Formulas

current flowing in the conductor

Angle b/w conductor and Magnetic field.

- $F = B I L \sin\theta$

Magnetic field strength, Tesla

length of conductor which is in contact with Magnetic field

velocity of the particle

Angle b/w direction of movement of particle and Magnetic field.

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

charge of particle

radius of circular motion deflection

- $r = \dfrac{mv}{Bq}$ derived by $F_b = F_c$

electric field strength

- $v = \dfrac{E}{B}$ ← V is the velocity from velocity selector.

1.26×10^{-6}

- $B = \dfrac{\mu_0}{2\pi} \times \dfrac{I}{x}$

Distance between conductor/wire and point of Magnetic field.

$$V_H = \frac{BI}{net}$$

Hall voltage

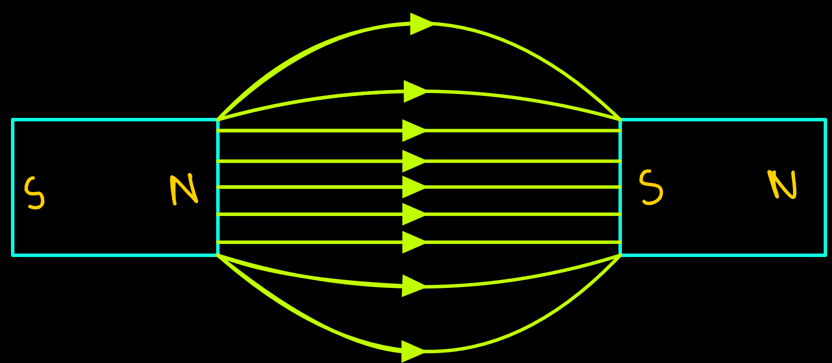
number of charge carriers

thickness of conductors.

Define lenses law and faraday

- A magnetic field is a region of space where a magnetic pole, charged particle, charge carrying conductor experiences a force

- One tesla is the uniform magnetic flux which, acting normally to a straight wire carrying a current of 1 A, causes a force of 1 Nm^{-1} on the conductor.



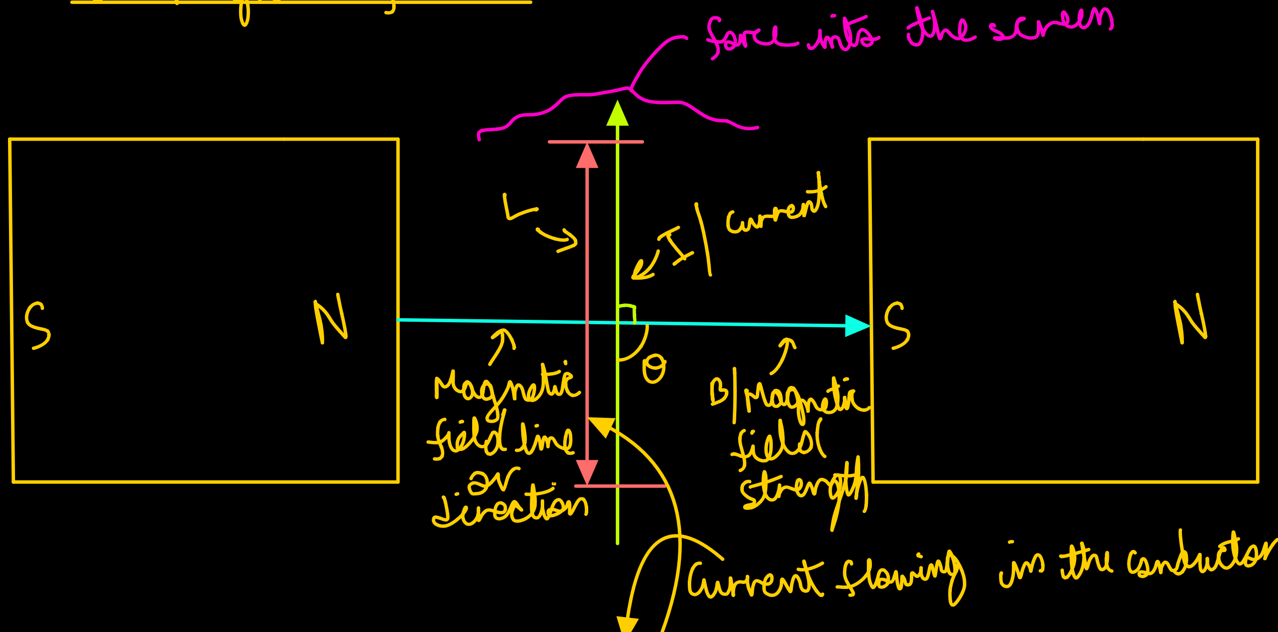
- The closer the field lines, the stronger the magnetic field strength

- magnetic field lines only go from North to south.

- magnetic field lines are smooth curves which never touch or cross

- The strength of magnetic field is indicated by the distance between the lines

Force on a current carrying conductor due to magnetic field

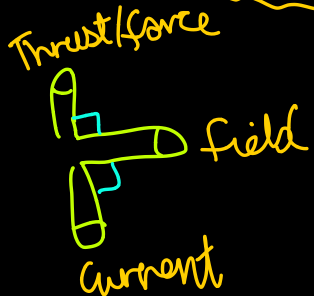


Force on wire = $B\,I\,L \sin\theta$

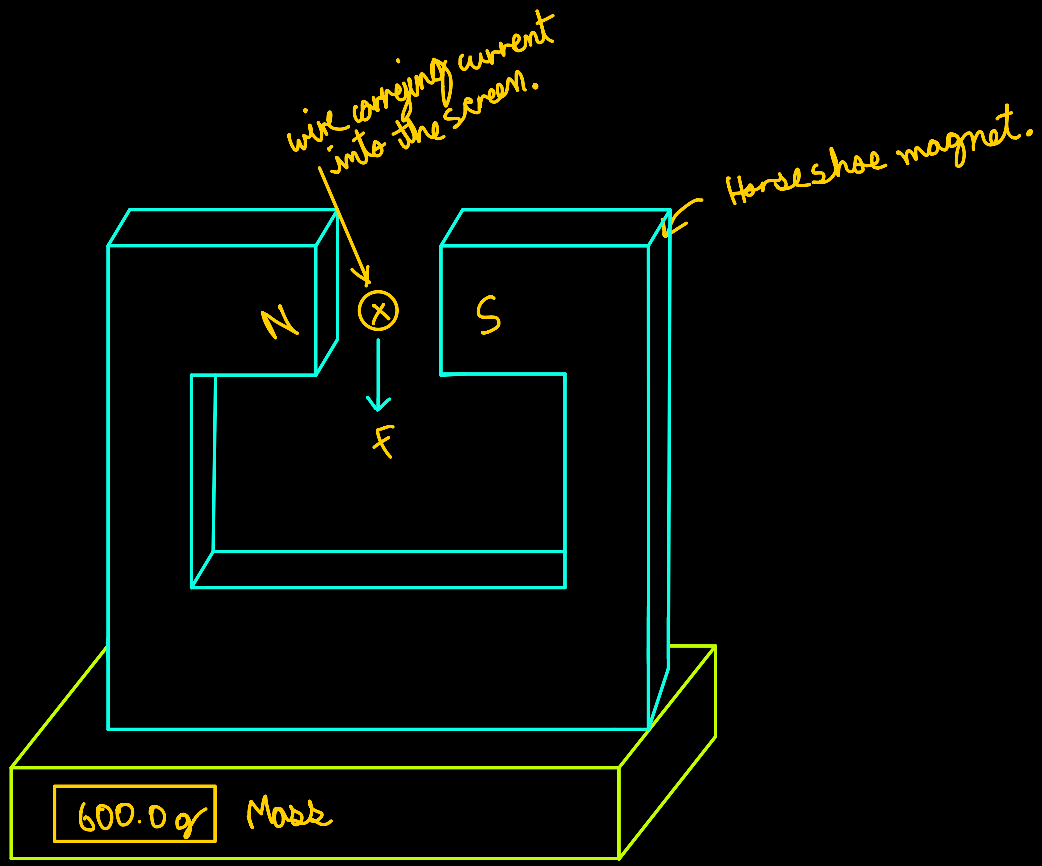
B — Magnetic field strength.

θ — Angle between conductor and M field

Flemings left hand rule



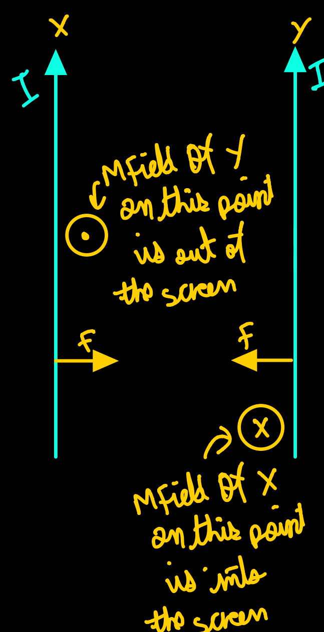
Practical, showing a wire carrying conductor experiences a force when placed in field.

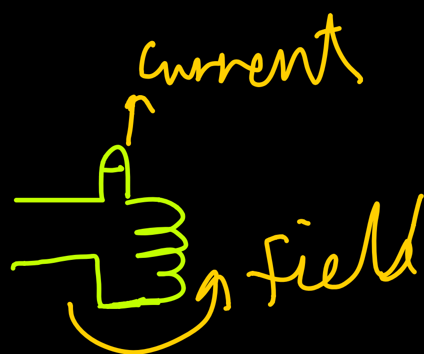


• As soon as current is switched on in the wire, the reading on the scale decreases, provided the wire is fixed, this is because the force acting on the wire is downwards thus according to newtons 3rd law force on the magnet will be upwards

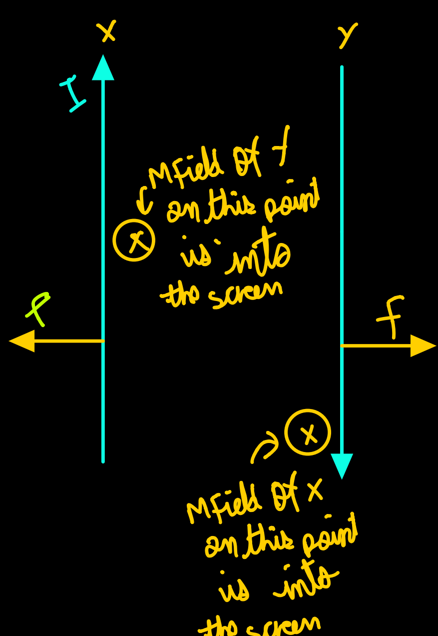
Force on a conductor due to M field of another nearby conductor

- Wires with current in same direction attract





- Wires with current in opposite direction repel



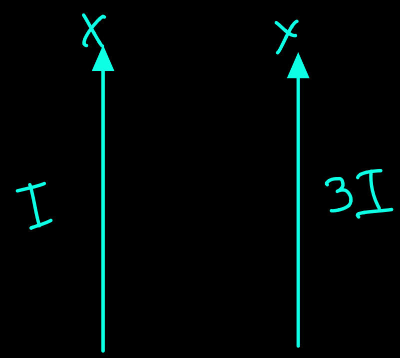
- The values of F are equal but opposite because newtons third law states every force has a equal but opposite reaction, but to prove this we use the formula on P10.

$F = BIL$

$$B = \frac{\mu_0 I}{2\pi x}$$

$$\therefore F = \frac{\mu_0 I_1}{2\pi x} \times I_2 \times L$$

$$= \frac{\mu_0 I_1 I_2 L}{2\pi x}$$

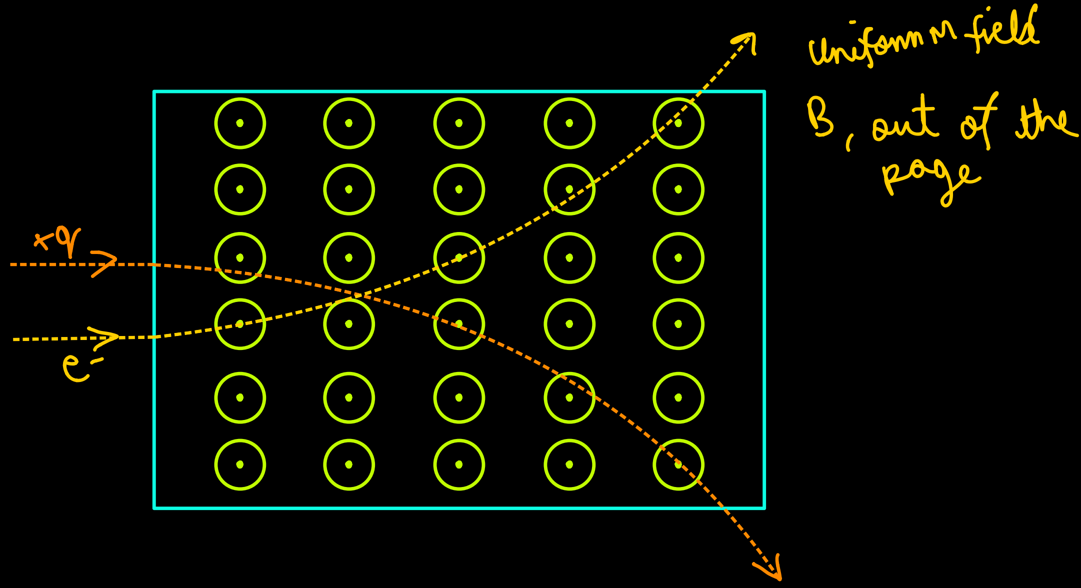


$$\therefore \text{force on } X = \frac{\mu_0 3I \times I \times L}{2\pi x} = \frac{3\mu_0 I^2 L}{2\pi x}$$

$$\text{force on } Y = \frac{\mu_0 I \times 3I \times L}{2\pi x} = \frac{3\mu_0 I^2 L}{2\pi x}$$

Both forces are equal

Force on a moving current due in a magnetic field



Force on charged particle = $Bqv \sin\theta$

velocity of particle when entering field

- The direction of flow of electrons is opposite to the direction of current, so use flemings left handrule accordingly.

- When partical enters field normall to M field it moves in a circular motion

$\therefore$ F_B provids F_c

$$Bq\cancel{v}\cancel{\sin 90} = \frac{m v^{\cancel{2}}}{r}$$

$$Bqr = mv$$

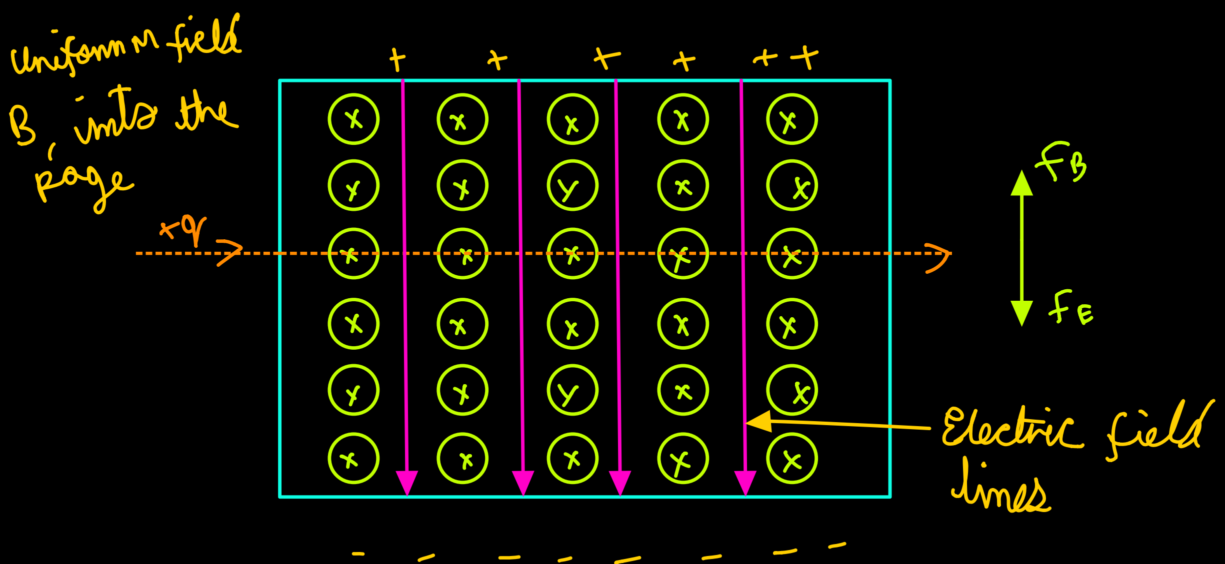
$$r = \frac{mv}{Bq}$$

Memorise derevation

Do not get confused between $F_B = F_c$ and $F_B = F_E$

Velocity selector

- The title implies combining electric field and magnetic field and chosing a velocity so the particle passes through the fields without any deflection



$F_B = F_E$

$\therefore \; BqV = Eq$

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

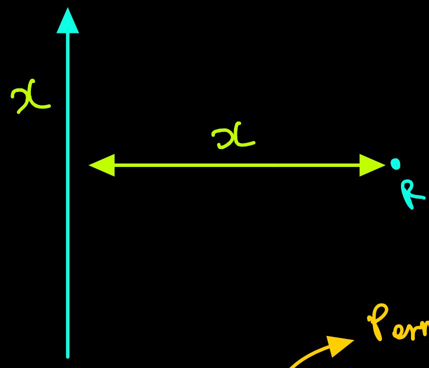
for a negative particle

$F_B = \downarrow \qquad F_E = \downarrow$

$F_B + F_E = 0$

For -ve particle force due to e^- is opposite to Electric field lines

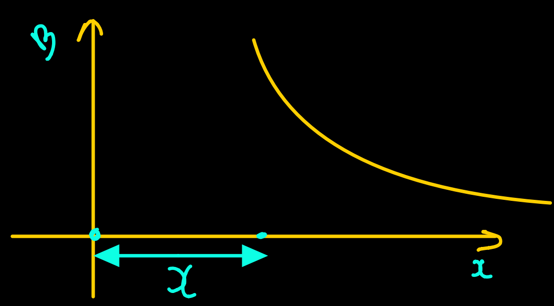
Value of B at a distance x from a current carrying conductor



Permeability of free space

$$B \text{ at } R = \frac{\mu_0 I}{2\pi x}$$

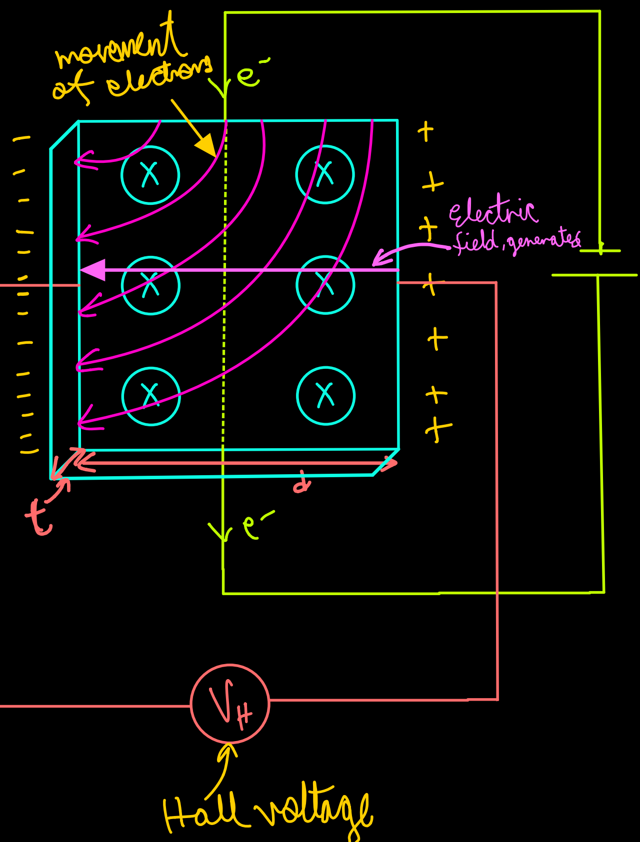
graph of B vs x



Hall effect

- The Production of a potential difference (Hall voltage), when a magnetic field is applied in a direction to that of the flow of current.

- Using flemings left hand rule we can see that the force on electrons will be towards the left, thus the left side of the conductor will be at a lower potential than the right, thus the potential difference (p.d), when the equilibrium is reached, the p.d is V_H.



- V_H is max when Hall probe is normal to M field

$E = \frac{V_H}{d}$ ← electric field strength

$F_e = Eq$

$F_b = Bqv$

$F_e = F_b$ for V_H ← Because we calculate Voltage when equilibrium of $F_b = F_e$ is acheived

$E\cancel{q} = B\cancel{q}v$

$\frac{V_H}{d} = Bv$ ← $I = nAve$ ∴ $v = \frac{I}{nAe}$

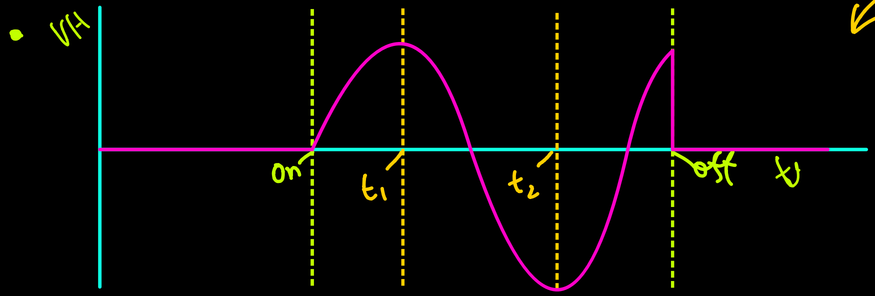
$A = d \times t$ ← thickness of conductor

∴ $v = \frac{I}{ndte}$

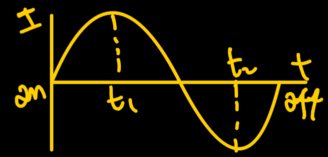
$V_H = B \times \cancel{d} \times \frac{I}{n\cancel{d}te}$

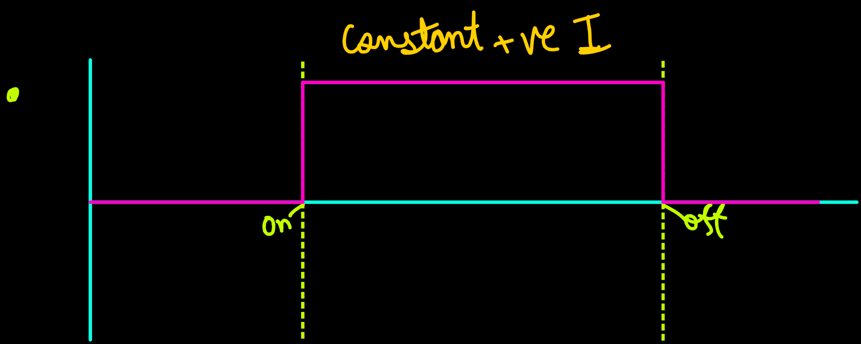
$V_H = \frac{BI}{nte}$ ← thickness

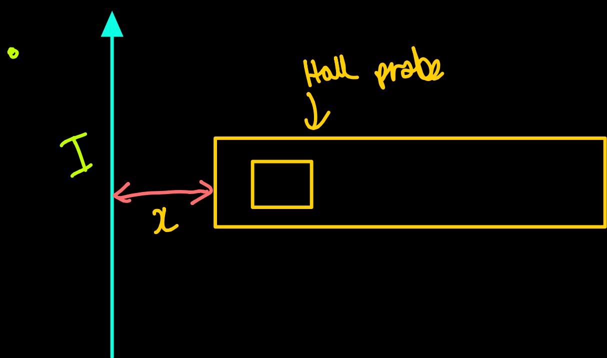
V_H vs time graph ($V_H \propto I$) ← In this senario



I vs t graph that's given







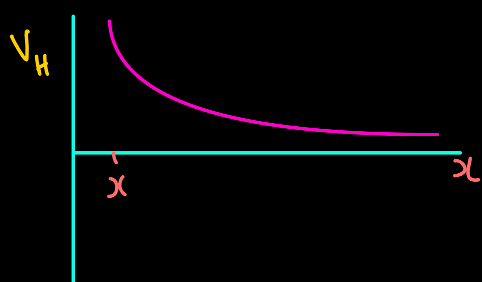
$$V_H = \frac{B I_2}{n e t}$$

$$V_H = \frac{\left(\frac{\mu_0 I_1}{2\pi x}\right) \times I_2}{n e t}$$

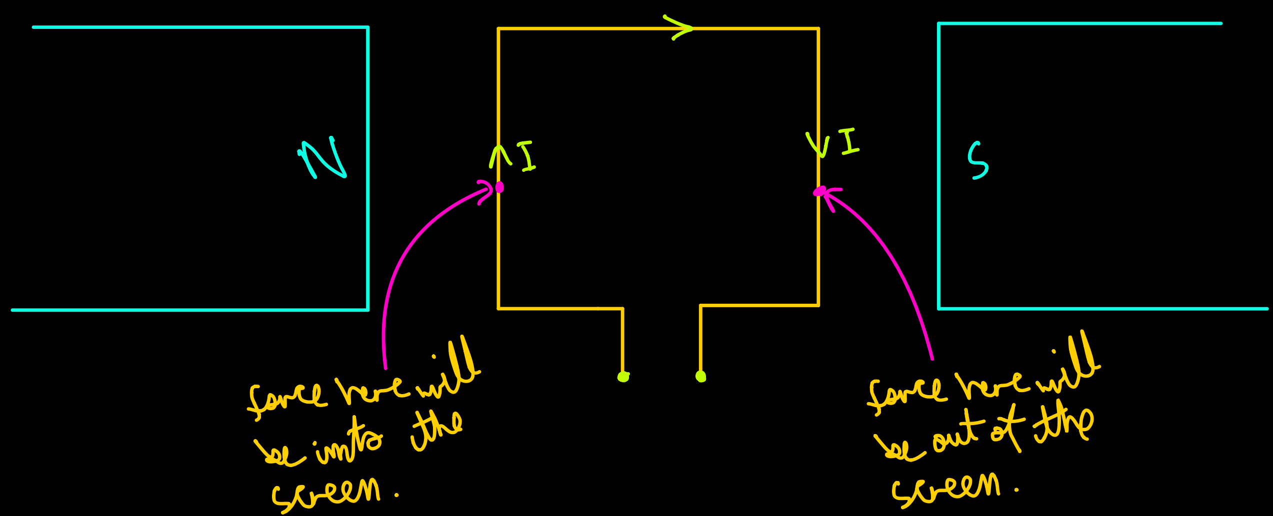
$$V_H \propto \frac{1}{x}$$

in this scenario

graph as x increases



A simple coil that rotates



- Torque is max on wire that is parallel to M field lines.
- Force is max on wire that is perpendicular to the M field lines.

Q A