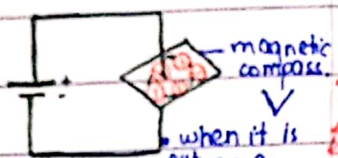
Date:

Sun Mon Tue Wed Thu Fri Sat

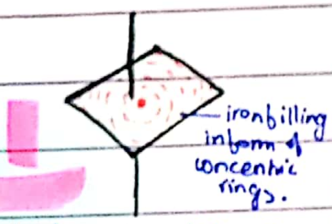
Chapter: 6. Electromagnetism

Magnetic field of constant current:

↳ Ampere told that when a current passes through a conductor it has a magnetic field. We can check this by two methods.
- By using magnetic compass.
- By using iron filling.

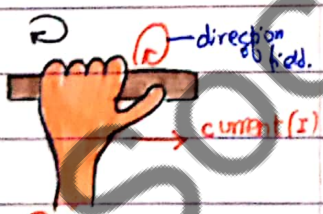


when it is put on a cardboard it will show deflection of needle, and it will tell flow of current, and magnetic field is present.



→ when iron filling are put on the card board, they will attract toward the magnet, since magnetic field is present in loop form due to current, so, the will arrange in circular form.

Direction of 'B'.



→ The direction of the magnetic field can be found by using the right hand rule

↳ Put the thumb in the direction of current

→ curl the fingers around the conductor, this will tell the 'B'.

SOLENOID (spring-shaped wire.)

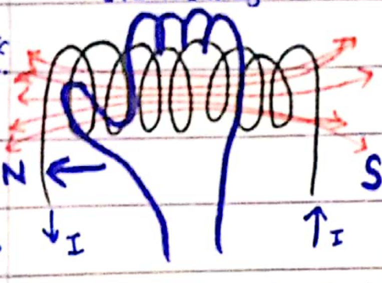
↳ A solenoid has many times larger magnetic field than a straight wire.

↳ magnetic field is so large that it is similar to the permanent magnet.

↳ when brought closer to a permanent magnet, it acquires N & S pole.

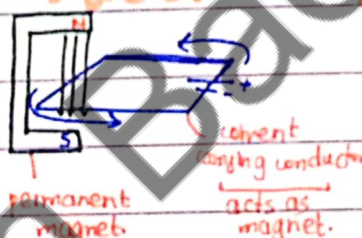
→ Temporary magnet

Electromagnet.



↳ Direction of thumb indicates North pole.

Force on a current carrying conductor placed in a magnetic field:



→ both magnets apply FORCE:

$F \propto I L B$

Force — current — length of conductor — magnetic field.

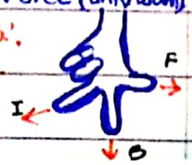
Direction of Force:

(physics gangster Rule).

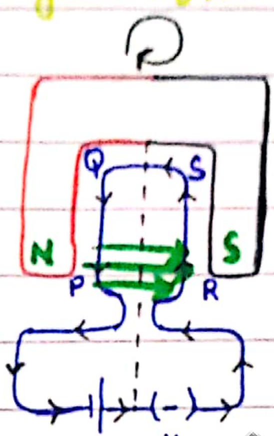
↳ Fleming left hand rule:

- index fingre: magnetic field.
- Middle fingre: Current.
- Thumb: Force (unknown)

① start from 'B'.
② Current 'I'.
③ unknown 'F'.

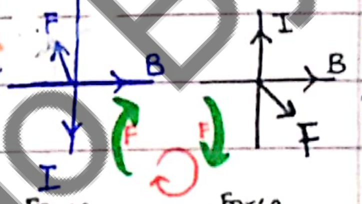


Torque on a current carrying coil in a magnetic field:



↳ Due to magnetic field the coil will rotate producing torque.

↳ At PQ: ↳ At RS:



- Force upwards
- Force downwards

Torque: depends upon following factors:

- N: No. of turns of a coil
- I: current
- A: Area of coil
- B: Magnetic field.

$\tau \propto NIAB$

D.C MOTOR:

↳ A commutator is added to the coil placed in a magnetic field, This commutator makes the coil continuously.

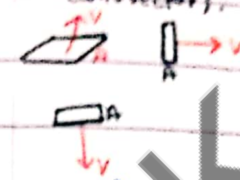
Electromagnetic Induction

- magnetic field lines passing through surface area is called magnetic flux.

Converting Area to vector Area:

↳ $A \cdot \hat{n} = \vec{A}$

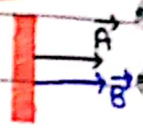
→ normal vector (unit vector).



$\phi = \vec{B} \cdot \vec{A}$

$BA \cos\theta$

↳ maximum Flux:



$\vec{B} \parallel \vec{A}$

$\theta = 0°$

$\phi = BA\cos\theta$

$BA\cos(0)$

$BA(1)$

$\phi = BA$ (max flux).

↳ Minimum Flux:

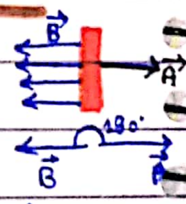
$\phi = BA\cos\theta$

$BA\cos(90)$

$BA(0)$

$\phi = 0$ (min flux).

↳ Negative flux.



$\phi = BA\cos\theta$

$BA\cos(180)$

$BA(-1)$

$-BA = \phi$

(negative Flux).

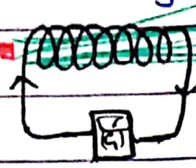
→ Emf is induced due to magnet

→ Current is induced

→ Current has a magnetic field

→ Solenoid will act as a magnet

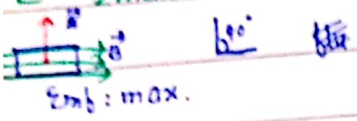
- Solenoid will neither let the magnet leave nor will it allow to come closer, cuz it changes its N & S continuously.



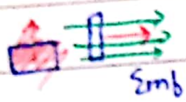
A.C generator:

→ coil rotated, B produced & induced I will be produced.

$\varepsilon = \varepsilon_{max} \cdot \sin\theta$.

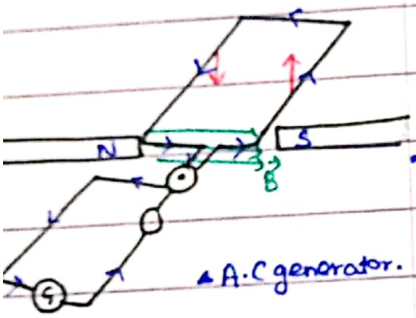


Emf : max.

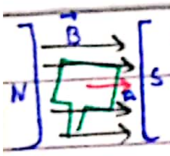


$\theta = 0°$

Emf : min, 0.



▲ A.C generator.

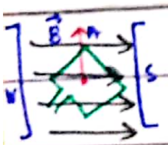


$\theta = 0$

$\varepsilon = \varepsilon_{max} \cdot \sin(0)$

$\varepsilon = 0$

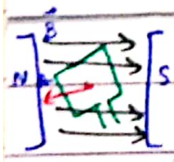
(minimum)



$\theta = 90$

$\varepsilon = \varepsilon_{max} \cdot \sin(90)$

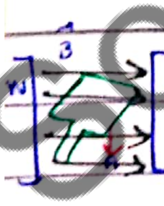
$\varepsilon = \varepsilon_{max}$



$\theta = 180$

$\varepsilon = \varepsilon_{max} \cdot \sin(180)$

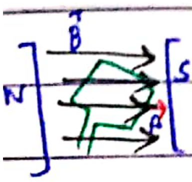
$\varepsilon = 0$



$\theta = 270$

$\varepsilon = \varepsilon_{max} \cdot \sin(270)$

$\varepsilon = -\varepsilon_{max}$

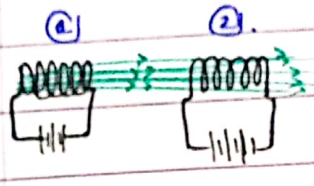


$\theta = 360$.

$\varepsilon = 0$.

Mutual Induction.

↳ when current flowing in first coil, it produces magnetic field, they move to 2nd coil and produce current, this is induced current.



Transformer:

• Primary coil

$V_p = -N_p \frac{\Delta\phi}{\Delta t}$

$\frac{V_p}{N_p} = -\frac{\Delta\phi}{\Delta t}$

$-\frac{\Delta\phi}{\Delta t} = \frac{-V_p}{N_p}$.

• Secondary coil

$V_s = -N_s \frac{\Delta\phi}{\Delta t}$

$\frac{V_s}{N_s} = -\frac{\Delta\phi}{\Delta t}$.

$\frac{\Delta\phi}{\Delta t} = \frac{-V_s}{N_s}$.

By comparing;

$\frac{V_p}{N_p} = \frac{V_s}{N_s}$

$\frac{V_p}{V_s} = \frac{N_p}{N_s}$.

$\frac{V_s}{V_p} = \frac{N_s}{N_p}$

Relay:

controls current in a circuit.

↳ uses very small I to control larg I.