



SUBJECT : SCIENCE (PHY)

CHAPTER-13:
MAGNETIC EFFECT OF ELECTRIC CURRENT

TOPIC-6:

ELECTRIC MOTOR:

OBJECTIVES:

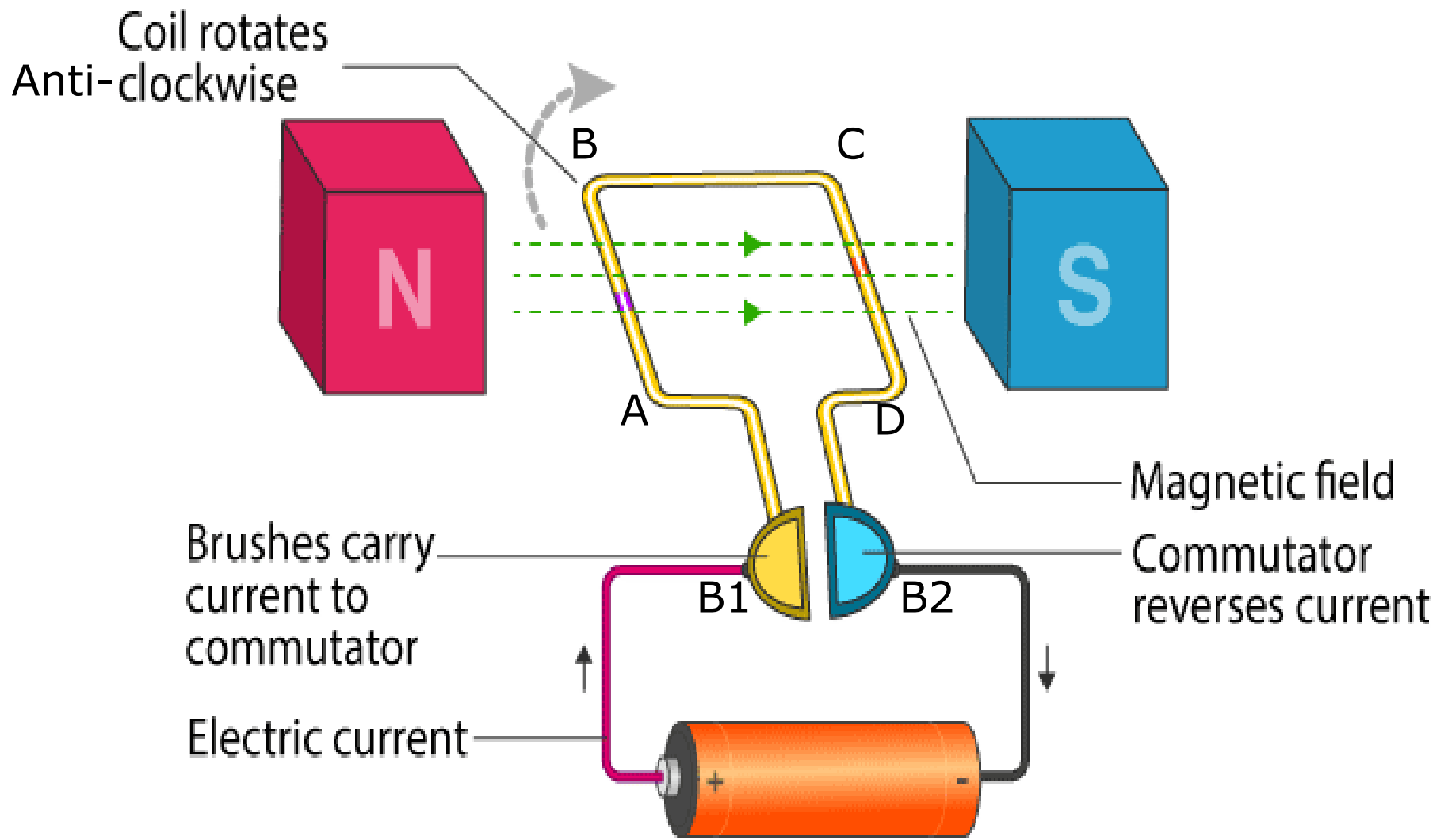
Upon completion of the topic, you will be able to

1. **DEFINE ELECTRIC MOTOR**
2. **EXPLAIN THE PRINCIPLE OF MOTOR**
3. **NAME THE DIFFERENT PARTS OF MOTOR**
4. **EXPLAIN THE FUNCTION OF DIFFERENT PARTS OF MOTOR**
5. **EXPLAIN THE CONSTRUCTION AND WORKING OF A MOTOR**
6. **DRAW THE DIAGRAM OF AN ELECTRIC MOTOR**
7. **WRITE THE TYPES OF MOTOR**
8. **WRITE A FEW APPLICATION OF MOTOR**

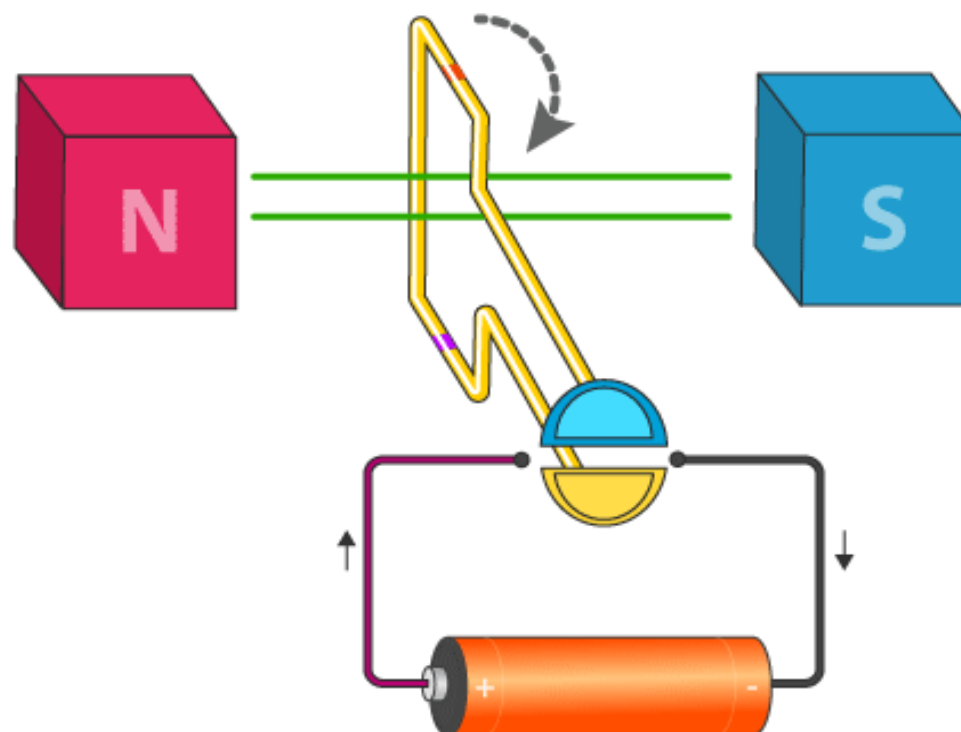
ELECTRIC MOTOR AND ITS WORKING:

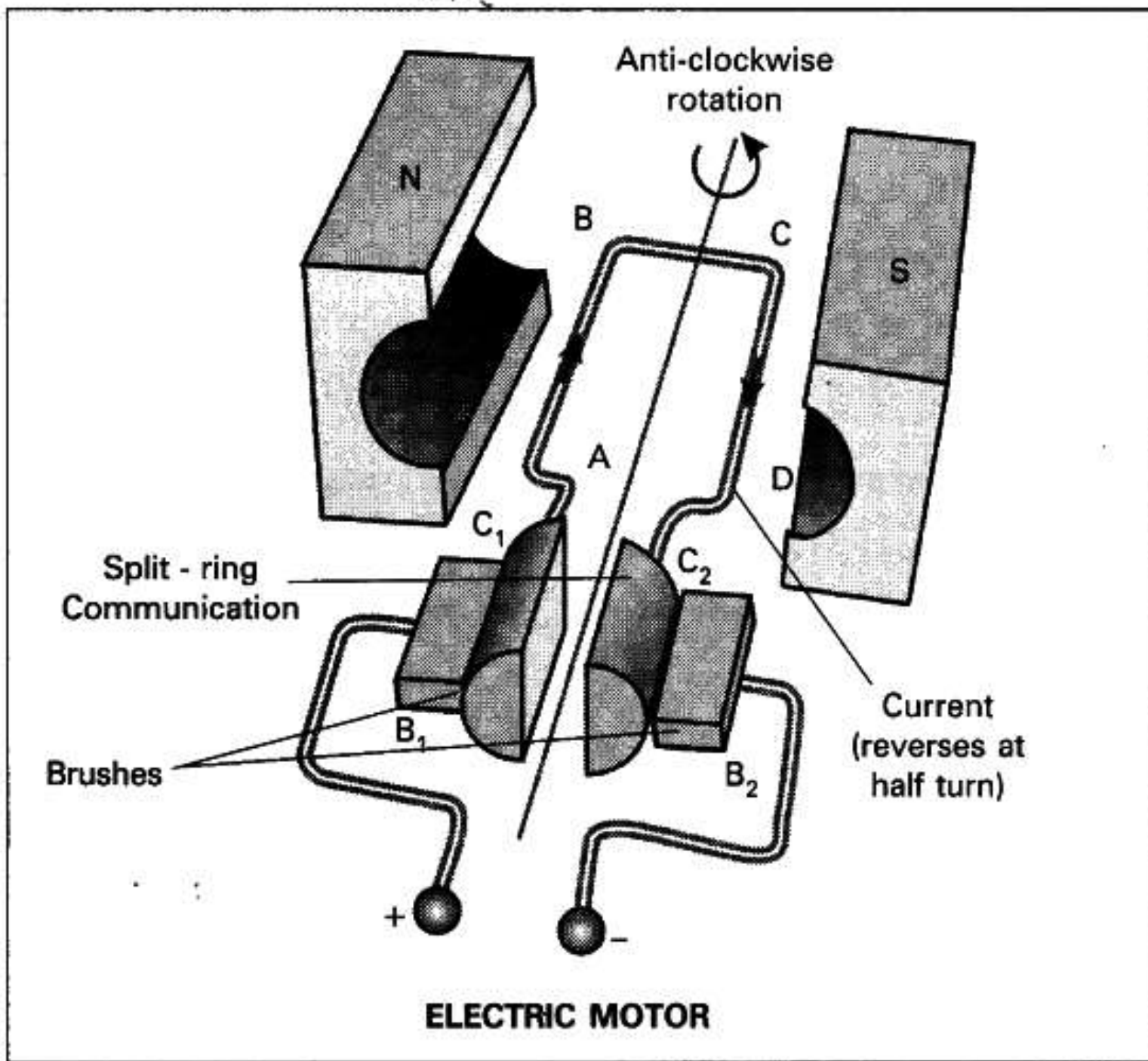
PARTS OF AN ELECTRIC MOTOR AND THEIR FUNCTION

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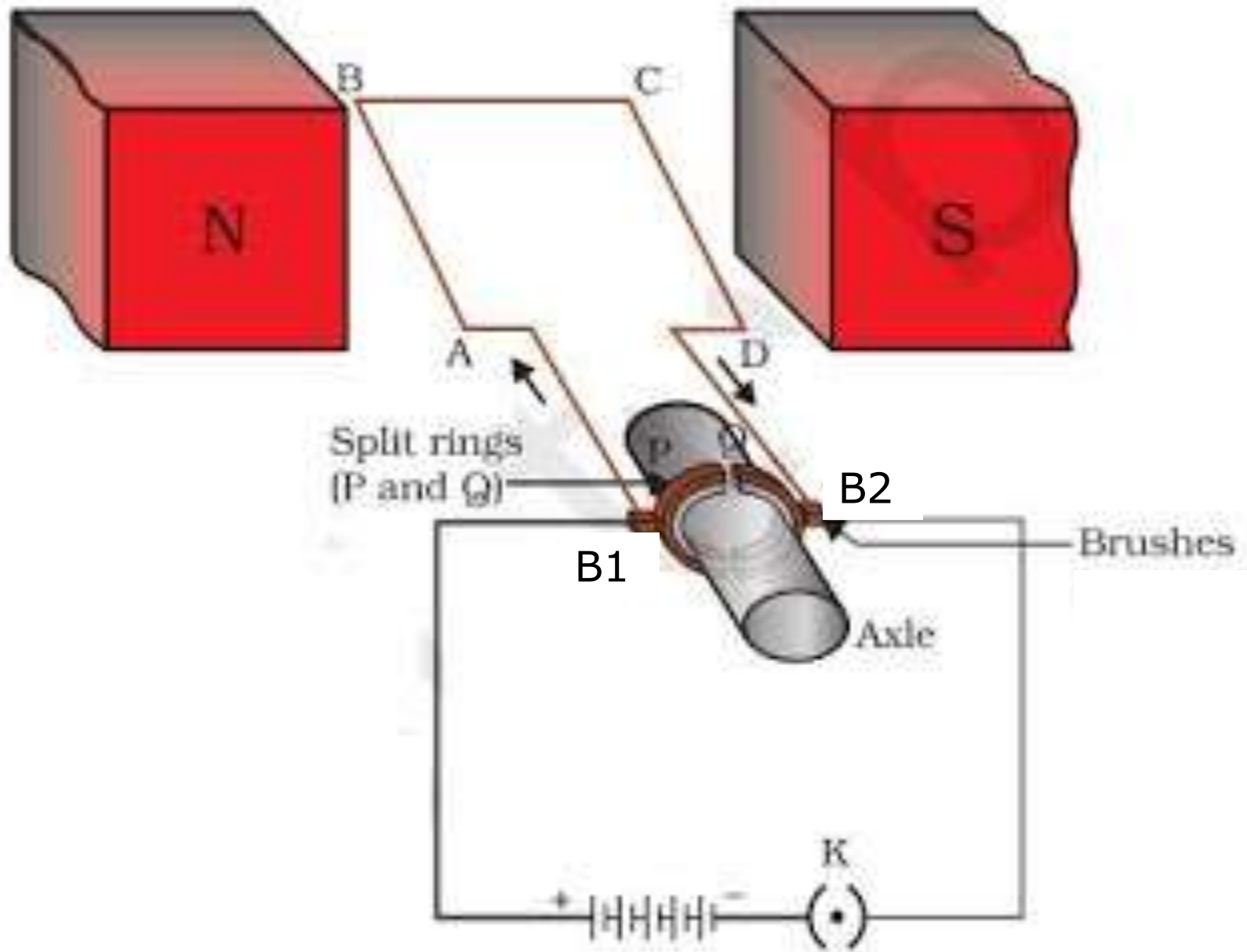


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ELECTRIC MOTOR



ELECTRIC MOTOR: It is an electric device that converts electrical energy into mechanical energy.

PRINCIPLE: Electric Motor is based on the fact that a current carrying conductor placed perpendicular to the magnetic field experiences a force.

CONSTRUCTION:

A simple motor has the following parts:

1. An Armature coil or rotor
2. Field Magnet
3. Split-ring or Commutator
4. Brushes
5. Battery
6. Axle

Types : 02 types

1. DC motor
2. AC motor

Armature Coil: It consists of large number of turns of insulated copper wire wound on iron core in the form of a rectangle. The rectangle ABCD as shown in fig is called an armature coil.

Field Magnet: Armature coil is placed between the two poles (N & S) of a strong magnet. This magnet provides a strong magnetic field that helps to produce a torque on the rotating armature coil by virtue of Fleming's left-hand rule.

Split ring or Commutator: It consists of two halves of a metallic ring. The two ends of the armature coil are connected to these two halves of the ring. Commutator reverses the direction of current in the armature coil.

Brushes or sliding contacts : These are flexible metal plates or carbon rods(B1 &B2) which are fixed and they constantly touch the revolving split rings(Commutator)

Power Source/battery : it is connected across the carbon brushes. This battery supplies the current to the armature coil.

Armature Core: Holds the armature coil in place and provides mechanical support.

WORKING OF ELECTRIC MOTOR:

When current flows through the coil as shown in the figure, arm AB and CD experience force. According to Fleming's left hand rule, arm AB of the coil, experience a force in the downward direction. Similarly, arm CD of the coil experiences a force in the upward direction. Both these forces are equal but opposite in direction and thus constitute a couple. This couple rotates the coil in anti-clockwise direction until the coil is in the vertical position. At this position, the contacts of commutator and brushes breaks. So the supply of current to the coil is cut off. Hence no force acts on the arms of the coil. But the coil does not come to rest. It goes on rotating due to the inertia of motion of the coil until Commutator again comes in contact with the brushes B1 & B2. On getting supply of current, the coil continues its rotation in the same direction(anti-clockwise).

Uses of an Electric Motor

Electric motors are used in a variety of applications. Some of them are listed below.

- Drills
- Water Pumps
- Hard Disc Drives
- Washing Machines
- Industrial Equipment

NOTE: You can expect the efficiency of a functioning motor to be around **70 – 85%** as the remaining energy is wasted in heat production and sounds emitted.

SPEED OF ROTATION OF MOTOR:

The speed of rotation of a motor can be increased by

- Increasing the strength of current through the armature (I)
- Increasing the number of turns in the coil of the armature (n)
- Increasing the strength of the magnetic field (B)

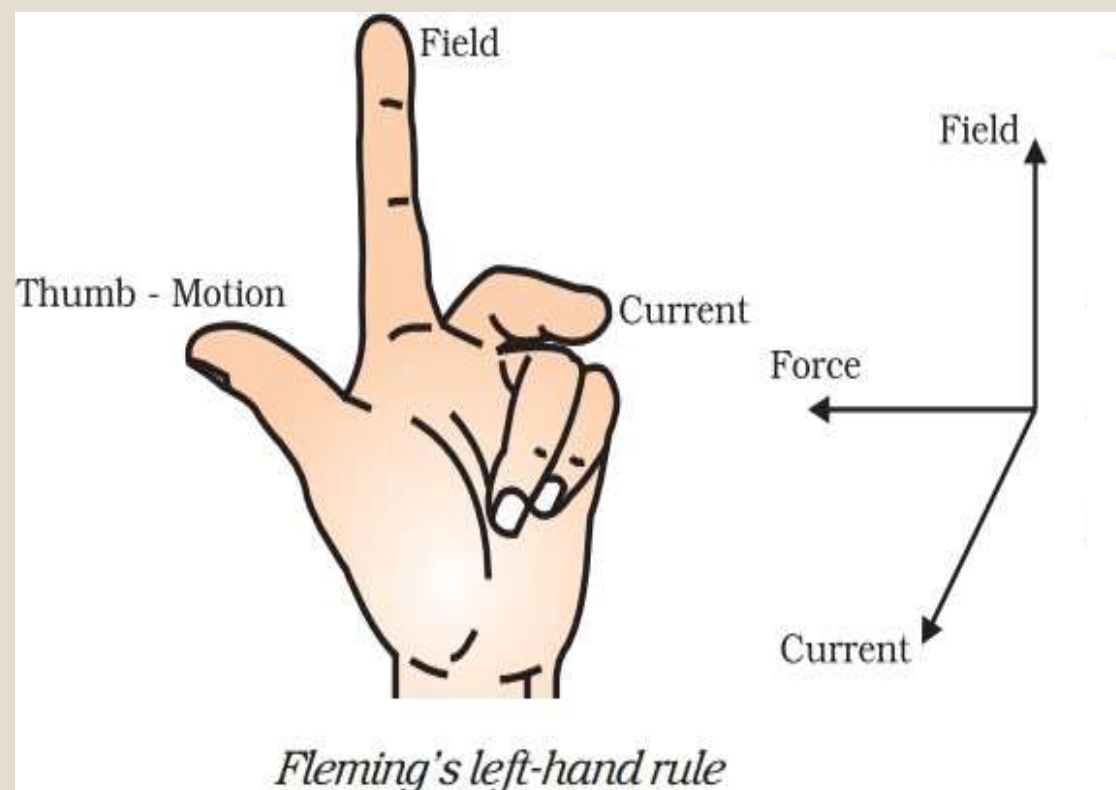
QUESTIONS

Question 1:

State Fleming's left-hand rule.

Answer 1:

According to Fleming's left-hand rule, stretch the thumb, forefinger and middle finger of your left hand such that they are mutually perpendicular. If the first finger points in the direction of magnetic field and the second finger in the direction of current, then the thumb will point in the direction of motion or the force acting on the conductor.



Question 2:

What is the principle of an electric motor?

Answer 2:

The working principle of an electric motor is based on the magnetic effect of current. A current-carrying loop experiences a force and rotates when placed in a magnetic field. The direction of rotation of the loop is given by the Fleming's left-hand rule.

Question 3:

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

Answer 3:

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.

Question-4: (a) State Fleming's left hand rule.

(b) Write the principle of working of an electric motor.

(c) Explain the function of the following parts of an electric motor.

(i) Armature, (ii) Brushes, (iii) Split ring [CBSE 2017]

Answer-4 :

a. Fleming's left hand rule: If we stretch thumb, forefinger and middle finger of left hand perpendicular to each other in such a way that forefinger points in the direction of magnetic field, middle finger points in the direction of current then the thumb will point in the direction of motion/force on the current carrying conductor.

b. Principle of working of electric motor: A current carrying coil placed in a magnetic field experience a force . If the coil is free to move it will rotate in the magnetic field.

(i) **Armature:** The soft iron core on which the coil is wound along with coils is called armature which enhances the power of motor.

(ii) **Brushes:** Brushes help in transfer of current between coil and external circuit.

(iii) Split rings reverses the direction of current after every half rotation of the coil so that the direction of torque/force on the coil remains and it continuous to rotate.

HOME WORK

- 1. What do you mean by electric motor? State the principle of motor**
- 2. Describe the construction and working of an electric motor**
- 3. Write the function of**
 - a. armature coil**
 - b. split rings**
 - c. brushes**
 - d. magnet**
- 4. Draw a neat label diagram of an electric motor**