1. Tell the odd one out. Give proper explanation.

a. Fuse wire, bad conductor, rubber gloves, generator.

Ans :Generator.

It is an electric device for producing electricity , however Other can be used as a safety measure against heavy electricity.

b. Voltmeter, Ammeter, galvanometer, thermometer.

Ans : Thermometer.

It is an instrument for measuring the temperature of a body. Other devices are used to measure electrical parameters.

c. Loud speaker, microphone, electric motor, magnet.

Ans : Magnet.

Loud speaker, microphone and electric Motor are based on the phenomenon of electro-magnetism.

2. Explain the construction and working of the following. Draw a neat diagram and label it.

a. Electric motor

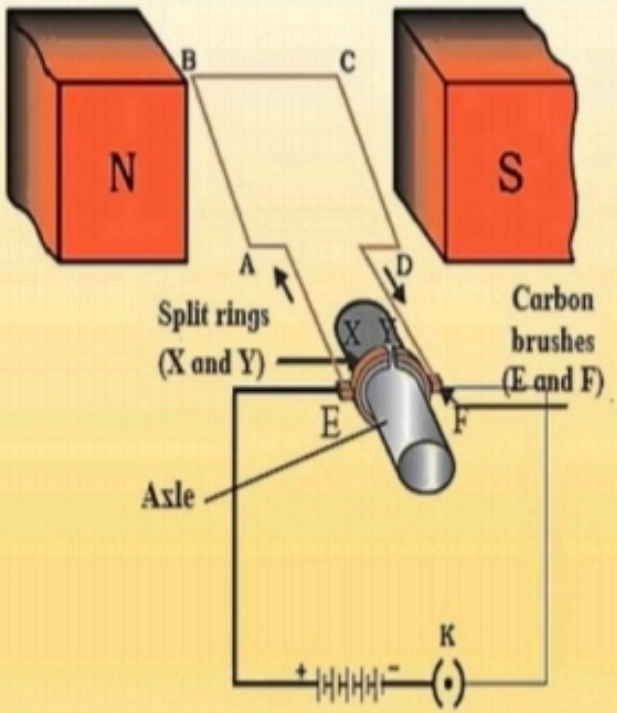
Ans :

Electric Motor : A device changing electrical energy into mechanical energy is known as electric motor.

Motor Principle : The basic principles on which the electric motor works is the magnetic effect of current. A current carrying Rectangular coil starts rotating when placed in a magnetic field.

Construction :

- The electric motor consists of rectangular loop of copper wire having resistive coating.
- It is placed between the north pole and south pole of a magnet in such a way that its branches AB and CD are perpendicular to the direction of magnetic field.
- The two ends of the loop are connected to the two halves (X and Y) of the split ring.
- The two halves of the ring have resistive coating on their inner surfaces and are tightly fitted on the axle.
- The two halves of the split ring, X and Y, have their outer conducting surfaces in contact with the two stationary carbon brushes, (E and F), respectively.



Working :

- When the circuit is completed, the current flows in the branch AB of the loop from A to B through the carbon brushes E and F.
- Since the direction of the magnetic field is from north pole to south pole, according to the Fleming's left hand rule, a force is exerted on the branch AB and pushes it down.
- The current in the CD branch is in a opposite direction to that in the AB branch, and therefore, a force is exerted on the branch CD in upward direction.
- Thus, the loop and the axle start rotating in an anticlockwise direction.
- After half rotation, the two halves of the split ring X and Y come in contact with carbon brushes F and E, respectively, and the current in a loop starts flowing in the direction DCBA.
- Therefore, a force is exerted on the branch DC in downward direction and on the branch BA in the upward direction, and the loop continues to rotate in the anticlockwise direction.
- Thus, the current in the loop is reversed after each half rotation and the loop and
- the axle continue to rotate in the anticlockwise direction.

b. Electric Generator(AC)

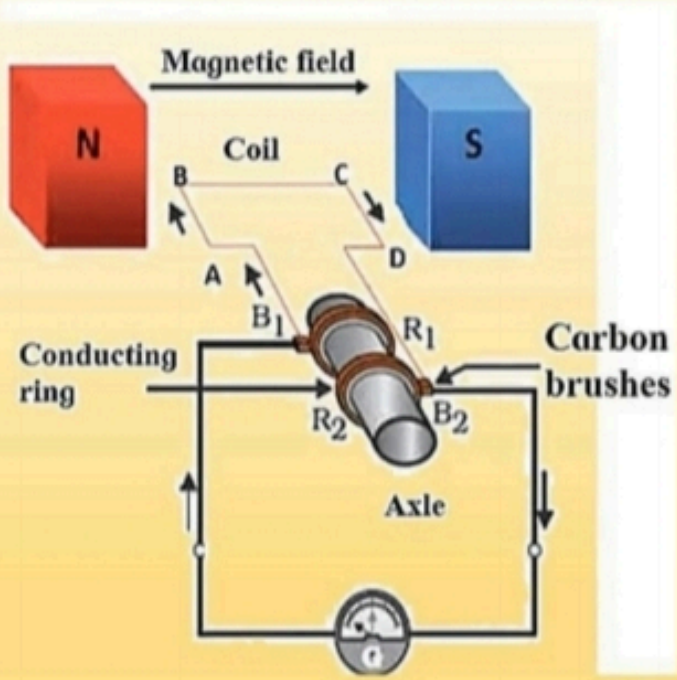
Ans :

Electric generator: A device mechanical energy is used to rotate the current carrying coil in a magnetic field, around an axle, thereby producing electricity is called as electric generator.

Electric generator principle : Electrical generator works on principal of electro magnetic induction.

Construction :

- Above fig. shows a copper wire coil ABCD, kept between the two pole pieces of a magnet.
- The two ends of the coil are conected to the conducting rings R1 and R2 via carbon brushes.
- Both the rings are fixed to the axle, but there is a resistive coating in between the ring and the axle.
- The axle is rotated with the help of a machine from outside.
- Because of this, the coil ABCD starts rotating.
- The stationary carbon brushes B1 and B2 are connected to a galvanometer, which shows the direction of current in the circuit.
- Upon rotating the axle, the branch AB goes up and the branch CD goes down (i.e. the coil ABCD rotates clockwise).



Working :

- When the axle is rotated , the branch AB goes uo and branch CD goes down.
- According to Fleming's right hand rule, electric current is produced in the branches AB and CD in the direction. A B and C D.
- Thus, the current flows in the direction A B C D . In the external circuit, the current flows from B_2 to B_1 through the galvanometer.
- If instead of one loop coil, a coil consisting of several turns is used, the current of magnitude several times flows.
- After half rotation, the branch AB takes the place of branch CD and the branch CD takes the position of the branch AB. Therefore, the induced current goes as D C B A .
- But, the branch BA is always in contact with the brush B_1 and branch DC in the contact with B_2.
- Hence, in the external circuit current flows from B_1 to B_2 i.e. opposite to the previous half rotation.
- This repeats after every half rotation and alternating current is produced. This is what is called an AC generator .

3. Electromagnetic induction means.

a. Charging of an electric conductor.

b. Production of magnetic field due to a current flowing through a coil.

c. Generation of a current in a coil due to relative motion between the coil and the magnet.

d. Motion of the coil around the axle in an electric motor.

Ans :

C. Generation of a current in a coil due to relative motion between the coil and the magnet.

4. Explain the difference :AC generator and DC generator.

AC generator	DC generator
1. AC generator is a mechanical device which converts Mechanical energy into AC electrical power. 2. *In an AC generator, the electrical current Reverses direction periodically.* 3. *AC generators does not require brushes .* 4. *The rotating parts in AC generators is low current and high resistivity.* 5. *These are used to power small motors.*	1. DC generator is a mechanical device which Converts mechanical Energy into DC electrical Power. 2. In *a DC generator, the electrical current flows only in one direction.* 3. *DC generators require brushes which have to replaced periodically.* 4. *The rotating part of DC generator is heavy and with high current.* 5. *They are used to power very large electric motors.*

Question 5:

Which device is used to produce electricity? Describe with a neat diagram.

a. Electric motor

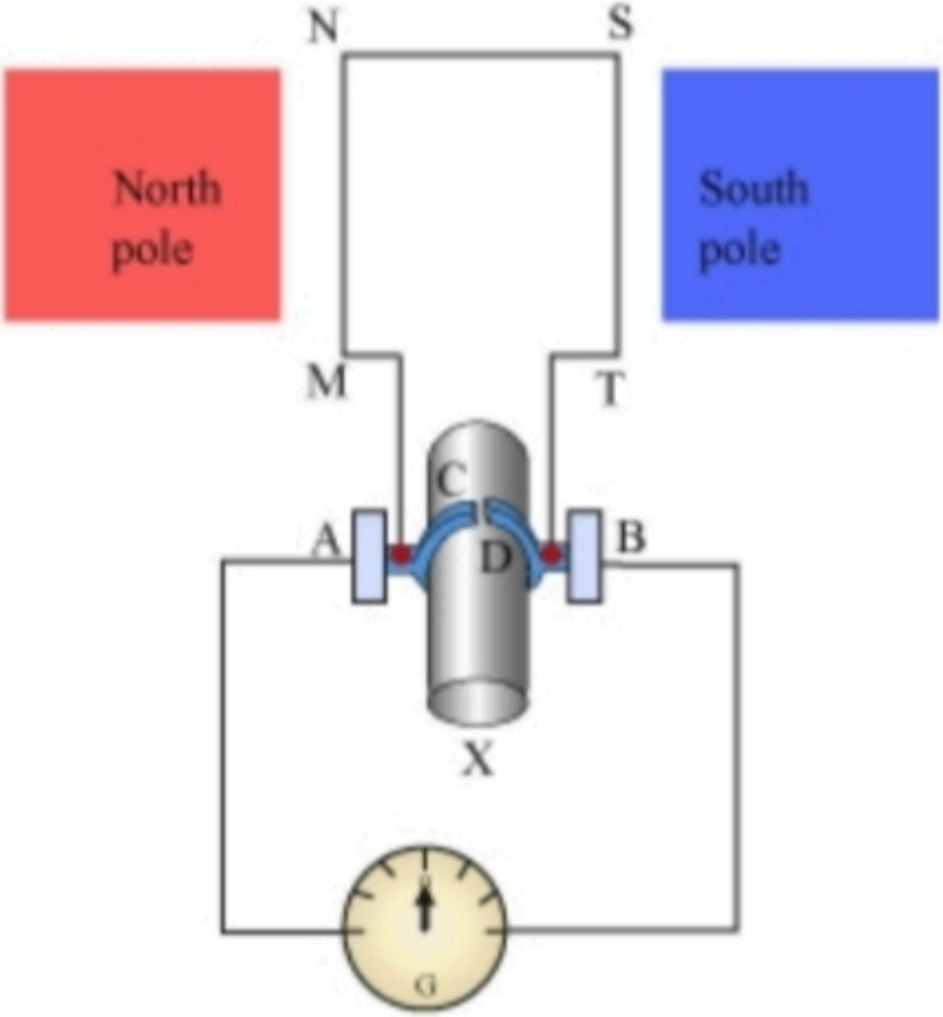
b. Galvanometer

c. Electric Generator (DC)

d. Voltmeter

ANSWER:

The device used for producing electricity is Electric generator (DC). It is based on the phenomenon of electromagnetic induction.



Working:

When the axle is rotated, lengths MN and ST move up and down, respectively. Since lengths MN and ST are moving in a magnetic field, a current gets induced in these lengths caused by an electromagnetic induction. The direction of the induced current in both the lengths is given by **Fleming's right hand rule**.
In this arrangement, brush A always remains in contact with the length moving up, whereas brush B always remains in contact with the length moving down. Here, split rings C and D act as a commutator. In this case, the direction of the current induced in the coil will be from M to T via N and S for the first half-rotation, and from T to M via S and N for the second half-rotation of coil MNST. Hence, we get a unidirectional current called **direct current** (DC).

Question 6:

How does the short circuit form? What is its effect?

ANSWER:

Short circuit occurs when naked live and neutral wires touch each other.
In such situations, the resistance of the circuit becomes very less. Now, according to Ohm's law, current is inversely proportional to resistance. Thus, the decrease in value of resistance of the circuit raises the current to a significant amount. As a result, the wires become hot and sparks are caused by Joule's heating effect of current.

Question 7.

Give scientific reasons:

a. Tungsten is used to make a solenoid type coil in an electric bulb.

Answer:

1. The intensity of light emitted by the filament of a bulb depends on the temperature of the filament. It increases with the temperature.

2. The melting point of the material used to make the filament of a bulb should be very high so that the filament can be heated to a high temperature by passing a current through it, without melting it. This enables us to obtain more light. The melting point of tungsten is very high.

Hence, tungsten is used to make a solenoid type coil (filament) in an electric bulb.

b. In the electric equipment producing heat e.g. iron, electric heater, boiler, toaster, etc. an alloy such as Nichrome is used, not pure metals.

Answer:

1. The working of heating devices such as a toaster and an electric iron is based on the heating effect of electric current, i.e., conversion of electric energy into heat by passage of electric current through a metallic conductor.

2. An alloy, such as Nichrome, has high resistivity and it can be heated to a high temperature without oxidation, in contrast to pure metals. Therefore, the coils in heating devices such as a toaster and an electric iron are made of an alloy, such as Nichrome, rather than a pure metal.

c. For electric power transmission, copper or aluminium wire is used.

Answer:

1. Copper and aluminium are good conductors of electricity.

2. Copper, and aluminium have very low resistivity. Hence, when an electric current flows through a wire of copper or aluminium, heat produced is comparatively low. Therefore, for electric power transmission, copper or aluminium wire is used.

d. In practice the unit kWh is used for the measurement of electric energy, rather than the joule.

Answer:

(1) If an electric device rated 230 V, 5 A is operated for one hour, electric energy used

= VIt = 230 V × 5 A × 3600 s = 4140000 joules.

(2) If this energy is expressed in kW.h, it will be $\frac{4140000}{3.6\times10^6}$ kW·h = 1.15 kW·h (more convenient). 3.6 × 10^6

Hence, in practice the unit kW·h is used for the measurement of electric energy, rather than the joule.

Question 8.

Which of the statements given below correctly describes the magnetic field near a long, straight current-carrying conductor?

(1) The magnetic lines of force are in a plane, perpendicular to the conductor in the form of straight lines.

(2) The magnetic lines of force are parallel to the conductor on all the sides of conductor.

(3) The magnetic lines of force are perpendicular to the conductor going radially outward.

(4) The magnetic lines of force are in concentric circles with the wire as the center, in a plane perpendicular to the conductor.

Answer:

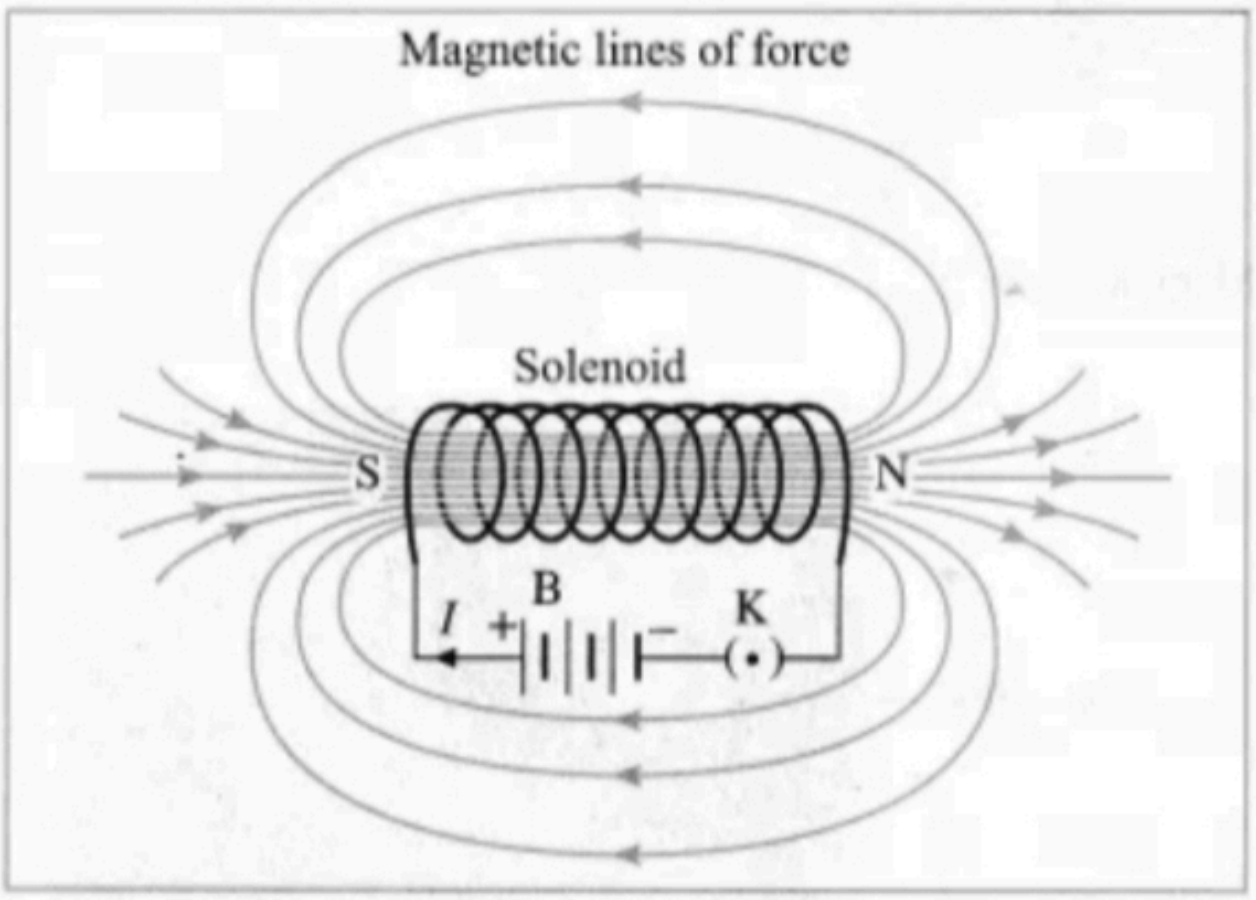
The magnetic lines of force are in concentric circles with the wire as the centre, in a plane perpendicular to the conductor.

Question 9.

What is a solenoid? Compare the magnetic field produced by a solenoid with the magnetic field of a bar magnet. Draw neat figures and name various components.

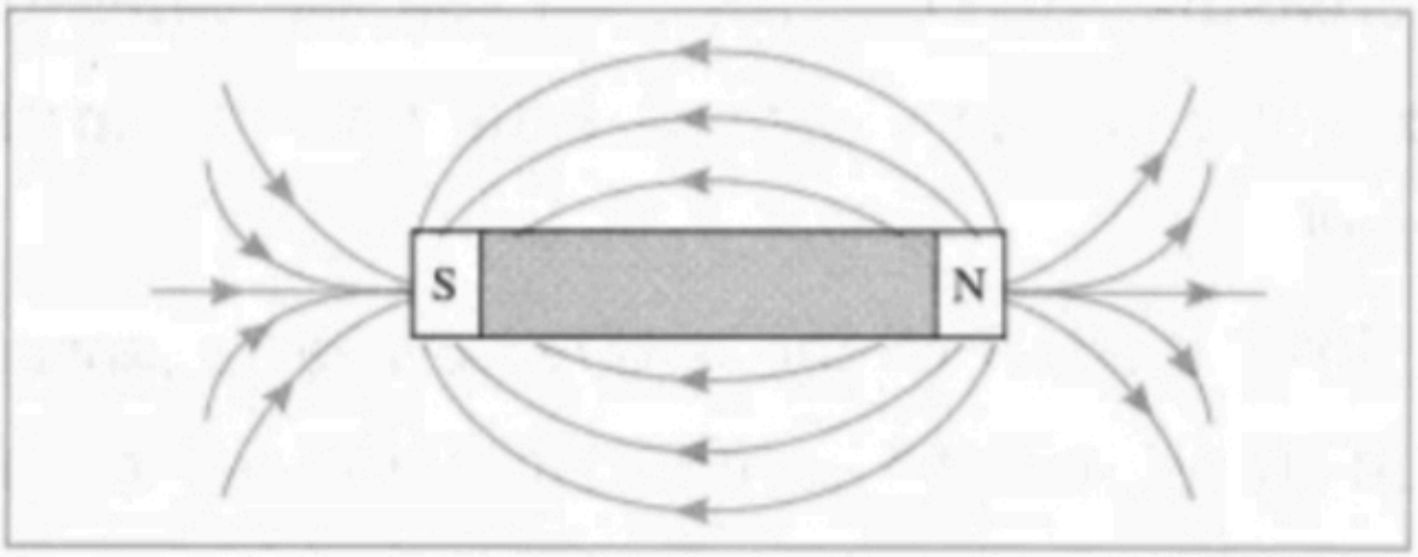
Answer:

When a copper wire with a resistive coating is wound in a chain of loops (like a spring), it is called a solenoid.



Magnetic lines of force (magnetic field lines) due to a current carrying solenoid.

B: Battery, K: Plug key, I: Current, N: North pole, S: South pole



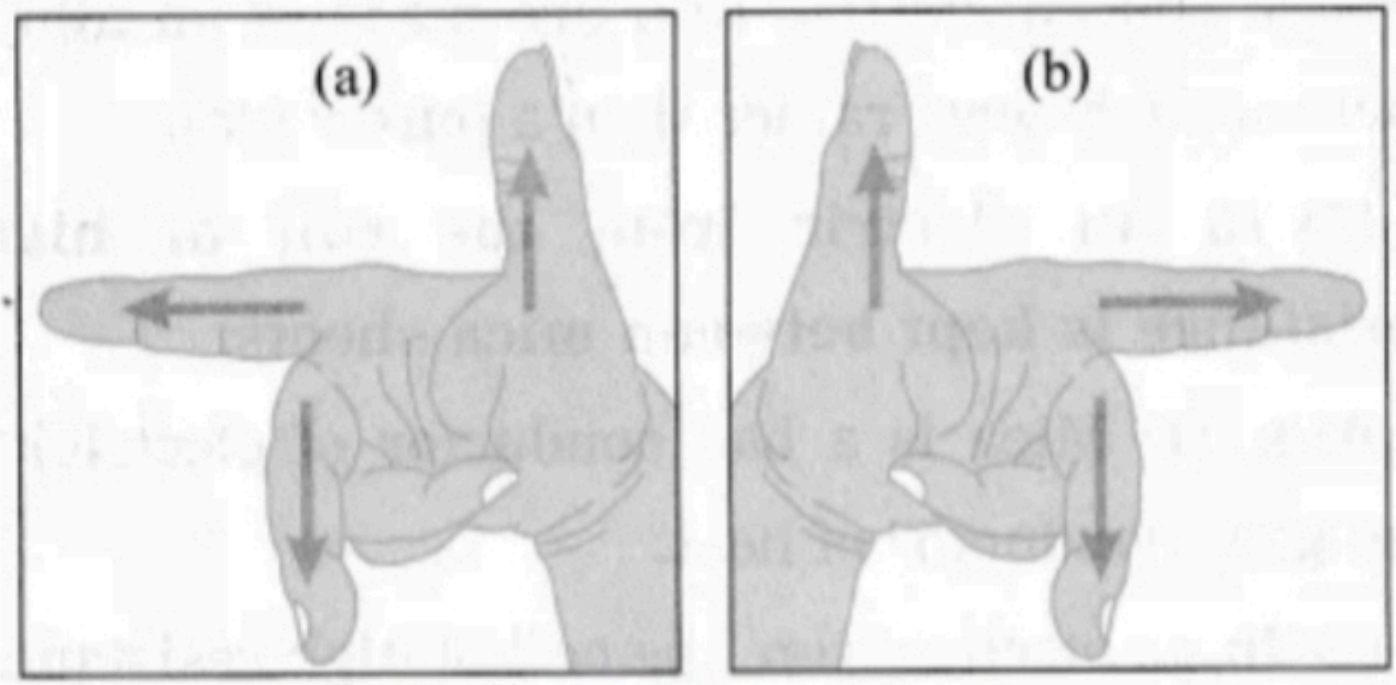
Magnetic lines of force around a bar magnet

The magnetic field lines (magnetic lines of force) due to a current-carrying solenoid are similar to those of a bar magnet. One face of the coil acts as the south pole and the other face as the north pole.

[Note: A current-carrying coil, like a magnet, can be used to magnetise the rod of a given material such as carbon steel or chromium steel. With a strong megnetic field, permanent magnetism can be produced in these materials.]

Question 10.

Name the following diagrams and explain the concept behind them.



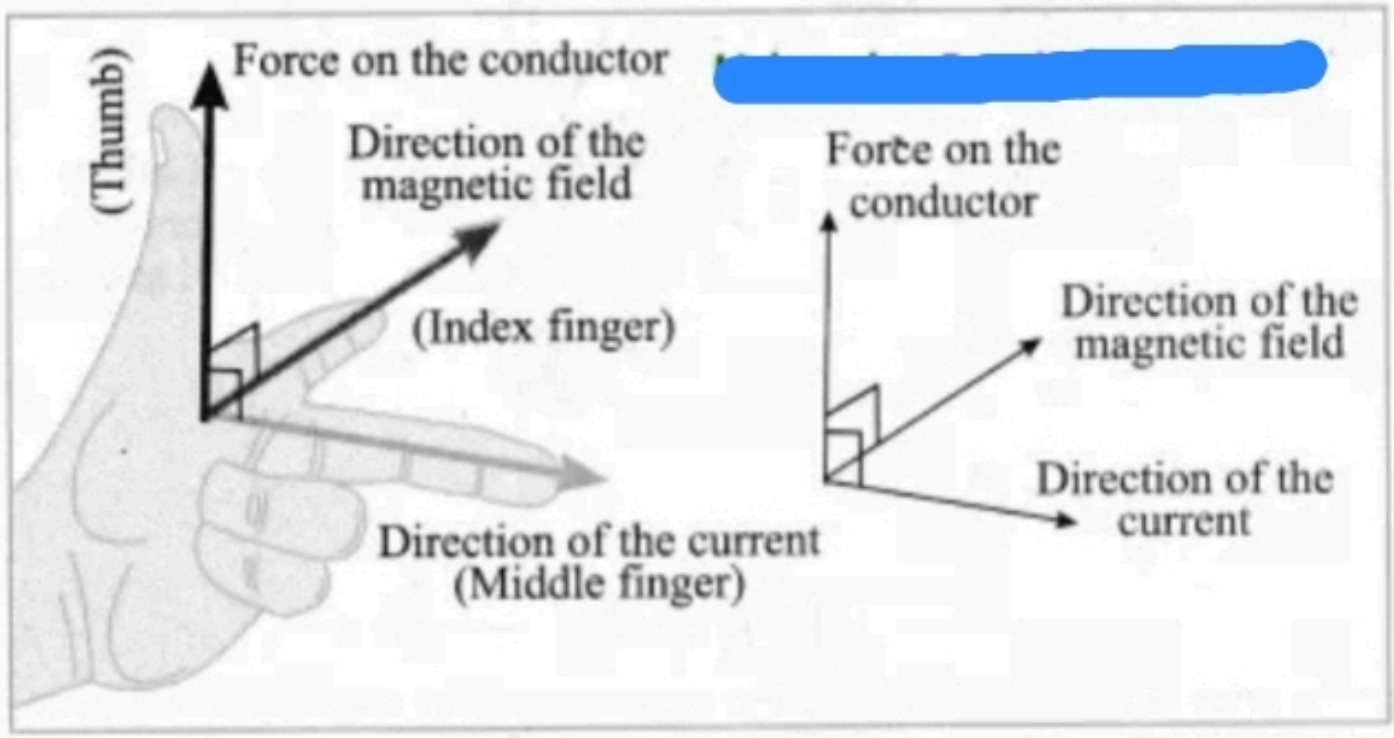
Answer:

(a) Fleming's right hand rule:

Answer:

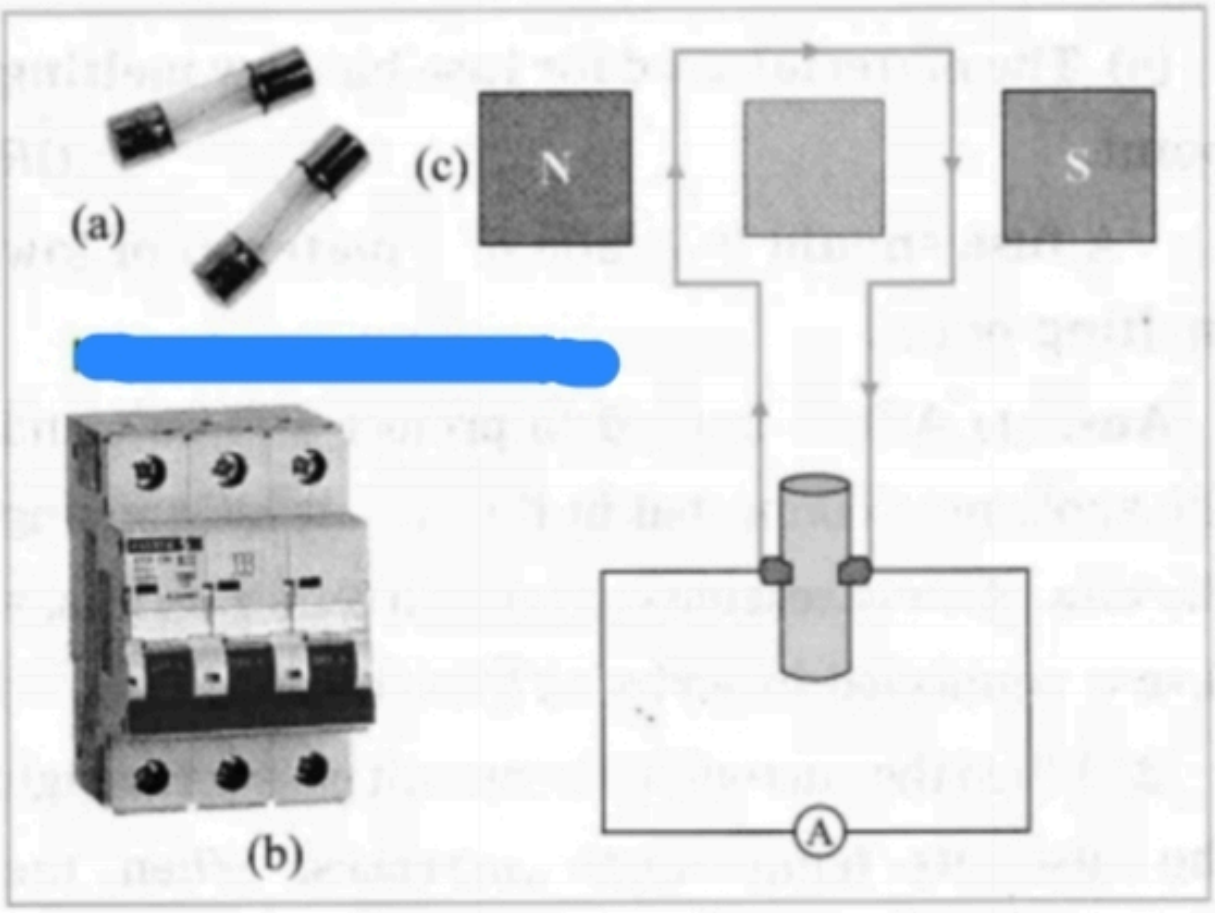
Stretch the thumb, the index finger and the middle finger of the right hand in such a way that they are perpendicular to each other. In this position, the thumb indicates the direction of the motion of the conductor, the index finger the direction of the magnetic field, and the middle finger shows the direction of the induced current.

(b) Fleming's left hand rule: The left hand thumb, index finger, and the middle finger are stretched so as to be perpendicular to each other. If the index finger is in the direction of the magnetic field, and the middle finger points in the direction of the current, then the direction of the thumb in the direction of the force on the conductor.



Question 11.

Identify the figures and explain their use.



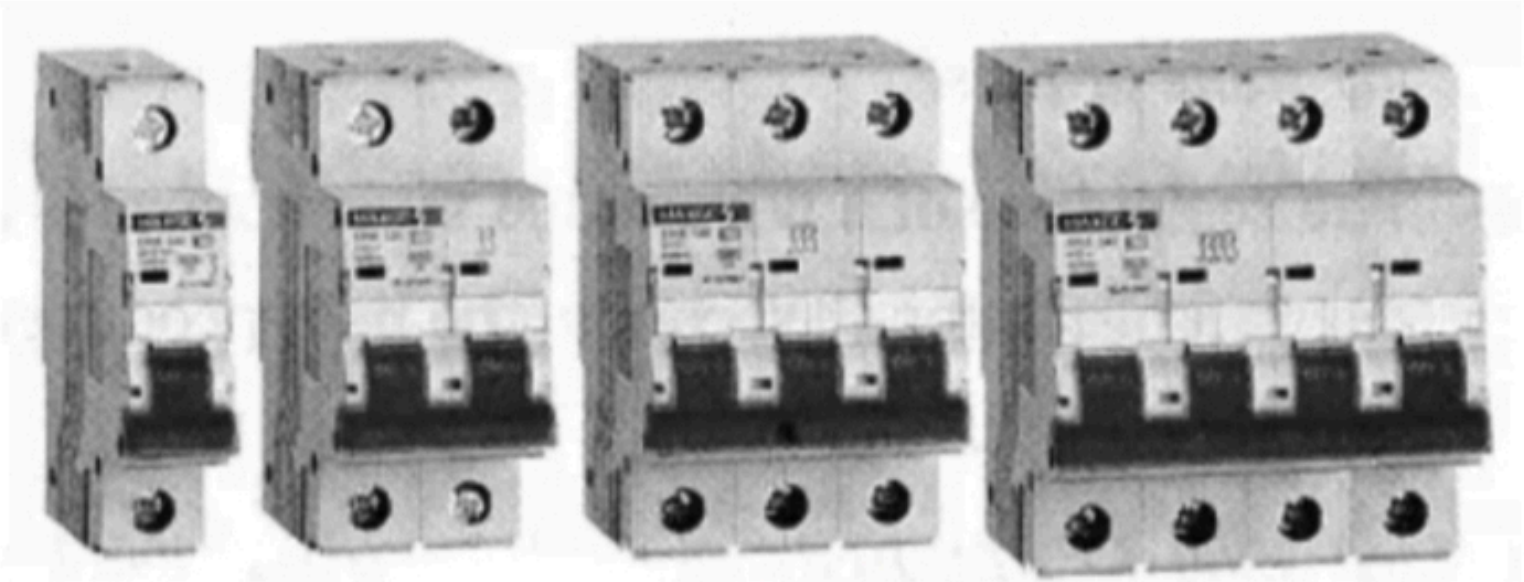
Answer:

(a) Fuse:

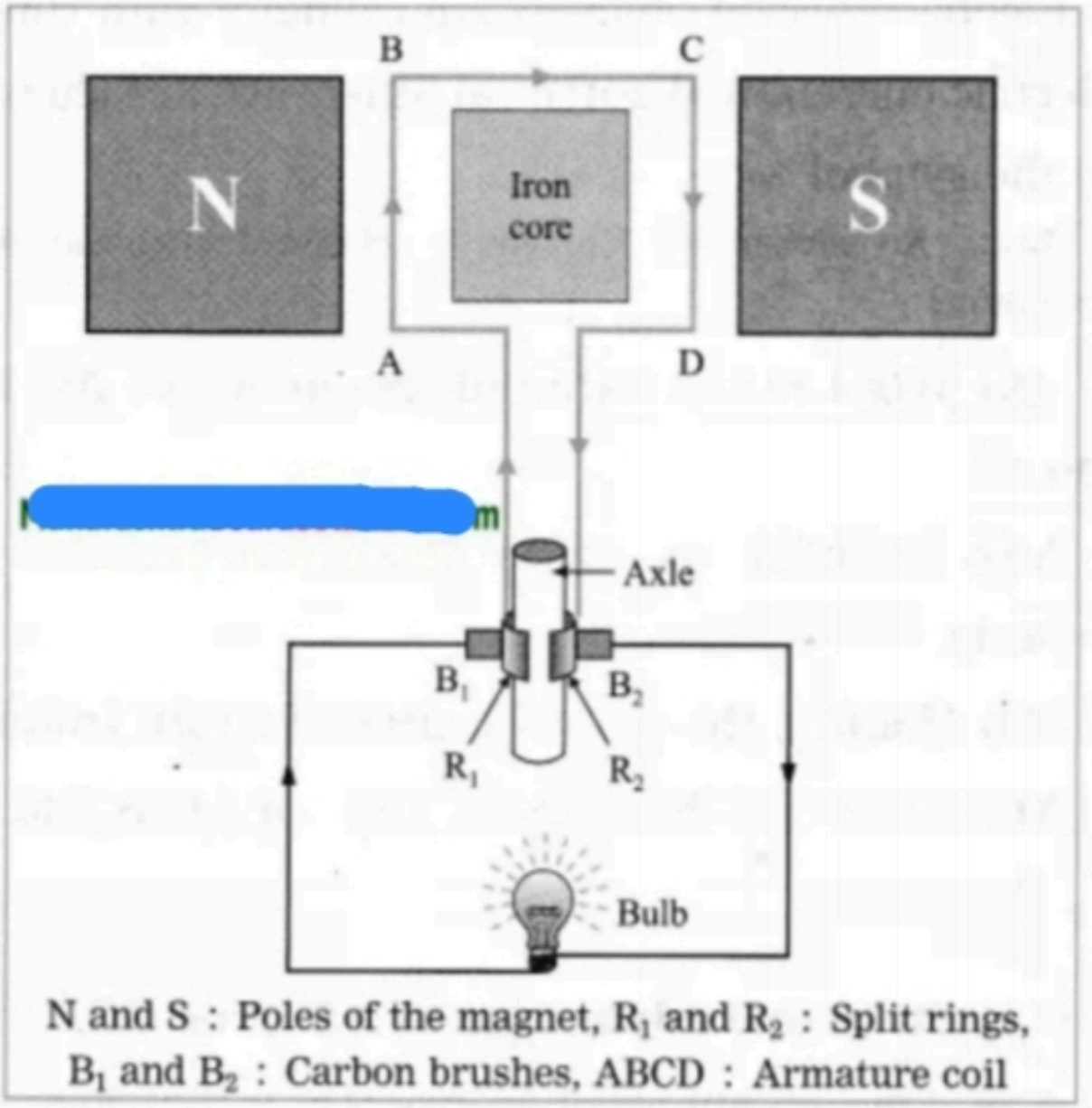
A fuse protects electrical circuits and appliances by stopping the flow of electric current when it exceeds a specified value. For this, it is connected in series with the appliance (or circuit) to be protected. A fuse is a piece of wire made of an alloy of low melting point (e.g. an alloy of lead and tin). If a current larger than the specified value flows through the fuse, its temperature increases enough to melt it. Hence, the circuit breaks and the appliance is protected from damage.

(b) Miniature circuit breaker:

These days miniature circuit breaker (MCB) switches are used in homes. When the current in the circuit suddenly increases this switch opens and current stops. Different types of MCBs are in use. For the entire house, however the usual fuse wire is used.



(c) Figure shows the construction of a DC generator.



N and S : Poles of the magnet, R_1 and R_2 : Split rings,
B_1 and B_2 : Carbon brushes, ABCD : Armature coil

Electric DC generator

Here, an ammeter is shown instead of a bulb.

Working: The axle is rotated with a machine from outside. When the armature coil of the generator rotates in the magnetic field, electric potential difference is produced in the coil due to electromagnetic induction. This produces a current as shown by the glowing of the bulb or by a galvanometer. The direction of the current depends on the sense of rotation of the coil.

Question 12.

Solve the following examples.

a. Heat energy is being produced in a resistance in a circuit at the rate of 100 W. The current of 3 A is flowing in the circuit. What must be the value of the resistance?

Solution:

Data: P = 100 W, I = 3 A, R = ?, $P = I^2R$

$\therefore$ Resistance, $R = \frac{P}{I^2} = \frac{100W}{(3A)^2} = \frac{100}{9}\Omega = 11.11\ \Omega$

b. Two tungsten bulbs of wattage 100 W and 60 W power work on 220 V potential difference. If they are connected in parallel, how much current will flow in the main conductor?

Solution:

Data : $P_1 = 100$ W, $P_2 = 60$ W, $V = 220$ V,

$I = ?, \therefore I = \frac{P}{V}$

$P = VI$

$\therefore I_1 = \frac{P_1}{V}$ and $I_2 = \frac{P_2}{V}$

Current in the main conductor, $I = I_1 + I_2$ (parallel connection)

$$= \frac{P_1}{V} + \frac{P_2}{V} = \frac{P_1 + P_2}{V} = \frac{100\ \text{W} + 60\ \text{W}}{220\ \text{V}} = \frac{160}{220}\ \text{A}$$

$$= 0.727\ \text{A} = \textbf{nearly 0.73 A.}$$

c. Who will spend more electrical energy? 500 W TV set in 30 mins, or 600 W heater in 20 mins?

Solution:

Data : $P_1 = 500$ W, $t_1 = 30$ min $= \frac{30}{60}$ h $= \frac{1}{2}$ h, $P_2 = 600$ W, $t_2 = 20$ min $= \frac{20}{60}$ h $= \frac{1}{3}$ h

Electrical energy used = Pt

TV set : $P_1t_1 = 500\ \text{W} \times \frac{1}{2}\ \text{h} = 250\ \text{W·h}$

Heater : $P_2t_2 = 600\ \text{W} \times \frac{1}{3}\ \text{h} = 200\ \text{W·h}$

Thus, the TV set will spend more electrical energy than the heater.

d. An electric iron of 1100 W is operated for 2 hours daily. What will be the electrical consumption expenses for that in the month of April? (The electric company charges ₹ 5 per unit of energy.)

Solution:

Data: P = 1100 W, t = 2 × 30 = 60 h,

₹ 5 per unit of energy, expenses = ?

$$N = \frac{Pt}{1000\ \text{W}\cdot\text{h/unit}} = \frac{1100\ \text{W} \times 60\ \text{h}}{1000\ \text{W}\cdot\text{h/unit}} = 66\ \text{units.}$$

∴ Electrical consumption expenses = 66 units × ₹ 5 per unit = ₹ 330.