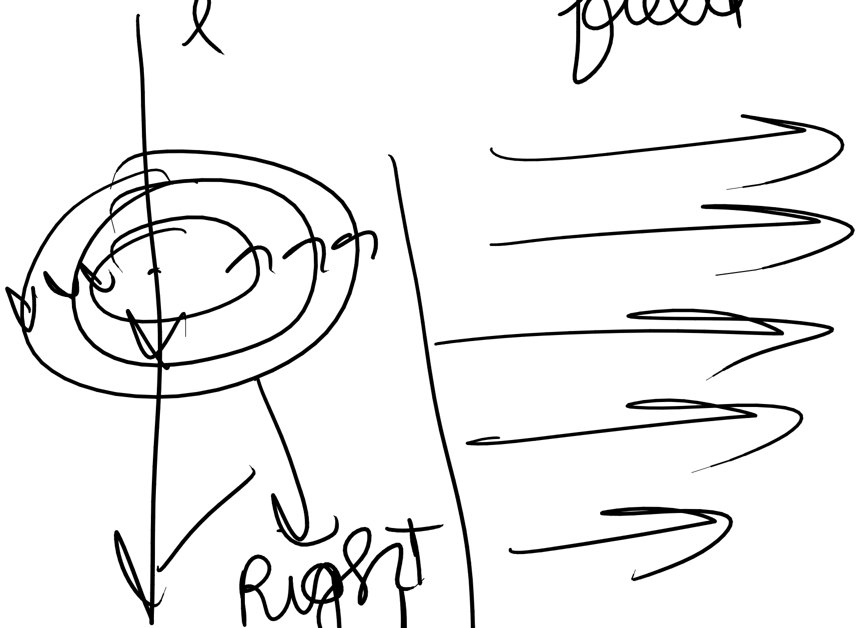
Magnetic Fields

Magnetic Field

mag field — lines of force or magnetic flux

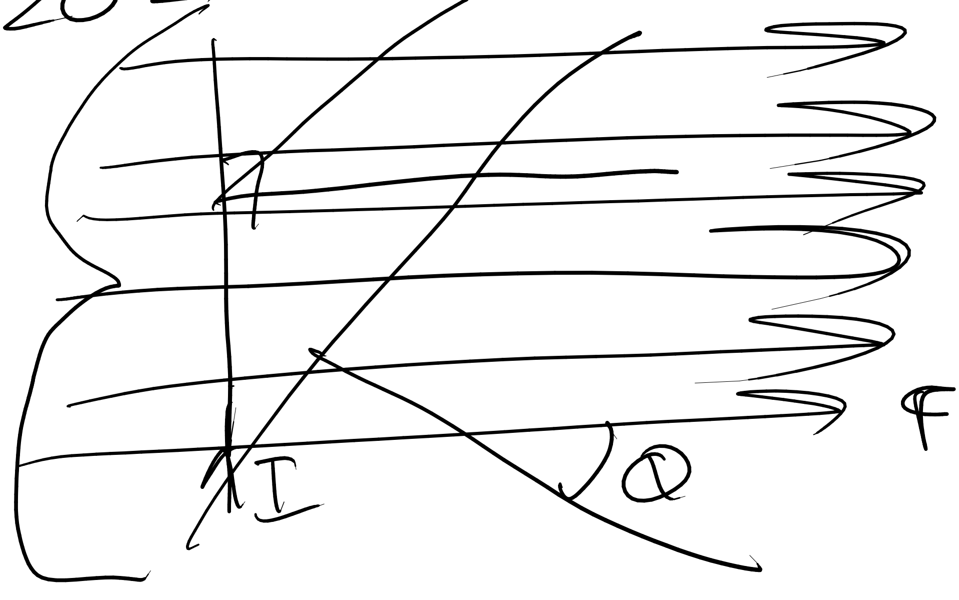


webers (Wb)

Right Hand Grip Rule

Force into the plane of Paper

20.2



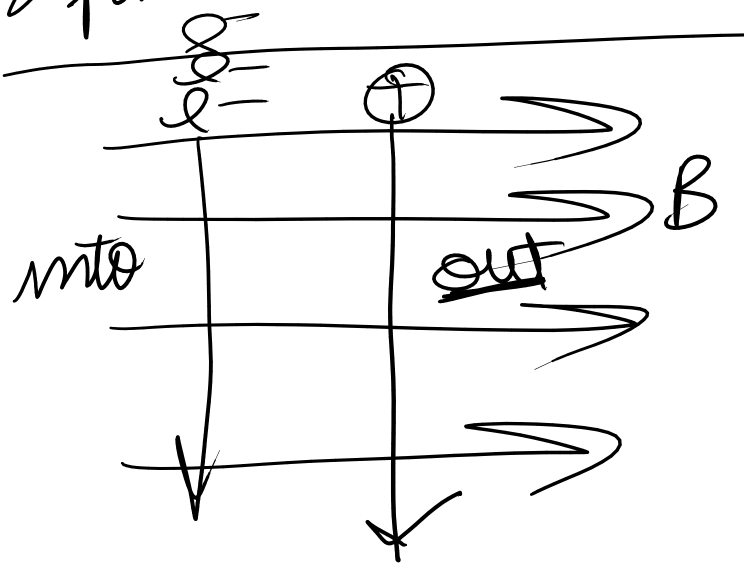
Force Field
Second Current
Thumb Motion
Left Hand Rule
$F = BIL\sin\theta$

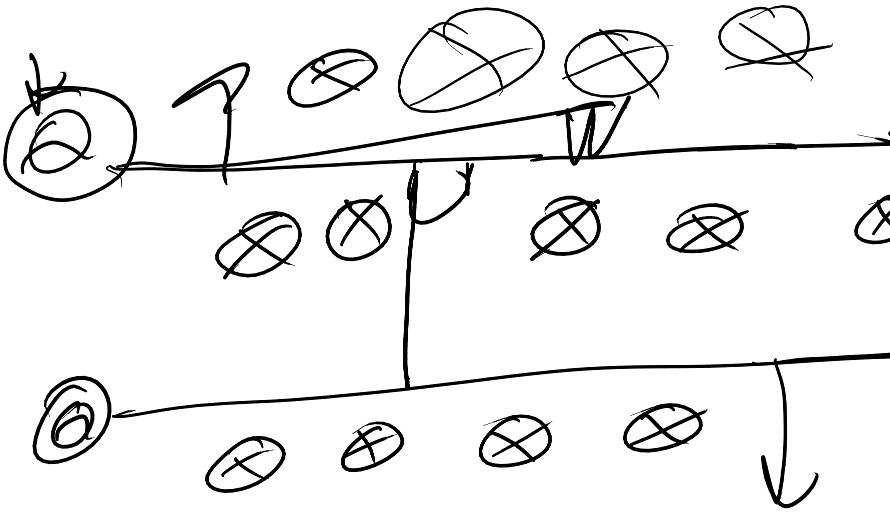
If the conductor is parallel to the magnetic field, it will not experience any force.

If $\perp$ $F = BIL$

$B = \frac{F}{IL}$ If $F = 1$, $I = 1$, $L = 1$

Magnetic fluxdensity can be defined as the force acting on a conductor of unit length, carrying a unit current & placed $\perp$ to the magnetic field.





$F = BaV$

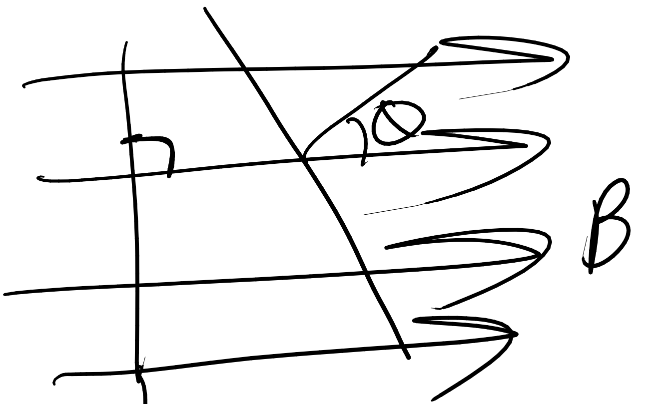
Left Hand Rule

Fore finger – Field

second – Current

Thumb – motion

$F = BaV \sin\theta$



$F = BaV \cdot \sin 90$

$BaV \times 1$

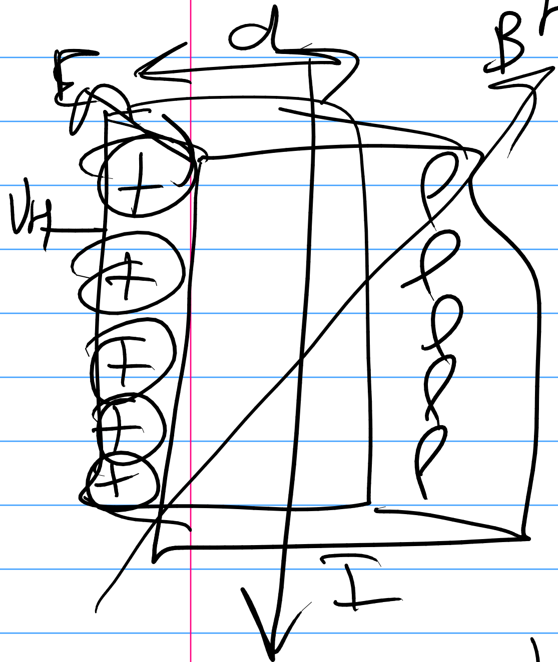
$= BaV$

Force acts on a moving charge.

If a charge Q moves through a magnetic field of intensity B with a velocity v then the force acting on the charge is given by $BQv\sin\theta$

To find the direction use Left Hand Rule.

Hall Voltage



$$E = \frac{V_H}{d}$$

$$I = nAvQ$$

$$v = \frac{I}{nAQ}$$

$$eE = Bev$$

$$\frac{eV_H}{d} = \frac{BeI}{nAe}$$

$$V_H = \frac{BeId}{nAe} = \frac{BeId}{ndte} = \frac{BeI}{nte}$$

note

Consider a metal conductor of cross sectional area A, length l & breadth (D). Let a current (I) flow through this conductor perpendicular to the cross sectional area (A). A magnetic field is applied ⊥ to the conductor & a current I. Due to this e will move to the right side & +ve charges build up on the left side. As the e build up on the right side, the internal electric field also builds up. Due to the +ve & -ve charges on either side of the conductor a Hall voltage is created b/w the two ends.

The electric field in the conductor can be given by $E = \frac{V_H}{D}$.

As the hall voltage builds up, the e are pushed to the opposite direction and equilibrium is reached & the resultant force on each e is 0. This will happen when the force due to the electric field is equal to the force due to the magnetic field.

$$eE = BeV \qquad \{q = e\}$$

Substituting for E & V ——— (derivation)

$$\frac{eV_H}{d} = \frac{BeI}{nAe}$$

$$I = nAVe$$

$$\frac{I}{nAe} = V$$

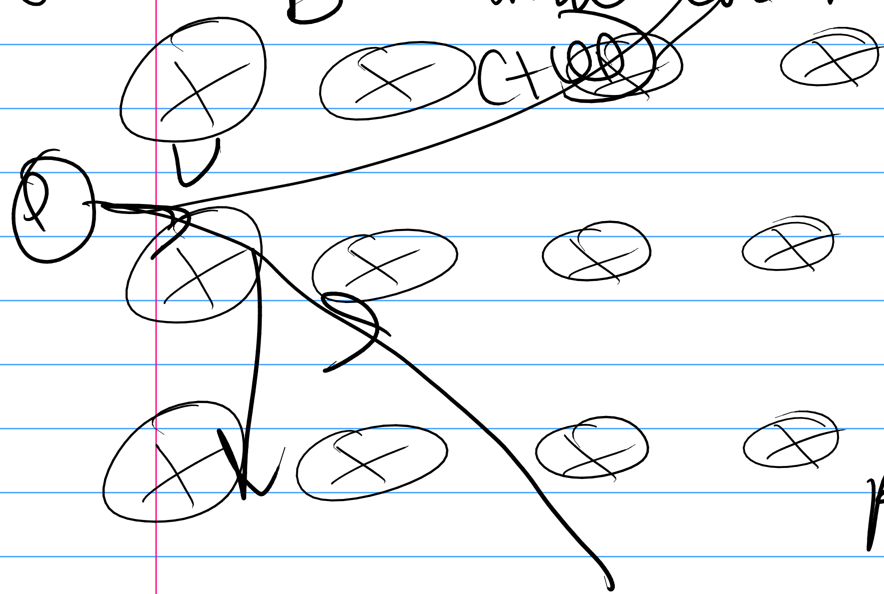
Making V_H subject of the

$(A = d \cdot t)$

$$V_H = \frac{BeId}{nAe} = \frac{BeId}{ndte} = \frac{BeI}{nte}$$

(4) practical activity 24.2, Page no. 495

B into the plane of paper ⊗



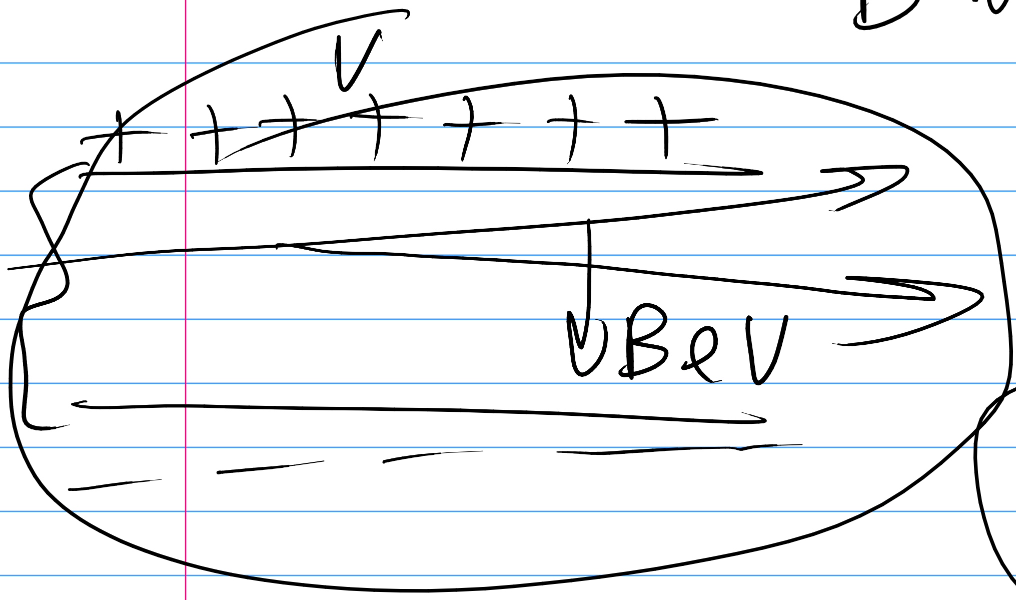
$F = BeV$

Left Hand Rule

If a charged particle moves into a magnetic field, ⊥ to the direction of the magnetic field, a force will act on it, given by $F = BeV$

$[q = e]$

Velocity selection



B into plane of paper

$BeV = Ee$

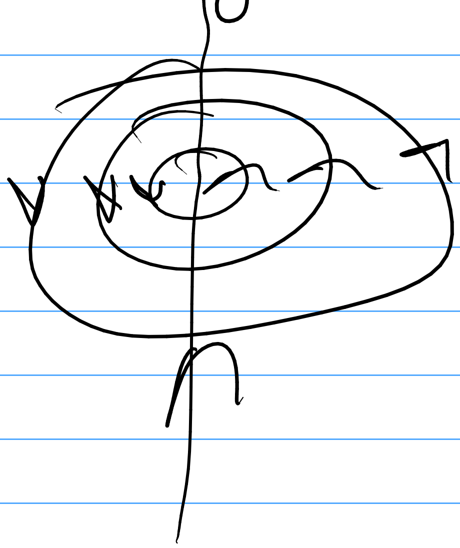
$V = \frac{E}{B}$

$E = \frac{V}{d}$

E & B are $\perp$ to each other

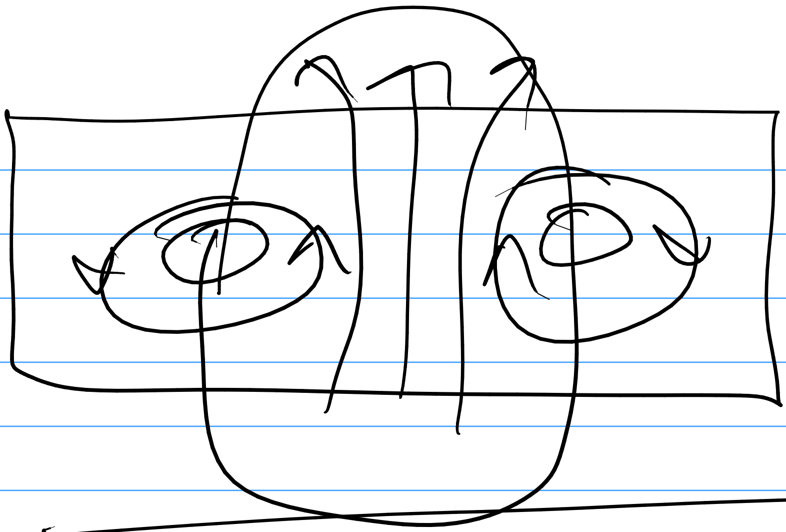
finished 20.3

20.4 Right Hand Grip Rule

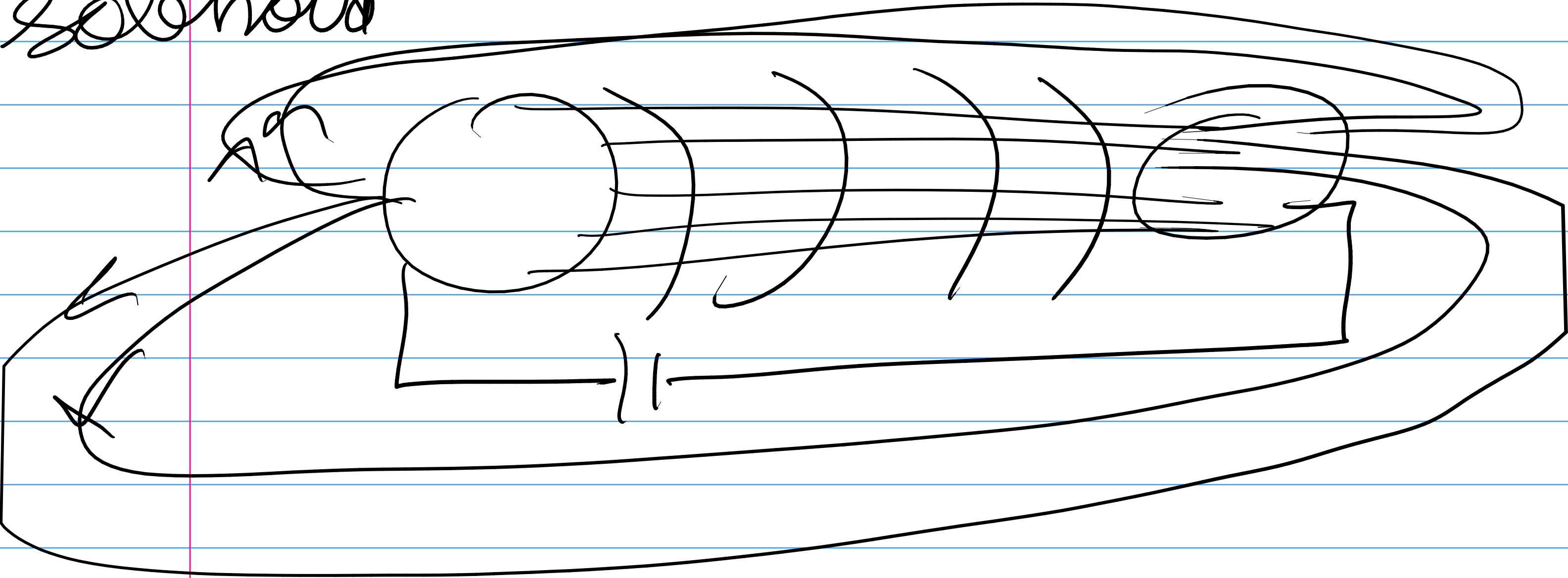


Long straight wire

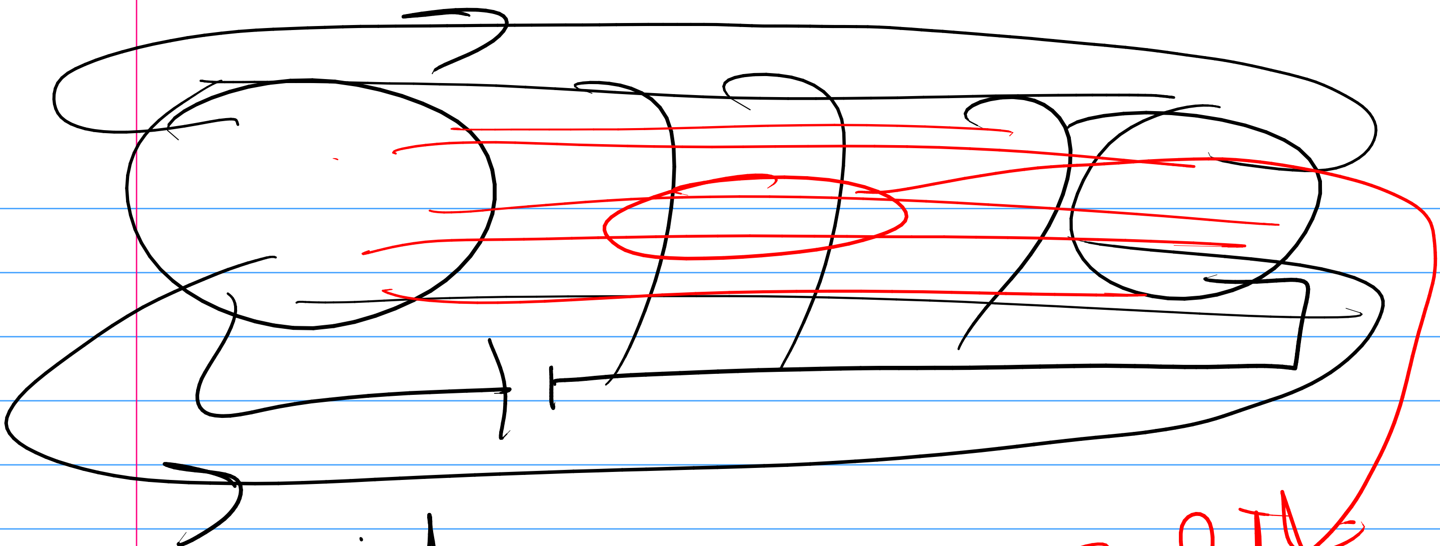
Flat circular coil



solenoid



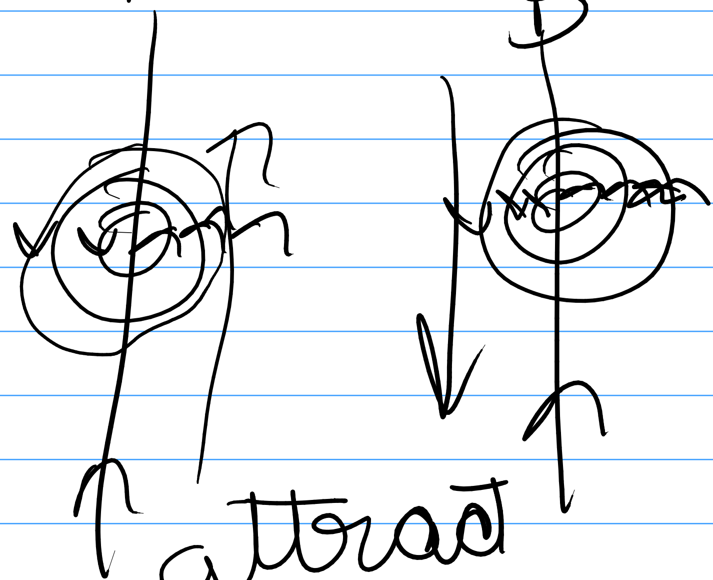
If we insert a bar of soft iron inside the solenoid then the soft iron will absorb the lines of magnetic flux & the magnetic field strength becomes stronger.



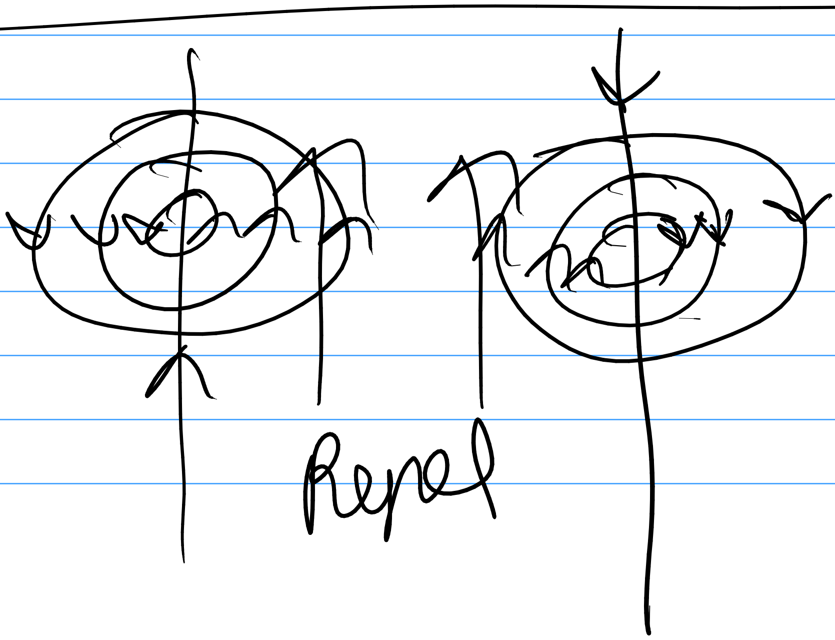
Solenoid

Soft Iron Wire

Force b/w current carrying conductors

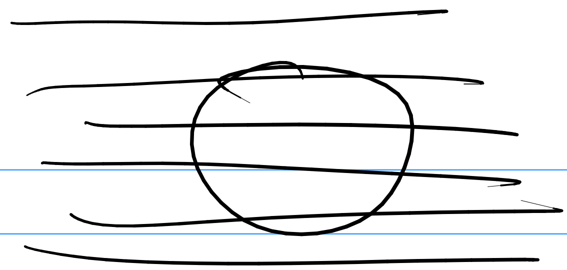


attract



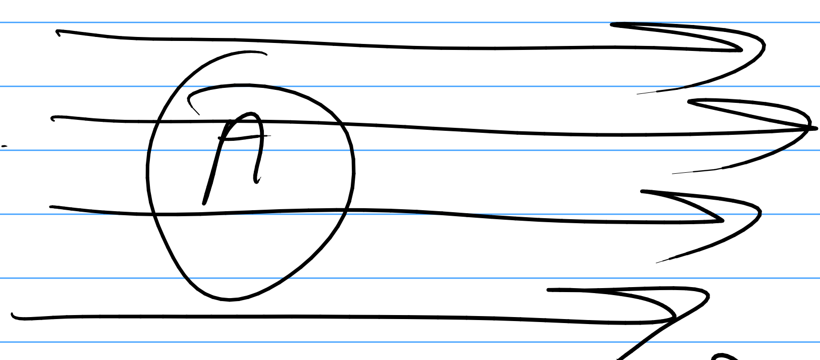
Repel

Magnetic flux density



$B = \frac{\Phi}{A}$ = webers/m^2
= Tesla

(1)



Flux passing through A = $\Phi = B \cdot A$

If we place a coil of Area A $\perp$ to the magnetic field of intensity B, then the flux passing through A = $\Phi = B \cdot A$

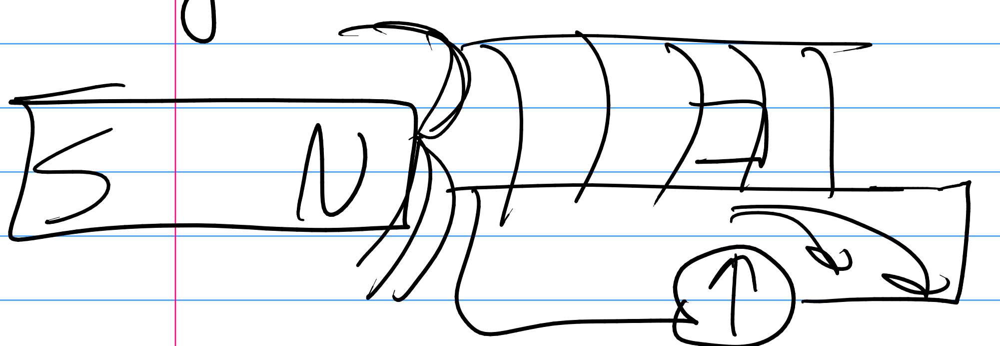
$\Phi = BA \sin\theta$

This is the flux linkage through A

Changing Magnetic Flux

Mag →

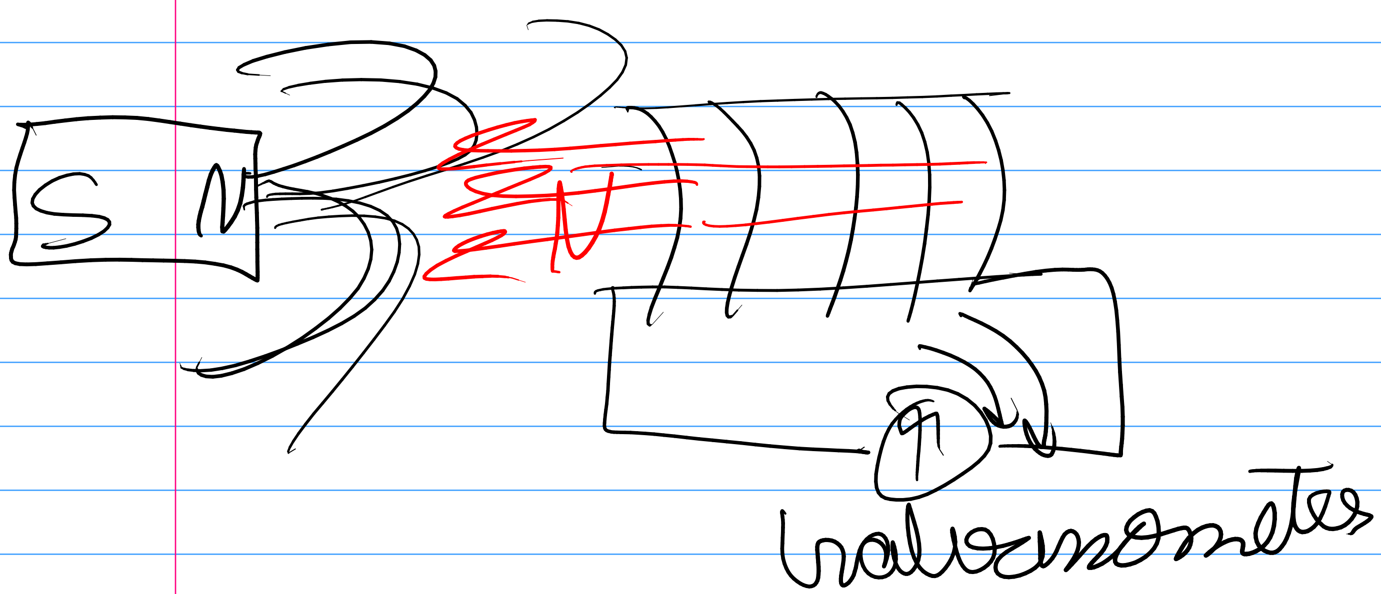
EMF
└ Voltage



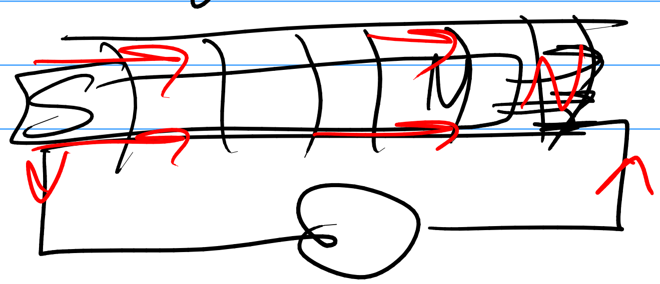
Galvanometer

Experiment → If only the magnet is moved into the solenoid, the galvanometer shows a deflection, which means that an EMF has been induced in the solenoid. If the magnet is moved faster then the deflection is greater, which means that a greater EMF is induced.

Faraday's Law → If a changing magnetic flux cuts through a conductor, it will induce an EMF in the conductor whose magnitude is proportional to the rate of change of flux.



← magnetic field



When the magnetic flux is increasing or decreasing through the coil the current in the coil will flow in a direction which produces a flux that opposes the increasing or decreasing flux.

Lenz's law → The induced EMF is such that it opposes a change in flux.

Factors affecting magnitude of induced EMF →

1. The strength of the changing magnetic field
2. Rate of change of magnetic flux.
3. The number of turns or length of conductor.