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Electromagnetism: Electromagnetism is the branch of physics involving the study of the electromagnetic force, a type of physical interaction that occurs between electrically charged particle.

⇒ The electromagnetic force is carried by electromagnetic fields composed of electric fields & magnetic fields.

⇒ We have already known that as observed by Faraday that, "whenever magnetic flux linked with a circuit changes, an e.m.f is induced in the circuit. If the circuit is closed it will cause an electric current to flow through the circuit."

Faraday's Laws of Electro-magnetic induction:-

Faraday's laws deal with the induction of an e.m.f in an electric circuit when magnetic flux linked with the circuit changes. They are stated as follows:

(i) Whenever magnetic flux linked with a circuit changes, an e.m.f is induced in it.

(ii) The induced e.m.f exists in the circuit so long as the change in the magnetic flux linked with it continues.

(iii) The induced e.m.f is directly proportional to the negative rate of change of magnetic flux linked with the circuit.

If '$d\phi_B$' is the change in magnetic flux linked with a circuit, that takes place in a time dt.

$$\text{Rate of change of magnetic flux} = \frac{d\phi_B}{dt}$$

If 'E' is e.m.f induced in the circuit as a result of this change

$$E \propto \frac{-d\phi_B}{dt} \quad \text{or} \quad \boxed{E = -k\frac{d\phi_B}{dt}}$$

By selecting units of 'E', 'ϕ_B' and 't' in a proper way, we can have $K = 1$

$$\therefore E = -\frac{d\phi_B}{dt}$$

Negative sign is due to direction of induced e.m.f.

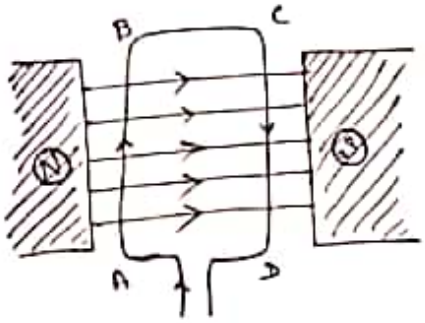
Lenz's Law :-

statement: "It states that direction of induced e.m.f is such that it tends to oppose the very cause which produces it."

Flemings' Left hand rule:

Whenever a conductor, carrying current is placed in a magnetic field, it experiences a force and tends to move under its action. Flemings's left hand rule gives the direction of motion of the conductor.

statement:- " Stretch first finger, central finger and thumb of your left hand in three mutually perpendicular directions. If first finger points towards the magnetic field, the central finger towards the current, direction of motion of the conductor is given by the direction of thumb."

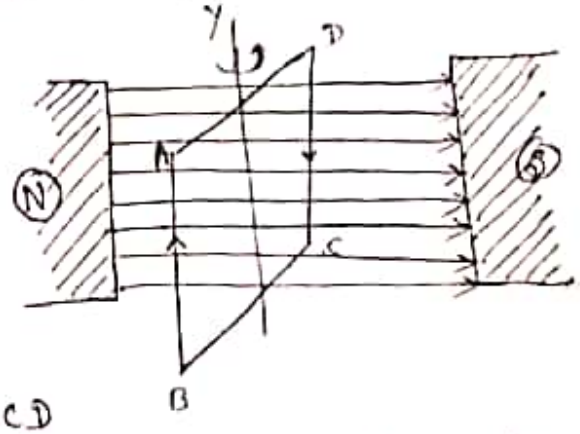


Consider a coil ABCD, capable of rotating in between the two pole pieces of a field magnet N-S. Send a current 'i' in direction A to B and C to D through it. Applying Flemings's left hand rule, it can be seen that AB tends to move into the plane of paper while CD tends to come out of it, thus exerting a couple on the coil.

Fleming's Right hand Rule:

It is a rule to find the direction of induced current in a conductor. It can be stated as follows:

"Stretch first finger, central finger and the thumb of your right hand in three mutually perpendicular directions. If the first finger points towards the magnetic field, thumb points towards the direction of motion of conductor, the direction of central finger gives the direction of induced current setup in the conductor."



Consider a coil ABCD turning inbetween the two pole pieces of a magnet as shown in fig. Let the direction of rotation of the coil be such that AB moves out of the plane of the paper while CD moves into. Appling Fleming's right hand rule separately on AB and CD, it can be seen that direction of induced current is from 'B to A' and 'D to C'.