

Chapter -12

Electromagnetism

SYNOPSIS

Hans Christian Orsted was the father of electromagnetism. His famous experiments refueled the connection between electricity and magnetism.

The number of magnetic lines passing through the Area 'A' is known as flux (ϕ).

If B is magnetic flux density then-

$$B = \frac{\phi}{A}$$

$$\text{or } \phi = BA.$$

When the reference plane makes an angle with the field, then

$$\phi = BA \cos\theta.$$

If q use the charge moving with velocity v in magnetic field of indentation B then the force acting on the charge is-

$$F = q v B \sin\theta.$$

The direction of force can be measured by the left hand rule.

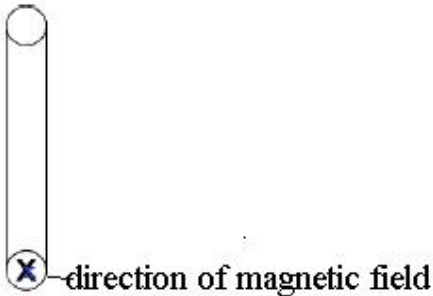
Electric motor is a device which can be converted electric energy into mechanical energy.

Faraday's experiments tell about the link between change of magnetic flux and a current generation in the coil.

2 Mark Questions

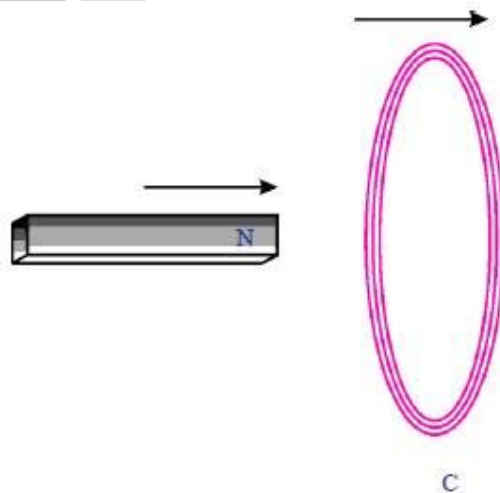
1. A coil is kept perpendicular to the page. At P, current flows into the page and at Q it comes out of the page as shown in figure. What is the direction of magnetic field due to the coil? (AS1)

A. To know the direction of magnetic field, we use right hand rule i.e., when you curl your right hand fingers in the direction of current, thumb gives the direction of magnetic field.



2. As shown in the figure, both coil and bar magnet moves in the same direction. Your friend is arguing that there is no change in flux. Do you agree with his statement? If not, what doubts do you have? Frame questions about the doubts you have regarding change in flux. (AS2)

A. Agree:



1) Yes, I will agree

2) The induced EMF will not produce when the coil and magnet are moving in the same direction with same velocity.

Disagree:

1) If both move in same direction, is any linkage of then with in coil.

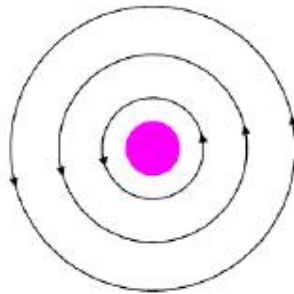
3. Give a few applications of Faraday's law of induction in daily life? [AS7]

A. Some of the daily life applications of Faraday's law of induction are-

- 1) Generation of electricity
- 2) The tape recorder
- 3) Induction stoves
- 4) Motors
- 5) Transformers etc.

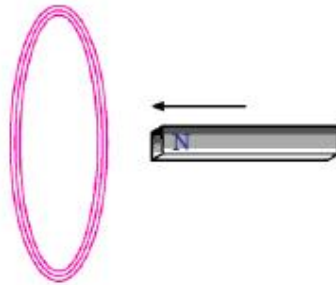
1 Mark Questions

1. See magnetic lines are shown. What is the direction of the current flowing through the wire? (AS1)



A. The magnetic lines are antilock wise using Right hand thumb rule, current flow upwards.

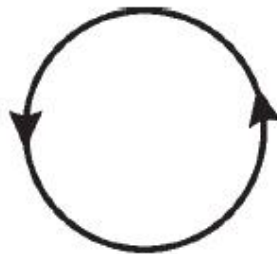
2. A bar magnet with North Pole facing towards a coil moves as shown in figure. Then what happens to the magnetic flux passing through the coil? (AS1)



- A. The magnetic flux passing through the coil induces current in coil. This current is also induced EMF.

3. The direction of current flowing in a coil is shown in fig.Q-5. What type of magnetic pole is formed at the face that has flow of current shown in figure? (AS1)

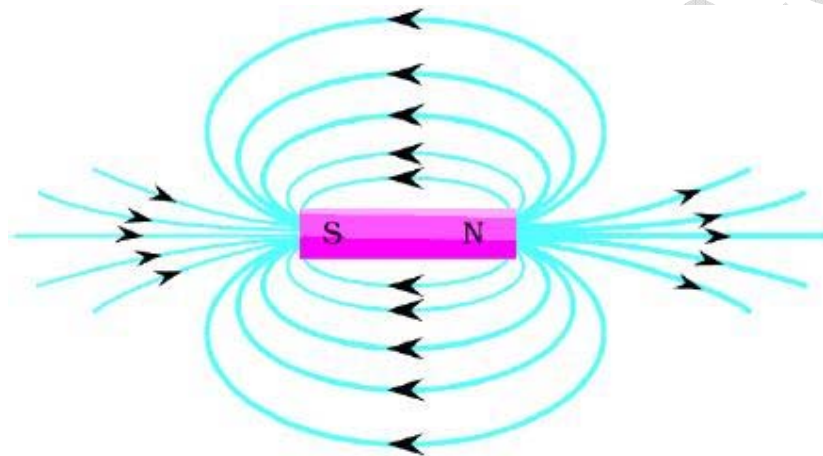
- A. North. Here current flowing in anticlockwise, north pole formed at face we are viewing.



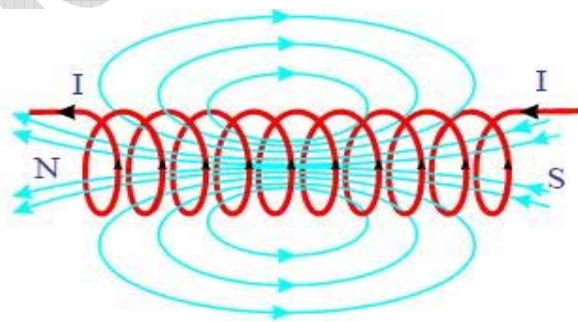
4 Mark Questions

1. Are the magnetic field lines closed? Explain.

- A.** The magnetic field lines produced by magnet field appear to be closed, but we can't conclude whether they are closed or open loops by just looking at the picture of the field lines, because the alignment of lines that are passing the bar magnet should also be considered. If we observe the field lines by a solenoid, they are continuous with those inside. Outside of the solenoid, the direction of the field lines is from north to south while inside the direction is opposite (i.e. south to north). Thus, the magnetic field lines are closed loops.



Magnetic field lines

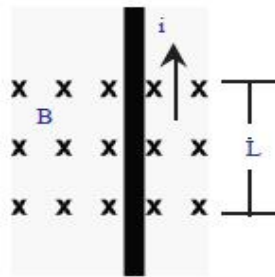


Magnetic field lines Magnetic field lines are closed loops

2. Why does a picture appear distorted when a bar magnet is brought close to the screen on television? Explain. (AS1)

A. Picture on a television screen is due to motion of the electrons reaching the screen. These electrons are affected by magnetic field of bar magnet. This must be due to the fact that magnetic field exerts a force on moving charges. This force is called magnetic force. Due to this magnetic force, the picture is distorted when you remove the bar magnet away from the screen, the motion of electron is not affected by the magnetic force and the picture will be normal.

3. Symbol 'X' indicates the direction of a magnetic field into the page. A straight long wire carrying current along its length is kept perpendicular to the magnetic field. What is the magnitude of force experienced by the wire? In what direction does it act? (AS1)



A. From the given figure, a straight wire carrying current which is kept perpendicular to a uniform magnetic field 'B'. This 'B' is directed into the page. Let the field be confined to the length 'L' we know that the electric current means charges in motion. Hence they move with a certain velocity called drift velocity 'V'. Let total charge inside the magnetic field be 'Q'. So magnetic force on the current carrying wire is given by

$$F = BQV \rightarrow (1)$$

Time taken by the charge (Q) to cross the field be

$$t = \frac{L}{v}$$

$$t = \frac{L}{v} \rightarrow (2)$$

Substituting (2) in (1) we get

$$F = BQ \cdot \frac{L}{t}$$

$$= BL \cdot \frac{Q}{t}$$

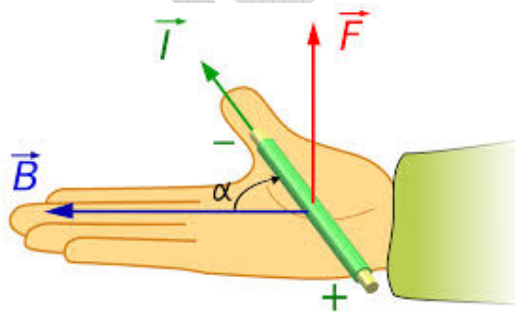
We know that $\frac{Q}{t} = I$

$$F = BLI$$

Direction of force:

The direction of force can be finding out by using Right Hand Rule

- 1) Fore finger points towards the velocity of current
- 2) Middle finger points to the direction of magnetic field (B).
- 3) Thumb gives the direction of force (F).



4. Explain the working of electric motor with a neat diagram? (AS1)

A. 1) Consider a rectangular coil kept in uniform magnetic field as shown in below figure

Switch on the circuit, so that the current flows through the coil. The direction of current is shown in figure.

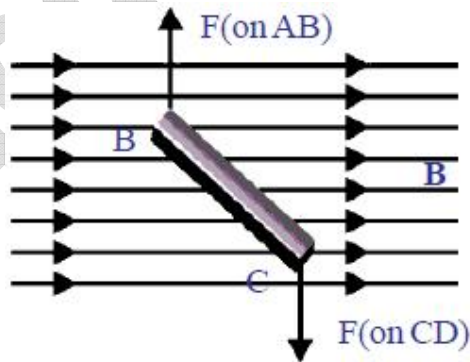
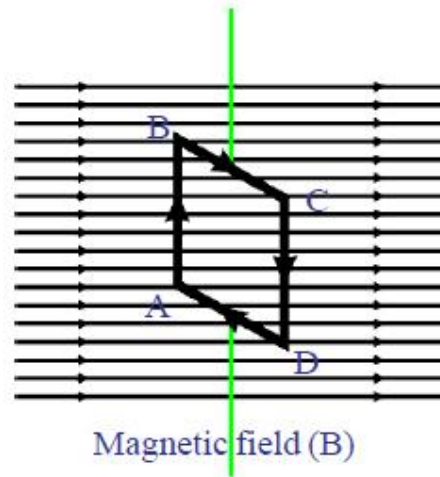
2) The sides AB and CD of the coil is always at right angles to the magnetic field.

3) According to Right Hand Rule, at AB the magnetic force acts inwards perpendicular to the field of magnet and on CD, it acts outward.

4) The top view of coil I shown in figure.

5) The force on the sides BC and DA varies because they make different angles at different positions of coil in the field. At BC, Magnetic force pulls the coil up and at DA magnetic force pulls it down.

6) The net force acting on AB and on CD is zero because they carry equal currents in the opposite directions. Similarly the sum of the forces on sides BC and DA is also zero. So, net force on coil is zero.



7) But the rectangular coil comes into rotation in clockwise direction because equal and opposite direction because equal and opposite pair of forces acting on the two sides of coil.

8) If the direction of current in the coil is unchanged, it rotates, up to half rotation in one direction and the next half in the direction opposite to previous like to and fro motion.

9) If the direction of current of coil is changed the coil will rotate continuously in one and same direction.

10) To achieve these brushes B_1 and B_2 were used.

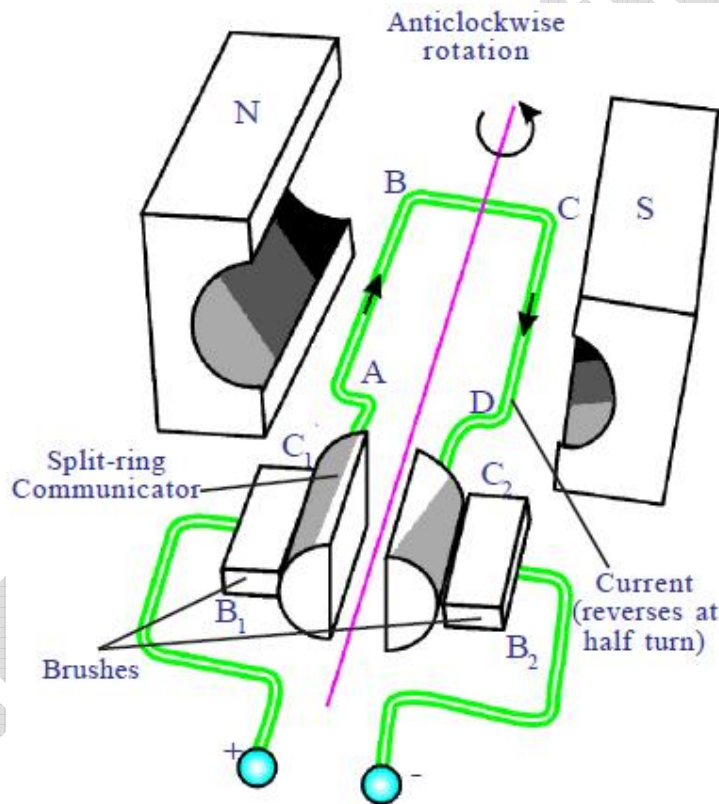
11) These brushes are connected to the battery. The ends of coils are connected to slip rings C_1 and C_2 which rotate along with coil.

12) Initially C_1 is in contact with B_1 and C_2 is in contact with B_2 .

13) After half rotation, the brushes come into contact with other rings in such a way that the direction of current through the coil is reversed this happens every half rotation.

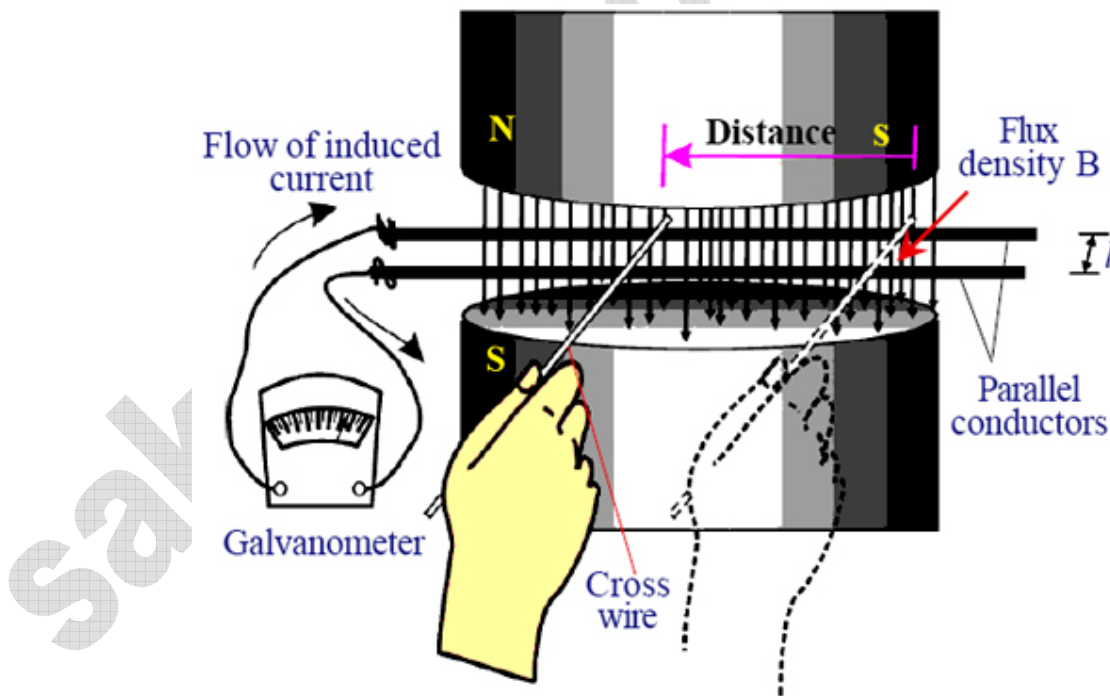
14) Thus the direction of rotation of coil remains the same. This is the principle used in electric motor.

15) In electric motor electrical energy is converted into mechanical energy.



5. Derive Faraday's law of induction from law of conservation of energy. (AS1)

- A.**
- 1) Let arrange an apparatus shown in the figure.
 - 2) It consists of a pair of parallel bare conductors which are spaced one meter apart in uniform magnetic field 'B'.
 - 3) We can hold another bare conductor in such a way that it is in contact with the two parallel wires.
 - 4) A galvanometer is connected to the ends of parallel conductors to complete an electric circuit.
 - 5) Now if the cross conductor placed across parallel conductors to move to left, galvanometer needle will defect in one direction.
 - 6) If the cross conductor is moved to the right its needle deflect in a direction opposite to previous deflection.
 - 7) A current will set up in the circuit where there is an EMF (Electro motive force) in the circuit. Let this EMF be ϵ .



8) According to the principle of conservation of energy this electric energy must come from the works that we have done in moving cross wire.

9) If we ignore friction, the work done by this applied force = F.S. (Where 'S' is the distance moved by cross conductor)

10) Force applied on cross wire by field B is

$$F = BIL.$$

11) Work done = F.S

$$= BIL.S \rightarrow (1)$$

12) Now we move the cross wire to the left, the area of loop decreases and the flux through the loop also decreases.

The decrease in flux = $\Delta\phi = BL.S \rightarrow (2)$

From (1)

$$W = BILS$$

$$= (BLS) I$$

From (2)

$$W = (\Delta\phi)I$$

Let divide both sides by Δt

$$\frac{W}{\Delta t} = I \cdot \left(\frac{\Delta\phi}{\Delta t} \right)$$

We know that electric power is the product of current and EMF

$$\varepsilon = \frac{\Delta\phi}{\Delta t}$$

Electric power = I.E $\rightarrow (3)$

$$\text{Electric power } p = I \cdot \frac{\Delta\phi}{\Delta t} \quad \left[\because \frac{W}{\Delta t} = \text{power } p \right]$$

13) Thus the electrical power generated in the circuit is equal to product in induced EMF and the current. Thus the mechanical energy utilized to move the cross wire in one second is converted into electric power $\left(\frac{\Delta\phi}{\Delta t} \right) \cdot I$

[Conservation of energy]

Divide (2) by Δt

$$\frac{w}{\Delta t} = \frac{Fs}{\Delta t} = \frac{BILs}{\Delta t}$$

Where $\frac{s}{\Delta t}$ is the speed of cross wire, let it be (v)

$$\text{Electric power } P = \frac{Fs}{\Delta t} = FV$$

$$= BILV \rightarrow (4)$$

Equating (3) and (4) we get

$$E.I = B.I. L.V$$

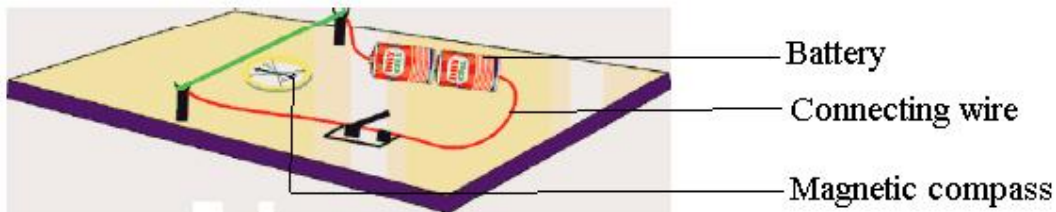
$$\varepsilon = B.L.V.$$

Induced EMF = BLV.

6. Explain with the help of two activities that current carrying wire produces magnetic field? (AS1)

A. Activity I:

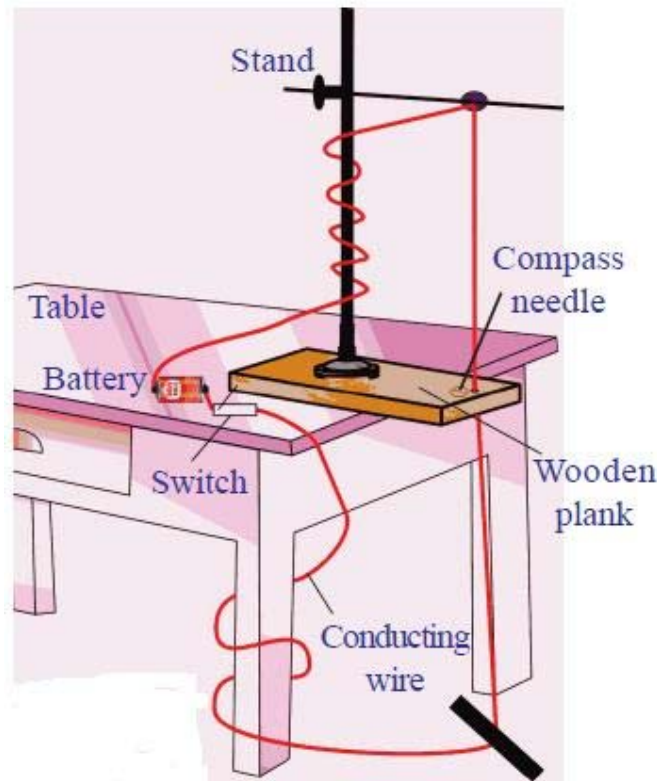
- 1) Take a thermocol sheet and fix two thin wooden sticks of height 1cm which have small slit at the top of their ends.
- 2) Arrange of copper wire of 24 gauge so that it passes through these slits and make a circuit.
- 3) The circuit of 3 or 9v battery, key and copper wire which is connected in series as shown in figure.
- 4) Now, keep a magnetic compass below the wire and bring a bar magnet close to the compass.
- 5) The needle in the compass deflects. This deflection is due to magnetic field produced by bar magnet.
- 6) Take the bar magnet far away from the circuit and switch on the circuit. Observe the changes in compass.
- 7) The compass needle deflects.



8) This deflection is due to magnetic field produced by current carrying conductor. (Wire)

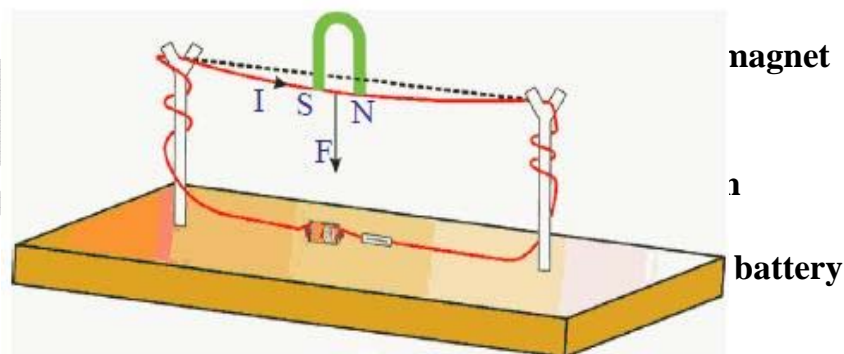
Activity II:

- 1) Take a wooden plank and make a hole as shown in figure.
- 2) Place this plank on a table. Now place a retort stand on the plank.
- 3) Pass a 24 gauge copper wire through a hole of the plank and rubber knob of the retort stand in such a way that the wire be arranged in a vertical position and doesn't touch the stand.
- 4) Connect the two ends of wire to a battery via switch.
- 5) Place 6 to 10 compass needles in a circular path around the hole so that its centre coincides with the hole. Use 3 or 9 volts battery in a circuit.
- 6) Now switch on current flows through wire.
- 7) The compass needle deflects in a particular direction.
- 8) The deflection is due to magnetic field produced by current carrying wire.



7. How do you verify experimentally that the current carrying conductor experiences a force when it is kept in magnetic field? (AS1)

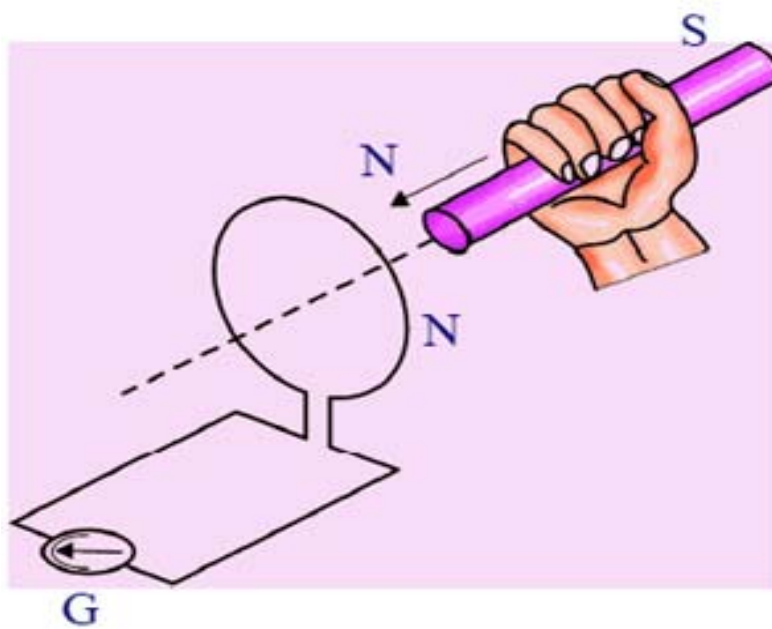
- A.
1. A copper wire is passed through splits of wooden stick.
 2. Connect the wire to 3 volts battery.
 3. Close the switch to make the circuit current passes through the wire.
 4. Bring the horse shoe magnet near the wire.



5. Then a force experienced on wire.
6. Reverse the polarities of magnet, then the direction of force is also reversed.
7. The right hand rule helps the direction of flow of current.

8. Explain Faraday's law of induction with the help of activity. (AS1)

- A. 1. Connect the terminals of a coil to a sensitive galvanometer as shown in figure.



2. Normally, we would not expect any deflection of needle in the galvanometer because there is no EMF in the circuit.

3. Now, if we push a bar magnet towards the coil, with its north pole facing the coil, the needle in the galvanometer deflects, showing that a current has been setup in the coil; the galvanometer doesn't deflect if the magnet is at rest.

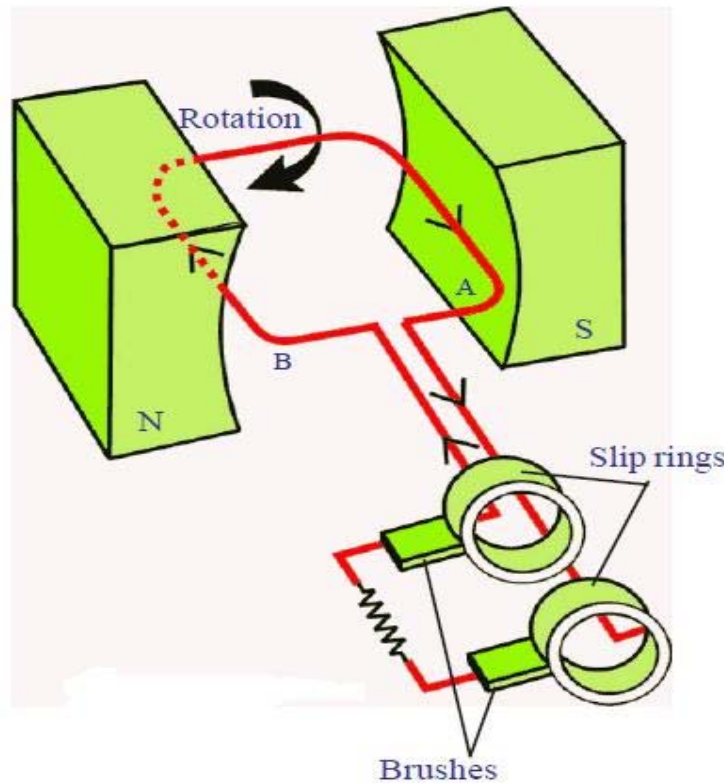
4. If the magnet is moved away from the coil, the needle in the galvanometer again deflects, but in opposite direction, which means that a current is set up in coil in opposite direction.

5. If we use the end of South Pole of magnet instead of North Pole, the results i.e., the deflection in galvanometer are exactly opposite to previous one.

6. Form this, we conclude that change in magnetic than liked with closed coil, produces current.

9. Explain the working of AC electric generator with a neat diagram. (AS1)

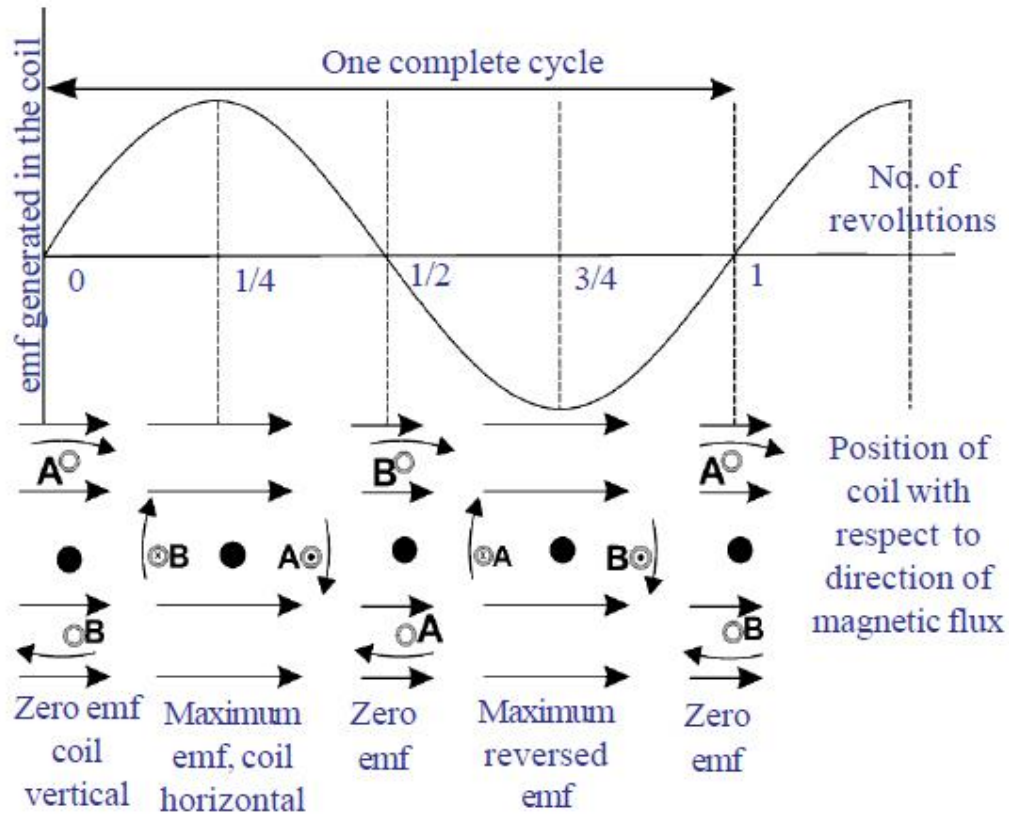
A.



1. Generators convert mechanical energy into electrical energy.
2. Consider a rectangular coil. Let it be held between the poles of curve- shaped permanent magnet as shown in figure.
3. As the coil rotates the magnetic flux passing through the coil changes.
4. According to the law of electromagnetic induction an induced current is generated in coil.

5. **Direction of Current:**

- i. Initially the coil positioned in such a way that magnetic field passes through it. When the coil is at rest in vertical position, with side [A] of coil at top position and side [B] at bottom position no. current is induced in it. In this position current is zero.



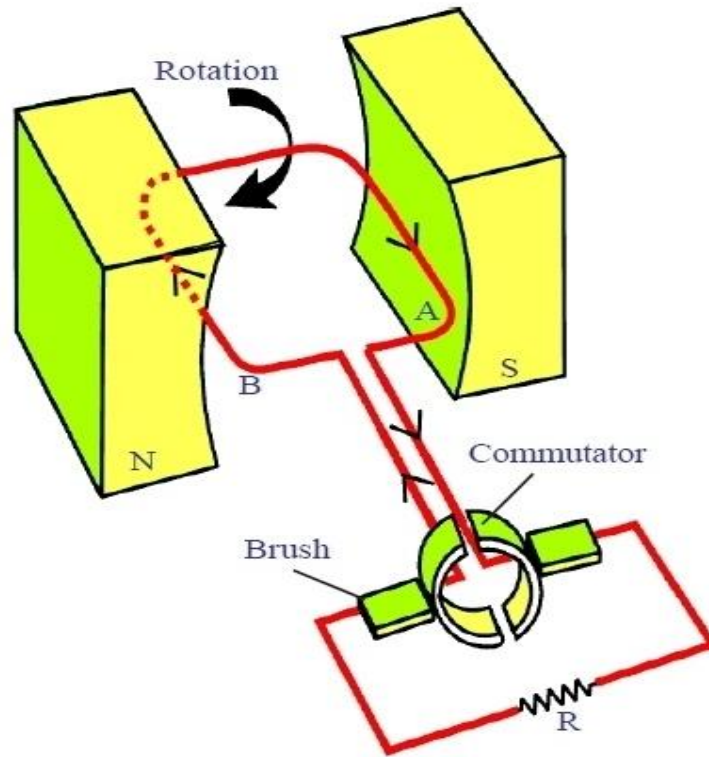
- ii. When a coil is rotated in clock wise direction, current will be induced in it flows from A to B, during the first quarter of rotation, the current increases from zero to a maximum position when the coil is in horizontal position.
- iii. If we continue the rotation of coil, current decreases during second quarter of the rotation and once again become zero. When coil comes to vertical position with side B at top and side A at bottom. During second part of rotation, current generated follows the same pattern as that in the first half; expect that the direction of current is reversed.

6. Usage of induced current produced:

- i. The ends of the coil are connected to two slip rings and two carbon brushes are arranged in such a way that they press the slip rings to obtain current form the coil
- ii. When these brushes are connected to external devices like T.V. etc we can make them work with the current supplied from ends of carbon brushes
- iii. This current is known as alternating current [AC]

10. Explain the working of D.C. generator with a neat diagram. (AS1)

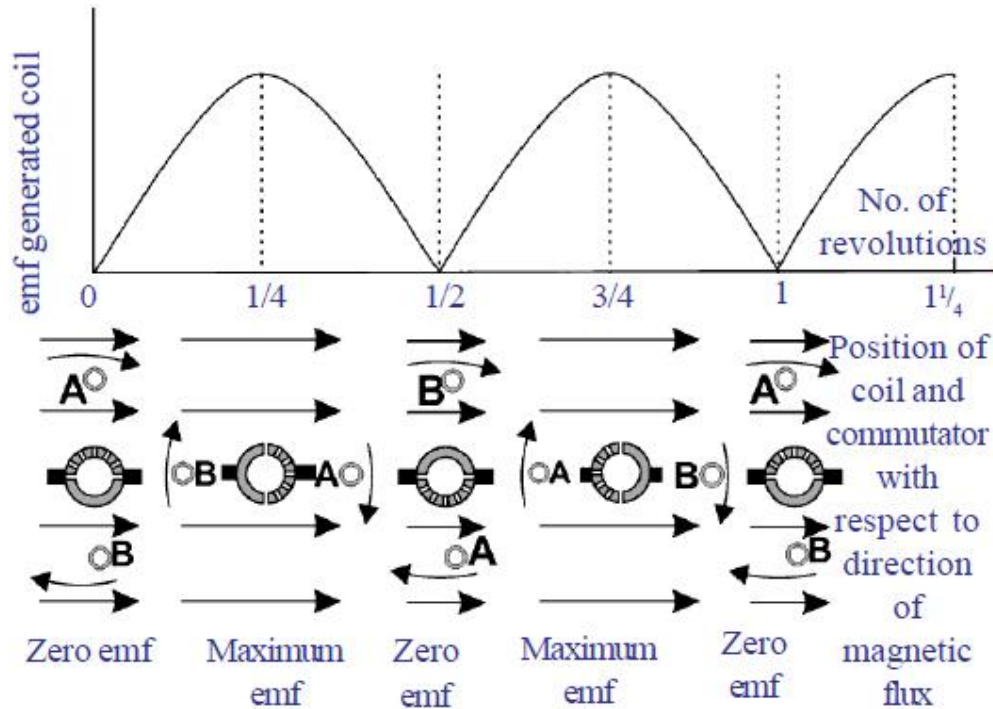
- A.
1. Generator works on the principle of electromagnetic induction.
 2. It converts mechanical energy into electrical energy.
 3. Consider a rectangular coil. Let it be held between the poles of core shaped permanent magnet as shown in figure.
 4. As the coil rotates the magnetic this passing through the coil changes.
 5. According to the law of electromagnetic induction an induced current is generated in coil.
 6. If two half slip rings are connected to ends of coil as shown in below, this generator works as DC generator to produce DC current.



Working:

1. When the coil is in vertical position the induced current generated during the first half rotation, rises from zero to maximum and falls to zero again.
2. As the coil moves further from this position, the ends of the coil go to other slip rings.

3. Hence, during the second half rotation, the current is reversed in the coil itself, the current is generated in the second half rotation of the coil is identical with that during the first half of the direct current for one revolution.



11. Rajkumar said to you that the magnetic field lines are open and they start at North Pole of bar magnet and end at South Pole. What questions do you ask Rajkumar to correct him by saying “field lines are closed”? [AS2]

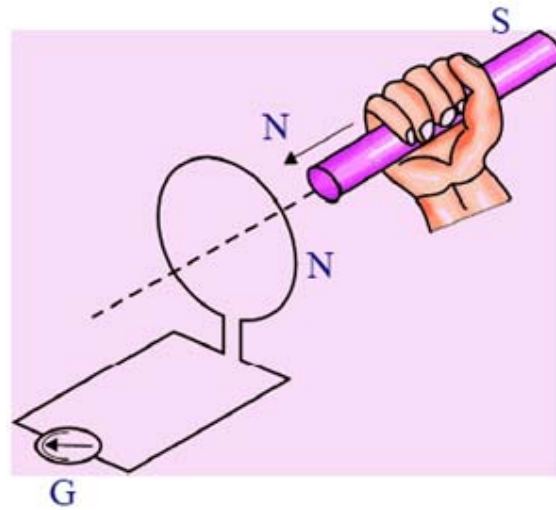
- A.
1. If the magnetic field lines start at North Pole and end at South Pole, where do the lines go from South Pole?
 2. What happening with in bar magnet?
 3. If the magnetic lines are open then is it possible to obey conservation of energy?

12. What experiment do you suggest to understand Faraday’s law? What items are required? What suggestions do you give to get good results of the experiment? Give precautions also? [As3]

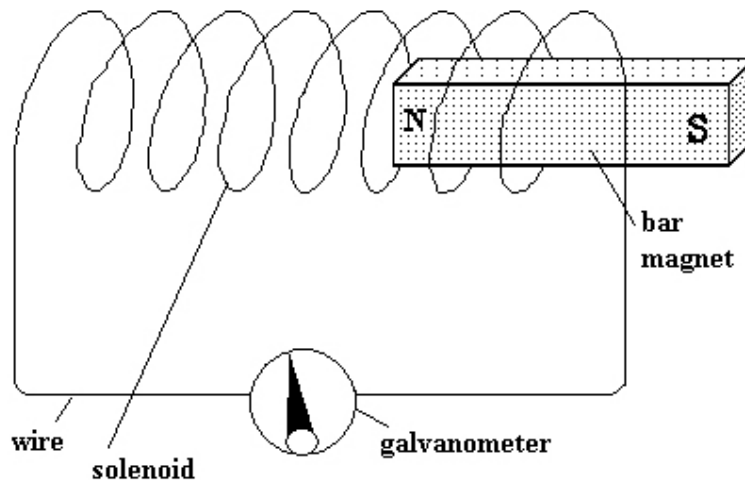
A. **Aim:** To understand Faraday’s law of induction-

Materials required:

- 1) A coil of copper wire
- 2) A bar magnet
- 3) Galvanometer etc



Faraday's laws



Procedure:

- 1) Connect the terminal of a coil to a sensitive galvanometer as shown in figure.
- 2) Normally we wouldn't expect any deflections of in the galvanometer because there is to be no EMF in this circuit.
- 3) Now if we push a bar magnet towards the coil with its north pole facing the coil, we observe the needle in the galvanometer deflect, Showing that a current is set up in the coil.
- 4) The galvanometer doesn't deflect if the magnet is at rest.

- 5) If the magnet is moved away from the coil, the needle in the galvanometer again deflects, but in the opposite direction, which means that a current is setup in the coil, in the opposite direction.
- 6) If we use end of South Pole of magnet instead of North Pole in the above activity, the deflections are partly reversed.
- 7) This experiment proves “Whenever there is a continents change of magnetic flux linked with closed coil, a current is generated in coil”.

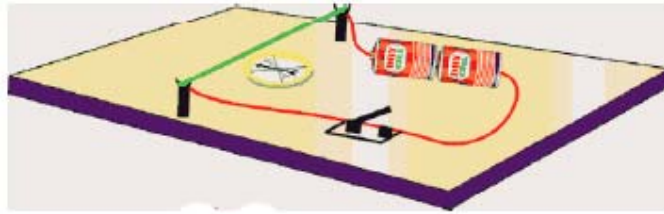
Precautions:

1. The coil should be kept on an insulating surface
2. Bar magnet should be of good magnetic moment
3. The centre of galvanometer scale must be zero.

13. How can you verify that a current carrying wire produces a magnetic field with the help of an experiment? (AS3)

A. Experiment:

1. Take a thermocol sheet and fix two thin wooden sticks of height 1cm which have small slit at the top of their ends.
2. Arrange a copper wire of 24 gauge so that it passes through these slits and make a circuit.
3. The circuit consists of 3 or 9 v battery, key and copper wire which are connected in series.
4. Now keep a magnetic compass below the wire bring a bar magnet, close to the compass.
5. The needle in the compass deflects. This deflection is due to magnetic field produced by bar magnet.
6. Take the bar magnet far away from the circuit and switch on the circuit.
7. The compass needle deflects.
8. The deflection is due to magnetic field produced by current carrying wire.



14. Collect information about generation of current by using Faraday's law. [AS4]

A. Faraday's law is used to generation of current-

1. Change in magnetic flux induces EMF in the coil.
2. Electromagnetic induction proposed by Faraday is the base for generator, which produces electric current.
3. Transformer also works on principle of electromagnetic induction, which used to transmit the current.

15. Collect information about material required and procedure of making a simple motor from internet and make a simple motor on your own. [AS4]

A. **Aim:** Preparation of electric motor-

Materials required:

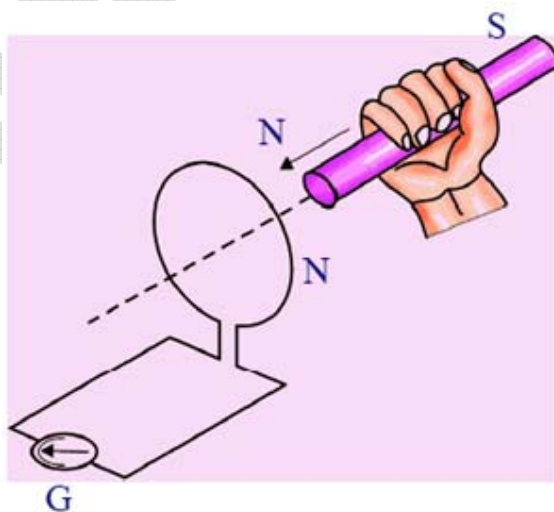
1. A wire nearly 15cm
2. 1.5 v battery
3. Iron nail
4. Strong magnet
5. Paper clip

Procedure:

1. Attach the magnet to the head of iron nail
2. Attach a paper clip to the open end of magnet
3. Now attach the other end of the nail to positive terminal of battery
4. Now connect the negative terminal of the battery and the head of the iron nail through a wire
5. We observe that paper clip rotates

16. Collect information of experiments done by Faraday? [AS4]

- A.
1. Connect the terminals of a coil to a sensitive galvanometer as shown in figure.
 2. Normally, we wouldn't expect any deflection of needle in the galvanometer because there is no EMF in the circuit.
 3. Now, if we push a bar magnet towards the coil, with its north pole facing the coil, the needle in the galvanometer deflects, showing that a current has been set up in the coil, the galvanometer doesn't deflect if the magnet is at rest.
 4. If the magnet is moved away from the coil, the needle in the galvanometer again deflects, but in the opposite direction, which means that a current is set up in the coil in the opposite direction.
 5. If we use the end of the South Pole instead of North Pole, the results i.e., the deflection in galvanometer are exactly opposite to each other.
 6. The activity proves that the change in magnetic flux linked with a closed coil, produces current.
 7. From this Faraday's law of induction can be stated as whenever there is a continuous change of magnetic flux linked with a closed coil. A current is generated in coil this induced EMF is equal to the rate of change of magnetic flux passing through it.



17. How do you appreciate Faraday's law, which is the consequence of conservation of energy? [AS6]

A. Law of Conservation of Energy:

1. Energy neither be created nor be destroyed, but can be converted from one form to another.
2. Faraday's law says whenever there is a change in magnetic flux linked with closed coil; a current is generated in the coil.
3. The induced EMF is equal to the rate of change of magnetic flux passing through it.
4. The work input: we have to move the magnet through the coil.
5. The energy is converted into electrical energy.

18. How do you appreciate the relation between magnetic field and electricity that changed the life style of mankind?

- A.
1. Changes in the life style of mankind are a result of several scientific many inventions.
 2. All appliances like generators, fans, mixers, motors make our life easy and comfortable.
 3. By using Faraday's law, electricity is produced from varying magnetic flux.

19. Which of the various methods of current generation protects nature well? Give examples to support your answer. (AS7)

- A. Nowadays, current is generated in many ways like hydel power, thermal power, wind power, nuclear power and power from solar radiation, among others.

Hydel Power:

1. It uses a lot of water stored at very high places.
2. Water is a non renewable source.

Thermal Power:

1. By heating the coal, water converts to steam runs the turbine and produces electricity.
2. Coal is non renewable source.

Fill in the Blanks

1. The SI unit of magnetic field induction is _____.
2. Magnetic flux is the product of magnetic field induction and _____.
3. The charge is moving along the direction of magnetic field. Then force acting on it is _____.
4. A current carrying wire of length L is placed perpendicular to a uniform magnetic field B . Then the force acting on the wire with current I is _____.
5. Faraday's law of induction is the consequence of _____.
6. The magnetic field inside a _____ is uniform.
7. S.I unit of magnetic field strength is _____.
8. The direction of magnetic field lines along a current carrying conductor is given by _____.
9. Dynamos work on the principle of _____.
10. Motor works on the principle of _____.
11. A DC generator is based on principle of _____.
12. S.I unit of magnetic flux is _____.
13. The magnetic field intensity at centre of magnetic is _____.

Key:

- | | | |
|-------------------------|-------------------------------|-------------------|
| 1) Tesla; | 2) Area; | 3) Zero; |
| 4) $F = B.I.L$; | 5) Consignation of energy; | 6) Magnet; |
| 7) Tesla; | 8) Maxwell's right hand rule; | 9) Faraday's law; |
| 10) Ampere's force law; | 11) Faraday's law; | 12) Weber; |
| 13) Zero; | | |

Objective Type Questions

- Which of the following converts electrical energy into mechanical energy? []
a) Motor b) Battery c) Generator d) Switch
- Which of the following converts mechanical energy into electrical energy? []
a) Motor b) Battery c) Generator d) Switch
- The magnetic force on a current carrying wire placed in uniform magnetic field if the wire is oriented perpendicular to magnetic field, is _____. []
a) 0 b) ILB c) $2ILB$ d) $ILB/2$
- _____ law gives direction of induced current. []
a) Faraday's law b) Kirchoff's law c) Lenz's law d) Lorentz law
- Magnetic field is a _____ quantity. []
a) Vector b) Scalar c) Dimension less d) unit law
- The relation between Weber and teals is _____. []
a) $\text{Weber} \cdot \text{m}^2 = \text{Tesla}$ b) $\text{wb} = \text{Tesla} \times \text{m}^2$
c) $\frac{\text{m}^2}{\text{wb}}$ d) $\text{wb} = \text{Tesla}$
- The magnetic field inside a _____ is uniform. []
a) Current carrying conductor b) Solenoid c) Coil d) Magnet
- Relation between flux linked with the coil (ϵ) and no of turns (N) is _____ []
where ϕ is magnetic flux.
a) $\epsilon = N \cdot \frac{d\phi}{dt}$ b) $\epsilon = \frac{1}{N} \cdot \frac{d\phi}{dt}$ c) $\epsilon = N \cdot \frac{dt}{d\phi}$ d) $N = \epsilon \frac{d\phi}{dt}$

9. Magnetic field lines are _____. []
 a) Closed loops b) Open loops c) Parallel d) None of these
10. Electric power $p =$ _____ []
 a) $p = I \cdot \frac{d\phi}{dt}$ b) $p = \frac{1}{I} \cdot \frac{d\phi}{dt}$ c) $I = \frac{pdt}{d\phi}$ d) $d\phi = \frac{PI}{dt}$

Key:

1.a; 2. c; 3. b; 4. c; 5. a; 6. b; 7. d 8. a; 9. a; 10. a.

Problems

- 1. The value of magnetic field induction which is uniform is 2T. What is the flux passing through a surface of area 1.5m^2 perpendiculars to field?**

Sol: Magnetic field induction $B = 2\text{T}$

$$\text{Area (A)} = 1.5\text{m}^2$$

$$\text{Magnetic flux} = B \cdot A$$

$$= 2 \times 1.5$$

$$= 3 \text{ wb.}$$

- 2. An 8N force on a rectangular conductor 20cm long placed perpendicular to a magnetic field. Determine the magnetic field induction if the current in conductor is 40A.**

Sol: Force acting $F = 8\text{N}$

$$\text{Length of conductor } l = 20\text{cm} = 0.2\text{m}$$

$$\text{Current } I = 40 \text{ A}$$

$$\text{Magnetic field induction } B = ?$$

$$\text{We know that } F = BIL$$

$$B = \frac{F}{IL}$$

$$= \frac{8}{40 \times 0.2} = 1 \text{ Tesla}$$

Magnetic field induction $B = 1 \text{ Tesla.}$

Match the following

Group – I

- | | | |
|--------------------------|-----|--|
| 1. Motor | [] | A) Magnitude of induced EMF |
| 2. Generator | [] | B) Direction of induced EMF |
| 3. Lenz's law | [] | C) Converts electrical energy to mechanical energy |
| 4. Faraday's law | [] | D) Converts mechanical to electrical energy |
| 5. Right hand thumb rule | [] | E) Direction of field by current wire |

Group – II

Key:

1.C; 2.E; 3.B; 4.A; 5.D;

II. Group - I

Physical Quantities

- | | | |
|--------------------------|-----|---------------|
| 1. Magnetic flux | [] | A) Volts |
| 2. Magnetic flux density | [] | B) Weber (wb) |
| 3. Induced EMF | [] | C) N-m |
| 4. Induced current | [] | D) Tesla (T) |
| 5. Torque | [] | E) Ampere |

Group - II

Units

Key:

1.B; 2.D; 3.A; 4.E; 5.C;

III Group – I

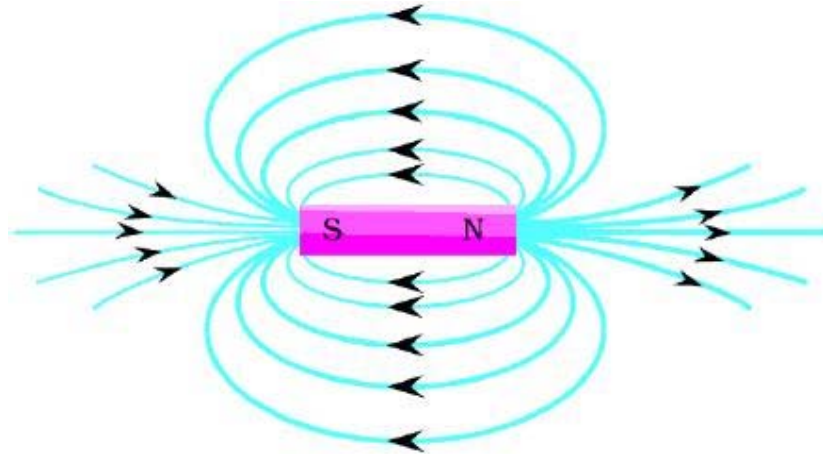
- | | | |
|---|-----|------------------------------------|
| 1. Force acting on '(F)'
current carrying wire | [] | A) BILS |
| 2. Magnetic flux 'φ' | [] | B) $\frac{\Delta\phi}{\Delta t}$ |
| 3. Induced EMF 'ε' | [] | C) BIL or BQV |
| 4. Work done on cross wire w | [] | D) $I \frac{\Delta\phi}{\Delta t}$ |
| 5. Power produced by induced EMF | [] | E) $\vec{B} \cdot \vec{A}$ |

Group – II

Key: 1.C; 2.E; 3.B; 4.A; 5.D;

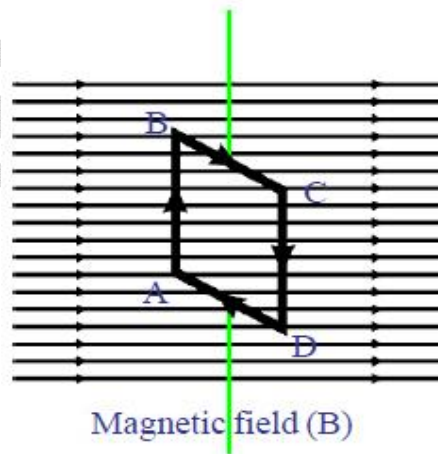
5 Mark Questions

1. Description of magnetic field lines in a magnet.

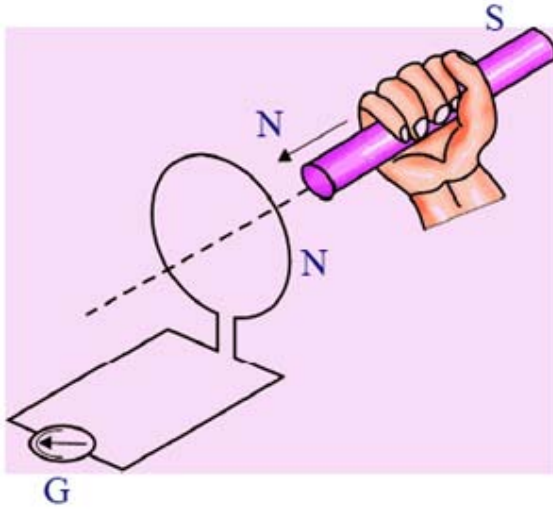


Magnetic field lines

2. Behavior of current carrying coil in a magnetic field.



3. Faraday's experimental analysis:



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