Connecting wire
- Soft iron shield




* Where is the voice coil situated?
- In the magnetic field

* To which part is the diaphragm connected?
- It is connected with the voice coil.

* From where does the electric current reach the voice coil?
- Current reaches from the amplifier.

* What happens when current is passed through the voice coil?
- It vibrates.

*<u>Working of a Moving coil loud speaker</u>*

*Strengthened electrical pulses reaches from the amplifier.*

↓

*Sent through the voice coil of a loudspeaker.*

↓

*The voice coil, moves to and fro rapidly, in accordance with the electrical pulses*

↓

*These movements make the diaphragm vibrate,*

↓

*Thereby reproducing sound.*

* *What is the energy change in Moving coil loud speaker?*

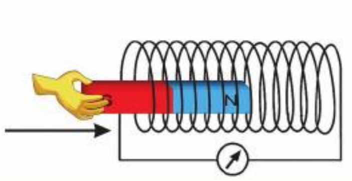
*Electrical energy* → *Mechanical energy*

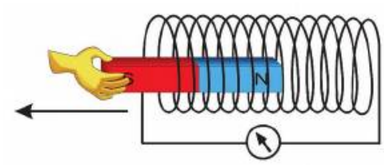
# 3. Electromagnetic Induction

Focus Area

1. Electromagnetic Induction, Factors affecting the induced emf
2. AC generator – Structure and Working
3. DC generator – Structure and Working
4. AC generator DC generator and Cell – Characteristics and graphical representation
5. Mutual Induction, Transformer - Structure and Working
6. Moving Coil Microphone
7. Power Transmission in high voltage
8. Electric Shock – Precautions and First aid

## 1. Electromagnetic Induction, Factors affecting the induced emf




| Sl. No. | Experimental procedure | Observation (Galvanometer needle) | |
|---|---|---|---|
| | | Deflects/ does not deflect | Direction to the left/ to the right |
| 1 | The magnet is stationary near the solenoid | Does not deflect | |
| 2 | North pole of the magnet is moved into the solenoid | Deflect | To the left |
| 3 | The magnet is stationary inside the solenoid | Does not deflect | |
| 4 | The magnet is moved out of the solenoid. | Deflect | To the right |
| 5 | The south pole of the magnet is moved into the solenoid | Deflect | To the right |
| 6 | Magnet and solenoid are moved in the same direction at the same speed | Does not deflect | |
| 7 | The solenoid is moved keeping the magnet stationary | Deflect | left or right |

Why did the galvanometer needle deflect in the experiment?
* Whenever there is a change in the magnetic flux linked with a coil, an emf is induced in the coil.

Which were the instances in which there was a flow of current through the solenoid?
* Whenever there is a relative motion between the magnet and the solenoid, there is flow of electricity.
* Whenever there is a change in the magnetic flux linked with a coil, an emf is induced in the coil. This phenomenon is electro-magnetic induction.

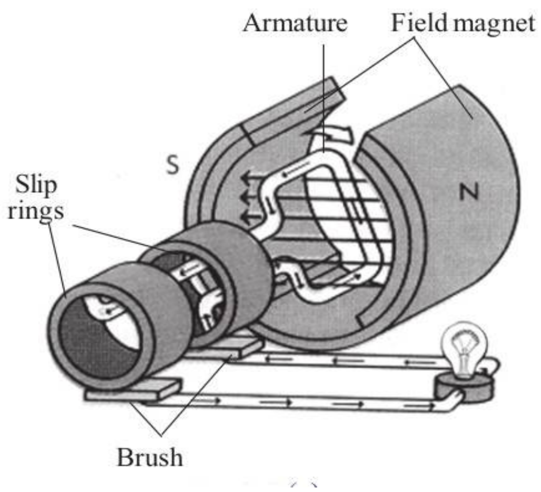
What may be the factors affecting the induced emf?

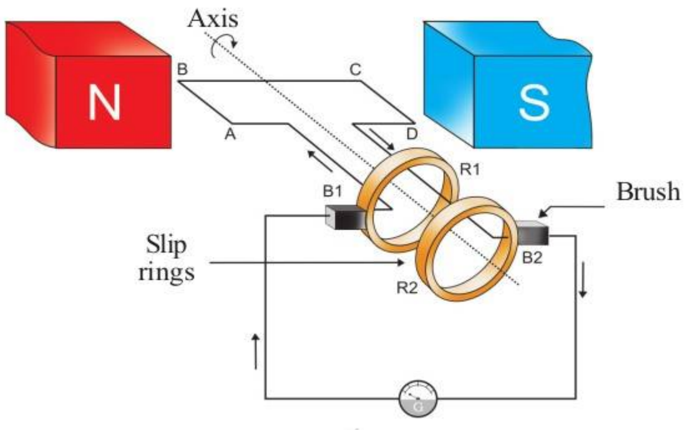
* Number of turns of the coiled conductor
* Strength of the magnet
* Movement of magnet and solenoid

## 2. AC generator – Structure and Working

Working principle : Electromagnetic Induction

Energy change : Mechanical Energy → Electrical Energy




### The main Parts of AC generator

* Field magnet (NS)

The magnet that creates magnetic flux in the generator.

* Armature (ABCD)
An arrangement of insulated conducting wire wound on a soft iron core. This can be made to rotate about an axis.

* Slip rings (R1,R2)
Metal rings which are welded together with the armature coil. They rotate along with the armature on the same axis of rotation as the armature

* Brushes(B1,B2)
They are arrangements which always make contact with the slip rings. Current flows through them to the external circuits.
* When the coil rotates about the axis in the clockwise direction, the portion AB moves upward and the portion CD moves downward.
Then according to the Fleming's Right Hand Rule . What is the direction of induced current in the portion AB?
* From A to B

What is the direction of induced current in the portion CD?
* From C to D

What is the direction of induced current in the coil ABCD?
* From A to D

What is the direction of induced current in the external circuit? (through the galvanometer)
* From B 2 to B 1

What will be the positions of AB and CD when the armature completes $180^0$ or one half rotation?
* AB will be near the south pole of the magnet and CD will be near the north pole.

At this instance, What is the direction of movement of AB?
* Downward
What is the direction of movement of CD?
* Upward
What is the direction of current in the armature?
* From D to A
What is the direction of current through the external circuit (through the galvanometer)?
* From B1 to B2

* The direction of current reverses during every half rotation of the armature and that the magnitude of current is increasing and decreasing.

## Stages of rotation of an armature coil while completing one rotation in a magnetic field

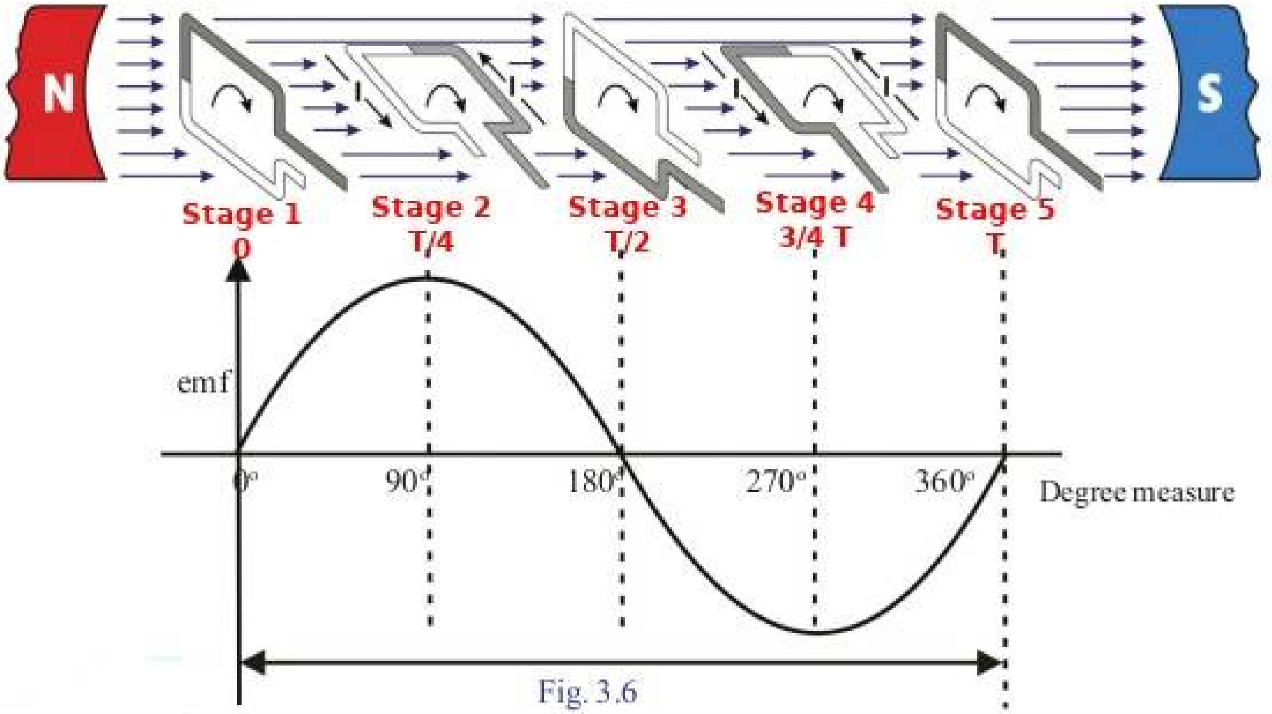


Fig. 3.6

### Stage 1 (angle of rotation 0 ,Time 0)

* The plane of armature coil is perpendicular to the direction of magnetic field.
* The rate of change of Flux is zero.
* Induced current in the coil is zero.

### Stage 2 (angle of rotation 90 ,Time T/4)

* The plane of armature coil is parallel to the direction of magnetic field.
* The rate of change of Flux is maximum.
* Induced current in the coil is maximum.

### Stage 3 (angle of rotation 180 ,Time T/2)

* The plane of armature coil is perpendicular to the direction of magnetic field.
* The rate of change of Flux is zero.
* Induced current in the coil is zero.

Stage 4 (angle of rotation 270 ,Time 3/4T)
* The plane of armature coil is parallel to the direction of magnetic field.
* The rate of change of Flux is maximum in the opposite direction.
* Induced current in the coil is maximum in the opposite direction.

Stage 5 (angle of rotation 360 ,Time T)
* The plane of armature coil is perpendicular to the direction of magnetic field.
* The rate of change of Flux is zero.
* Induced current in the coil is zero.

Period T
The time taken by the armature coil for a full rotation is called the period, T. Time taken for half rotation ($180^0$) is T/2.

The frequency of AC
* In an AC generator, the induced emf generated in the first half rotation in one direction and that generated in the second half rotation in the opposite direction together form the cycle of AC.

* The number of cycles per second is the frequency of AC.

* The frequency of AC generated for distribution in our country is 50 cycles per second or 50 Hz.

* If the frequency of AC is to be 50 Hz, the armature coil is to rotate fifty times per second. How to overcome this practical difficulties?
The number of rotations is reduced by increasing the number of armature coils and the number of pole pieces of the field magnet in a generator.

## 3. DC generator – Structure and Working

Working principle : Electromagnetic Induction

Energy change : Mechanical Energy → Electrical Energy

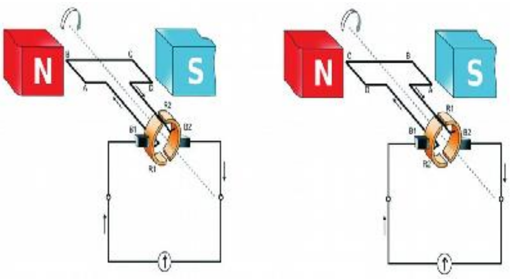
The main Parts of DC generator

* Field magnet (NS)

* Armature (ABCD)

* Split ring commutator (R1,R2)

* Brushes(B1,B2)



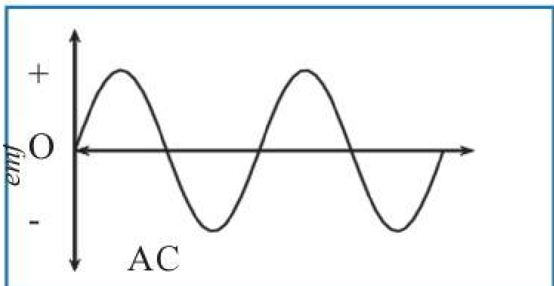
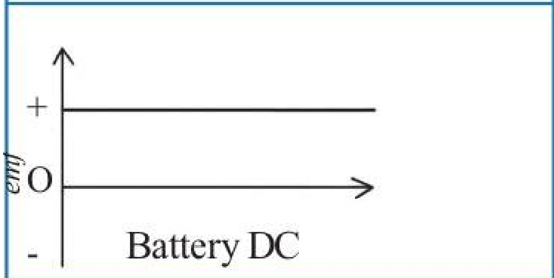
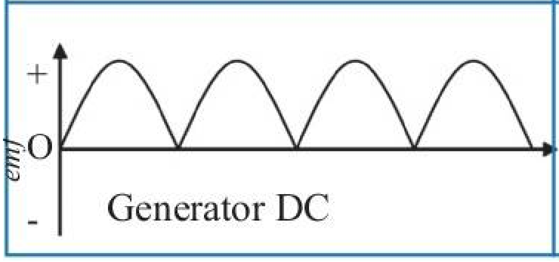
If split ring commutator is used in a generator instead of slip rings Though AC current is produced in a DC generator with the help of split ring commutator AC is converted into DC . The AC generated in the armature becomes DC in the external circuit as a result of the change in contact between the ring and the brush at each half-rotation of the armature

* What are the similarities between the DC motor and a DC generator?
Permanent magnet.
Armature
Brushes
Split rings

* Connect the output of a small DC generator to a galvanometer and rotate the armature continuously. How is the needle deflected?
* Same direction

Is the direction of current changing?
* No
Is the magnitude of current the same?
* No. Emf increases and decreases

## 4. AC generator , DC generator and Cell – Characteristics and graphical representation

| | |
|---|---|
|  | • Direction changes continuously<br>• **emf increases and decreases** |
|  | • **Direction constant**<br>• **emf constant** |
|  | • **Direction constant**<br>• emf increases and decreases. |

## 5. Mutual Induction, Transformer - Structure and Working

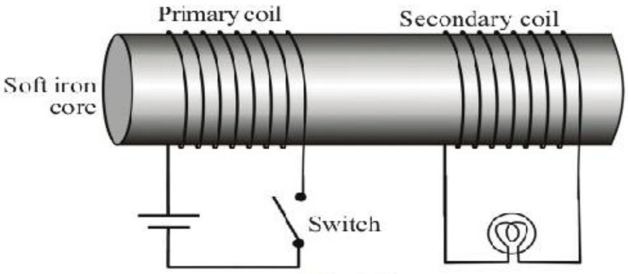



Fig. 3.8

1. Turn on & turn off the switch continuously. What do you observe?
* Bulb glows and then goes off

2. If the switch is kept in the on position what do you observe?
* Bulb does not glow

3. On what occasions do the flux change?
* Turn on & turn off the switch continuously.

4.What are the occasions when current flows through the second coil?
* When the switch in the first coil is kept on or off

* The coil into which we give current for the production of magnetic field is the primary coil and the coil in which induced emf is generated is the secondary coil.

5. Can you suggest a method by which change can be brought in magnetic flux without switching on and off continuously?
* If AC is given to the primary coil instead of DC, emf will be continuously induced in the secondary coil.

6. What is this phenomenon? Explain.
* Mutual induction

Consider two coils of wire kept side by side. When the strength or direction of the current in one coil changes, the magnetic flux around it changes. As a result, an emf is induced in the secondary coil. This phenomenon is the mutual induction

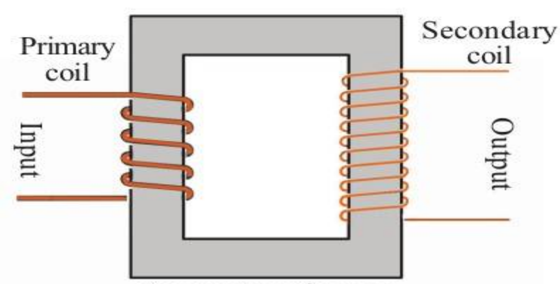
# *Transformer*

Working Principle : Mutual induction

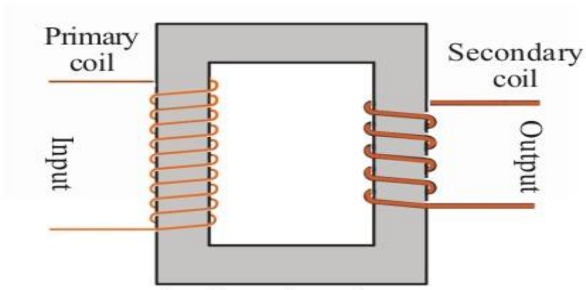
- Transformer is a device for increasing or decreasing the voltage of an AC without any change in the electric power.

- Transformers are of two types
  - Step up transformer
  - Step down transformer

## Difference between Step up transformer and Step down transformer



step up transformer



step down transformer

| Step up transformer | Step down transformer |
|---|---|
| Thick wires are used in the Primary. | Thick wires are used in the Secondary. |
| Less number of turns are used in the Primary | Less number of turns are used in the Secondary |
| Thin wires are used in the Secondary. | Thin wires are used in the Primary. |

- The emf in each turn of the primary and the secondary coils will be the same.
- Let the emf in one turn be ε

Then, the emf in the primary is $V_p = N_p \times \varepsilon$

The induced emf in the secondary is $V_s = N_s \times \varepsilon$

## The relation between the voltage and the number of turns of a transformer

- The voltage is directly proportional to the number of turns (The voltage increases as the number of turns increases and the voltage decreases as the number of turns decreases)

The primary voltage - Vp
The number of turns in the primary - Np
The secondary voltage - Vs
The number of turns in the secondary - Ns
Then

$$\frac{V_s}{V_p} = \frac{N_s}{N_p}$$

The relation between the voltage and the current of a transformer

- The voltage is indirectly proportional to the current (The voltage increases as the current decreases and the voltage decreases as the current increases)
- If there is no loss of power from a transformer
- The power in the primary and the secondary coils of a transformer is the same.

Power = Voltage x Current
Primary power, Vp x Ip = secondary power, Vs x Is

That is $$V_P \times I_P = V_S \times I_S$$

$$\therefore \frac{I_p}{I_s} = \frac{V_s}{V_p}$$

In a step up transformer the voltage in the secondary coil is more and the current is less. But in a step down transformer the secondary voltage is less and the current is more.

1. A transformer working on a 240 V AC supplies a voltage of 8 V to an electric bell in the circuit. The number of turns in the primary coil is 4800. Calculate the number of turns in the secondary coil.

The primary voltage  Vp = 240 V
The number of turns in the primary  Np = 4800 turns
The secondary voltage  Vs = 8 V
The number of turns in the secondary  Ns = ?

$$\frac{V_s}{V_p} = \frac{N_s}{N_p}$$

Ns = (Vs x Np) / Vp

= (8 x 4800) / 240

= 38400/240

Ns = 160 turns

2. The input voltage of a transformer is 240 V AC. There are 80 turns in the secondary coil and 800 turns in the primary. What is the output voltage of the transformer?

The primary voltage  Vp = 240 V
The number of turns in the primary  Np = 800 turns
The secondary voltage  Vs = ?
The number of turns in the secondary  Ns = 80 turns

$$\frac{V_s}{V_p} = \frac{N_s}{N_p}$$

Vs = (Ns x Vp) / Np
= (80 x 240) / 800
= 19200/800
Vs = 24 V

Examine the Table and answer the following questions.

| | Primary | | | Secondary | | |
|---|---|---|---|---|---|---|
| Transformer | Total voltage Vp | No. of turns Np | Voltage in one turn (ε) Vp/Np | Total voltage Vs | No. of turns Ns | Voltage in one turn (ε) Vs/Ns |
| T1 | 500 V | 100 | 5 V | 50 V | 10 | 5 V |
| T2 | 20 V | 10 | 2 V | 200 V | 100 | 2 V |
| T | N p × ε | Np | ε | N s × ε | Ns | ε |

1. What kind of transformers are T1 and T2 ?
   - ➔ T1 – Step down transformer
   - ➔ T2 – Step up transformer
2. What is the voltage in one turn when 500 V is given as input in T1 primary?
   - ➔ 5 V
3. Is there a change in one turn voltage of the same transformer when the output voltage decreases to 50 V?
   - ➔ No change
4. Is there a voltage change in each one turn of the primary and secondary in the step up transformer T2?
   - ➔ No change
5. How the ratio of voltages to the number of turns in each of the transformers, primary and secondary is related? Write this ratio in mathematical form.
   - ➔ The voltage is directly proportional to the number of turns

$$\frac{V_s}{V_p} = \frac{N_s}{N_p}$$

6. What could be the reason for using thicker wire windings in the primary of a step up transformer and the secondary of a step down transformer?
   - ➔ The primary and secondary power of a transformer will be equal. Therefore the current in the primary of the step up transformer and the secondary of the step down transformer will be higher. So thicker wires will be used to prevent the coil from overheating. Thicker wires have less resistance.

* In a transformer without any loss in power, there are 5000 turns in the primary and 250 turns in the secondary. The primary voltage is 120 V and the primary current is 0.1 A. Find the voltage and current in the secondary.

Primary voltage Vp = 120 V
No. of turns in the primary Np = 5000 turns
No. of turns in the secondary Ns = 250 turns
Primary current Ip = 0.1 A
Secondary voltage Vs = ?

Secondary current Is = ?

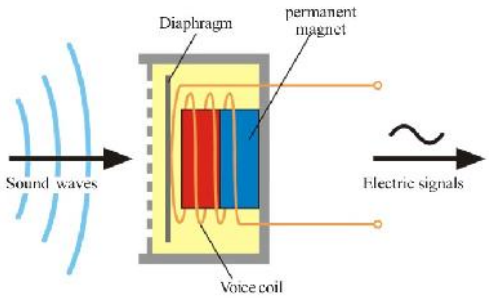
$$\frac{V_s}{V_p} = \frac{N_s}{N_p}$$

Secondary voltage Vs = (Ns x Vp)/Np
= (250 x 120)/5000
= 6 V

Vp x Ip = Vs x Is

Secondary current Is = (Vp x Ip)/Vs
= (120 x 0.1)/6
= 2 A

## 6. Moving Coil Microphone




* Working principle : Electromagnetic induction

* What is the energy transformation that takes place in a moving coil microphone?
  - Mechanical energy - Electrical energy.

* Which are the main parts of a moving coil microphone?
  - Diaphragm, Permanent magnet and voice coil.

* Which is the moving part in it?
  - Diaphragm and voice coil

* If a sound is produced in front of a movable diaphragm, what will happen to the diaphragm?
  - Diaphragm Vibrate corresponding to the sound signals.

* What happens to the voice coil then?
  - Vibrate

* What will be the result?
  - Creates electric signal corresponding to the sound

## The working of Moving coil microphone

When a sound is produced in front of a microphone

↓

The diaphragm connected to the voice coil vibrates in accordance with the sound waves falling on it

↓

As a result, electrical signals corresponding to the sound waves are generated in the voice coil.

↓

The weak signals obtained from the microphone are strengthened by an amplifier.

↓

The signals reaching the amplifier are strengthened and sent to the loud speaker.

↓

The loud speaker reproduces the original sound.

* Find out the similarities and differences between a moving coil microphone and a moving coil loud speaker

| | moving coil microphone | moving coil loud speaker |
|---|---|---|
| Similarities | Voice coil<br>Permanent magnetic<br>Diaphragm | Voice coil<br>Permanent magnetic<br>Diaphragm |
| Differences | Mechanical energy – Electrical energy | Electrical energy – Mechanical energy |
| | Electromagnetic induction | Motor Principle |

# 7. Power Transmission in high voltage

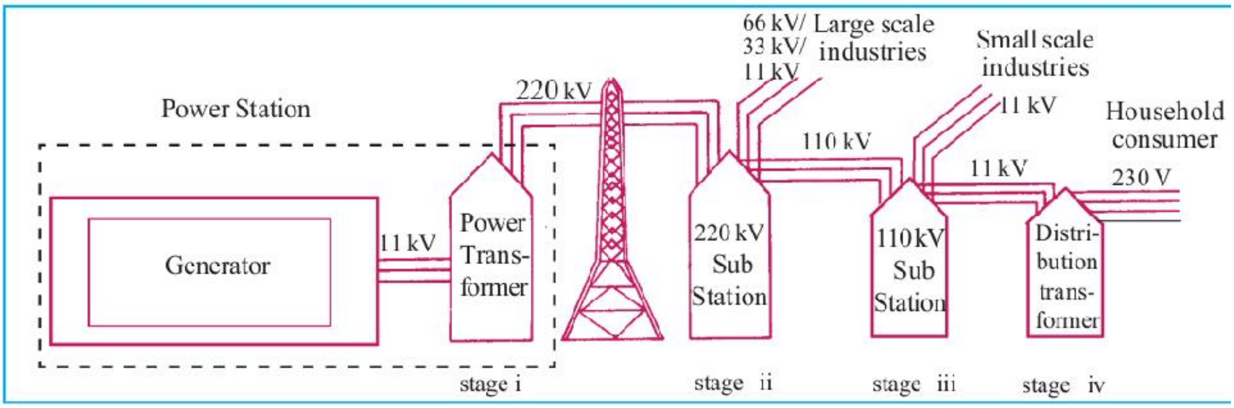
### Transmission loss.

- ➔ When electricity is transmitted to distant places there is loss of energy in the conductors in the form of heat. This is known as transmission loss.
- ➔ In India electricity is produced at 11 kV (11000 V) in power stations.

➔ What are the methods to reduce the heat generated?
Reduce current
Reduce Resistance
Reduce the time taken

➔ How can we reduce the current without change in power? Find out on the basis of the equation P = V×I.
By increasing the Voltage.

➔ What is the method to reduce the transmission loss?
The voltage is increased up to 220 kV at the power station itself (Depending on the distance to which the transmission is to be done, different voltages like 110 kV, 400 kV, are also made use of). As a result the current and loss of energy in the form of heat decreases.




Different stages of electric power transmission

➔ Which type of transformer is there in a power station?
Step up transformer

➔ Which type of transformer is there in a sub station?
Step down transformer

➔ Which type of transformer is a distribution transformer?
Step down transformer

➔ How many lines reach the distribution transformer?
3 lines (11 KV)

➔ How many lines go out of the distribution transformer?
4 lines (3 Phase line and 1 neutral line)

- What is the potential difference between 2 phase lines?
  400 V
- What is the potential difference between any one phase line and the neutral line?
  230 V
- What is the potential difference between the earth and the neutral line?
  0 V
- Which are the lines essential for household electrification?
  Phase line, Neutral line, and Earth line.
- If a person standing on the earth touches a phase line, will she get an electric shock? Why?

  The person will get an electric shock because there is a potential difference (230 V) between phase and earth.

## 8. Electric Shock – Precautions and First aid

* what are the precautions to be taken to avoid electric shock.?
Precautions

• Never handle electric equipments or operate switches when the hands are wet.

• Insert plug pins into socket and withdraw them only after switching off.

• Do not operate devices of high power using ordinary sockets.

• Wear rubber footwear while operating electric devices.

• Do not touch the interior parts of the cable TV adapters. Ensure that there is an insulated cap for the adapters.

• Do not fly kites near electric lines.

• Do not use table fan to dry hair.

• Ensure that there are no tall buildings or tall trees near electric lines.

• Ensure that the main switch and ELCB are switched off when maintenance work is being carried out at home.

## Precautions during some Special Circumstances

• During lightning, avoid doing any work that will bring you in contact with electric circuits. (There is a possibility of excess current in the circuit during lightning)

• Disconnect the plugs from the socket whenever there is a chance of lightning.

• During rain and wind, electric lines are likely to touch the ground. This may cause danger. We have to be cautious on such occasions.

• If water enters home due to floods or other reasons, disconnect electric connections. Reconnect it only after ensuring that the main switch and the switch board are perfectly dry.

## First aid to be given in the case of electric shock

* As a result of electric shock, the body temperature of the victim decreases, viscosity of blood increases and clotting of blood occurs. In addition, muscles of the body contract.

First aid should be given only after disconnecting the victim from the electric wire.

## How to provide the first aid:

• Raise the temperature of the body by massaging.

• Give artificial respiration.

• Massage the muscles and bring them to the original condition.

• Start first aid for the functioning of the heart (Apply pressure on the chest regularly)

• Take the person to the nearest hospital immediately.

”Saving electricity is equivalent to generating electricity”

# 4.Reflection of light

## Focus Area

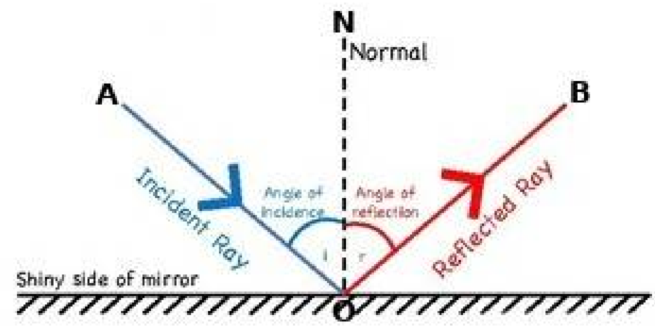
1. Reflection - laws of reflection.
2. Characteristics of image formed in concave mirror and convex mirror.
3. Mirror equation- related problems.
4. Magnification- related problems.
5. New cartesian sign convention.

## 1. Reflection - laws of reflection.

### Reflection of light

* Light falling on the surface of an object comes back to the same medium. This is reflection of light.

Laws of reflection




• Which is the incident ray?
AO
• Which is the reflected ray?
OB
• Is there any relation between the angle of incidence and the angle of reflection?
angle of incidence is equal to the angle of reflection
• Are the incident ray, reflected ray and normal to the mirror at the point of incidence in the different planes?
In the same plane

Laws of reflection

When light is reflected from a smooth surface, the angle of incidence and angle of reflection are equal. The incident ray, reflected ray and normal to the surface are in the same plane.

## 2.Characteristics of image formed in concave mirror and convex mirror.

| Plane mirror | Convex mirror | Concave mirror | |
|---|---|---|---|
| | | Position of object | Position of image and features |
| Image is behind the mirror. Distance of object from the mirror and distance of the image from the mirror are equal. The image is virtual, erect and is of the same size as that of the object. | Image is formed In between the pole of the mirror and the principal focus. The image is diminished, virtual and erect. | At infinity | At focus, Small, real, inverted |
| | | Beyond C | Between F and C, small, real, inverted |
| | | At C | At C, Same size as object, real, inverted |
| | | Between C and F | Beyond C, Big, real, inverted |
| | | At F | At infinity |
| | | Between F and P | At behind the mirror, Very large, virtual, Erect |

Situations in daily life where we can make use of these mirrors

| Mirror | Inferences (Position of image and features) | Situations making use of them |
|---|---|---|
| Plane mirror | The image is behind the mirror. Distance to object and distance to image from the mirror are the same. The image is virtual, erect and is of the same size as that of the object. | For observing the face. |
| Convex mirror | Image is always formed in between the pole of the mirror and the principal focus. The image is diminished, virtual and erect. | Used as rear view mirror |
| Concave mirror | Converges distant rays to the principal focus. | Used as solar concentrators |
| Concave mirror | Reflects the rays coming from principal focus as parallel rays. | Used as head light of car ( As reflector) |
| Concave mirror | For the object placed between principal focus and pole, the images formed are enlarged and erect. | Used as shaving mirror. Dentist |

## 3. Mirror equation- related problems.

Mirror Equation and Focal Length

The distance of the object from the mirror = u
The distance to the image from the mirror = v
The focal length of the mirror = f

$$1/f = 1/u + 1/v$$

This is known as mirror equation

$$1/f = 1/u + 1/v$$
$$= (u + v) / uv$$

$$f = uv/(u+v)$$

$$1/u = 1/f - 1/v$$
$$= (v – f)/vf$$

$$u = vf/(v-f)$$

$$1/v = 1/f – 1/u$$
$$= (u – f)/uf$$
$$v = uf/(u-f)$$

1. When an object is placed in front of a concave mirror at a distance 30 cm from an image is obtained on a screen at a distance of 20 cm from the mirror. Find the focal length of the mirror.

The distance of the object from the mirror u = - 30 cm
The distance to the image from the mirror v = - 20 cm
The focal length of the mirror f = ?

$$f = uv/(u+v)$$
$$= (-30 \times -20) / (-30 -20)$$
$$= (600) / (-50)$$
$$f = - 12 \text{ cm}$$

2. An object is placed in front of a concave mirror 20 cm away from it. If its focal length is 40 cm, locate the position of image and its nature

The distance of the object from the mirror u = - 20 cm

The distance to the image from the mirror v = ?
The focal length of the mirror f = - 40 cm

$$v = uf/(u-f)$$
$$= (-20 \times -40) / (-20 + 40)$$
$$= (800) / (20)$$
$$v = 40 \text{ cm}$$

Nature of the image - erect and virtual

3. When an object is placed in front of a concave mirror at a distance 15 cm an image is formed on a screen 10 cm away from the mirror. If the object is placed 30 cm away what is the distance to the image?

The distance of the object from the mirror u = - 15 cm
The distance to the image from the mirror v = - 10 cm
The focal length of the mirror f = ?

$$f = uv/(u+v)$$
$$= (-15 \times -10) / (-15 - 10)$$
$$= (150) / (-25)$$
$$f = -6 \text{ cm}$$

The distance of the object from the mirror u = - 30 cm
The distance to the image from the mirror v = ?
The focal length of the mirror f = - 6 cm

$$v = uf/(u-f)$$
$$= (-30 \times -6) / (-30 + 6)$$
$$= (180) / (-24)$$
$$v = -7.5 \text{ cm}$$

Nature of the image - real and inverted

## 4. New Cartesian Sign Convention

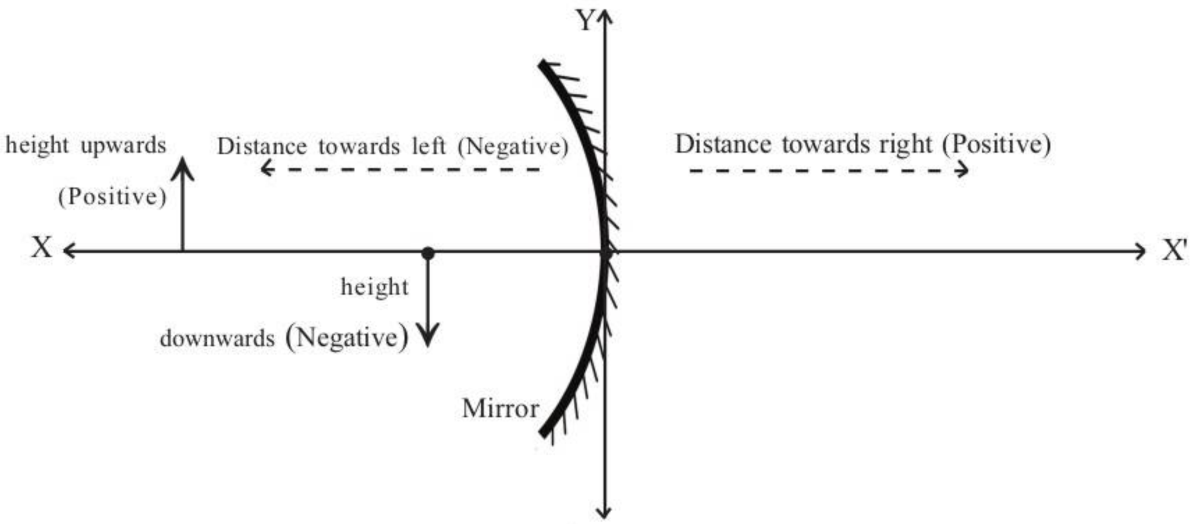
In all experiments related to lenses and mirrors the distances are measured in the same way as in graphs.

- Distances are measured considering the Pole of the mirror as the origin (O).

- Those measured to the right from O are positive and those in the opposite direction are negative.

• Distances measured upwards from X axis are positive and those downwards are negative. The incident ray is to be considered as travelling from left to right.

Record the measurements shown in the figure using the New Cartesian Sign Convention.



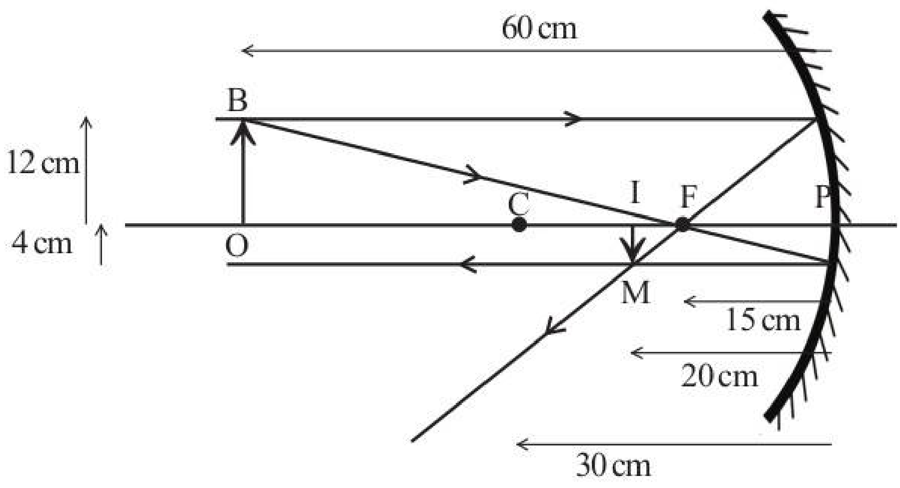

Distance to the object from the mirror (u) = Negative

Distance to the image from the mirror (v) = Negative

Height of object (OB) = Positive

Height of image (IM) = Negative

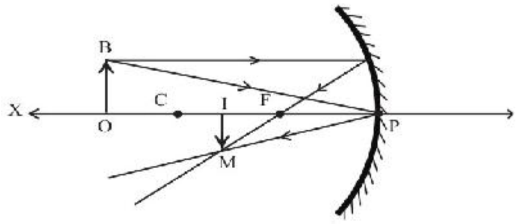
The given figure shows the image formation by a concave mirror. Analyse the figure and write down different measures using New Cartesian Sign Convention.



| | |
|---|---|
| Distance of object from the mirror, (u) | -60 cm |
| Distance of image from the mirror, (v) | -20 cm |
| Focal length (f) | -15 cm |
| Radius of curvature (r) | -30 cm |
| Height of object (OB) | +12 cm |
| Height of image (IM) | -4 cm |

## 5. Magnification- related problems.

Magnification is the ratio of height of the image to the height of the object. It is the number that indicates how many times the size of the object is the size of the image.




The figure shows the image formation when an object is placed beyond the centre of curvature C. The ray parallel and close to the principal axis has been considered. In the figure OBP and IMP are similar triangles according to the concept of similarity. Let s write down the ratio of corresponding sides of similar triangles.

IM/IP =OB/OP

In the figure, IM = $h_i$ , OB = $h_o$ , IP = v, OP = u. On substituting in the above equation we get $h_i / h_o = v/u$. On writing this equation in accordance with the New Cartesian Sign Convention we get

$h_o$ = positive , $h_i$ = negative, u = negative, v = negative.

that is $-h_i / h_o = -v/-u$

$-h_i / h_o = v/u$

But $m = h_i / h_o$

Hence $m = h_i / h_o = -v/u$

Magnification is $m = h_i / h_o = -v/u$

Height of the object = $h_o$
Height of the image = $h_i$
Position of the object = u
Position of the image = v
Magnification is $m = h_i / h_o = -v/u$

1. When an object of height 6 cm is placed in front of a concave mirror at a distance 10 cm away from it , an image is obtained 16 cm away, on the same side. Find out the height of image and magnification.

Distance to object $u = -10$ cm
Distance to image $v = -16$ cm
Height of object $h_o = +6$ cm
Height of image $h_i = ?$
Magnification is $m = -v/u$

$$m = -(-16/-10)$$
$$= -1.6$$

Magnification is $m = h_i / h_o$

$$h_i = m \times h_o$$

Height of image $h_i = -1.6 \times 6 = -9.6$ cm

Nature of the image - Real and inverted

Features of an image that is obtained from magnification

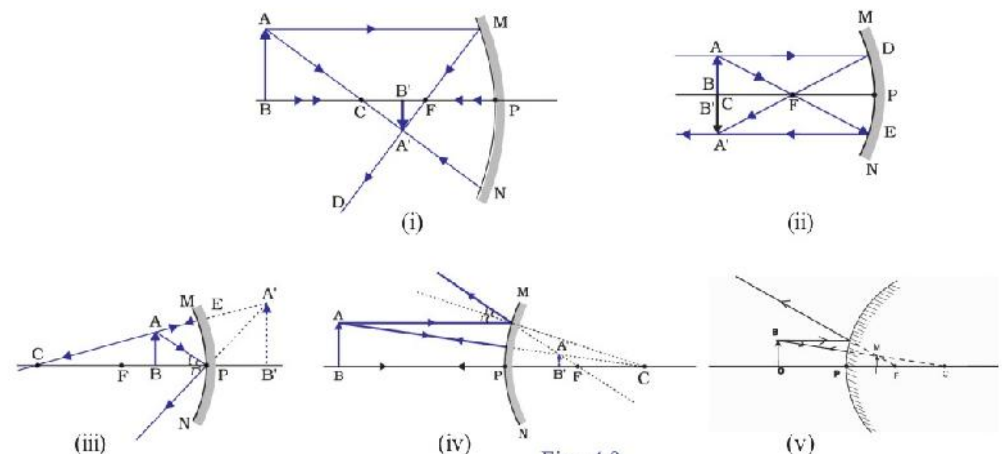


Fig. 4.9

| Fig | $h_i$ | $h_o$ | Magnification $m = \frac{h_i}{h_o}$ | Erect, virtual/ inverted, real | Size is same as that of the object/ magnified / diminished |
|---|---|---|---|---|---|
| Fig 1 | Negative | Positive | Negative | inverted, real | diminished |
| Fig 2 | Negative | Positive | Negative | Inverted,real | Same as that of object |
| Fig 3 | Positive | Positive | Positive | Erect,Virtual | Magnified (bigger than object) |
| Fig 4 | Positive | Positive | Positive | Erect,Virtual | Diminished (smaller than object) |
| Fig 5 | Positive | Positive | Positive | Erect,Virtual | Diminished (smaller than object) |

1. What are the features of an image that is obtained from magnification?

- When magnification is 1, the size of the image and the size of the object are equal.
- When magnification is more than 1, the size of the image is greater than the size of the object.
- When magnification is less than 1, the size of the image is smaller than the size of the object.
- When the magnification is positive, image is virtual and erect.
- When the magnification is negative, image is real and inverted.

2. From the above table, find out which mirror always gives an erect and diminished image and write it down.

- The image formed by a convex mirror is always erect and diminished.

3. Why it is written on rear view mirrors that “Objects in the mirror are closer than they appear”

- The image formed by a convex mirror is always erect and diminished. Hence the driver who sees the image of vehicles on the mirror develops a feeling that the vehicles coming from behind are at a greater distance. This may turn out to be dangerous.

# 5.Refraction of Light

**Focus area**

1. Relation between Speed of light and optical density
2. Refraction of Light
3. Refraction in different Media
4. Total Internal Reflection
5. Lenses -technical terms - image formation -ray diagrams - characteristics of image- power of lens.

## 1. Relation between Speed of light and optical density

| Medium | Speed of light (m/s) |
|---|---|
| Vacuum | $3\times10^8$ m/s |
| Water | $2.25\times10^8$ m/s |
| Glass | $2\times10^8$ m/s (*approximately*) |
| Diamond | $1.25\times10^8$ m/s |

* The speed of light through various media differs.

The characteristics of each medium influence the speed of light that passes through the respective medium. Optical density is a measure that shows how a medium influences the speed of light passing through it.

* As the optical density of a medium increases, the speed of light through it decreases and vis-versa.

* Can the media given in the table be arranged in the increasing order of their optical densities?

decreases ◄—— Optical density ——► increases

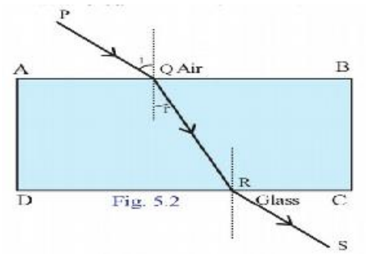
Air < Water < Glass < Diamond

increases ◄—— Speed of light ——► decreases

## 2. Refraction of Light

It is the difference in the optical densities that causes the deviation. When a ray of light entering obliquely from one transparent medium to another, its path undergoes a deviation at the surface of separation. This is refraction.

### 3. Refraction in different Media




• Which is the incident ray on the surface of separation CD?
* QR
• The angle between the incident ray and the normal is called the angle of incidence. If so, can you explain what is angle of refraction?
* The angle between the refracted ray and the normal
• Using a protractor measure the angle of incidence and the angle of refraction.
* Angle of incidence i = $45^0$ , Angle of refraction r = $28^0$
• Is the angle of refraction greater or lower than the angle of incidence when it goes from air to glass?
* Lower
• What about from glass to air?
* grater
• Which is of greater optical density air or glass?
* Glass
• While going from air to glass,(from a medium of lower optical density to that of a greater one) the refracted ray deviates towards the normal/ deviates away from the normal.
* Deviates towards the normal

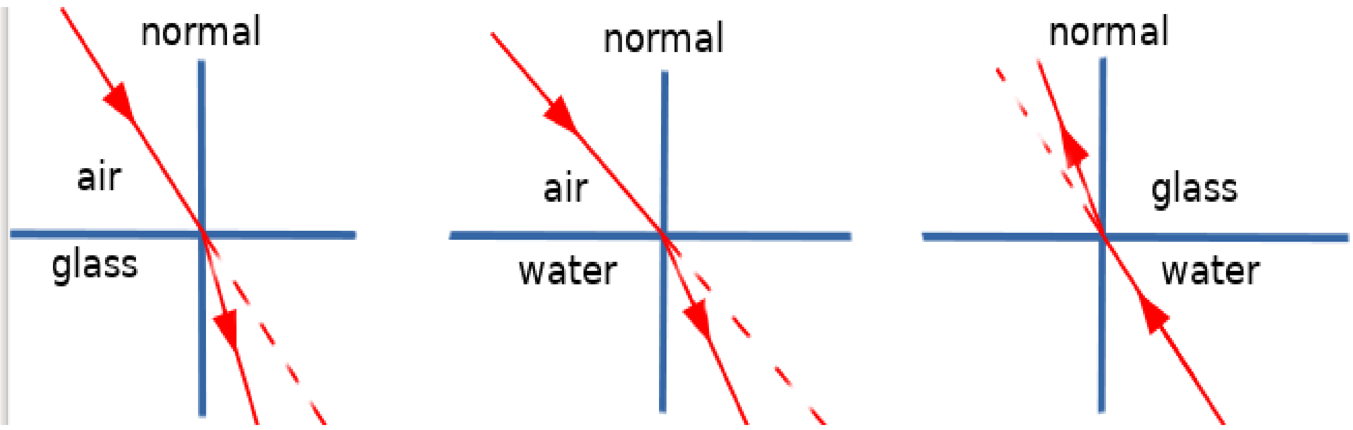
• What happens while it goes from glass to air(from a medium of greater optical density to that of a lower one)?
* Deviates away from the normal.

• Are the angle of incidence, angle of refraction and the normal at the point of incidence on the same plane?
* Yes

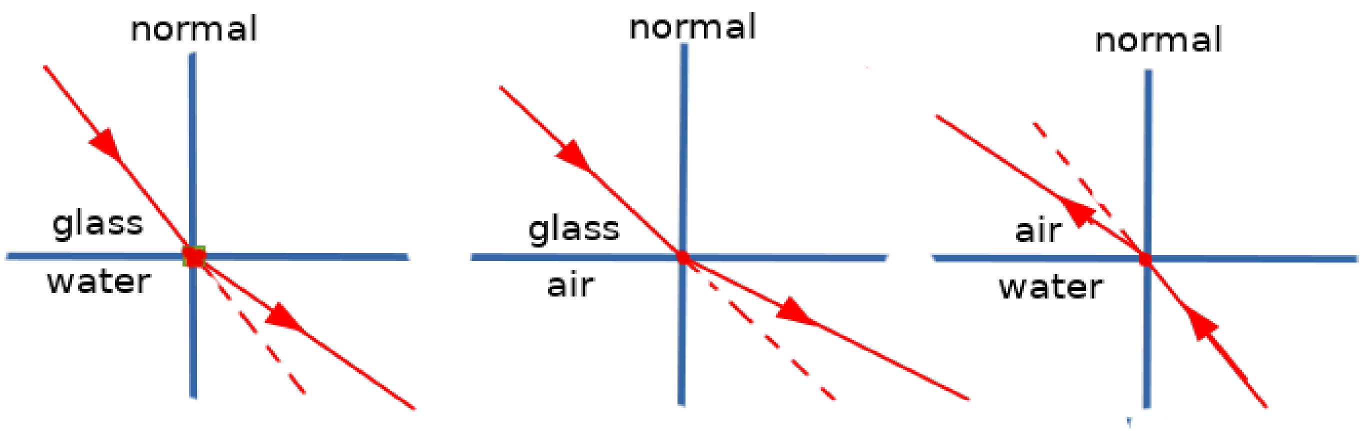
• Does refraction take place for a ray while entering a glass slab normal to it?

* No

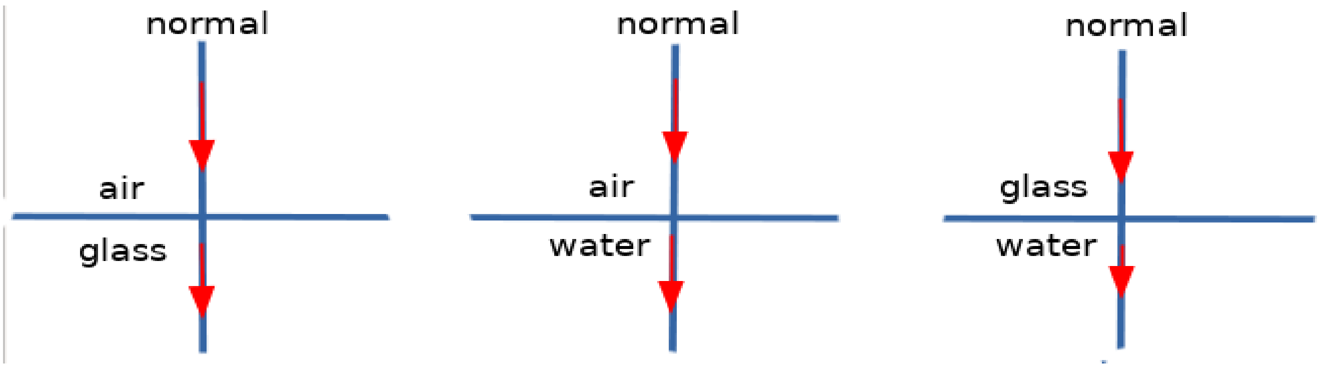
* From a medium of lower optical density to that of a greater one the refracted ray deviates towards the normal.




* From a medium of greater optical density to that of a lower one the refracted ray deviates away from the normal.

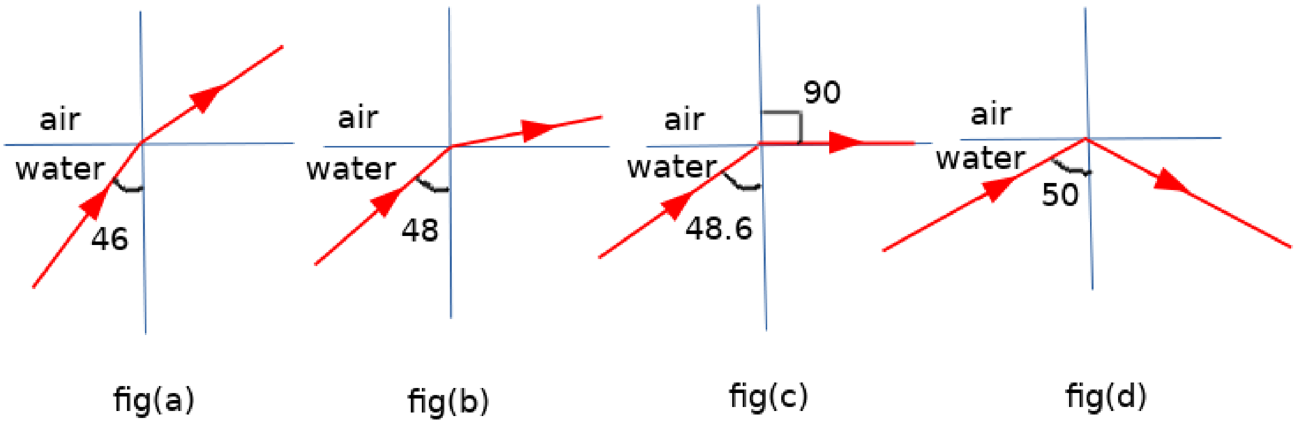



*No deviation takes place in the case of a light ray falling normally on a medium




## 4. Total Internal Reflection

When a ray of light passes from a medium of greater optical density to that of lower optical density, (ray of light passes from water to air)




Fig(a) angle of incidence = $46^0$

- Refraction is taking place

Fig(b) angle of incidence = $48^0$

- Refraction is taking place,
- The refracted ray approaches the surface of the water

Fig(c) angle of incidence = $48.6^0$ (Critical angle).

- Refraction is taking place,
- Refracted ray passes along the surface of water
- Now the angle of refraction is $90^0$

Fig(d) angle of incidence = $50^0$

- Refraction doesn't taking place,
- The ray is reflected back to the same medium without undergoing refraction.

## Critical angle

When a ray of light passes from a medium of greater optical density to that of lower optical density, the angle of incidence at which the angle of refraction becomes $90^0$ is the critical angle.

* The critical angle in water is $48.6^{\,0}$
* The critical angle in glass is $42^{\,0}$

## Total internal reflection

When a ray of light passes from a medium of higher optical density to a medium of lower optical density at an angle of incidence greater than the critical angle, the ray is reflected back to the same medium without undergoing refraction. This phenomenon is known as total internal reflection.

* The path of light in different media is shown in the figures. Analyse them and answer the following questions.

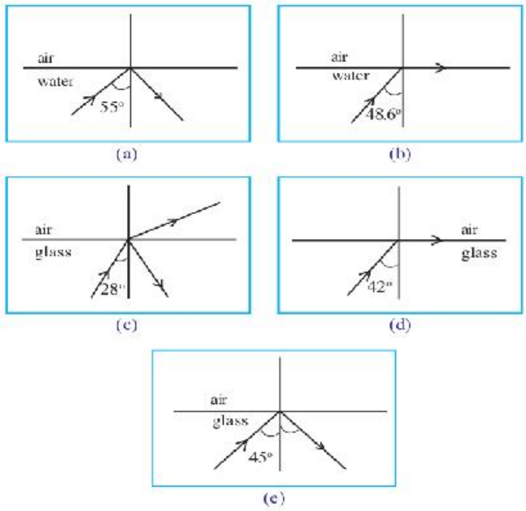


Fig. 5.13

- Which are the figures that show total internal reflection?
  * Fig (a) and (e)
- What is the critical angle of glass?

* $42^{\,0}$

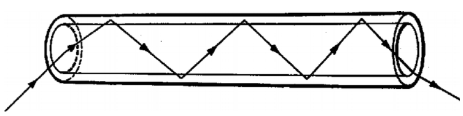
- Will total internal reflection take place when light passing through water is incident on the surface of separation with air at an angle of incidence of $45^0$ ? Why?

* No. The critical angle of water is $48.6^{\,0}$. Total internal reflection will take place only if the angle of incidence is greater than the critical angle.

* Find out the practical applications of total internal reflection in our day to day life.

Medical field → Endoscope.

In the field of telecommunications → Optical fibre cables.

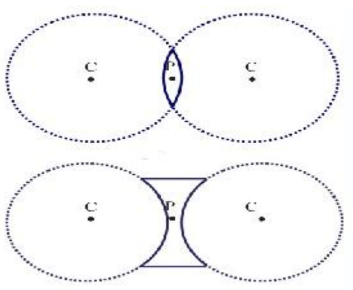


# 5. Lenses -technical terms - image formation -ray diagrams - characteristics of image- power of lens.

## Lens

A lens is a transparent medium having spherical surfaces.

### Terms and characteristics associated with convex and concave lenses.



#### 1. Optic centre

Optic centre is the midpoint of a lens (P).

#### 2. Centre of curvature

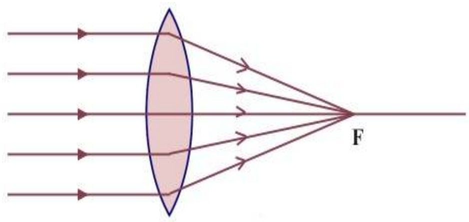
A lens has two spherical surfaces as parts of the lens. Centre of curvature (C) is the centre of the imaginary spheres of which the sides of the lens are parts.

#### 3. Principal axis

Principal axis is the imaginary line that passes through the optic centre joining the two centres of curvature.

#### 4. Principal focus

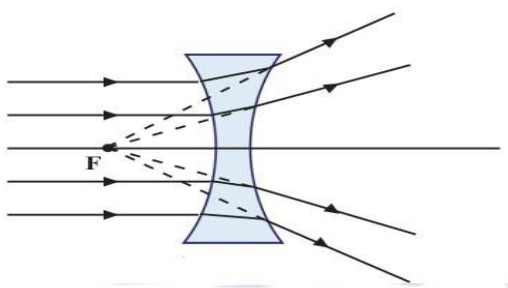
a) Principal focus of a convex lens




Light rays incident parallel and close to the principal axis after refraction converges to a point on the principal axis of a convex lens. This point is the principal focus of a convex lens

* The principal focus of a convex lens is real
* The convex lens has two focuses.

b) Principal focus of concave lens




Light rays incident parallel and close to the principal axis diverge from one another after refraction. These rays appear to originate from a point on the same side. This point is the principal focus of a concave lens.

* The principal focus of a concave lens is virtual.
* The concave lens has two focuses.

#### Focal length

Focal length is the distance from the optic centre to the principal focus. This is denoted by the letter f'.

## Formation of image using a Convex lens

| Position of object | Position of image | Nature of image/ size | | |
|---|---|---|---|---|
| | | Real/ virtual | Inverted/ erect | Magnified/ diminished/ same size |
| 1. At infinity | At F | Real | Inverted | Diminished |
| 2. Beyond 2 F | Between 2F and F | Real | Inverted | Diminished |
| 3. At 2 F | At 2F | Real | Inverted | Same size |
| 4. Between 2F and F | Beyond 2 F | Real | Inverted | Magnified |
| 5. At F | At infinity | Real | Inverted | Very much magnified |
| 6. Between F and lens | At behind the lens | Virtual | Erect | Magnified |

## Ray diagram of formation of images by lenses

### The points to be taken care of while drawing ray diagrams

1. When a ray of light passes through the optic centre of a thin lens, it does not undergo deviation.

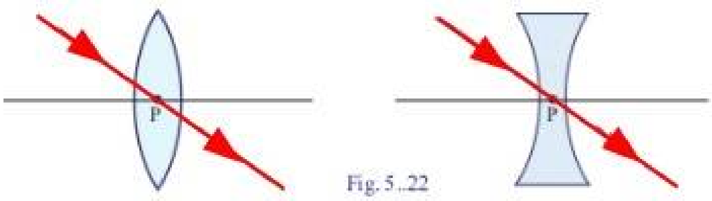


Fig. 5..22

2. A ray of light falling parallel to the principal axis of a convex lens passes through the principal focus after refraction.

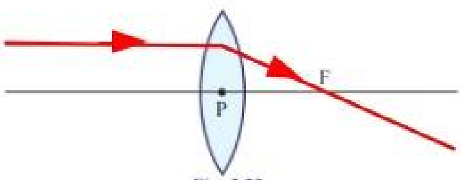


Fig. 5.23

3. A ray incident parallel to the principal axis of a concave lens appears to diverge from the focus on the same side of the lens.

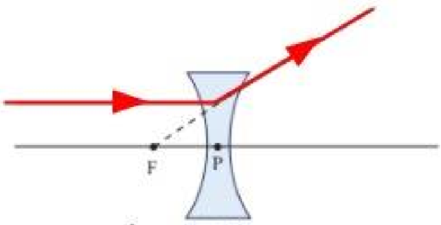


Fig. 5.24

4. A ray of light passing through the principal focus of a convex lens passes parallel to the principal axis after refraction.

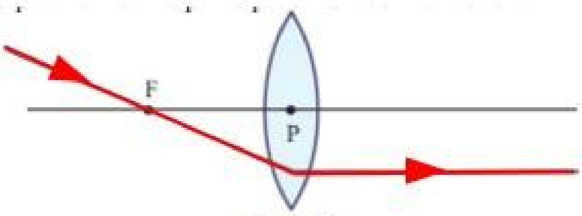
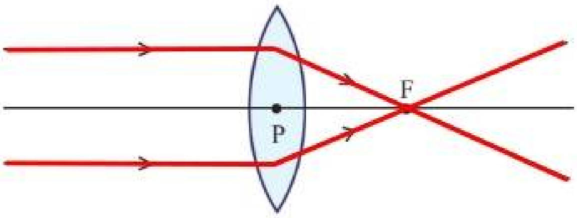


Fig. 5.25

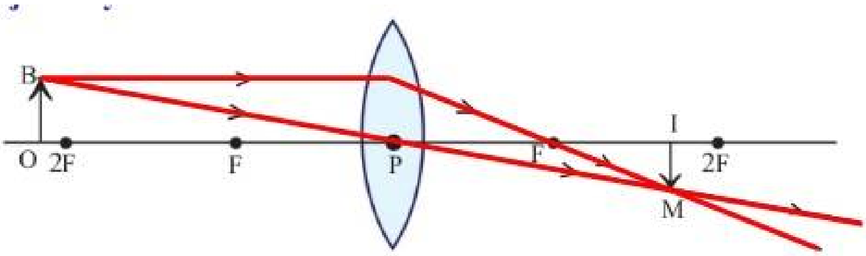
## Ray diagram of formation of images by convex lenses

### 1. Object at infinity




The characteristics of the image
Position of the image : At F
Nature of the image : Real, Inverted
Size of the image : Diminished

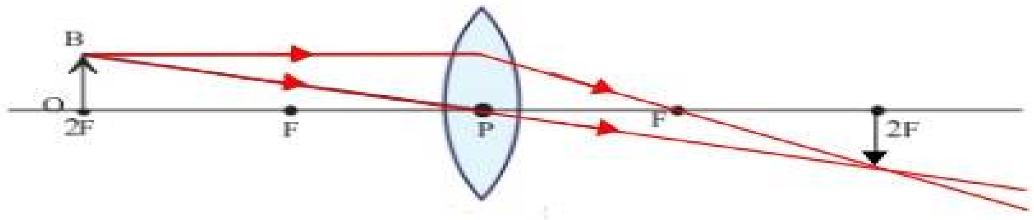
### 2. Object beyond 2F




The characteristics of the image
Position of the image : Between F and 2F

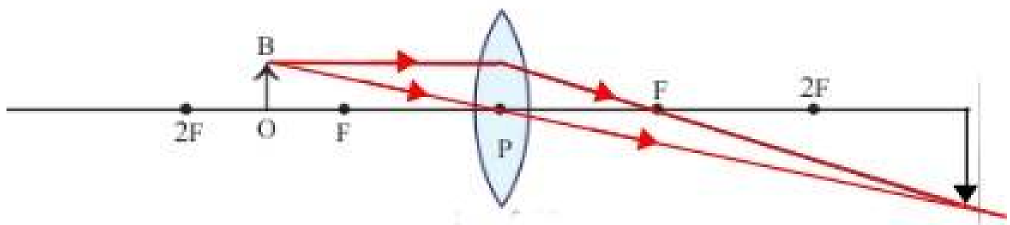
Nature of the image : Real, Inverted
Size of the image : Diminished

## 3. Object at 2F



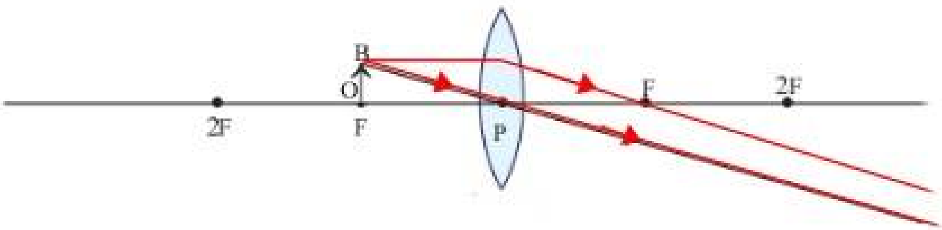

The characteristics of the image
Position of the image : 2F
Nature of the image : Real, Inverted
Size of the image : Same size

## 4. Object between F and 2F




The characteristics of the image
Position of the image :Beyond 2F
Nature of the image : Real, Inverted
Size of the image : Magnified

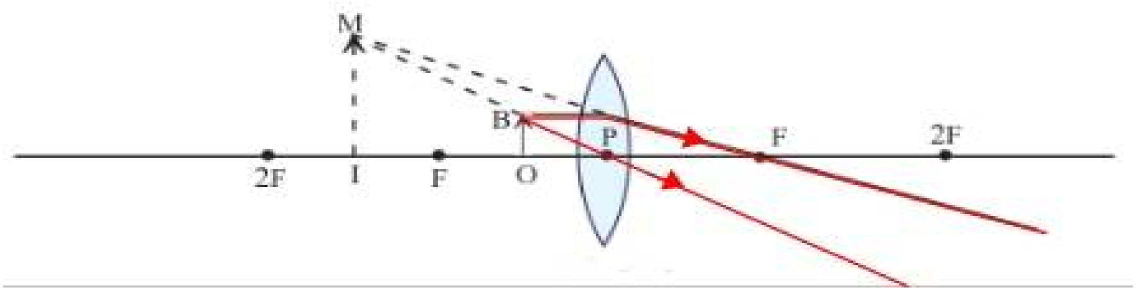
## 5. Object at F




The characteristics of the image
Position of the image : At infinity
Nature of the image : Real, Inverted

Size of the image : Magnified

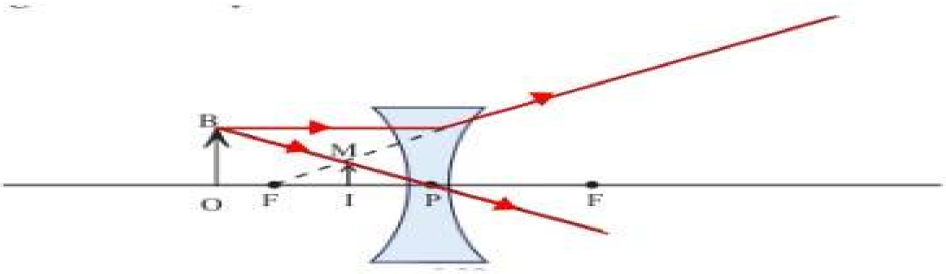
6. Object between F and lens




The characteristics of the image

Position of the image : At behind the lens
Nature of the image : Virtual, Erect
Size of the image : Magnified

Ray diagram of formation of images by concave lenses




The characteristics of the image

Position of the image : At behind the lens
Nature of the image : Virtual, Erect
Size of the image : Diminished

# Power of a Lens

Power is a term related to the focal length of a lens. Power of a lens is the reciprocal of focal length expressed in metres.

$$\text{Power} = {}^{1}/_{f}$$

* Unit of power is dioptre. It is represented by D.

* The power of a convex lens is positive and that of a concave lens is negative.

1. What is the focal length of a lens of power +2D?

$$\text{Power (p)} = +2\text{ D}$$
$$\text{Power} = {}^{1}/_{f}$$
$$f = 1/p$$
$$= 1/2\text{x}10^{-2} = 100/2 = +50\text{ cm}$$

Focal length of the lens = +50 cm

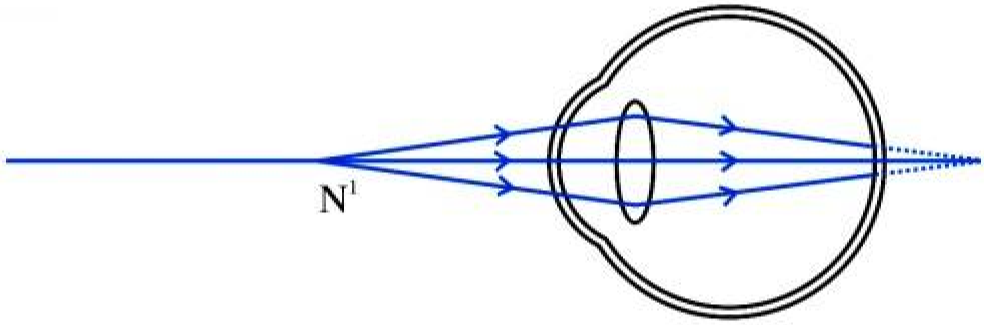
# 6.VISION AND THE WORLD OF COLOURS

## FOCUS AREA

1. Long-sightedness, Near-sightedness- Reasons and Remedies
2. Dispersion of light
3. Formation of Rainbow
4. Scattering of light
5. Relation between wavelength of colours and Scattering
6. Colours of the rising and the setting sun

## 1. Long-sightedness, Near-sightedness- Reasons and Remedies

### Hypermetropia or Long-sightedness

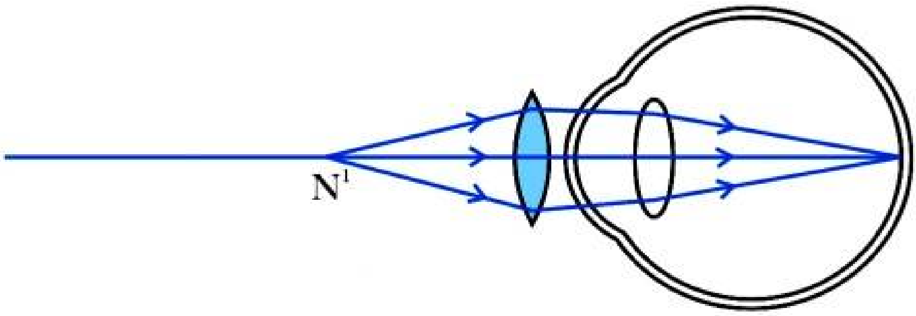



* For some persons, even though distant objects can be seen clearly, they may not be able to see nearby objects clearly. This defect is the long sightedness.
* The near point of the eye of such a person will be at a distance of more than 25 cm.
* The image of nearby objects formed behind the retina.

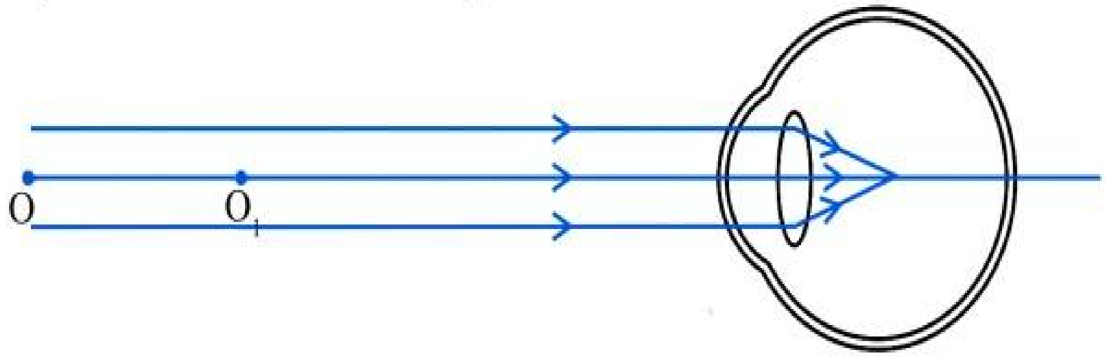
* What shall be the reasons behind this defect?

- The size of the eye ball is smaller.
- Power of the lens is low (focal length is high).

* What is the remedy for long – sightedness?
This can be rectified by using a convex lens of suitable power.



## Myopia or Near-sightedness



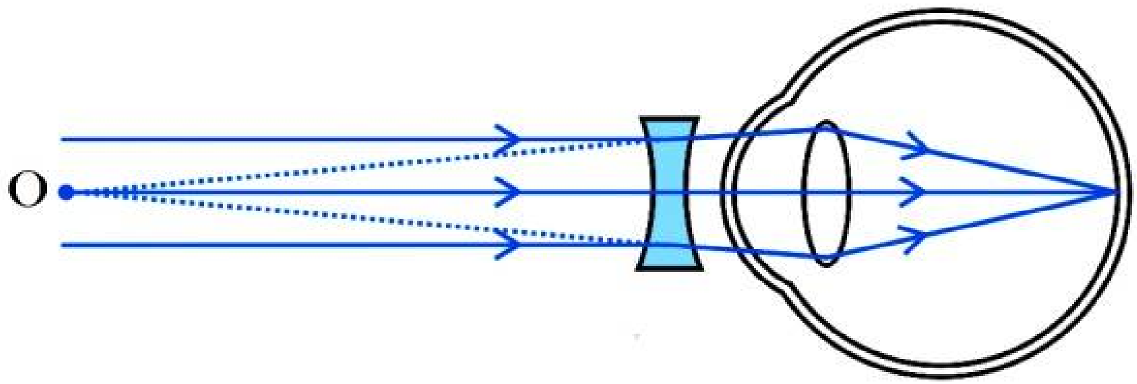

* For some persons, even though nearby objects can be seen clearly, they may not be able to see distant objects clearly. This defect is the near sightedness.

* The near point of such persons will not be at infinity. It will be at a definite distance from the eye.

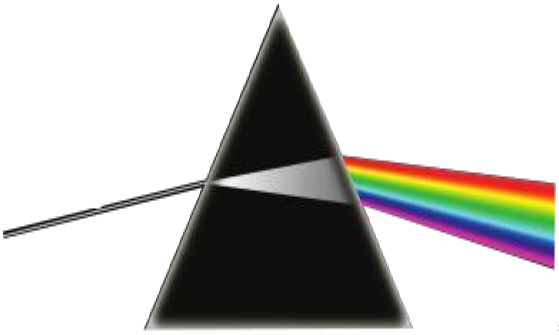
* The image of distant objects formed in front of retina.

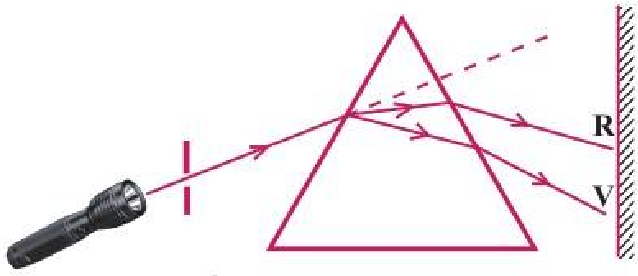
* What shall be the reasons behind this defect?
  - The size of the eye ball is larger.
  - power of the lens is high (focal length is low).

* What is the remedy for long – sightedness?
This can be overcome by using concave lens of suitable power.



## 2. Dispersion of light






* *

What are the colours seen on the screen?
VIBGYOR

Red (R)

Orange (O)

Yellow (Y)

Green (G)

Blue (B)

Indigo (I)

Violet (V)


* Which colour deviates the most?
Violet

* Which colour deviates least?
Red

* What may be the reason behind this difference in deviation?
Difference in wavelengths.
* What is this phenomenon? Explain.
Dispersion of light

- Dispersion is the phenomenon of splitting up of a composite light into its constituent colours. The regular array of colours formed by dispersion is the visible spectrum.

* What is composite light
Any light that is composed of more than one colour is a composite light
Ex: Sunlight

* Which colour has the shortest wavelength?
Violet

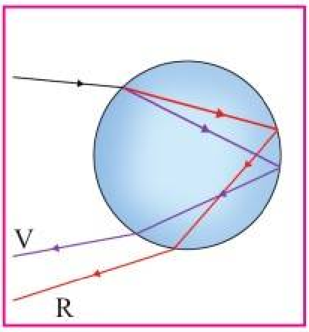
* Which one has the longest?
Red

* When light passes through the prism, as the wavelength increases, how does the deviation change?
- When the wavelength of the colour decrease, the deviation increases
- When the wavelength of the colour increases, the deviation decrease

## 3.Formation of Rainbow

1. When is the rainbow formed?
 * In the morning and in the evening
2. Where will be the Sun when the rainbow is seen in the East?
* West
3. Where will be the Sun when the rainbow is seen in the West?
*East
4. What is the phenomenon that causes rainbow?
*Dispersion of light caused by the water droplets in the atmosphere causes rainbow.

### The figure shows a ray of sunlight falls obliquely on a water drop.




1. How many times does a ray of light undergo refraction when it passes through a water droplet?
* The light undergoes two times refraction in the water droplet

2. What about the internal reflection?
* One time

3. What is the colour seen at the upper edge of the rainbow?
* Red

4. What is the colour seen at the lower edge?
* Violet

5. How the rainbow is formed?

* Sunlight, when it passes through water droplets, undergoes refraction and internal reflection. The light ray emerging from the water droplets which make the same angle with the line of vision have the same colour. These droplets appear in the form of an arc of a particular colour. Thus there is red colour at the upper edge and violet colour at the lower edge. All the other colours are seen in between, depending on their wavelengths.

* When the position of the sun is near the horizon, the rainbow appears to be bigger.

* When seen from an aeroplane, the rainbow is seen as a circle.

* When the sun is much above the horizon, the rainbow disappears.

## 4. Scattering of light

Scattering is the change in direction brought out by the irregular and partial reflection of light when it hits the particles of the medium.

## 5. Relation between wavelength of colours and Scattering

* Colours like violet, indigo and blue have the smallest wavelengths in sunlight. They undergo maximum scattering.

* Red has comparatively greater wavelength and it can overcome small obstacles and hence scattering is low. As a result they travel greater distance.

* Rate of scattering and the size of the particles are interrelated. As the size of the particle increases, the rate of scattering also increases. If the size of the particles is greater than the wavelength of light, then the scattering is same for all colours.

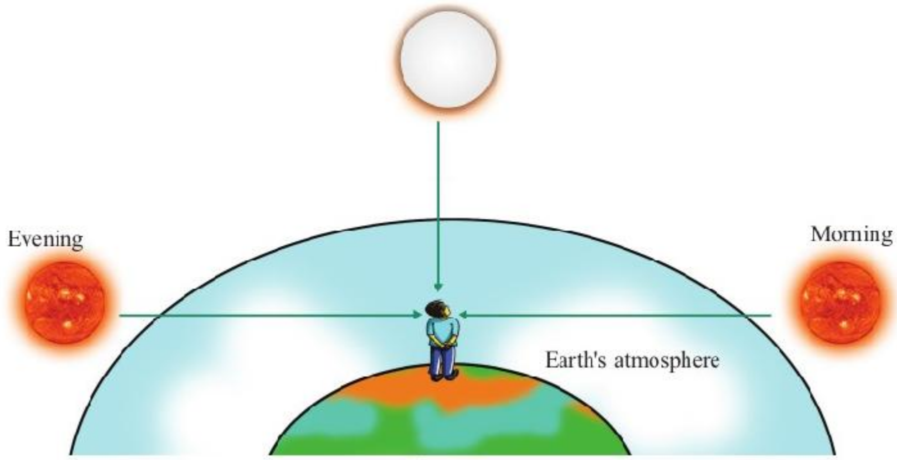
## 6. Colours of the rising and the setting sun

1. Which are the occasions when sunlight has to travel greater distance through the atmosphere before reaching the eyes of an observer on the earth?
* Morning and evening.
2. As sunlight passes through the atmosphere, which colour in it undergoes maximum scattering? Which colour undergoes minimum scattering?
* Colour in it undergoes maximum scattering – Violet
* Colour in it undergoes minimum scattering – Red

3. When light reaches the observer after travelling long distances through the atmosphere, which colour reaches the eye? What is the reason?
* Red, it has highest wavelength and least scattering.

4. The western horizon remains reddish for some more time even after sunset. Why?
* During sunrise and sunset, light reaching us from the horizon has to travel long distances through the atmosphere. During this long journey, colours of shorter wavelength would be almost fully lost due to scattering. Then, the red light which undergoes only less amount of scattering decides the colour of the horizon. That is why the sun appears red during sunset and sunrise.

5. Can you now guess why red colour has been given to the tail lamps of vehicles and signal lights?
* Red light has highest wavelength and least scattering. So red light is able to travel the longest distance through the atmosphere.



# 6.Energy management

## FOCUS AREA

1. Incomplete and complete combustion
2. Fossil Fuels – Coal, C N G, L N G, L P G
3. L P G and Safety
4. Green Energy and Brown Energy
5. Energy Crisis – Reasons and Solutions.

## 1. Incomplete and complete combustion

### Combustion of fuels

* Fuels burn with the help of oxygen.

### Complete combustion

* Complete combustion is a reaction in which fuels react intensively with oxygen, producing carbon dioxide, steam, heat and light.

### Partial combustion.

* If sufficient oxygen is not available, the rate of combustion decreases. If oxygen is not sufficient, large quantities of carbon monoxide, soot and a little of carbon dioxide will be formed. This type of burning is partial combustion.

1. What are the conditions favourable for the complete combustion of different fuels?
    * The solid fuels must be dry.
    * Liquid fuels must evaporate easily.
    * The ignition temperature should be attained.
    * Sufficient oxygen must be available for burning.

2. What are the features of complete combustion?
    * Carbon monoxide is not formed.
    * More heat is generated

3. Write down the situations/specialities for partial combustion.
    * Insufficient availability of $O_2$
    * Partial dryness
    * Lack of facilities for the removal of oxygen.

4. What are the drawbacks of partial combustion?

* Loss of fuel
* Economic loss
* Fuel loss
* Atmospheric pollution
* Wastage of time
* More smoke is produced

## 2. Fossil Fuels

* Fossil fuels are formed by the transformation of plants and animals that went under the earth's crust millions of years ago. The transformation took place in the absence of air under high pressure and high temperature.
* Coal, petroleum and natural gases are fossil fuels.

### Coal

* Coal is the most abundant fossil fuel on the earth.
* The main component of coal is carbon.
* Based on the carbon content, it is classified into four groups as peat, lignite, anthracite and bituminous coal.
* When coal is distilled in the absence of air, the substances obtained are ammonia, coal gas, coal tar and coke.

### petroleum

1. Which are the products obtained from fractional distillation of petroleum?

* Petroleum gas- Petrol – Diesel- Kerosene - Naphtha – Fuel oil – Lubricating oil - Grease – Wax ...

### Natural gases (CNG, LNG)

* liquefied natural gas (LNG) and compressed natural gas (CNG) from the natural gas obtained along with petroleum.
* The main component of all these is methane.
* These are used as fuels in vehicles, industries and thermal power stations.
* The importance of LNG is that natural gas can be liquefied and transported to distant places conveniently. It can again be converted into gaseous form at atmospheric temperature and distributed through pipe lines.

### LPG

* The full form of LPG is liquefied petroleum gas.

* This is a colourless, odourless gas obtained through the fractional distillation of petroleum.
* Domestic LPG produces an odour since ethyl mercaptan is added as an indicator to detect gas leakage.
* The main constituent of LPG is butane.

## 3. L P G and Safety

* The expiry date marked on a cooking gas cylinder.

| marked on the top of the cylinder | Expiry date |
|---|---|
| ”A 24” | 2024 months from January to March |
| ”B24” | 2024 months from April to June |
| ”C 24” | 2024 months from July to September |
| ”D 24” | 2024 months from October to December |

* A,B,C,D indicate the month
* 24 indicate the year
* LPG is denser than air.

### BLEVE (Boiling Liquid Expanding Vapour Explosion).

* If there is a fire due to leakage of LPG then due to the heat the cylinder/ tanker will also get heated. Owing to the excess heat, the LPG becomes gas increasing the pressure inside .The ability to expand is 250 times for the gaseous LPG. Therefore when LPG becomes gas, the container cannot accommodate the entire gas. This increases the pressure to a very high level causing a huge explosion. This is known as BLEVE.

1.Never switch on or switch off electricity when there is a leakage of LPG. Why?

* It is because the fumes of gas are highly flammable and even smallest of sparks can ignite a huge fire.

2.If there is a leakage of LPG does it rise up or come down in the atmosphere? Why?

* Come down in the atmosphere. LPG is denser than air, so any leakage will sink to the ground and accumulate in low lying areas and may be difficult to disperse.

3.What precautions are to be taken to avoid accidents due to LPG leakage?

* Examine the rubber tube at regular intervals and ensure that it does not have a leakage.
* Turn on the knob of stove only after the regulator is turned on.
* Always store the LPG cylinder in an upright position and away from other combustible and flammable material.
* Check for gas leaks regularly by applying soap solution on cylinder joints and suraksha pipes

4. If a gas leak is suspected or if the fire spreads on a cylinder, what else could be done?

* If you are convinced that there is a gas leak, disconnect electricity from outside the home (switch off the main switches).
* Switch off the regulator and shift the cylinder to an empty space. Keep the windows and doors open.
* Request help from the Fire Force by calling in the toll free number 108.
* Well trained rescue operators can put out the fire by covering the top end of the cylinder with wet sack to prevent the contact with oxygen.
* If the fire is in flat or the top storey, then one should not try to escape using lifts. Only staircase should be used.
* Cover the nose and the mouth with soft cloth to avoid the intake of smoke or gases.

## 4. Green Energy and Brown Energy

### Green Energy / Clean energy

* Green energy is the energy produced from natural sources that does not cause environmental pollution.

* All the energy produced from renewable sources belong to this category.

* The renewable sources like solar energy, wind energy, energy from waves and energy from biomass are considered as green energy.

* This is also referred to as clean energy.

### Green Energy

* The energy produced from non renewable sources such as petroleum and coal, and the nuclear energy are named brown energy.

* These are sources which cause environmental problems including global warming.

* Classify the energy sources as green energy and brown energy:

| Green Energy | Brown Energy |
|---|---|
| * Solar cells<br>* Tidal energy<br>* Hydro electric power<br>* Windmills | * Atomic reactors<br>* Diesel engines<br>* Thermal power stations. |

* What must be done to ensure maximum utilization of green energy while constructing a house?

1. Sufficient sunlight should be available in the rooms during day time.
2. Comfortable warmth, coolness and air circulation must be available without the help of electricity.

## 5. Energy Crisis – Reasons and Solutions.

* 'Energy crisis is the consequence of increasing demand but decreasing availability'

* What can be done for reducing energy crisis as far as possible?

1. Judicious utilisation of energy.
2. Maximum utilisation of solar energy.
3. Minimising the wastage of water.
4. Making use of public transportation as far as possible.
5. Construction and beautifying of houses and roads in a scientific manner.
6. Controlling of the street lamps with LDR (Light Dependent Resistor).
7. Timely maintenance of machines.
8. Limiting the size of newly constructed buildings.
9. Ensuring of maximum efficiency of the machines used.

* List down the devices that can be used at home to reduce energy consumption.

1. Hot box
2. Pressure cooker
3. Energy efficient oven