Science
10th Standard
Physics Notes
As per reduced syllabus for the academic year 2020-21

By

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Electricity

1. **Define Static and current electricity**

Ans:- Static electricity deals with the electric charges at rest while the current electricity deals with the electric charges in motion.

2. **What do you mean by Conductor?**

Ans: A substance which allows passage of electric charges through it easily is called a conductor. A conductor offers very low resistance to the flow of current. For example copper, silver, aluminum etc.

3. **What is Insulator?**

Ans: A substance that has infinitely high resistance does not allow electric current to flow through it. It is called an insulator. For example rubber, glass, plastic, ebonite etc.

4. **Define Electric current**

Ans: The amount of charges flowing through a particular area in unit time.

Electric current = Charge/Time

or

$I = Q/t$

Electric current is a scalar quantity.

SI unit of current is "Ampere" represented by A

SI unit of electric charge is coulomb (C)

5. **What is Conventional current?**

Ans: Conventionally, the direction of motion of positive charges is taken as the direction of current. The direction of conventional current is opposite to that of the negatively charged electrons.

6. **Define Coulomb**

Ans: It is the S.I. unit of charge.

Coulomb is equivalent to the charge contained in nearly 6×10^{18} electrons.

Charge on an electron = 1.6×10^{-19} coulomb.

7. **What do you mean by unit of current?**

Ans: If one coulomb of charge flows through any section of a conductor in one second then current through it is said to be one ampere.

$1 \ A = 1Cs^{-1}$

8. **What do you mean by Ampere?**

Ans: It is the S.I. unit of current. If one coulomb of charge flows through any section of a conductor in one second, then current through it is said to be one ampere.

1 ampere = 1 coulomb/1 second or $1 \ A = 1C/1s \ 1Cs^{-1}$

1 milliamp ere = 1 mA = 10^{-3}A microampere = 1μA = 10^{-6} A

9. **Define Electric circuit**

Ans: The continuous and closed path of an electric current is known as electric circuit.

10. What is Electric field?

Ans: It is the region around a charged body within which its influence can be experienced.

11. Define Ammeter

Ans: It is an instrument used to measure the electric current in a circuit. It is always connected in series in a circuit through which current is to be measured.

12. What is the condition for flow of electron?

Ans: The electron can only flow when there is difference of electric pressure

For example "water flowing through a tube" It is only possible when there high pressure at one side and low at another side, then it will move from high pressure to low pressure.

In case of electric current, the flow of charge is made possible due chemical action with in a cell that generates the potential difference across the terminals of the cell.

Electrons move with the drift speed of $1mms^{-1}$

13. Define electrostatic potential

Ans: Electrostatic potential at any point in an electric field is defined as the amount of work done in bringing a unit positive charge from infinity to that point. Its unit is volt. Positive charges move from higher to lower potential regions. Electrons, being negatively charged, move from lower to higher potential regions.

14. Define potential difference

Ans: The Potential difference between two points in an electric circuit carrying some current as the work done to move a unit charge from one point to the other.

Potential difference(v) = Work done/Charge

or

$V = W/Q$

The SI unit of electric potential difference is volt (V)

15. What is a Volt ?

Ans: When 1 Joule of work is done to carry one coulomb (1C) of charge from one point to another of a current carrying conductor then the potential difference is said to be 1 V.

$$IV = \frac{1J}{1C}$$

16. What is Galvanometer?

Ans: It is device to detect current in an electric circuit.

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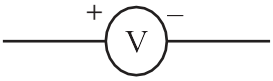
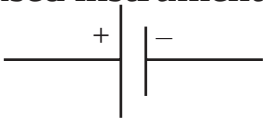
17. What is Voltmeter?

Ans: It is a device to measure potential difference. It is always connected in parallel to the component across which the potential difference is to be measured.

It is represented by the symbol 

in an electric circuit

Symbols for some commonly used instrument in circuit diagrams

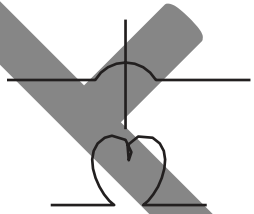
(1) Cell 

(2) Battery 

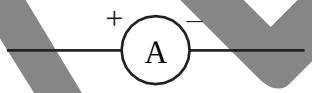
(3) Key (switch) open 

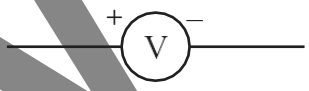
(4) Key (Close) 

(5) Joint wire 

(6) Wires with no join 

(7) Bulb

(8) Ammeter 

(9) Voltmeter 

18. Define Ohm's law.

Ans: The potential difference (v) across the ends of a given metallic wire in an electric circuit is directly proportional to the current flowing through it, provided its temperature remains the same.

$V \alpha I$ or $V = RI$

The proportionality constant R is called resistance of conductor.

19. Define Resistance

Ans: It is a property of a conductor to resist the flow of charges through it. Its SI unit is ohm and is represented by **Ω**

It is equal to the ratio of the potential difference applied across its ends and the current flowing through it.

Resistance = Potential difference/Current or

$R = V/I$

20. What is 1 Ohm?

Ans: It is the S.I. unit of resistance. A conductor has a resistance of one ohm if a current of one ampere flows through it on applying a potential difference of one volt across its ends.

1 ohm = 1 volt/1 ampere or 1Ω = 1V/1A

Current through a resistor is inversely proportional to its resistance.

21. Define Resistor

Ans: A conductor having some appreciable resistance is called a resistor.

22. List the factors on which resistance of a conductor depends.

Ans: The resistance R of a conductor depends

i) Directly on its *length* L i.e. R α L.

ii) inversely on its area of *cross-section* A i.e. R α 1/A

iii) on the *nature of material* of the conductor on.

iv) Its *temperature*

On combining the above factors, we get R α L/A

R = ρ * L/A The proportionality constant ρ is called resistivity of conductor. The SI unit of resistivity is Ωm

23. Define Resistivity

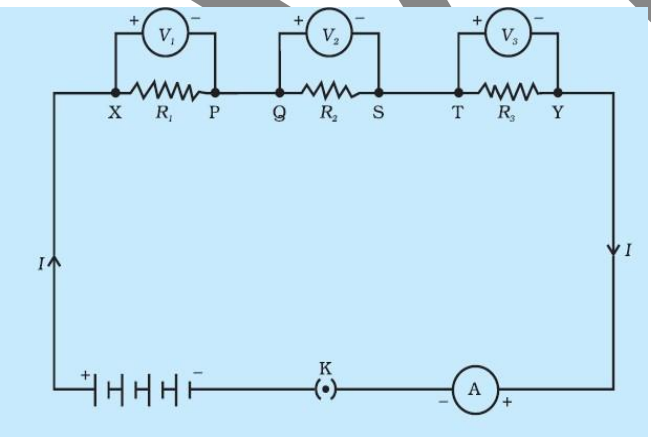
Ans: It is defined as the resistance offered by a cube of a material of side 1 m when current flows perpendicular to its opposite faces. Its S.I. unit is ohm-meter (Ωm). Resistivity, ρ = RA/L

24. Silver has lowest resistivity.

25. Give a brief note on resistors in series

Ans: Resistors in series combination of resistors the current is the same in every part of the circuit or the same current through each resistor.

Laws of resistances in series:



Let us take three resistances R1, R2 and R3 that are connected in series in a circuit.

Ohm`s Law stated as

$V = IR$

i) Current through each resistance is same.

ii) Total voltage across the combination = Sum of the voltage drops.

$V = V_1 + V_2 + V_3$

iii) Voltage drops across any resistor is proportional to its resistance.

$V_1 = IR_1$, $V_2 = IR_2$, $V_3 = IR_3$

iv) Equivalent resistance = Sum of the individual resistances.

$R_s = R_1 + R_2 + R_3$

v) Equivalent resistance is larger than the largest individual resistance.

26. Give a brief note on resistances in parallel

Let us take three R1, R2 and R3, that are connected in parallel in the electric circuit.

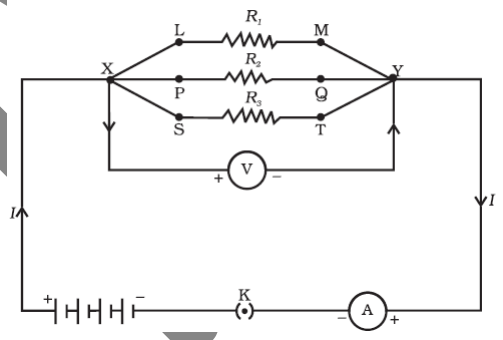
a. Voltage across each resistance is same and is equal to the applied voltage.

b. Total current = Sum of the currents through the individual resistances.

$I = I_1 + I_2 + I_3$

c. Currents through various resistances are inversely proportional to the individual resistances.

$I_1 = V/R_1$, $I_2 = V/R_2$, $I_3 = V/R_3$



d. Reciprocal of equivalent resistance = Sum of reciprocals of individual resistances.

e. $1/R_p = 1/R_1 + 1/R_2 + 1/R_3$

f. Equivalent resistance is less than the smallest individual resistance.

27. What do you mean by equivalent resistance

Ans: If a single resistance can replace the combination of resistances in such a manner that the current in the circuit remains unchanged, then that single resistance is called the equivalent resistance.

28. What are the disadvantage of series connection in an electric circuit ?

1. In series connection if any of the component fail to work, the circuit will break and then none of the component (ex. TV, bulb, fan..) will work.
2. It is not possible to connect a bulb and a heater in series, because they need different value of current to operate properly.

29. Define electric energy

Ans: It is the total work done in maintaining an electric current in an electric circuit for given time.

Electric energy, $W = VIt = I^2Rt$ joule

30. Define electrical power

Ans: Electrical power is the rate at which electric energy is consumed by an appliance.

$$P = W/t = VI = I^2R = V^2/R$$

31. Define Watt

Ans: It is the S.I. unit of power. The power of an appliance is 1 watt if one ampere of current flows through it on applying a potential differences of 1 volt across its ends.

1 watt = 1 joule/1 second =1 volt x 1 ampere

or 1 W = 1 Js^{-1} = 1 VA

1 kilowatt = 1000 W

32. What is Kilowatt hour?

Ans: It is the commercial unit of electrical energy. One kilowatt hour is the electric energy consumed by an appliance of 1000 watts when used for one hour.

1 kilowatt hour (kWh) = 3.6×10^6 J

33. What does the Joule's law of heating state?

Ans: The law stated that the heat produced in a resistor is

(i) directly proportional to square of the current(I)

(ii) directly proportional to resistance (R) for given current

(iii) directly proportional to time (t) for which current flow through resistor.

34. List the application of Heating Effect of Electric Current

(1) Used in electric iron, toaster, oven, heater etc.

(2) It is also used in bulb to produce light.

(Filament of bulb is made of strong metal with high melting point such as tungsten (m.pt = 3380°C). This filament can retain as much of the heat generated as possible, to become very hot and emit light)

3) It is also used in the "fuse connected in an electric circuit {Fuse a safety device, protect the circuits and appliance by stopping the flow of high current. The wire of fuse is made of an alloy of metals for ex Aluminum, Copper, Iron, lead etc. The alloy should be of low m.pt and high resistivity, fuse is always connected in series circuit. When large current flow through the circuit, the temperature of fuse wire will increase. This melts the fuse wire and break the circuit.

" Fuses" used for domestic purposes are rated as 1A, 2A, 3A, 5A, 10A etc. for various operation depending upon the power of appliance using.

35. Define electric Power

Ans: In case of electricity, it is defined as the rate of change electrical energy dissipated or consumed in an electric electrical energy dissipated or consumed in an electric circuit.

$$P = \frac{\text{Electrical Energy (E)}}{\text{time (t)}}$$

SI unit of electric power is "Watt" (W).

36. Why is the tungsten metal more coiled in the bulb and not installed in straight parallel wire form?

Ans. The coiled wire of tungsten increases the surface area of the wire in very less space so as to emit more light and helps in glowing with more intensity.

37. Why are fairy decorative lights always connected in parallel?

Ans. When the fairy lights are connected in series the resistance offered will be greater and brightness of the bulbs will be affected. But in parallel connection all the bulbs will glow with same intensity and if any more bulbs gets fused the other bulbs will continue to glow.

38. What will happen when -

i. Voltmeter is connected in series?

ii. Ammeter is connected in parallel?

Ans. a) Negligible current will pass through the circuit because the voltmeter has a very high resistance.

1. Ammeter will get damaged due to flow of large amount of current through it, because it has low resistance.

Text Book Question and answers

1. What does an electric circuit mean?

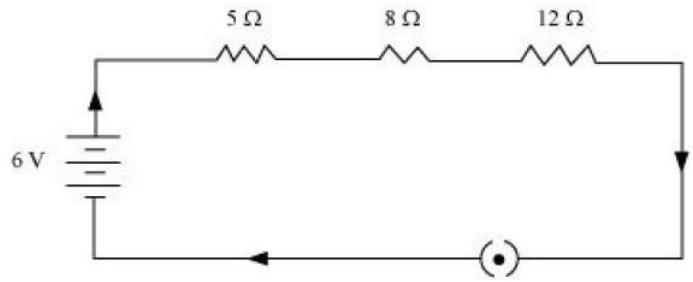
Answer A continuous and closed path of an electric current is called an electric

circuit. An electric circuit consists of electric devices, source of electricity and wires that are connected with the help of a switch.

2. **Define the unit of current.**
   Answer The unit of electric current is ampere (A). 1 A is defined as the flow of 1 C of charge through a wire in 1 s.
3. **Name a device that helps to maintain a potential difference across a conductor.**
   Answer Any source of electricity like battery, cell, power supply, etc. helps to maintain a potential difference across a conductor.
4. **What is meant by saying that the potential difference between two points is 1 *V*?**
   Answer If 1 J of work is required to move a charge of amount 1 C from one point to another, then it is said that the potential difference between the two points is 1 *V*.
5. **On what factors does the resistance of a conductor depend?**
   Answer The resistance of a conductor depends upon the following factors:
   → Length of the conductor
   → Cross-sectional area of the conductor
   → Nature of the conductor
   → Temperature of the conductor
6. **Will current flow more easily through a thick wire or a thin wire of the same material, when connected to the same source? Why?**
   Answer The current will flow more easily through thick wire. It is because the resistance of a conductor is inversely proportional to its area of cross - section. If thicker the wire, less is resistance and hence more easily the current flows.
7. **Let the resistance of an electrical component remains constant while the potential difference across the two ends of the component decreases to half of its former value. What change will occur in the current through it?**
   Answer According to Ohm's law $V = IR$
   $\Rightarrow I=V/R$ ... (1) Now Potential difference is decreased to half ∴ New potential difference $V'=V/2$ Resistance remains constant So the new current
   $I' = V'/R = (V/2)/R = (1/2)\ (V/R) = (1/2)\ I = I/2$
   Therefore, the amount of current flowing through the electrical component is reduced by half.
8. **Why are coils of electric toasters and electric irons made of an alloy rather than a pure metal?**
   Answer The resistivity of an alloy is higher than the pure metal. Moreover, at high temperatures, the alloys do not melt readily. Hence, the coils of heating appliances such as electric toasters and electric irons are made of an alloy rather than a pure metal.
9. **Use the data in Table 12.2 to answer the following - Table 12.2 Electrical resistivity of some substances at 20°C**

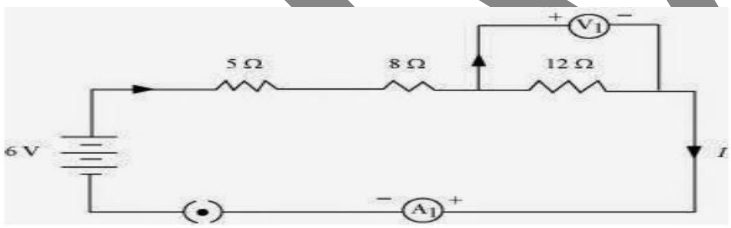
Answer (a) Resistivity of iron = 10.0 x 10^{-8} Ω Resistivity of mercury = 94.0 x 10^{-8} Ω Resistivity of mercury is more than that of iron. This implies that iron is a better conductor than mercury. (b) It can be observed from Table that the resistivity of silver is the lowest among the listed materials. Hence, it is the best conductor.

10. Draw a schematic diagram of a circuit consisting of a battery of three cells of 2 *V* each, a 5 Ω resistor, an 8 Ω resistor, and a 12 Ω resistor, and a plug key, all connected in series.



11. Redraw the circuit of question 1, putting in an ammeter to measure the current through the resistors and a voltmeter to measure potential difference across the 12 Ω resistor. What would be the readings in the ammeter and the voltmeter?

Answer:- An ammeter should be connected in the circuit in series with the resistors. To measure the potential difference across the resistor it should be connected in parallel, as shown in the following figure.



The resistances are connected in series. Ohm's law can be used to obtain the readings of ammeter and voltmeter. According to Ohm's law, $V = IR$, Where, Potential difference, V = 6 V Current flowing through the circuit/resistors = I Resistance of the circuit, $R = 5 + 8 + 12 = 25\Omega$ $I = V/R = 6/25 = 0.24$ A Potential difference across 12 Ω resistor = $V1$ Current flowing through the 12 Ω resistor, I = 0.24 A Therefore, using Ohm's law, we obtain $V1 = IR$ = 0.24 x 12 = 2.88 V Therefore, the reading of the ammeter will be 0.24 A. The reading of the voltmeter will be 2.88 V.

12. What are the advantages of connecting electrical devices in parallel with the battery instead of connecting them in series?

Answer There is no division of voltage among the appliances when connected in parallel. The potential difference across each appliance is equal to the supplied voltage.

The total effective resistance of the circuit can be reduced by connecting electrical appliances in parallel.

13. Why does the cord of an electric heater not glow while the heating element does?

Answer The heating element of the heater is made up of alloy which has very high resistance so when current flows through the heating element, it becomes too hot and glows red. But the resistance of cord which is usually of copper or aluminum is very law so it does not glow.

14. What determines the rate at which energy is delivered by a current?

Answer The rate of consumption of electric energy in an electric appliance is called electric power. Hence, the rate at which energy is delivered by a current is the power of the appliance.

15. How is a voltmeter connected in the circuit to measure the potential difference between two points?

Answer To measure the potential difference between two points, a voltmeter should be connected in parallel to the points.

16. Explain the following.

(a) Why is the tungsten used almost exclusively for filament of electric lamps?

Answer:- The melting point and of Tungsten is an alloy which has very high melting point and very high resistivity so does not burn easily at a high temperature.

(b) Why are the conductors of electric heating devices, such as bread-toasters and electric irons, made of an alloy rather than a pure metal?

Answer:- The conductors of electric heating devices such as bread toasters and electric irons are made of alloy because resistivity of an alloy is more than that of metals which produces large amount of heat.

(c) Why is the series arrangement not used for domestic circuits?

In series circuits voltage is divided. Each component of a series circuit receives a small voltage so the amount of current decreases and the device becomes hot and does not work properly. Hence, series arrangement is not used in domestic circuits.

(d) How does the resistance of a wire vary with its area of cross-section?

Answer:- Resistance (R) of a wire is inversely proportional to its area of cross-section (A), i.e. when area of cross section increases the resistance decreases or vice versa.

(e) Why are copper and aluminium wires usually employed for electricity transmission?

Answer:- Copper and aluminum are good conductors of electricity also they have low resistivity. So they are usually used for electricity transmission.

Diagrams

1. Draw the schematic diagram of electric circuit.

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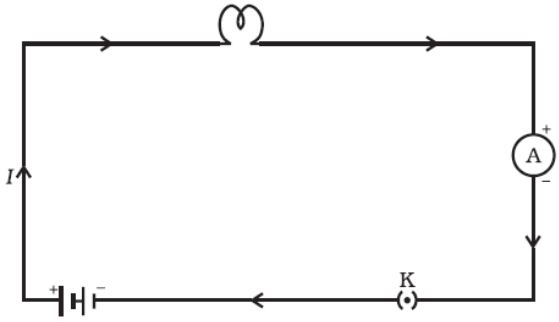


Figure 12.1
A schematic diagram of an electric circuit comprising – cell, electric bulb, ammeter and plug key

2. Draw the circuit diagram used to verify Ohm`s law.

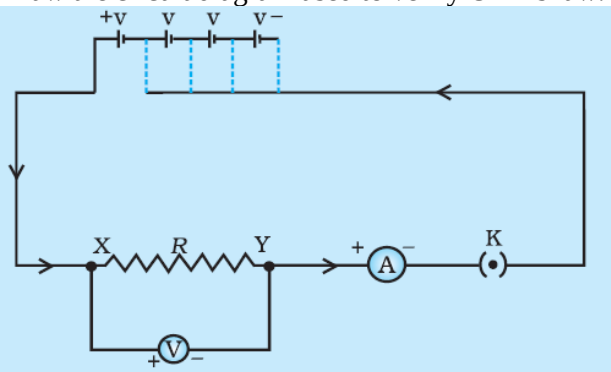


Figure 12.2 *Electric circuit for studying Ohm's law*

3. Draw the tabular column used to verify Ohm`s law

Sl No	Number of cells used in the circuit	Current through the nichrome wire, I (ampere)	Potential difference across the nichrome wire, V(volt)	V/I (Volt/ampere)
1	1			
2	2			
3	3			
4	4			

4. Draw the nature of the graph obtained to verify Ohm`s law

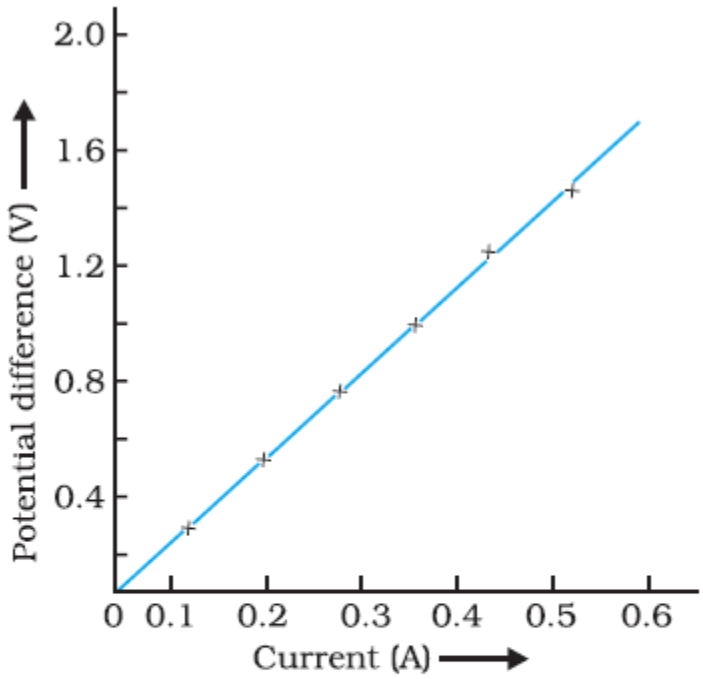


Figure 12.3
V–I graph for a nichrome wire. A straight line plot shows that as the current through a wire increases, the potential difference across the wire increases linearly – this is Ohm's law.

Formulas of Chapter Electricity

✓ **I _** ✓ **V=__** ✓ ***V=IR*** ✓ ***R= _*** ✓ ***P=V_= VI=I²R=__*** ✓ ***H=VIt*** ✓ ***H=I²Rt***	*I* → *Current(Ampere (A))* *V* → *Potential Difference (Volt(V))* *W* → *Work Done (Joule (J))* *Q* → *Net Charge (Coulomb (C))* *t* → *time (Second (Sec))* *R* → *Resistance (Ohm( ))* *(rho)* → *Resistivity (Ohm meter( ))* → *length (meter(m))* *A* → *Area of cross-section* *P* → *Power (Watt(W))* *H* → *Heat Produced(Joule (J))*
Connection in Series *(Current (I) is constant)* • $V=V_1+V_2+V_3$ • $V=IR$ • $IR=I_1R_1+I_2R_2+I_3R_3$ • $R_S=R_1+R_2+R_3$	*V* → *Total Potential Difference* V_1,V_2,V_3 → *Individual Potential Difference* *I* → *Current* R_S → *Total Resistance in series* R_1, R_2,R_3 → *Individual Resistance*
Connection in Parallel *(Potential Difference (V) is Constant)* • $I=I_1+I_2+I_3$ • *I=__* • __ = __ __ __	*I* → *Total Current* V_1,V_2,V_3 → *Individual Potential Difference* R_P → *Total Resistance in parallel* R_1, R_2,R_3 → *Individual Resistance*

MAGNETIC EFFECT OF ELECTRIC CURRENT

1. What is north seeking or North Pole?

Ans:- The end of magnet pointing towards north is called north seeking or north pole.

2. What is south seeking or South Pole?

Ans:- The end of magnet pointing towards south is called south seeking or south pole.

3. What is compass needle?

Ans:- A compass needle is a small bar magnet, the end of the compass needle point approximately towards north and south directions.

4. Why does a compass needle get deflected when brought near a bar magnet?

Ans:- A compass needle is a small bar magnet. When it is brought near a bar magnet, its magnetic field lines interact with that of the bar magnet. Hence, a compass needle shows a deflection when brought near the bar magnet.

5. What is magnetic field?

Ans:- The region surrounding a magnet, in which the force of the magnet can be detected or experienced is called magnetic field.

The S.I. unit of magnetic field is oersted.

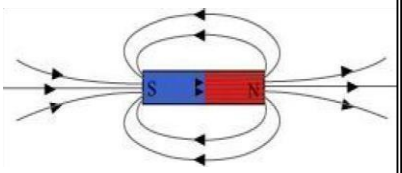
6. Name the scientist who first establish the connection between electricity and magnetism.

Ans: Hans Christian Oersted

7. What are magnetic field lines?

Ans:- The lines along which the iron filings align themselves represent the magnetic field lines.

8. Draw magnetic field lines around a bar magnet.



9. Explain the properties of magnetic field (lines).

Ans:- i. It is a quantity that has both direction and magnitude (vector quantity).

ii. The magnetic field lines emerge from North Pole and merge at the South Pole.

iii. Inside the magnet, the direction of field lines is from its south pole to its north pole.

iv. The relative strength of the magnetic field is shown by the degree of closeness of the field lines.

v. No two field lines are found to cross each other.

10. Why don't two magnetic lines of force intersect each other?

Ans: If two field lines of a magnet intersect, then at the point of intersection, the compass needle points in two different directions. This is not possible. Hence, two field lines do not intersect each other.

11. How can it be shown that a magnetic field exists around a wire through which direct electric current is passing?

Ans:- A magnetic needle brought close to a straight current carrying wire Aligns itself perpendicular to the wire, reversing the direction of current reverses the direction of deflections. This shows that the current carrying wire is associated with a magnetic field.

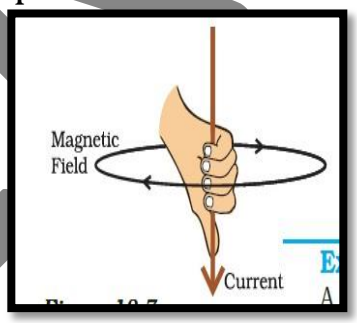
12. List three sources of magnetic field.

Ans: a) Magnetic field due to a bar magnet.

b) Magnetic field due to current-carrying conductor.

c) Magnetic field due to current carrying circular loop.

13. State Right hand thumb rule or Maxwell's Corkscrew rule.



Ans: Imagine that you are holding a current-carrying straight conductor in your right hand such that the thumb points towards the direction of current. Then your fingers will wrap around the conductor in the direction of the field lines of the magnetic field, as shown in figure. This is known as right hand thumb rule.

14. A current through a horizontal power line flows in east to west direction. What is the direction of magnetic field at a point directly below it and at a point directly above it?

Ans: The current is in the east-west direction. Applying the right-hand thumb rule, we get that the magnetic field (at any point below or above the wire) turns clockwise in a plane perpendicular to the wire when viewed from the east end, and anti-clockwise, when viewed from the west end.

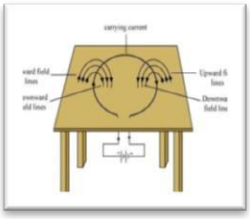
15. How does the magnitude of the magnetic field produced by straight current carrying conductor vary?

Ans:- The magnitude field produced at a given point is

a) Directly proportional to the current passing through the wire.

b) Inversely proportional to the distance of that point from the wire.

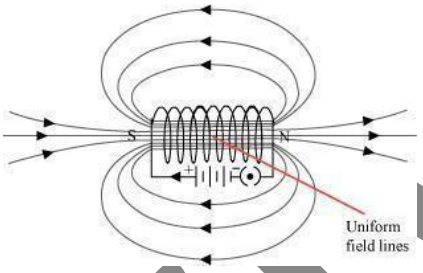
16. Consider a circular loop of wire lying in the plane of the table. Let the current pass through the loop clockwise. Apply the right-hand rule to find out the direction of the magnetic field inside and outside the loop.



Answer: For downward direction of current flowing in the circular loop, the direction of magnetic field lines will be as if they are emerging from the table outside the loop and merging in the table inside the loop. Similarly, for upward direction of current flowing in the circular loop, the direction of magnetic field lines will be as if they are emerging from the table outside the loop and merging in the table inside the loop, as shown in the given figure.

17. The magnetic field in a given region is uniform. Draw a diagram to represent it (through solenoid).

Answer: The magnetic field lines inside a current-carrying long straight solenoid are uniform.



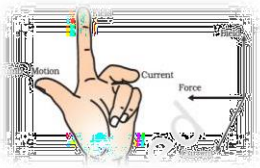
18. Describe the magnetic field in Solenoid.

- **Ans:-** The coil of many circular turns of insulated copper wire wrapped closely in the shape of a cylinder is called a solenoid.
- The magnetic field in the solenoid is similar to that of the bar magnetic.
- The field lines inside the solenoid are in the form of parallel straight lines that indicates that the magnetic field is the same (uniform) at all points inside the solenoid.

19. Define electromagnet.

Ans: A strong magnetic field produced inside a solenoid can be used to magnetise a piece of magnetic material, like soft iron, when placed inside the coil. The magnet so formed is called an electromagnet.

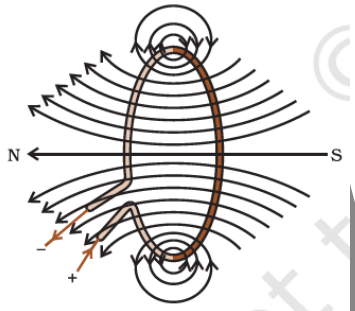
20. Explain Fleming's left-hand rule.



Ans: Fleming's left-hand rule. According to this rule, stretch the thumb, forefinger and middle finger of your left hand such that they are mutually perpendicular. If

the forefinger points in the direction of magnetic field and the middle finger in the direction of current, then the thumb will point in the direction of motion or the force acting on the conductor.

21. Draw the magnetic field lines of the field produced by a current carrying circular loop.



Ans:

22. How does the strength of the magnetic field at the center of a circular coil of wire depend on a) the radius of the coil. B) the number of turns of wire on the coil and c) the strength of current flowing in the coil?

Ans: The magnetic field produced at the centre of circular coil carrying current depends on.

i) It is inversely proportional to the radius of the coil.

ii) It is directly proportional to the number of turns of the coil.

iii) It is directly proportional to the strength of current passing through the coil.

23. On what factors does the strength of the magnetic field produced by a current carrying solenoid depend?

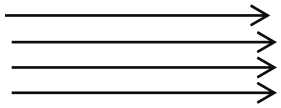
Ans: i) Number of turns of the solenoid (n): The larger the number of turns in the solenoid. Stronger is the magnetic field produced.

ii) Strength of the current(I): Larger the current passed through the solenoid, stronger is the magnetic field produced.

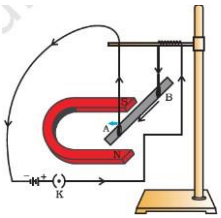
iii)Nature of the core material: By winding the coil over a soft iron cylinder, the magnetic field can be increased several times.

24. The magnetic field in a given region is uniform. Draw a diagram to represent it.

Ans:



25. How do we think the displacement of rod AB will be affected if (i) current in rod AB is increased; (ii) a stronger horse-shoe magnet is used; and (iii) length of the rod AB is increased?



Ans: i) If the current in the rod AB is increased, force also increases.

ii) When a stronger horse-shoe magnet is used, magnetic field increases as a result force also increases.

iii) If the length of the rod AB is increased, force also increased.

26. The two main organs in the human body where the magnetic field produced is significant are the **heart** & **brain.**

27. Expand MRI:- Magnetic Resonance Imaging.

28. On what factors does the direction of force on the conductor depend?

Ans: The direction of the force on the conductor depends upon the direction of current and the direction of the magnetic field.

29. What is an electric motor?

Ans:- An electric motor is a rotating device that converts electrical energy to mechanical energy.

30. What kind of energy transformation takes place in an electric motor? Name two devices which use electric motor as an essential component of working.

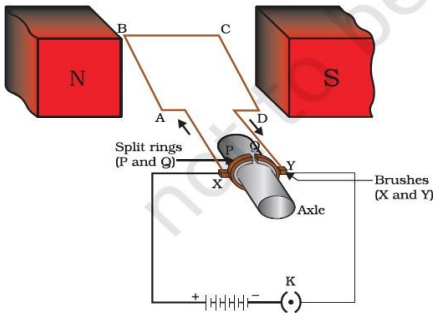
Ans: In an electric motor, electrical energy is converted into mechanical energy. Electric motor is used in electric fan, washing machine etc.

31. What is the principle of an electric motor?

Ans: An electric motor works on the principle that a current carrying conductor placed in a magnetic field experiences a force.

The direction of the force is given by Fleming's left hand rule.

32. Draw the neat labeled diagram of Electric Motor and explain its construction.



Ans: An electric motor, as shown in Figure, consists of a rectangular coil ABCD of insulated copper wire. The coil is placed between the two poles of a magnetic field

such that the arm AB and CD are perpendicular to the direction of the magnetic field. The ends of the coil are connected to the two halves P and Q of a split ring. The inner sides of these halves are insulated and attached to an axle. The external conducting edges of
P and Q touch two conducting stationary brushes X and Y, respectively, as shown in figure.

33. Define commutator.

Ans: A device that reverses the direction of flow of current through a circuit is called commutator.
In electric motors the split ring acts as a commutator.

34. Define Armature.

Ans: In electric motor, the soft iron core, on which the coil is wound, plus the coils, is called an armature. It enhances the power of motor.

35. What is the role of the split ring in an electric motor?

Ans: The split ring in the electric motor acts as a commutator. The commutator reverses the direction of current flowing through the coil after each half rotation of the coil. Due to this reversal of the current, the coil continues to rotate in the same direction.

36. How can the speed of rotation of the armature coil of an electric motor be increased?

Ans: The speed of rotation of the armature coil can be increased by increasing:

a) The strength of the magnetic field.
b) The number of turns in the coil.
c) The current in the coil.

37. Who studied that moving magnet can be used to generate electric currents.

Ans: English Physicist Michael Faraday.

38. Explain Faraday's experiment to illustrate the phenomenon of electromagnetic induction.

Ans: Faraday wound a long copper wire, on a cardboard cylinder. The ends of the wire were connected to a galvanometer. Faraday thrust a pole of a bar magnet quickly into the coil. The galvanometer showed the presence of an electric current through deflection. He pulled the magnet out of the coil. The pointer of the galvanometer deflected, showing the presence of an electric current pointer moved in the opposite direction. The amount of deflection was found to increase with the increase in

speed of the magnet. He found that when the magnet was at rest inside the coil, no electricity was produced. He repeated the experiment in a different way, moving the coil and keeping the magnet still. The result was the same. Thus, he discovered how magnetism could produce electricity. Relative motion between the conductor and the magnet produces electricity in the conductor.

39. Explain different ways to induce current in a coil.

Ans: The different ways to induce current in a coil are as follows:

(a) If a coil is moved rapidly between the two poles of a horse-shoe magnet, then an electric current is induced in the coil.

(b) If a magnet is moved relative to a coil, then an electric current is induced in the coil.

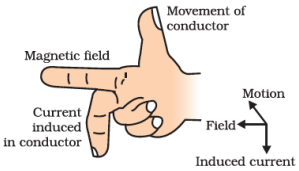
40. Two circular coils A and B are placed closed to each other. If the current in the coil A is changed, will some current be induced in the coil B? Give reason.

Ans: Two circular coils A and B are placed close to each other. When the current in coil A is changed, the magnetic field around coil b also changes. This change in magnetic field lines around coil B induces an electric current in it. This is called electromagnetic induction.

41. Define Electromagnetic induction.

Ans: The process by which a change in the magnetic field in a conductor induces a current in another conductor is called electromagnetic induction.

42. Explain Fleming's Right hand rule.



Ans: Stretch the thumb, forefinger and middle finger of right hand so that they are perpendicular to each other, as shown in Figure. If the forefinger indicates the direction of the magnetic field and the thumb shows the direction of motion of conductor, then the middle finger will show the direction of induced current. This simple is called Fleming's right-hand rule.

43. State the principle of an electric generator.

Ans: An electric generator works on the principle of electromagnetic induction. It generates electricity by rotating a coil in a magnetic field.

44. Name some sources of direct current.

Ans: Some sources of direct current are cell, DC generator, etc.

45. Which sources produce alternating current?

Ans: AC generators, power plants, etc., produce alternating current.

46. Explain the underlying principle and working of an electric generator by drawing a labeled diagram. What is the function of brushes?

Ans: An electric generator converts mechanical energy into electrical energy.

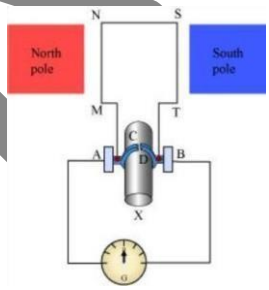
The principle of working of an electric generator is that when a loop is moved in a magnetic field, an electric current is induced in the coil. It generates electricity by rotating a coil in a magnetic field. The following figure shows a simple AC generator.

MNST → Rectangular coil

A and B → Brushes

C and D → Two slip rings

X → Axle, G → Galvanometer

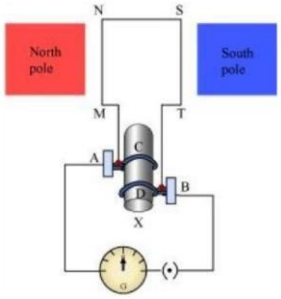


If axle X is rotated clockwise, then the length MN moves upwards while length ST moves downwards. Since the lengths MN and ST are moving in a magnetic field, a current will be induced in both of them due to electromagnetic induction. Length MN is moving upwards and the magnetic field acts from left to right. Hence, according to Fleming's right hand rule, the direction of induced current will be from M to N. Similarly, the direction of induced current in the length ST will be from S to T.

The direction of current in the coil is MNST. Hence, the galvanometer shows a deflection in a particular direction. After half a rotation, length MN starts moving down whereas length ST starts moving upward. The direction of the induced current in the coil gets reversed as TSNM. As the direction of current gets reversed after each half rotation, the produced current is called an alternating current (AC).

Direct Current

To get a unidirectional current, instead of two slip rings, two split rings are used, as shown in the following figure.



In this arrangement, brush A always remains in contact with the length of the coil that is moving up whereas brush B always remains in contact with the length that is moving down. The split rings C and D act

as a commutator.

The direction of current induced in the coil will be MNST for the first rotation and TSNM in the second half of the rotation. Hence, a unidirectional current is produced from the generator called DC generator. The current is called AC current.

47. Define alternating Current.

Ans: If the current changes its direction after equal interval of time is called alternating current.

48. Define direct current.

Ans: A current in which the magnitude and the direction do not change with time is called direct current.

49. What is the meaning of the term frequency of an alternating current? What is its value in India?

Ans: The frequency of an alternating current is the number of times the direction of electric current changes in one second. In India the frequency of A.C. is 50Hz.

50. Why is an alternating current considered to be advantageous over direct current for long range transmission of electrical energy?

Ans: The generation of A.C. is more economical than D.C.

Only alternating voltage can be stepped up or stepped down by using transformer. This makes AC more suitable than DC for transmission of electric power over long distances without much loss of energy.

51. What type of electricity is supplied to our homes?

a) The type of current

b) The voltage supplied

c) Frequency of current supplied.

Ans: a) Alternating Current (A.C.)

b) 220V

c)50Hz

52. Why do we use power supply of two different current rating at our homes?

Ans: Different appliances have different power rating.

The 5 Ampere current rating is used for electric bulb, fans etc.

The 15 Ampere current rating is used for heater, geysers, air conditioners, electric iron box, etc.

53. What is live wire?

Ans: The wire which is at 220V potential is called live wire.

54. What is neutral wire?

Ans: The wire which is at 0V potential is called neutral wire.

55. What is earth wire?

Ans: A wire which is usually connected to a metal plate deep in the earth near the house is called earth wire.

56. Write the colour code of the wires used in a common domestic circuit.

Ans: Live wire—Red, Neutral Wire—Black and Earth wire--Green

57. What is the function of an earth wire? Why is it necessary to earth the metallic appliances?

Ans: Earthing of an electrical appliance means connecting the metallic body of the high powered appliance to the earth through the earth wire of the domestic circuit. The earth wire is green in colour.

This prevents any electric shock to the user. That is why earthing of the electrical appliances is necessary.

58. What is an electric shock?

Ans:- When a person comes in contact with the live wire, electric current passes through the body to the earth. The person gets an electric shock.

59. Why should various appliances be connected parallel to each other in the domestic circuit?

Ans: In order that each appliance has equal potential difference, they are connected parallel to each other.

60. What is electric fuse?

Ans: Electric fuse consists of a piece of wire made up of a metal or an alloy of appropriate melting point, for example aluminum, copper, iron and lead etc… If a current larger than the specified value flows through the circuit, the temperature of the fuse wire increases. This melts the fuse wire and breaks the circuit.

61. What is the principle of fuse?

Ans: The Joule heating that takes place in the fuse melts it to break the electric circuit.

62. When does an electric short circuit occur?

Ans: If the resistance of an electric circuit becomes very low, then the current flowing through the circuit becomes very high. This is caused by connecting too many appliances to a single socket or connecting high power rating appliances to the light circuits. This results in a short circuit. When the insulation of live and neutral wires undergoes wear and tear and

then touches each other, the current flowing in the circuit increases abruptly. Hence, a short circuit occurs.

63. State the rule to determine the direction of a (i) magnetic field produced around a straight conductor-carrying current, (ii) force experienced by a current-carrying straight conductor placed in a magnetic field which is perpendicular to it, and (iii) current induced in a coil due to its rotation in a magnetic field.

Ans: (i) Maxwell's right hand thumb rule
(ii) Fleming's left hand rule
(iii) Fleming's right hand rule

64. What is the function of the main switch in domestic circuits?

Ans: The main switch is used to switch off the main supply required at the time of repairing or any other emergency.

65. What are the causes for overloading of domestic circuit?

Ans: a) Overloading occurs when the insulation of wires is damaged or there is fault in the appliance.
b) Overloading can also occur due to an accidental hike in the supply of voltage.
c) Sometimes overloading is caused by connecting too many appliances to single socket.

66. What precaution should be taken to avoid the overloading of domestic electric circuits?

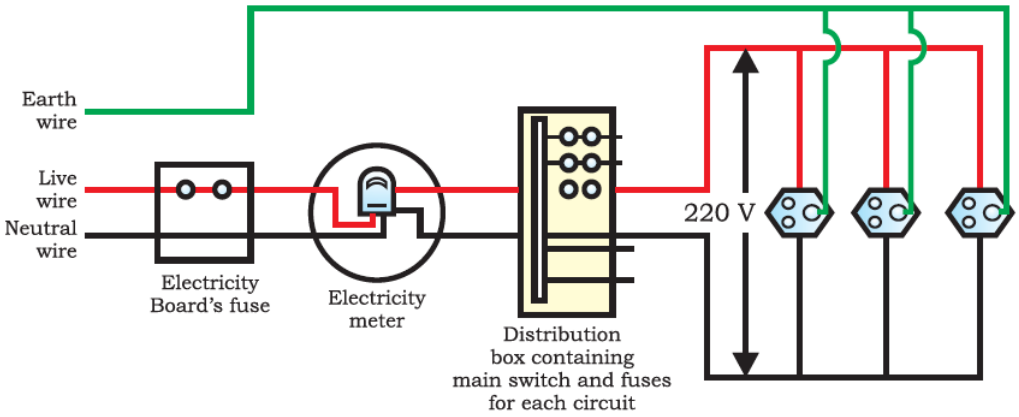
Ans; The precautions that should be taken to avoid the overloading of domestic circuits are as follows:
(a) Too many appliances should not be connected to a single socket.
(b) Too many appliances should not be used at the same time.
(c) Faulty appliances should not be connected in the circuit.
(d) Fuse should be connected in the circuit.

68. Name two safety measures commonly used in electric circuits and appliances.

Ans: Two safety measures commonly used in electric circuits and appliances are as follows:
(i) Each circuit must be connected with an electric fuse. This prevents the flow of excessive current through the circuit. When the current passing through the wire exceeds the maximum limit of the fuse element, the fuse melts to stop the flow of current through that circuit, hence protecting the appliances connected to the circuit.

(ii) Earthing is a must to prevent electric shocks. Any leakage of current in an electric appliance is transferred to the ground and people using the appliance do not get the shock.

69. A schematic diagram of one of the common domestic circuits



70. List three methods of producing magnetic fields.

Ans: Three methods of producing magnetic fields are as follows.

a) Current carrying conductors.
b) Permanent magnets.
c) Electromagnets

<u>Choose the correct answer from the given alternatives.</u>

1. The magnetic field inside a long straight solenoid-carrying current

(a) is zero (b) decreases as we move towards its end
(c) increases as we move towards its end (d) is the same at all points

Ans: (d) The magnetic field inside a long, straight, current-carrying solenoid is uniform. It is the same at all points inside the solenoid.

2. Which of the following property of a proton can change while it moves freely in a magnetic field? (There may be more than one correct answer.)

(a) mass (b) speed (c) velocity (d) momentum

Ans: (c) and (d)

When a proton enters in a region of magnetic field, it experiences a magnetic force. As a result of the force, the path of the proton becomes circular. Hence, its velocity and momentum change.

3. A rectangular coil of copper wires is rotated in a magnetic field. The direction of the induced current changes once in each

(a) two revolutions (b) one revolution
(c) half revolution (d) one-fourth revolution

Ans: (c) When a rectangular coil of copper is rotated in a magnetic field, the direction of the induced current in the coil changes once in each half revolution. As a result, the direction of current in the coil remains the same.

4. Which of the following correctly describes the magnetic field near a long straight wire?

(a) The field consists of straight lines perpendicular to the wire
(b) The field consists of straight lines parallel to the wire
(c) The field consists of radial lines originating from the wire
(d) The field consists of concentric circles centred on the wire

Ans: (d) The magnetic field lines, produced around a straight current-carrying conductor, are concentric circles. Their centres lie on the wire.

5. The phenomenon of electromagnetic induction is

(a) the process of charging a body
(b) the process of generating magnetic field due to a current passing through a coil
(c) producing induced current in a coil due to relative motion between a magnet and the coil
(d) the process of rotating a coil of an electric motor

Ans: (c) When a straight coil and a magnet are moved relative to each other, a current is induced in the coil. This phenomenon is known as electromagnetic induction.

6. The device used for producing electric current is called a

(a) generator (b) galvanometer (c) ammeter (d) motor

Answer: (a) An electric generator produces electric current. It converts mechanical energy into electricity.

7. The essential difference between an AC generator and a DC generator is that

(a) AC generator has an electromagnet while a DC generator has permanent magnet.
(b) DC generator will generate a higher voltage.
(c) AC generator will generate a higher voltage.
(d) AC generator has slip rings while the DC generator has a commutator.

Answer: (d) An AC generator has two rings called slip rings. A DC generator has two half rings called commutator. This is the main difference between both the types of generators.

8. At the time of short circuit, the current in the circuit

(a) Reduces substantially (b) does not change

(c) increases heavily (d) vary continuously

Answer: (c) When two naked wires of an electric circuit touch each other, the amount of current that is flowing in the circuit increases abruptly. These causes short-circuit.

9. State whether the following statements are true or false.

(a) An electric motor converts mechanical energy into electrical energy.

(b) An electric generator works on the principle of electromagnetic induction.

(c) The field at the centre of a long circular coil carrying current will be parallel straight lines.

(d) A wire with a green insulation is usually the live wire of an electric supply.

Ans: (a) False

An electric motor converts electrical energy into mechanical energy.

(b) True

A generator is an electric device that generates electricity by rotating a coil in a magnetic field. It works on the principle of electromagnetic induction.

(c) True

A long circular coil is a long solenoid. The magnetic field lines inside the solenoid are parallel lines.

(d) False

Live wire has red insulation cover, whereas earth wire has green insulation colour in the domestic circuits.

10. Choose the incorrect statement from the following regarding magnetic lines of field.

a) The direction of magnetic field at a point is taken to be the direction in which the north pole of a magnetic compass needle points.

b) Magnetic field lines are closed curves.

c) If magnetic field lines are parallel and equidistant, they represent zero field strength.

d) Relative strength of magnetic field is shown by the degree of closeness of the field lines.

11. Commercial electric motors do not use

a) An electromagnet to rotate the armature.

b) Effectively large number of turns of conducting wire in the current carrying coil.

c) A permanent magnet to rotate the armature.

d) A soft iron core on which the coil is wound.

12. The strength of magnetic field inside a long current carrying straight solenoid is.

a) More at the ends than at the centre. b) Minimum in the middle

c) Same at all points d) Found to increase from one end to the other.

13. To convert an AC generator into Dc generator

a) slip rings and brushes must be used

b) Split ring type commutator must be used

c) A stronger magnetic field has to be used

d) A rectangular wire loop has to be used

14. A positively-charged particle (alpha-particle) projected towards west is deflected towards north by a magnetic field. The direction ofmagnetic field is

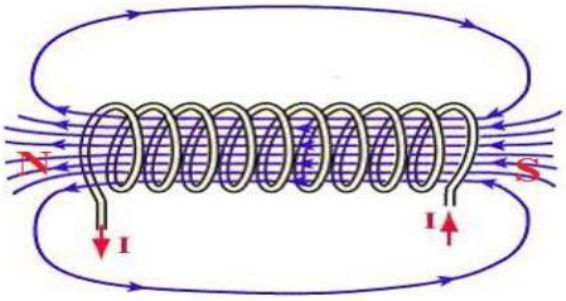
(a) towards south (b) towards east

(c) downward (d) upward

(d) upward

Ans: In accordance with Fleming's left-hand rule, the direction of magnetic field is vertically upward.

71. How does a solenoid behave like a magnet? Can you determine the north and south poles of a current–carrying solenoid with the help of a bar magnet? Explain.



Ans: When current is passed through a solenoid coil, magnetic field produced due to each turn of solenoid coil is in the same direction. As a result, the resultant magnetic field becomes very strong and uniform. The field lines inside the solenoid are in the form of parallel straight lines along the axis of solenoid. Thus, the solenoid behaves like a bar magnet. One end of solenoid behaves as a magnetic North pole while the other end behaves as the South Pole.

We can determine the magnetic poles formed in a solenoid. The end of the current-carrying solenoid, which attracts North Pole but repels South Pole of a bar magnet, is behaving as south magnetic pole. The other end, which

attracts South Pole of a bar magnet but repels the North Pole, is behaving as north magnetic pole. It is because like poles repel but unlike poles attract each other.

72. Name some devices in which electric motors are used.

Ans: Electric motors are used in all such devices where we want to convert electrical energy into mechanical energy so as to drive that machine. In our houses, electric motors are being fitted in electric fans, coolers, air conditioners, mixer grinders, washing machines, refrigerators, juicers, computers etc. In factories, motors are used in almost all machines.

73. A coil of insulated copper wire is connected to a galvanometer. What will happen if a bar magnet is (i) pushed into the coil, (ii) withdrawn from inside the coil, (iii) held stationary inside the coil?

Ans: A current induces in a solenoid if a bar magnet is moved relative to it. This is the principle of electromagnetic induction.

(i) When a bar magnet is pushed into a coil of insulated copper wire, a current is induced momentarily in the coil. As a result, the needle of the galvanometer deflects momentarily in a particular direction.

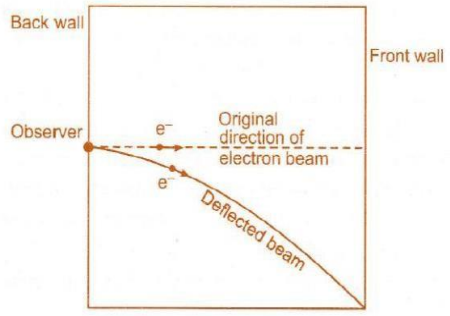
(ii) When the bar magnet is withdrawn from inside the coil of the insulated copper wire, a current is again induced momentarily in the coil in the opposite direction. As a result, the needle of the galvanometer deflects momentarily in the opposite direction.

(iii) When a bar magnet is held stationary inside the coil, no current will be induced in the coil. Hence, galvanometer will show no deflection.

74. When is the force experienced by a current–carrying conductor placed in a magnetic field largest?

Ans: The force experienced by a current-carrying conductor placed in a magnetic field is largest when the current-carrying conductor is placed in a direction perpendicular to that of magnetic field.

75. Imagine that you are sitting in a chamber with your back to one wall. An electron beam, moving horizontally from back wall towards the front wall, is deflected by a strong magnetic field to your right side. What is the direction of magnetic field?



An electron beam moving horizontally from back wall towards the front wail is equivalent

to a current flowing in the opposite direction (i.e., from front wall towards the back wall). The deflection of electron beam as seen by observer is to his right side and is shown in Figure. On applying Fleming's left-hand rule we find that the magnetic field is acting in vertically downward direction.

14. A positively-charged particle (alpha-particle) projected towards west is deflected towards north by a magnetic field. The direction of magnetic field is

(a) towards south (b) towards east
(c) downward (d) upward
(d) upward

Ans: In accordance with Fleming's left-hand rule, the direction of magnetic field is vertically upward.

75. An electric oven of 2 kW power rating is operated in a domestic electric circuit (220 V) that has a current rating of 5 A. What result do you expect? Explain.

Ans:

Power rating of electric oven P = 2 kW = 2000 W
Supply voltage V = 220 V
So, the current drawn by electric oven $I = PV = 2000\ W 220\ V = 9\ A$
As the current rating of domestic electric circuit is only 5 A and the oven draws a current 9 A, which is more than the current rating, hence the circuit will be damaged due to overheating/overloading.

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Light-Reflection and Refraction

1) How do we see things around us?

Ans:- The light helps us to see objects. An object reflects light that falls on it. This reflected light, when received by our eyes, enables us to see things.

2) Define diffraction.

Ans:- If an opaque object on the path of light becomes very small, light has a tendency to bend around it and not walk in a straight line this effect is known as the diffraction of light.

3) What does quantum theory say about light?

Ans:- Quantum theory of light says light is neither a 'wave' nor a 'particle' the quantum theory reconciles the particle properties of light with the wave nature.

4) Define reflection of light. List the laws of reflection of light.

Ans:- Light ray falling on smooth surface and bouncing back is called reflection of light.

(i) The angle of incidence is equal to the angle of reflection

(ii) The incident ray, the normal to the mirror at the point of incidence and the reflected ray, all lie in the same plane.

5) Define refraction of light.

Ans:- When light travelling obliquely from one medium to another, the direction of propagation of light in the second medium changes. This phenomenon is known as refraction of light.

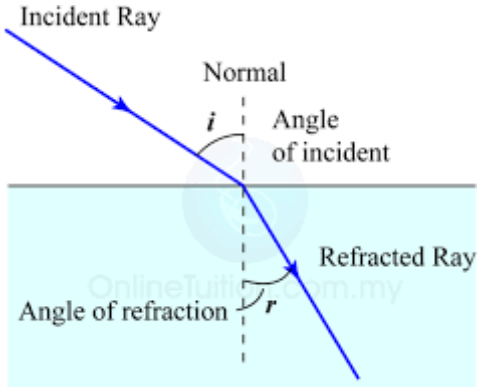
6) Explain the causes for refraction of light.

Ans:- When a light travels from one medium to another, refraction takes place.

A ray of light bends as it moves from one medium to another

Refraction is due to ***change in the speed of light*** as it enters from one transparent medium to another.

Speed of light decreases as the beam of light travel from rarer medium to the denser medium.



Speed of light increases as it travels from denser medium to rarer medium.

When ray travel from Rarer to Denser it bends towards normal after refraction.

When ray travel from denser to rarer medium it bends away from normal after refraction.

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7) List Some Commonly observed phenomenon due to Refraction

1. The stone at the bottom of water tub appear to be raised.
2. A fish kept in aquarium appear to be bigger than its actual size.
3. A pencil partially immersed in water appears to be displaced at the interface of air and water.

8) List the laws of refraction of light.

Ans:- The laws of refraction of light are:-

(i) The incident ray, the refracted ray and the normal to the interface of two transparent media at the point of incidence, all lie in the same plane.

Definition of Snell`s law

(ii) The ratio of sine of angle of incidence to the sine of angle of refraction is a constant, for the light of a given colour and for the given pair of media.

This law is also known as Snell's law of refraction.

If i is the angle of incidence and r is the angle of refraction, then,

$$\frac{\quad}{\quad} = \text{Constant}$$

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

9) What do you mean by refractive index?

Ans:- If *c* is the speed of light in air and *v* is the speed of light in the medium, then, the refractive index of the medium n_m is given by

$$n_m = \frac{\quad}{\quad} = \frac{\quad}{\quad}$$

The absolute refractive index of a medium is simply called its refractive index.

Here, speed of light in air is taken as $3 \times 10^8 ms^{-1}$

10) What is the refractive index of water and glass?

Ans:- Refractive index of Water n_w=1.33

Refractive index of Water n_g= 1.52

Note:- an optically denser medium may not possess greater mass density.

11) Define optical density.

Ans:- The ability of a medium to refract light is expressed in terms of its optical density.

12) When can we say that a medium is optically denser than the other?

Ans:- In comparing two media, the one with the larger refractive index is optically denser medium than the other. The other medium of lower refractive index is optically rarer.

13) What changes do you observe in light when it travels from rarer medium to a denser medium?

Ans:- The speed of light is higher in a rarer medium than a denser medium. Thus, a ray of light travelling from a rarer medium to a denser medium slows down and bends towards the normal.

When it travels from a denser medium to a rarer medium, it speeds up and bends away from the normal.

14) A ray of light travelling in air enters obliquely into water. Does the light ray bend towards the normal or away from the normal? Why?

Ans:- The light ray bends towards the normal. When a ray of light travels from an optically rarer medium to an optically denser medium, it gets bent towards the normal. Since water is optically denser than air, a ray of light travelling from air into the water will bend towards the normal.

15) The refractive index of diamond is 2.42. What is the meaning of this statement?

Ans:- The refractive index of diamond is 2.42. This suggests that the speed of light in diamond will reduce by a factor 2.42 compared to its speed in air.

16) Define lens.

Ans:- A transparent material bound by two surfaces, of which one or both surfaces are spherical, forms a lens.

17) What do you mean by convex lens?

Ans:- A lens may have two spherical surfaces, bulging outwards. Such a lens is called a double convex lens. It is simply called a convex lens.

It is thicker at the middle as compared to the edges.

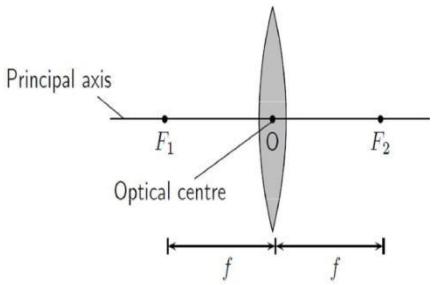
Convex lens converges light rays. Hence, convex lenses are called converging lenses.

18) What do you mean by convave lens?

Ans:- Concave lens is bounded by two spherical surfaces, curved inwards. It is thicker at the edges than at the middle. Such lenses diverge light. Such lenses are called diverging lenses.

19) Define the terms.

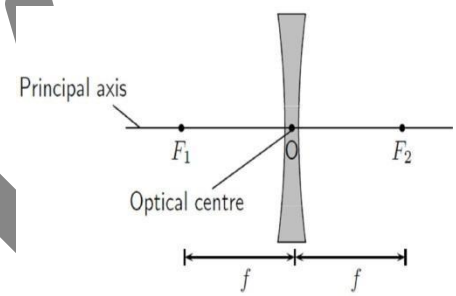
<u>Principal Axis:</u> The principal axis is the line which runs horizontally straight through the optical centre of the lens. It is also sometimes called the optic axis. In other words, an imaginary straight line passing through the two centres of the curvature of a lens is called its ***principal axis.***



Optical Centre: The optical centre (O) of a convexlens is usually the centre point of the lens. The direction of all light rays which pass through the optical centre, remains unchanged.

Centre of Curvature: A lens has two spherical surfaces. Each of these surfaces forms a part of a sphere. The centers of these spheres are called ***centres of curvatureof the lens***. The centre of curvature of a lens is usually represented by the letter C.Since there are two centre's of curvature, we may represent them as C_1 and C_2.

Aperture: The effective diameter of the circular outline of a spherical lens is called its ***aperture***. Lenses whose aperture is much less than its radius of curvature are called thin lenses with small aperture.



Focus: The focus or focal point of the lens is the position on the principal axis where all light rays that run parallel to the principal axis through the lens converge (come together) at a point. Since light can pass through the lens either from right to left or left to right, there is a focal point on each side of the lens (F_1 and F_2), at the same distance from the optical centre in each direction. (Note: the plural form of the word focus is foci.)

Focal Length: The focal length (f) is the distance between the optical centre and the focal point.

21) Write the lens formula and explain terms involved.

$$\frac{1}{\ } - \frac{1}{\ } = \frac{1}{\ }$$

The distance of the object from its pole is called the object distance (*u*)

The distance of the image from the pole of the mirror is called the image distance (*v*)

The distance of the principal focus from the pole is called the focal length (*f*)

22) Write the magnification formula for lens.

Magnification (m) = _____

m= —

The magnification *m* is also related to the object distance (*u*) and image distance (*v*). It can be expressed as:

m= — = –

23) What is speed of light in air?

Ans:- Light travels in vacuum with an enormous speed of 3×10^8 m s-1. The speed of lightis different in different media.

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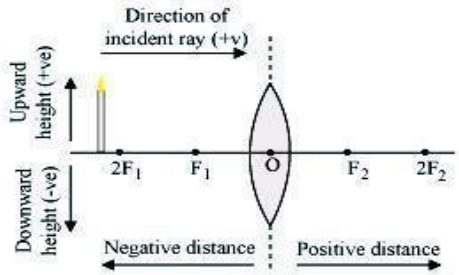
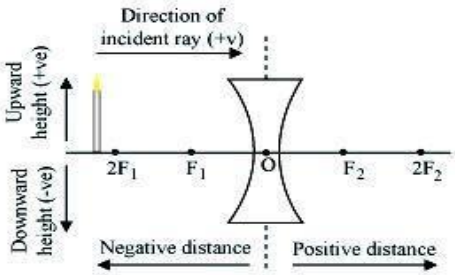
SIGN CONVENTION FOR SPHERICAL LENSES (needed to solve the numerical problems)

- All distances are measured from the optical centre of the lens.
- The distances measured in the same direction as the incident light are taken positive.
- The distances measured in the direction opposite to the direction of incident light are taken negative.
- Heights measured upwards and perpendicular to the principal axis are taken positive.
- Heights measured downwards and perpendicular to the principal axis are taken negative.



Convex mirror



Concave mirror

Consequences of new Cartesian sign convention:

- The focal length of a convex lens is positive and that of a concave lens is negative.
- Object distance u is always negative.
- The distance of real image is positive and that of virtual image is negative.
- The object height h is always positive. Height h' of virtual erect image is positive and that of real inverted image is negative.
- The linear magnification, m = h'/h is positive for a virtual image and negative for a real image.

Points to be remembered about magnification

- If the magnification 'm' has a positive value, the image is virtual and erect. And if the magnification 'm' has a negative value, the image will real and inverted.
- A convex lens can form virtual images as well as real images, therefore, the magnification produced by a convex lens can be either positive or negative.
- A convex can form images which are smaller than the object, equal to the object or bigger than the object, therefore magnification 'm' produced by a convex lens can be less than 1, equal to 1 or more than 1.

- A concave lens, however, forms only virtual images, so the magnification produced by a concave lens is always positive.
- A concave lens forms image which are always smaller than the object, so the magnification 'm' produced by a concave lens is always less than 1.

24)Write a note on power of lens.

Ans:- Def ^{n} :-The power of a lens is defined as the reciprocal of its focal length. It is represented by the letter *P*. The power *P* of a lens of focal length *f* is given by

f= $\frac{1}{}$

The degree of convergence or divergence of light rays achieved by a lens is expressed in terms of its power.

25) Define 1 dioptre of power of a lens.

The SI unit of power of a lens is 'dioptre'. It is denoted by the letter D. If *f* is expressed in metres, then, power is expressed in diopters Thus, 1 dioptre is the power of a lens whose focal length is 1 metre. $1D = 1m^{-1}$. The *power of a convex lens is positive and that of a concave lens is negative.*

26) Write a note net power of lens.

Ans:- Many optical instruments consist of a number of lenses. They are combined to increase the magnification and sharpness of the image. The net power (*P*) of the lenses placed in contact is given by the algebraic sum of the individual powers $P_1, P_2, P_3, \ldots$ as $P = P_1 + P_2 + P_3 + \ldots$

EXERCISE QUESTIONS

1) Which one of the following materials cannot be used to make a lens?

(a) Water (b) Glass (c) Plastic **(d) Clay**

Ans:A lens allows light to pass through it. Since clay does not show such property, it cannot be used to make a lens.

3) Where should an object be placed in front of a convex lens to get a real image of the size of the object?

a) At the principal focus of the lens

b) At twice the focal length

c) At infinity

d) Between the optical centre of the lens and its principal focus.

Ans: When an object is placed at the centre of curvature in front of a convex lens, its image is formed at the centre of curvature on the other side of the lens. The image formed is real, inverted, and of the same size as the object.

6) Which of the following lenses would you prefer to use while reading small letters found in a dictionary?

a) A convex lens of focal length 50 cm
b) A concave lens of focal length 50 cm
c) A convex lens of focal length 5 cm
d) A concave lens of focal length 5 cm

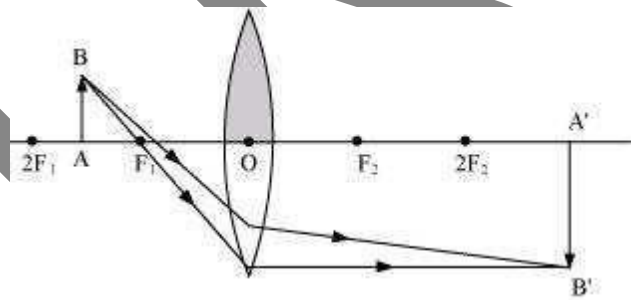
Ans.: (c) A convex lens gives a magnified image of an object when it is placed between the radius of curvature and focal length. Also, magnification is more for convex lenses having shorter focal length. Therefore, for reading small letters, a convex lens of focal length 5 cm should be used.

9) One-half of a convex lens is covered with a black paper. Will this lens produce a complete image of the object? Verify your answer experimentally. Explain your observations.

Ans:- The convex lens will form complete image of an object, even if its one half is covered with black paper. It can be understood by the following two cases.

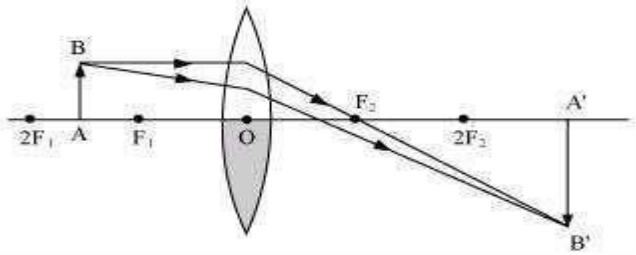
Case I

When the upper half of the lens is covered
In this case, a ray of light coming from the object will be refracted by the lower half of the lens. These rays meet at the other side of the lens to form the image of the given object, as shown in the following figure.



Case II

When the lower half of the lens is covered
In this case, a ray of light coming from the object is refracted by the upper half of the lens. These rays meet at the other side of the lens to form the image of the given object, as shown in the following figure.



10) The magnification produced by a plane mirror is +1. What does this mean?

Ans:- Magnification produced by a mirror is given by the relation

Magnification (m) =

The magnification produced by a plane mirror is +1. It shows that the image formed by the plane mirror is of the same size as that of the object. The positive sign shows that the image formed is virtual and erect.

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Formulas of Light-Reflection and Refraction

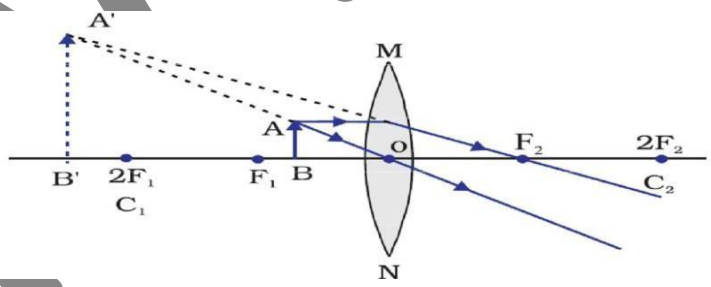
➢ R=2f	⟶ Radius of curvature
For Lens	⟶ focal length
➢ Lens formula	⟶ object distance
$\frac{1}{\_} - \frac{1}{\_} = \frac{1}{\_}$	⟶ Image distance
	⟶ Magnification
➢ m = __= _	⟶ Height of the image
➢ P= $\frac{1}{\_}$	⟶ Height of the object
	⟶ refractive index
	⟶
	⟶ Speed of light in the medium
	⟶ Power of lens

Ray diagram for convex lens

Case–1: Object is in between optical centre(O) and focus (F_1)

When the object is placed between optical centre(O) and focus(F_1), the image formed is

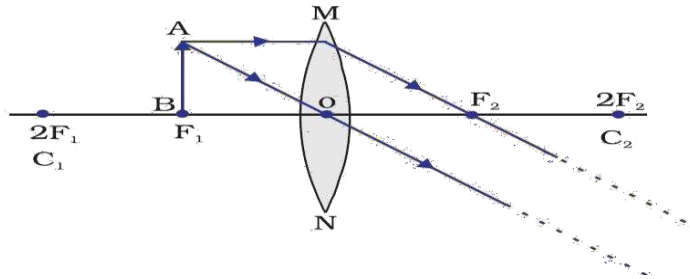
- behind the object (on th left side of lens)
- virtual and erect, and
- larger than the object (enlarged or magnified)



Case–2: Object is at the focus (F_1)

When the object is placed at the focus(F_1), the image formed is

- at infinity
- real and inverted, and
- highly enlarged



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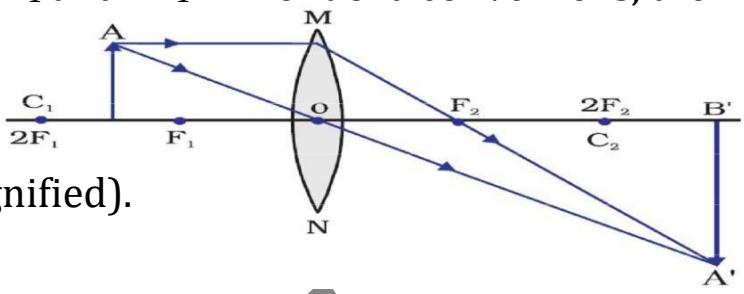
Case–3: Object is in between F_1 and $2F_2$

When the object is placed between F_1 and $2F_1$ in front of a convex lens, the image formed is

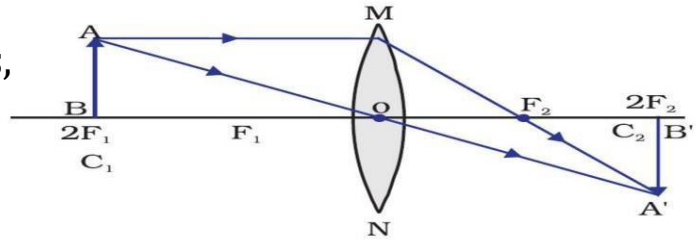
- beyond $2F_2$
- real and inverted, and
- larger than the object (or magnified).



Case–4: Object is at $2F_1$

When the object is placed at a distance $2f$ in front of convex lens, the image formed is

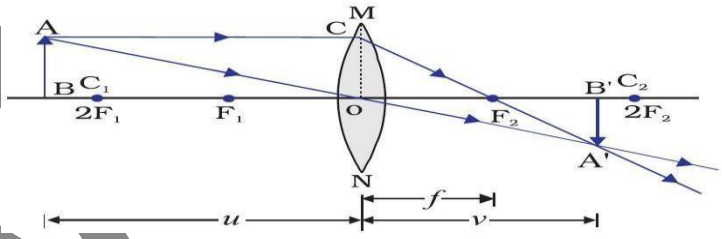
- at $2F_2$ on the other side of the lens,
- real and inverted, and
- of the same size as the object.



Case–5: Object is at beyond $2F_1$

When the object is placed beyond $2F_1$ in front of the convex lens, the image formed is

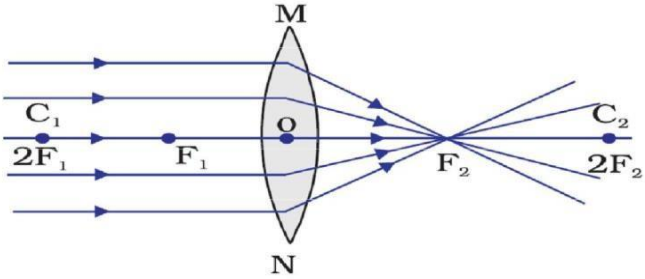
- between F_2 and $2F_2$ on the other side of the lens,
- real and inverted, and
- smaller than the object (or diminished)



Case–6: Object is at infinity

When the object is placed at the infinity, the image formed is

- at the focus F_2.
- real and inverted, and
- much smaller than the object (or highly diminished or point sized)

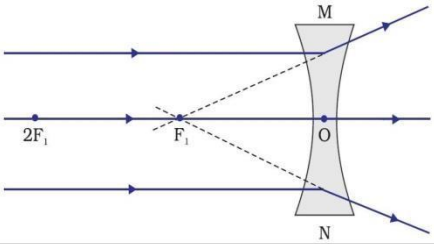


<u>Ray diagram of concave les</u>

Case–1: Object is at infinity

When the object is placed at the infinity, the image formed is

- at the focus F_1.
- virtual and erect, and
- much smaller than the object (or highly diminished or point sized)



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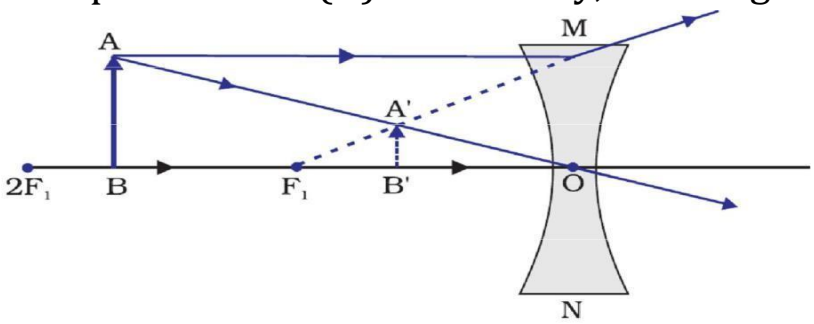
Case–2: Object is in between optical centre(O) and infinity

When the object is placed in between optical centre(O) and infinity, the image formed is

- between optical centre(O) and focus F_1.
- virtual and erect, and
- smaller than the object (or diminished)



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Sources of Energy

1. **Define law conservation of energy.**

Ans:-Energy can neither be created nor destroyed, but can be converted to one form to another form.

2. **Define Sources of energy.**

Ans:- A source of energy is that which is capable of providing enough useful energy at a steady rate over a long period of time.

3. **What is a good source of energy?**

OR

List out the characteristics of good sources of energy.

Ans:- A good source of energy fulfills following criteria:

i) The sources of energy would do a large amount of work per unit volume or mass.

ii) Be easily accessible.

iii) Be easy to store and transport.

iv) Most importantly, be economical.

v) It should cause less environmental pollution.

4. **What is a good fuel?**

Ans:- A good fuel produce huge amount of heat on burning, does not produce lot of smoke, and easily available.

5. **If you could use any source of energy for heating your food, which one would you use why?**

Ans:- We shall use LPG/CNG gas or electricity for heating our food because these are efficient ways of supplying energy. Thermal efficiency of the energy source is large, there is less pollution and the source can be used easily.

6. **<u>Wood</u>** was the most commonly used source of energy.

7. **Why are we looking at alternate sources of energy?**

Ans: Fossil fuels, which have been traditionally used by human beings as an energy sources, are non-renewable sources of energy.

These sources of energy are limited and cannot replenish on their own. They are being consumed at a large rate. If this rate of consumption continues, then the fossil fuels would be exhausted from the Earth. Therefore, we should look for alternate sources of energy.

8. **How has the traditional use of wind and water energy been modified for our convenience?**

Ans: To use energy of flowing water large dams are built in hilly regions to store huge amount of water at a height. The stored water from high level in

dam is carried through pipes to the turbine at the bottom of the dam and runs hydropower plant. Similarly, the wind energy is used to generate electricity. For the same purpose, the rotatory motion of windmill is used to tum the turbine of the electric generator.

9. How energy is generated in thermal power plant?

Ans: Large amount of fossil fuels are burnt every day in power stations to heat up water to produce steam which further runs the turbine to generate electricity.

10. Why thermal power plant is set up near coal or oil fields?

Ans:- The transmission of electricity is more efficient than transporting coal or petroleum over the same distance.

Therefore, many thermal power plants are set up near coal or oil fields.

11. What is Hydro power plant? How do they work?

Ans:- Hydro power plants are one which convert the potential energy of falling water to the electricity.

Working:- When the water flowing in a river is stored in a high rise dam and allowed to fall from the top of the dam. The water rushes down with a great force, which can be utilized to drive large water turbine. These turbines are connected with electric generators, which generate electric current.

The electricity generated in this process is termed as hydroelectricity. Infact the process involves transference of potential energy of the water into kinetic energy and then into electric energy.

12. Define Bio-mass.

Ans:- Biomass is defined as source of fuel obtained by plant and animal products.

13. What is charcoal? What are its advantage?

Ans:- When wood is burnt in a limited supply of oxygen, water and volatile materials present in it get removed and residue left behind is called charcoal.

The advantages of charcoal are:

i) It burns without flames
ii) It is comparatively smokeless
iii) It has higher heat generation efficiency.

14. How bio-gas (gobar-gas) is produced?

Ans:- Cow-dung, various plant materials like residue after harvesting the crops, vegetable waste and sewage are decomposed in the absence of oxygen to give bio-gas.

15. Define bio-gas? Is it a renewable source of energy?

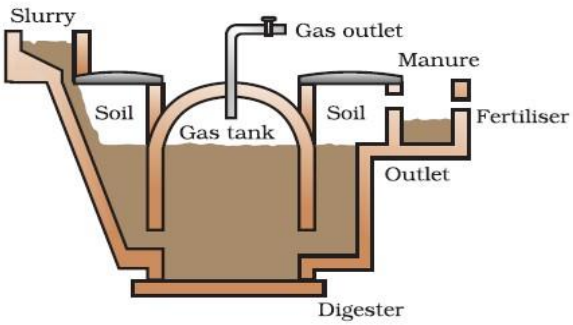
Ans:- Biogas:- Biogas is a mixture of gases produced by anaerobic

degradation of biomass in the presence of water but in the absence of oxygen.

It is a renewable source of energy on account of its production from vastly and continuously available organic wastes.

16. Explain the working of bio-gas plant. With diagram.

Ans:- The plant has a dome-like structure built with bricks. A slurry of cow-dung and water is made in the mixing tank from where it is fed into the digester. The digester is a sealed chamber in which there is no oxygen. Anaerobic micro-organisms that do not require oxygen decompose or break down complex compounds of the cow-dung slurry. It takes a few days for the decomposition process to be complete and generate gases like methane, carbon dioxide, hydrogen and hydrogen sulphide. The bio-gas is stored in the gas tank above the digester from which they are drawn through pipes for use.



17. List the advantages of Bio-gas plant.

Ans:- i) Bio-gas is an excellent fuel as it contains up to 75% methane.

ii) It burns without smoke.

iii) leaves no residue like ash in wood, charcoal and coal burning.

iv) Its heating capacity is high. Bio-gas is also used for lighting.

v) The slurry left behind is removed periodically and used as excellent manure, rich in nitrogen and phosphorous.

vi) The large-scale utilization of bio-waste and sewage material provides a safe and efficient method of waste-disposal besides supplying energy and manure.

18. Define windmill.

Ans:- A windmill essentially consists of a structure similar to a large electric fan that is erected at some height on a rigid support.

19. Define Wind energy form.

Ans:- A number of windmills are erected over a large area, is known as wind energy farm.

20. Denmark is called the country of wind, Why?

Ans:- Denmark is called the country of 'winds'. More than 25% of their electricity needs are generated through a vast network of windmills.

21. Where do you find the large installation of wind mills in India?

Ans:- Near Kanyakumari in Tamil Nadu

22. What is the principle of working of wind mill?

Ans:- Principle of utilization of wind energy: -

Wind energy is efficiently converted into electrical energy with the aid of a windmill. A windmill is a large fan having big blades, which rotate by the force exerted by moving wind on them. These blades remain continuously rotating as long as wind is blowing and can be used to drive a large number of machines like water pumps, flour mills etc. But these days a windmill is used to generate electric current which is used for various purposes and therefore wind power stations are established all over the world which convert wind energy directly into electrical energy.

23. List the basic criteria for setting up of wind mill. (Limitations)

Ans:-i) Wind energy farms can be established only at those places where wind blows for the greater part of a year.

ii) The wind speed should also be higher than 15 km/h to maintain the required speed of the turbine.

iii) There should be some back-up facilities to take care of the energy needs during a period when there is no wind.

iv) Requires large area of land.

v) The initial cost of establishment of the farm is quite high.

24. Can any source of energy be pollution-free? Why or why not?

Ans: No source of energy can be pollution-free. It is considered that solar cells are pollution-free. However, even their making causes environmental damage indirectly. Also, in the case of nuclear energy, there is no waste produced after the fusion reactions. However, it is not totally pollution-free. To start the fusion reactions, approximately 107 K temperature is required, which is provided by fission reactions. The wastes released from fission reactions are very hazardous. Hence, no source of energy is pollution-free.

25. Hydrogen has been used as a rocket fuel. Would you consider it a cleaner fuel than CNG? Why or why not?

Ans: Hydrogen can be considered a cleaner fuel because its burning produces water vapour which is non-polluting. However, due to explosive nature of hydrogen, its storage and transportation is difficult

26. Name two energy sources that you would consider to be renewable. Give reasons for your choices.

Ans: Solar energy, wind energy, ocean energy etc., are renewable sources of energy due to the following reasons:

i) These forms of energy are available in plenty in our natural environment in the form of continuous currents of energy.

ii) These energy sources will not be depleted because their supply is large and extraction of usable energy from these sources is negligible.

27. Give the names of two energy sources that you would consider to be exhaustible. Give reasons for your choices.

Ans: Coal and petroleum are two exhaustible sources of energy. These fuels were formed over millions of years ago and there are only limited reserves. If we continue to use them as at present, these reserves will be exhausted very soon.

Exercises

2. Which of the following is not an example of a bio-mass energy source?

(a) wood **(b) gobar-gas**

(c) nuclear energy **(d) coal**

Ans: (c) Bio-mass is a source of energy that is obtained from biodegradable natural things (plant materials and animal wastes). Nuclear energy is released during nuclear reactions like fission or fusion producing huge amount of energy. Hence, nuclear energy is not an example of bio-mass energy source. Wood is a plant material, Gobar gas is formed from animal dung and coal is a fossil fuel obtained from the buried remains of plants and animals. Hence, these are bio-mass products.

Hence, the option (c) is correct.

5. Compare and contrast bio-mass and hydroelectricity as sources of energy.

Ans: Bio-mass and hydro-electricity both are renewable sources of energy.

i) *Bio-mass* is derived from dead plants and animal wastes. Hence, it is naturally replenished. It is the result of natural processes. Wood, Gobar gas, etc. are some of the examples of bio – mass.

ii) *Hydro-electricity*, on the other hand, is obtained from the potential energy stored in water at a height (Making dams). Energy from it can be produced again and again. It is harnessed from water and obtained from mechanical processes.

8. What are the qualities of an ideal source of energy?

Ans: An ideal source of energy must be:

i) Economical

ii) Easily accessible
iii) Smoke/pollution free
iv) Easy to store and transport
v) Able to produce huge amount of heat and energy on burning

9. What are the advantages and disadvantages of using a solar cooker? Are there places where solar cookers would have limited utility?

Ans: Solar cooker uses Sun's energy to cook food stuff. It is inexhaustible, clean and renewable source of energy. It is free for all and available in unlimited amount. Hence, operating a solar cooker is not expensive.

Disadvantage of a solar cooker is that it (solar cooker) is very expensive. It works only in sunlight. Hence, on cloudy day, it becomes useless.

The places where the days are too short or places with cloud covers round the year, have limited utility for solar cooker.

10. What are the environmental consequences of the increasing demand for energy? What steps would you suggest to reduce energy consumption?

Ans:- Environmental consequences of the increasing demand for energy:-

1. The combustion for fossil fuels is producing acid rain and damaging plants (crops), soil and aquatic life.
2. The burning of fossil fuels is increasing the amount of greenhouse gas carbon dioxide in the atmosphere.
3. The cutting down of trees from the forest (deforestation) for obtaining fire-wood is causing soil erosion and destroying wild life.
4. The construction of hydro-power plants is disturbing ecological balance.
5. Nuclear power plants are increasing radioactivity in the environment.

- It is not possible to completely reduce the consumption of fossil fuels. However, some measures can be taken such as using electrical appliances wisely and not wasting electricity. Unnecessary usage of water should be avoided. Public transport system with mass transit must be adopted on a large scale. These small steps may help in reducing the consumption of natural resources and conserving them.

To whom so ever……

Whoever using these notes as part of reference for your studies, please do send your feedback or opinion (with address) to the following number with regards to notes so that I could make it better in coming day.

+91-9164337006 (What's up Number)
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Thank you