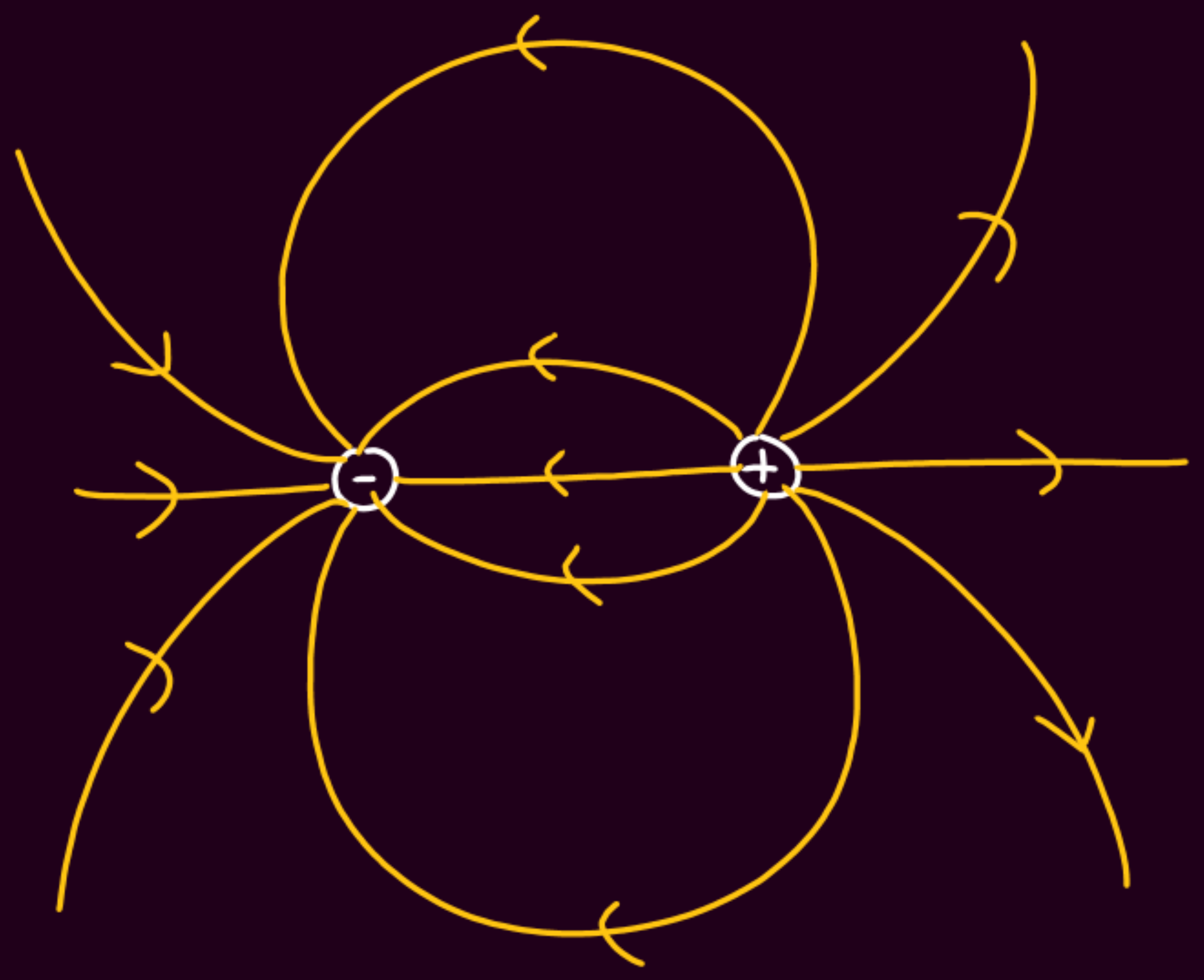
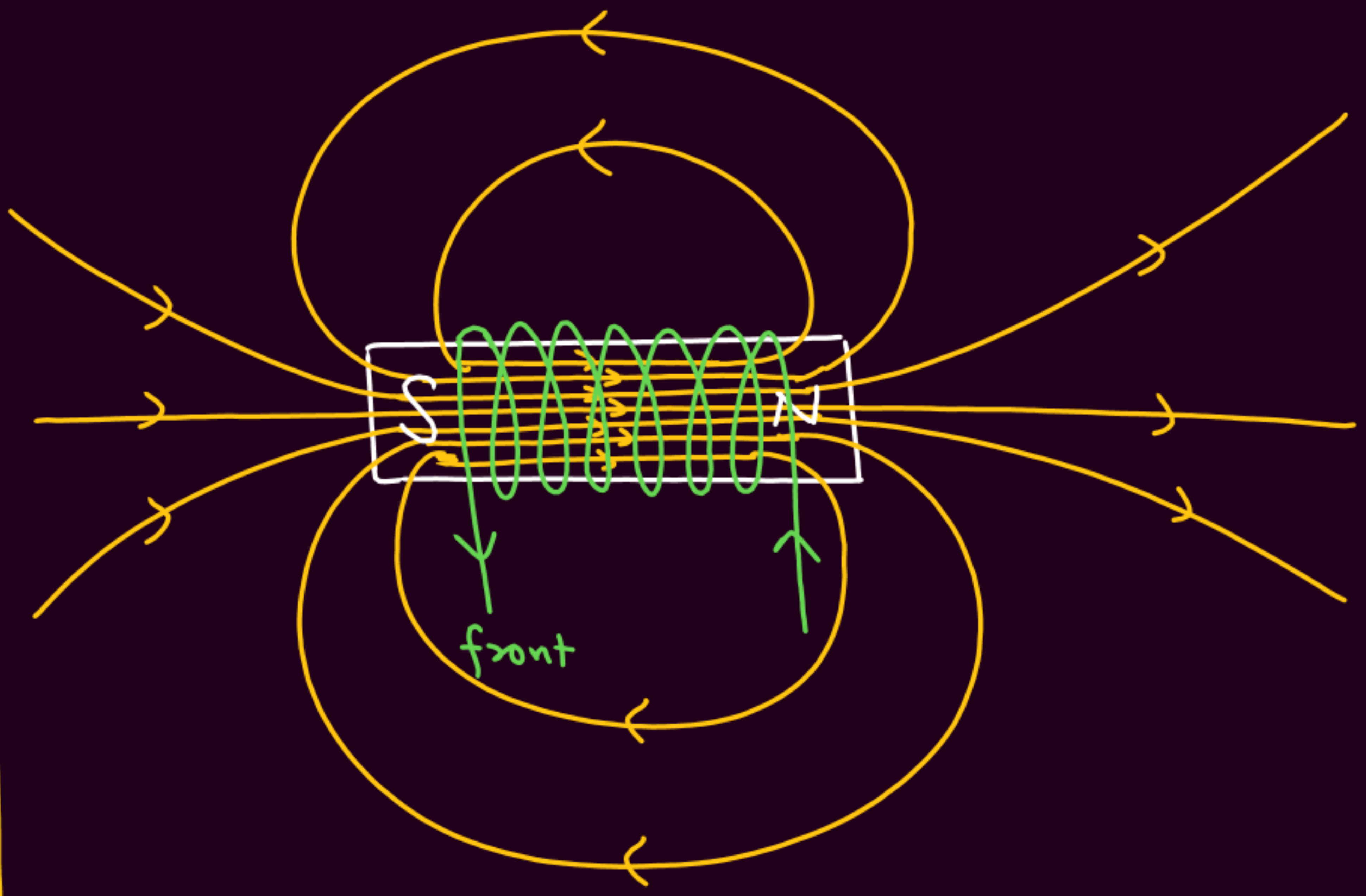
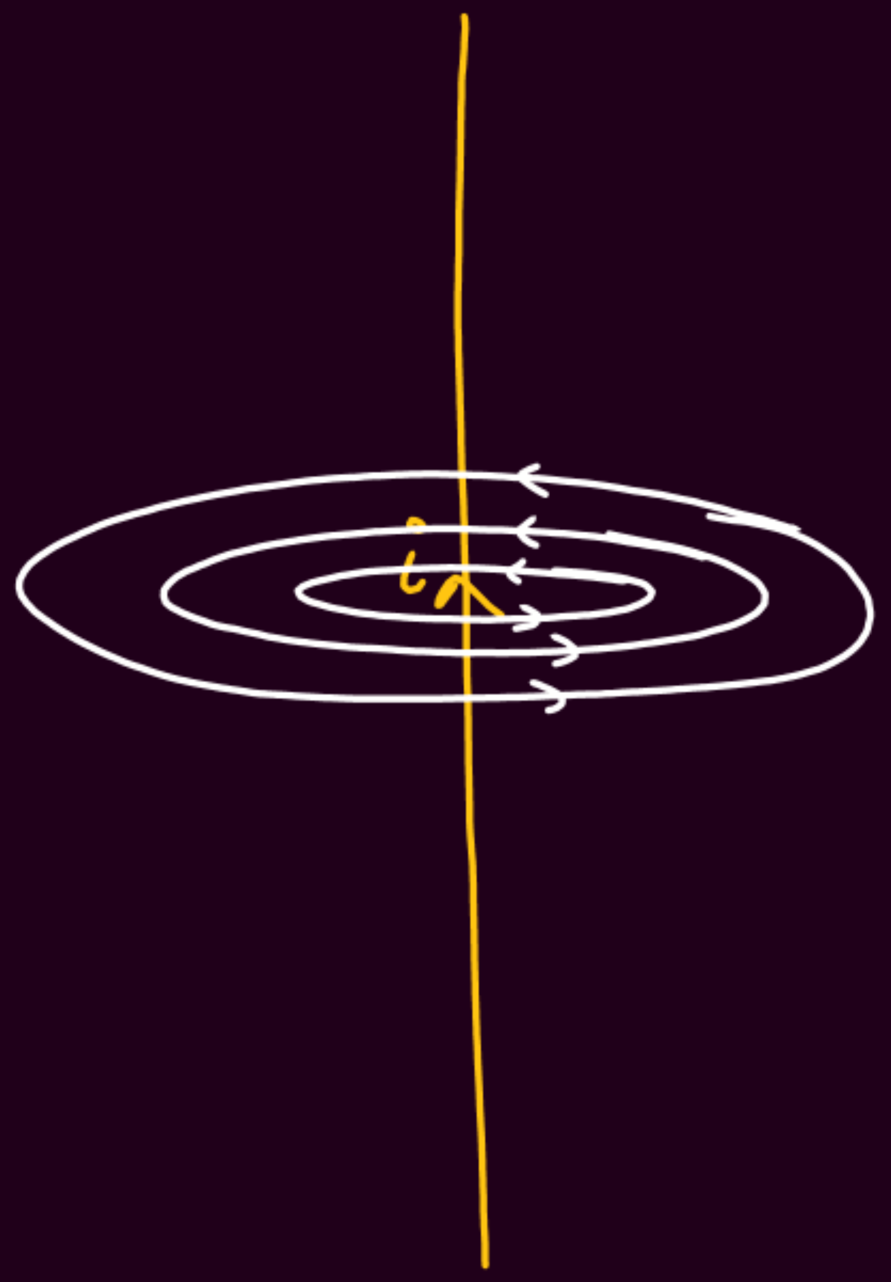
Magnetic field lines

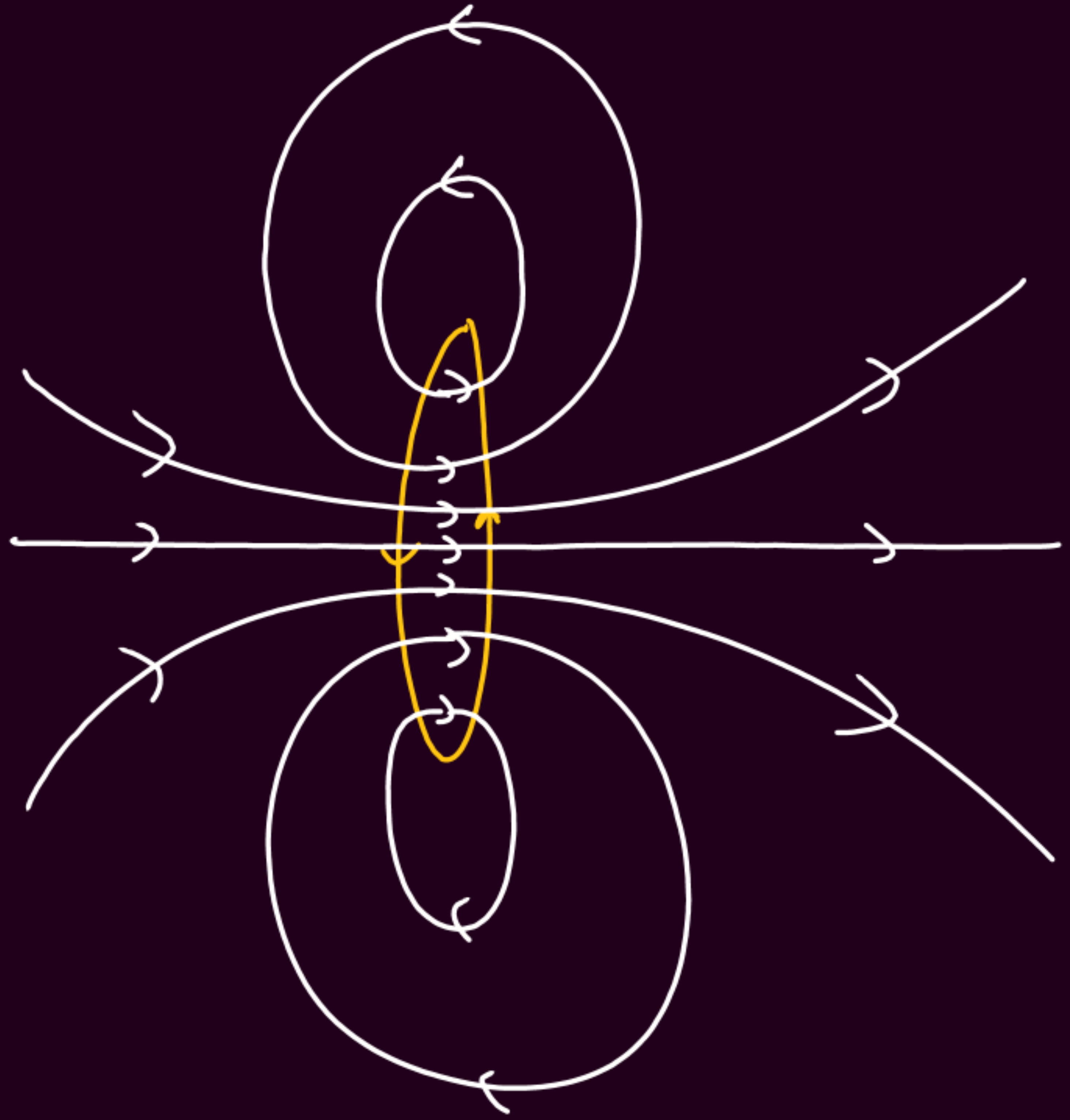
Electric dipole



Bar Mag. / Solenoid




i



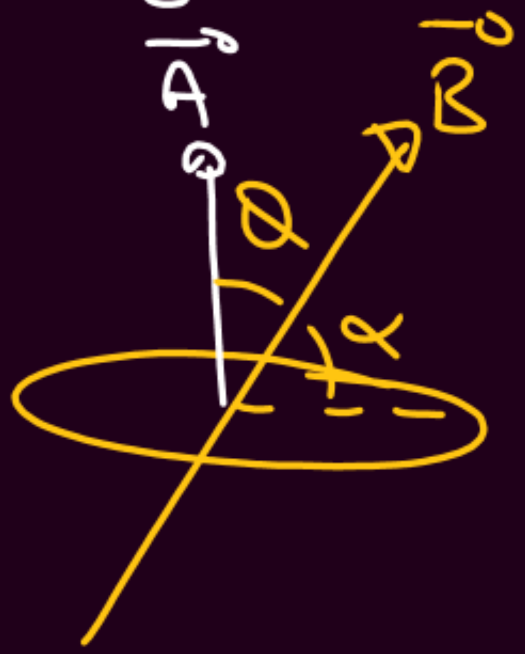
Magnetic flux

$$\boxed{\int \vec{B}\cdot d\vec{A} = \phi_B}$$ Wb (weber)

'B' $\quad T = \frac{Wb}{m^2}$

Case Uniform $\vec{B}$

$$\phi_B = \vec{B}\cdot\vec{A} = BA\cos\theta = BA\sin\alpha$$



$$F = Bil$$

$$[B] = \left[\frac{F}{il}\right] = \left[\frac{MLT^{-2}}{AL}\right]$$

$$[B] = [MT^{-2}A^{-1}]$$

$$[\mu] = \left[\frac{F}{i^2}\right] = [MLT^{-2}A^{-2}]$$

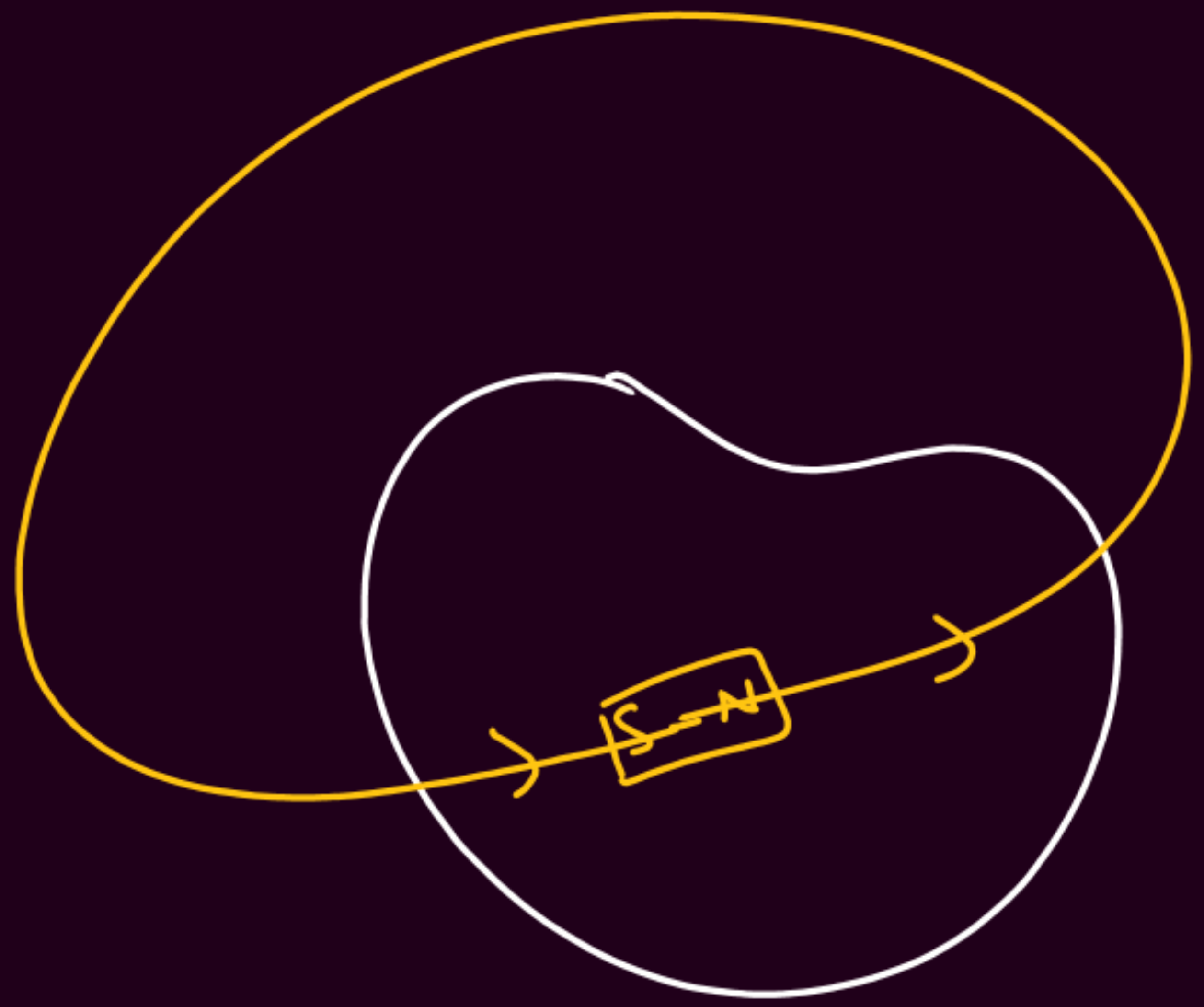
$$F = Bil$$

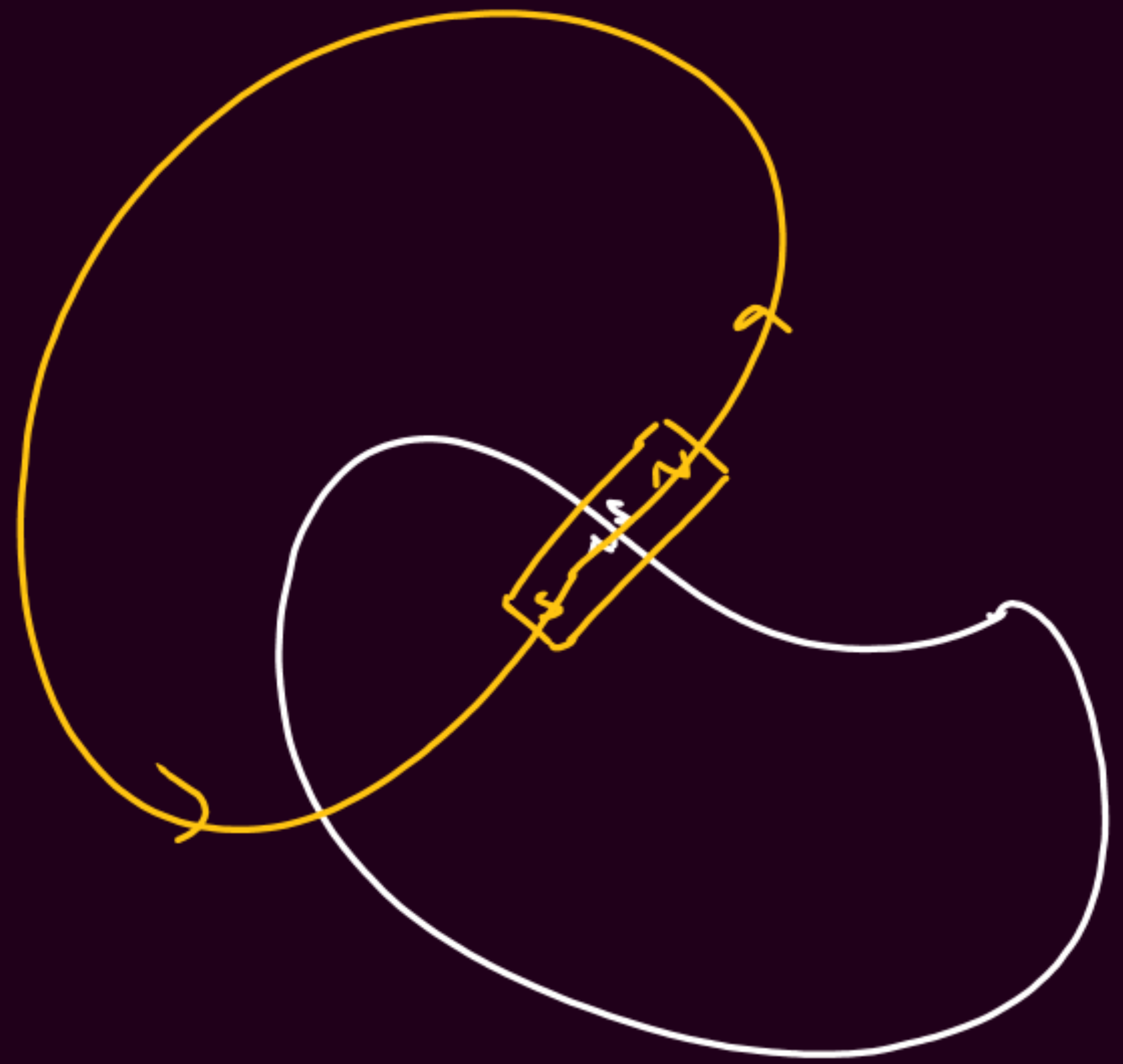
$$F = \frac{\mu_0 N i}{\cancel{l}}\, i\cancel{l}$$

Gauss's law for Magnetism

$$\boxed{\phi_B = \oint \vec{B} \cdot d\vec{A} = 0}$$

$\rightarrow$ MFL always form CL





Q Bar may along x-axis

$\phi_{yz} = 0$

$\phi_{xz} = 0$

Q A Solenoid

$n = 100$ per cm

$i = 2A$

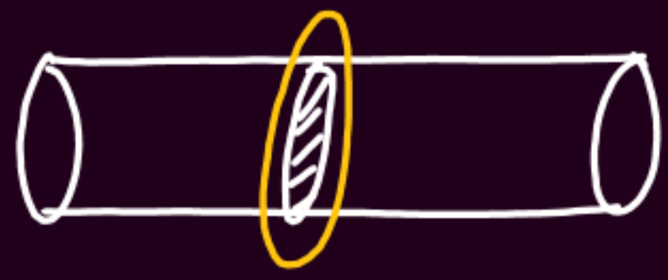
$r_0 = 4cm$

(1) $r = 2cm$

$\phi = BA_c = (\mu_0 n i)(\pi r^2)$

$= (4\pi \times 10^{-7})\left(\frac{100}{10^{-2}}\right)(2)\,\pi\,(2\times10^{-2})^2$

(2) $r = 5cm$



$\phi = BA_c$

$\phi = (\mu_0 n i)(\pi r_0^2)$

$\phi = (4\pi\times10^{-7})\left(\frac{100}{10^{-2}}\right)(2)\,\pi\,(4\times10^{-2})^2$

Faraday's law

Induced EMF

$$\boxed{\mathcal{E} = -\frac{d\phi}{dt}}$$

$$[\phi = NBA\cos\theta]$$

Lenz's law

$\phi\uparrow$

$$i = \frac{\mathcal{E}}{R}$$ induced current

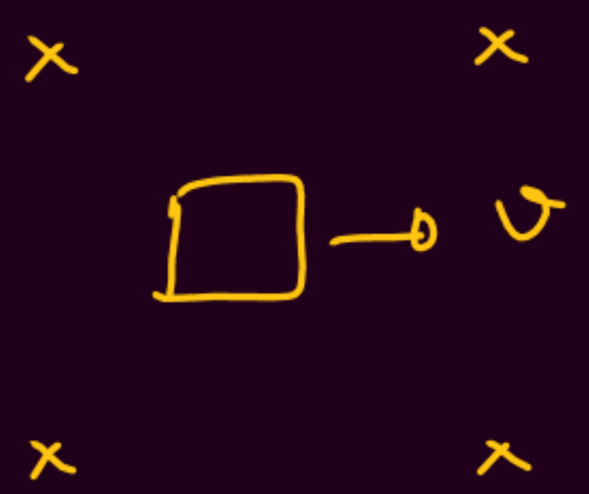
$$\boxed{\Delta Q = -\frac{\Delta\phi}{R}}$$ charge flown

$$\mathcal{E} = -(\text{slope})$$

$$i = -\frac{1}{R}\frac{d\phi}{dt}$$

$$\Delta Q = \int i\,dt = -\frac{1}{R}\int d\phi$$

Q

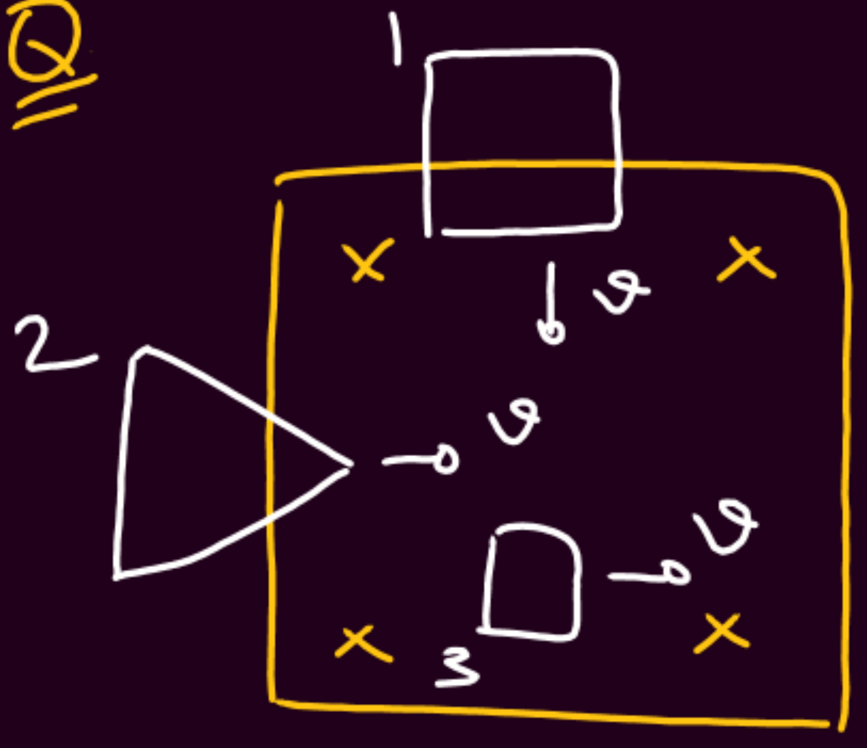


$\phi = \text{const.}$

$\varepsilon = 0$

$i = 0$

Q

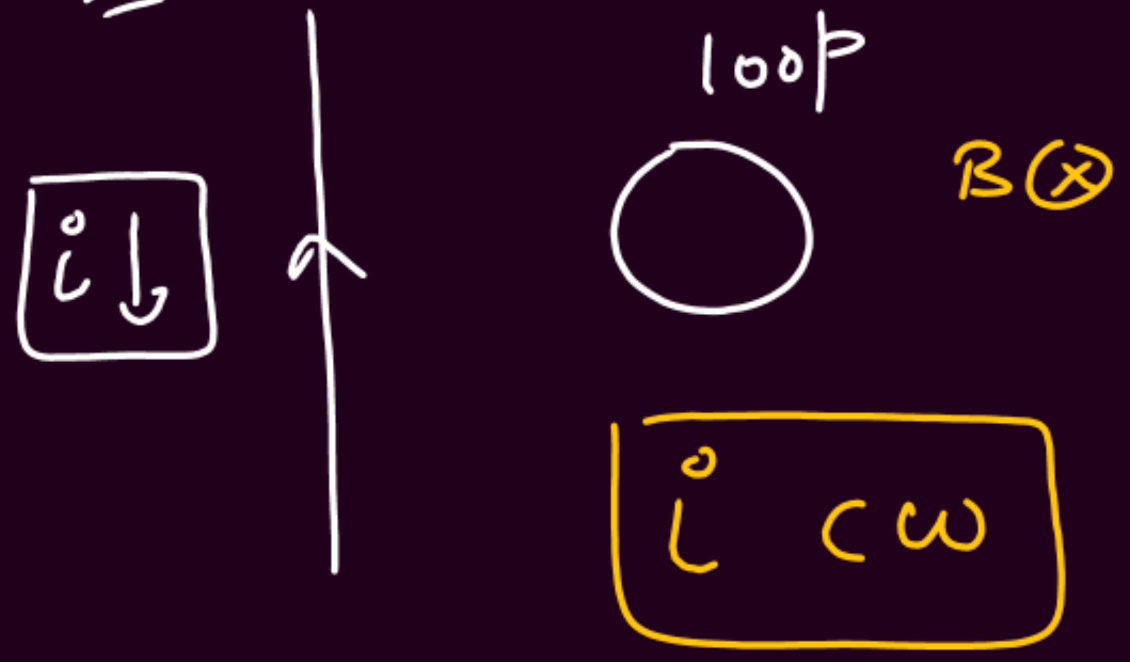


(1) $\phi \uparrow$ (ACW i)

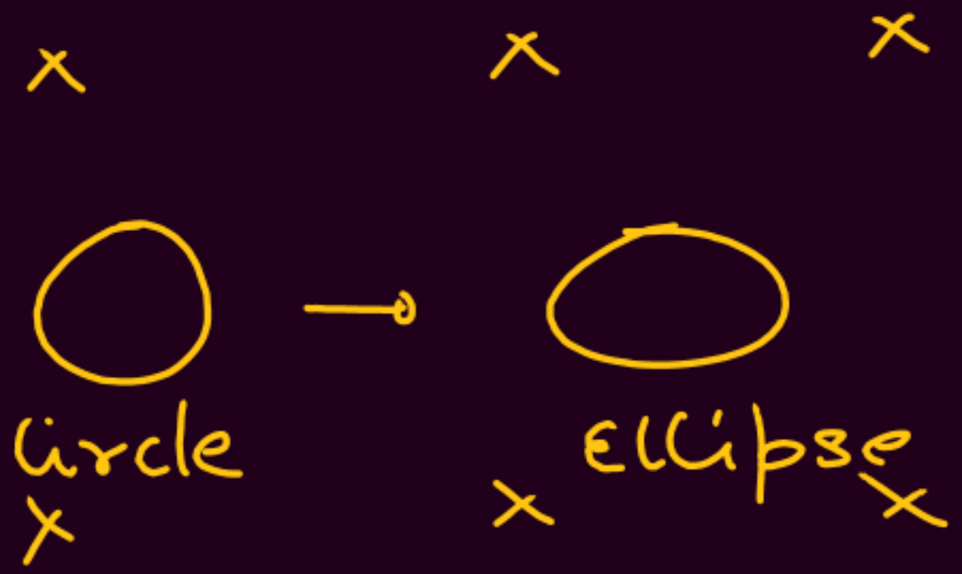
(2) —— " ——

(3) $\phi = \text{const.}$ $i = 0$

Q.



Q

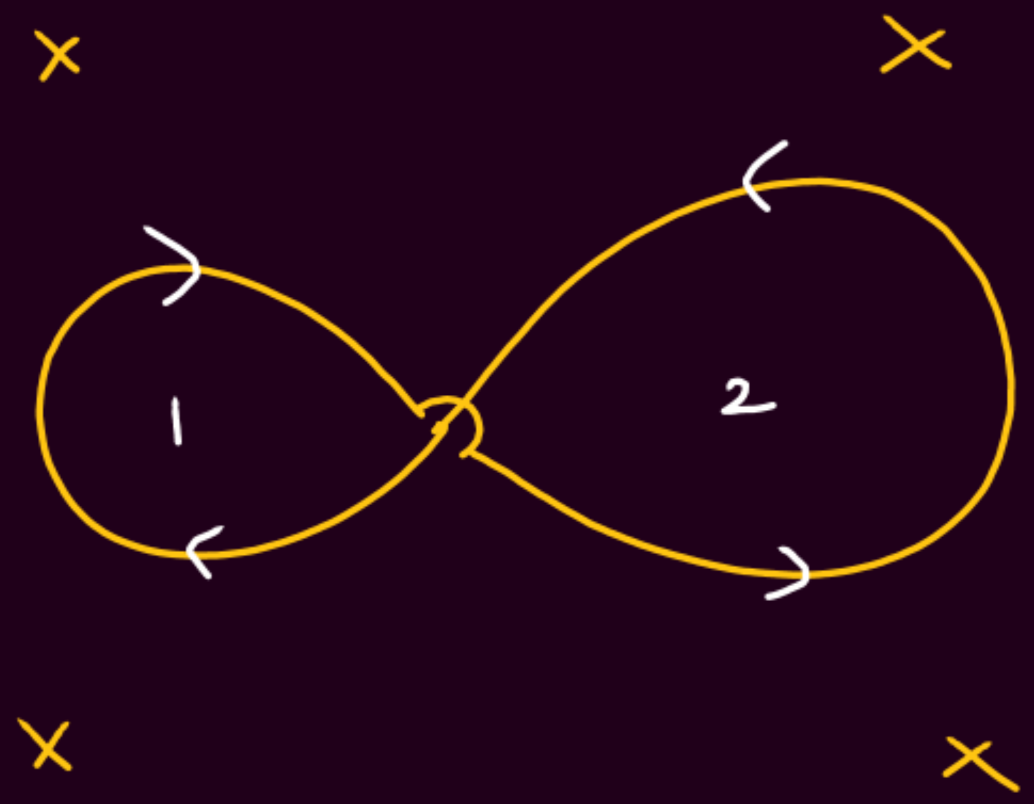


$A \downarrow$

$\phi \downarrow$

$\boxed{i \ \text{CW}}$

Q

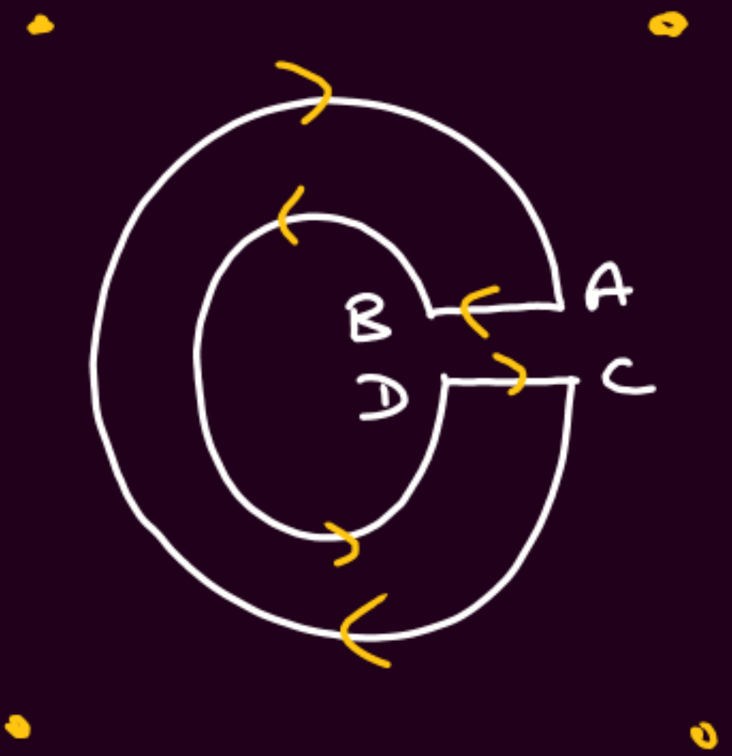


$B \uparrow$

$\phi \uparrow$

$2 \rightarrow$ ACW

Q



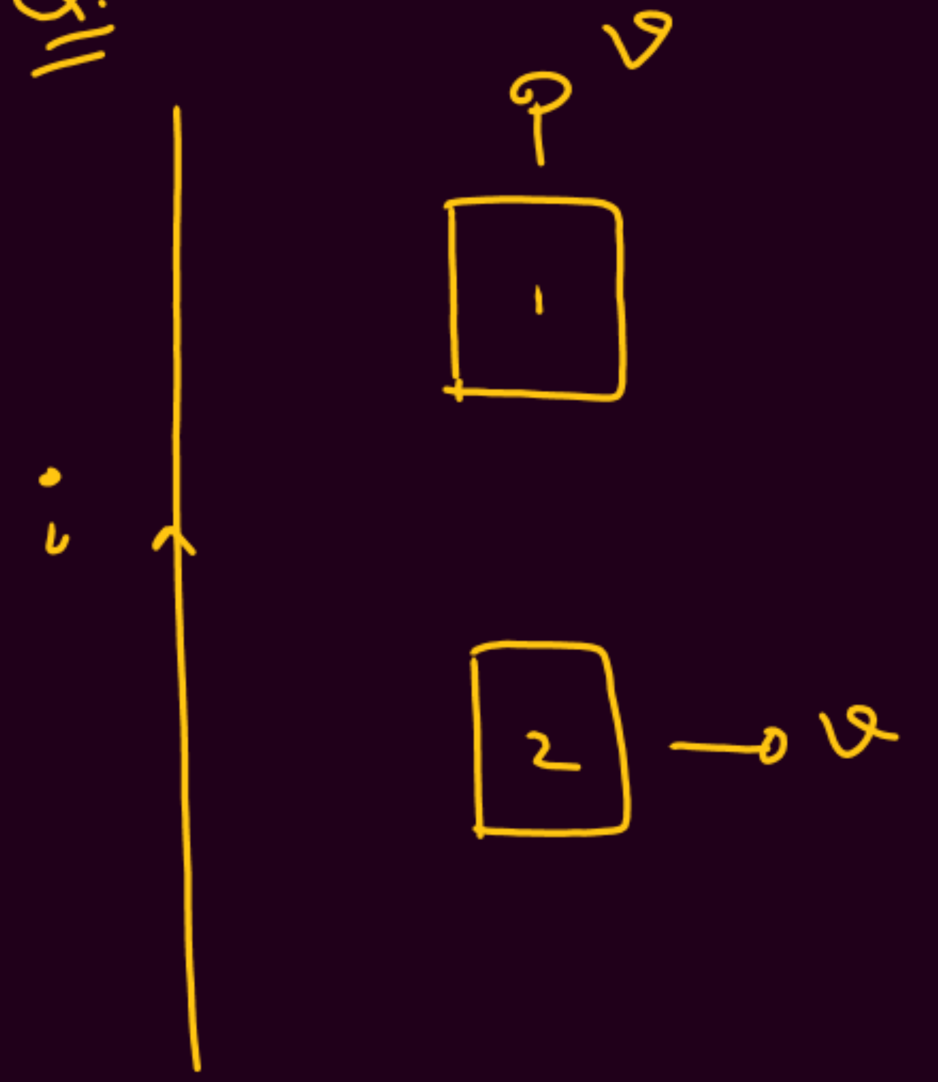
$B \uparrow$

$\phi \uparrow$

$A \rightarrow B$

$D \rightarrow C$

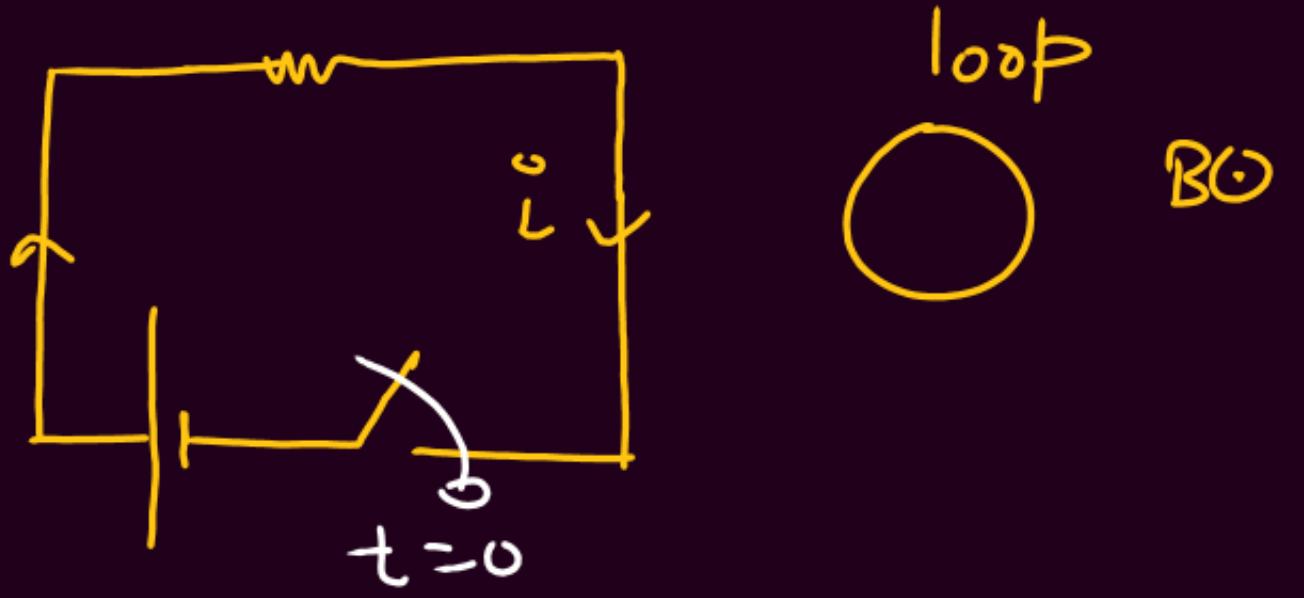
Q.



① $\phi = \text{const}$ $\quad i = 0$

② $\phi \downarrow$ $\quad \boxed{i \text{ CW}}$

Q.

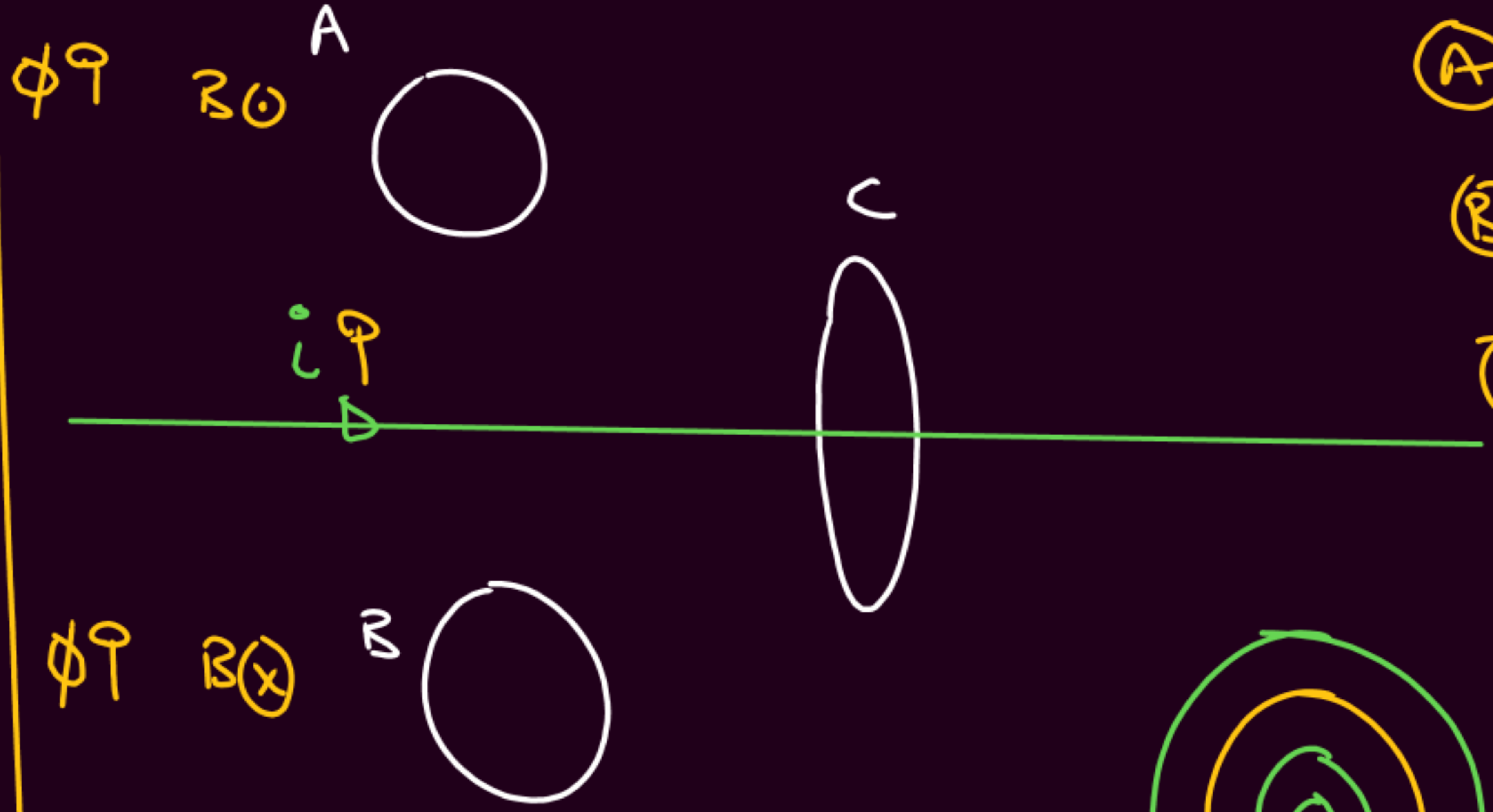


Just after the switch is closed

$i \uparrow$

$\phi \uparrow$

$\boxed{i \text{ CW}}$

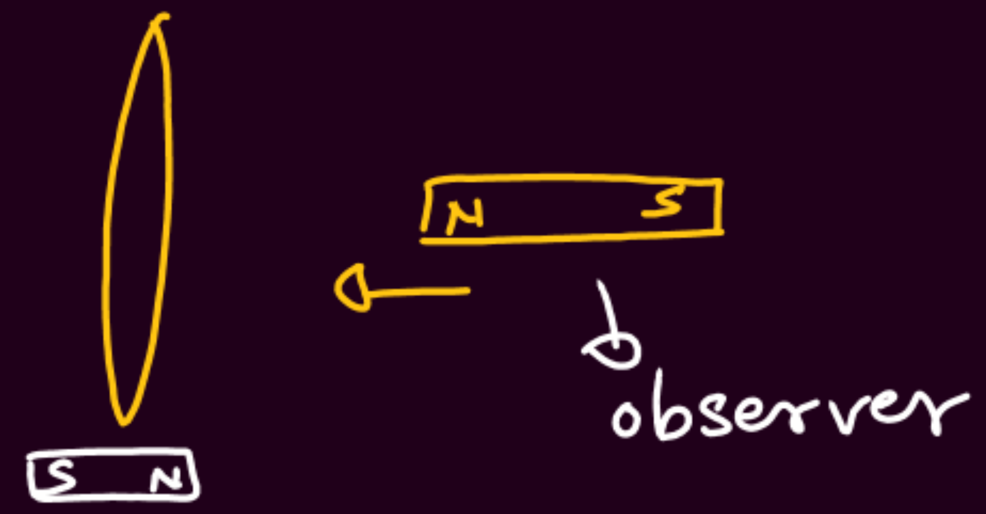


(A) CW

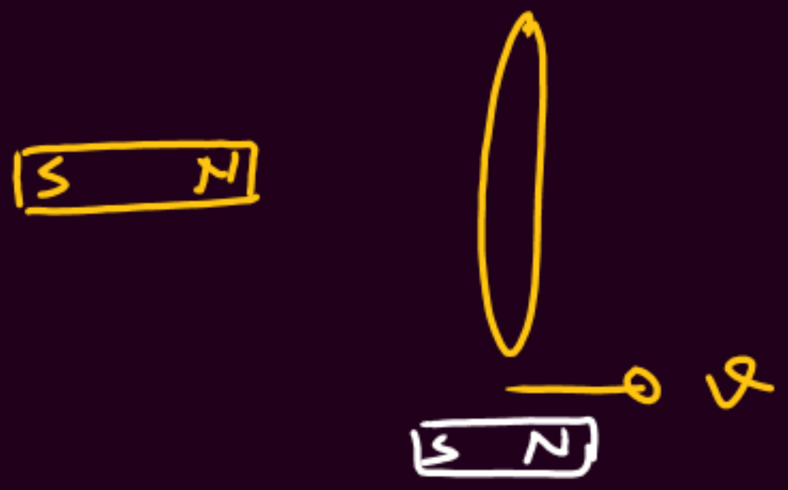
(B) ACW

(C) $\phi = 0$

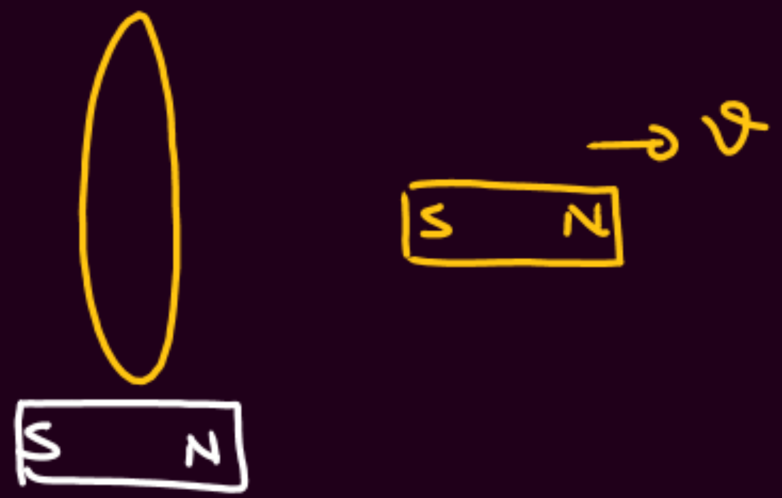
$i = 0$



$\boxed{\text{ACW}}$



$\boxed{\text{CW}}$



ACW

free fall 

$(a<g)$

metal Ring 

$(a=g)$

 wooden Ring

EMF is induced

But induced $i=0$

$\phi = \text{const}$

$i = 0$

$i = \text{const}$

$\phi = \text{const}$

$i = 0$

$v = \text{const}$

$\bar{e}$-beam (β-Ray)

$B \odot$

$\phi \uparrow$

$\boxed{i \text{ CW}}$

$i \uparrow$

$B \otimes$

$\phi \uparrow$

i ACW

$v \uparrow$

i

$\bar{e}$-beam

$\bar{e}$

$v = \text{const}$

① Approach

$B \otimes$

$B \uparrow$

$\phi \uparrow$

$\boxed{i \text{ ACW}}$

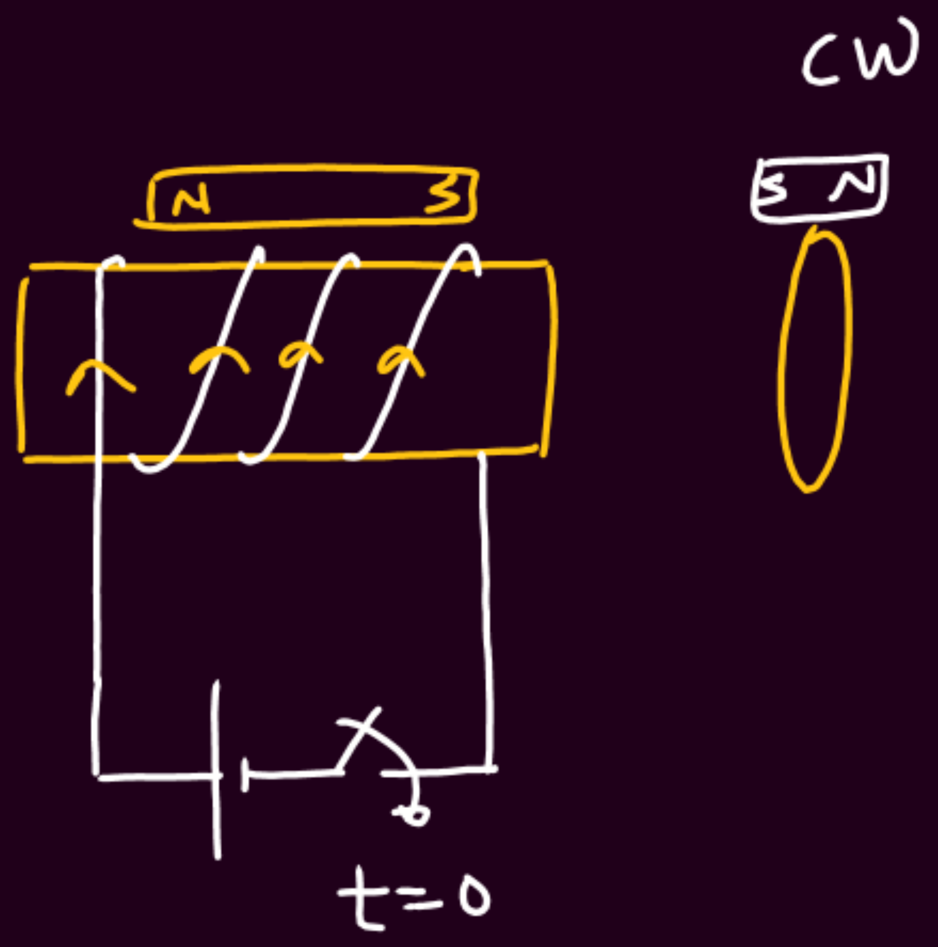
② going Away

$B \otimes$

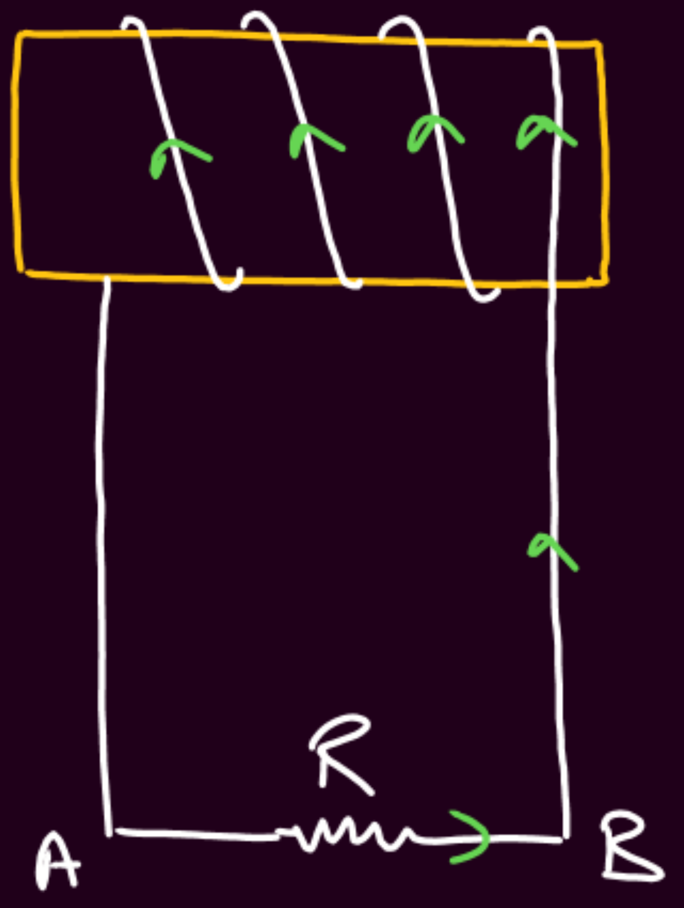
$B \downarrow$

$\phi \downarrow$

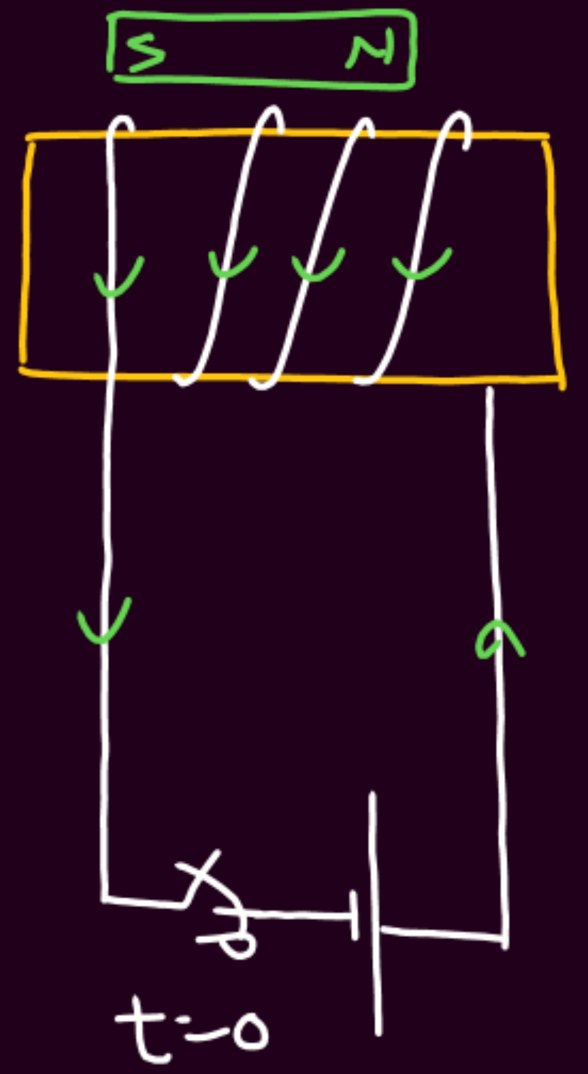
$\boxed{i \text{ CW}}$



Just after the switch is closed



$\boxed{\text{A to B}}$



Just after the switch is closed

Q. $\phi = 3t^2 - 2t + 4$

find ε_{ind} at $t = 2s$

$$\frac{d\phi}{dt} = 6t - 2$$

$$\varepsilon = -\frac{d\phi}{dt} = -6t + 2$$

$$\varepsilon = -(6\times2) + 2$$

$$\underline{\varepsilon = -10V}$$

Q. $\phi = (t^2 - 4t + 3)$

find ϕ when $\varepsilon = 0$

$$\varepsilon = 0$$

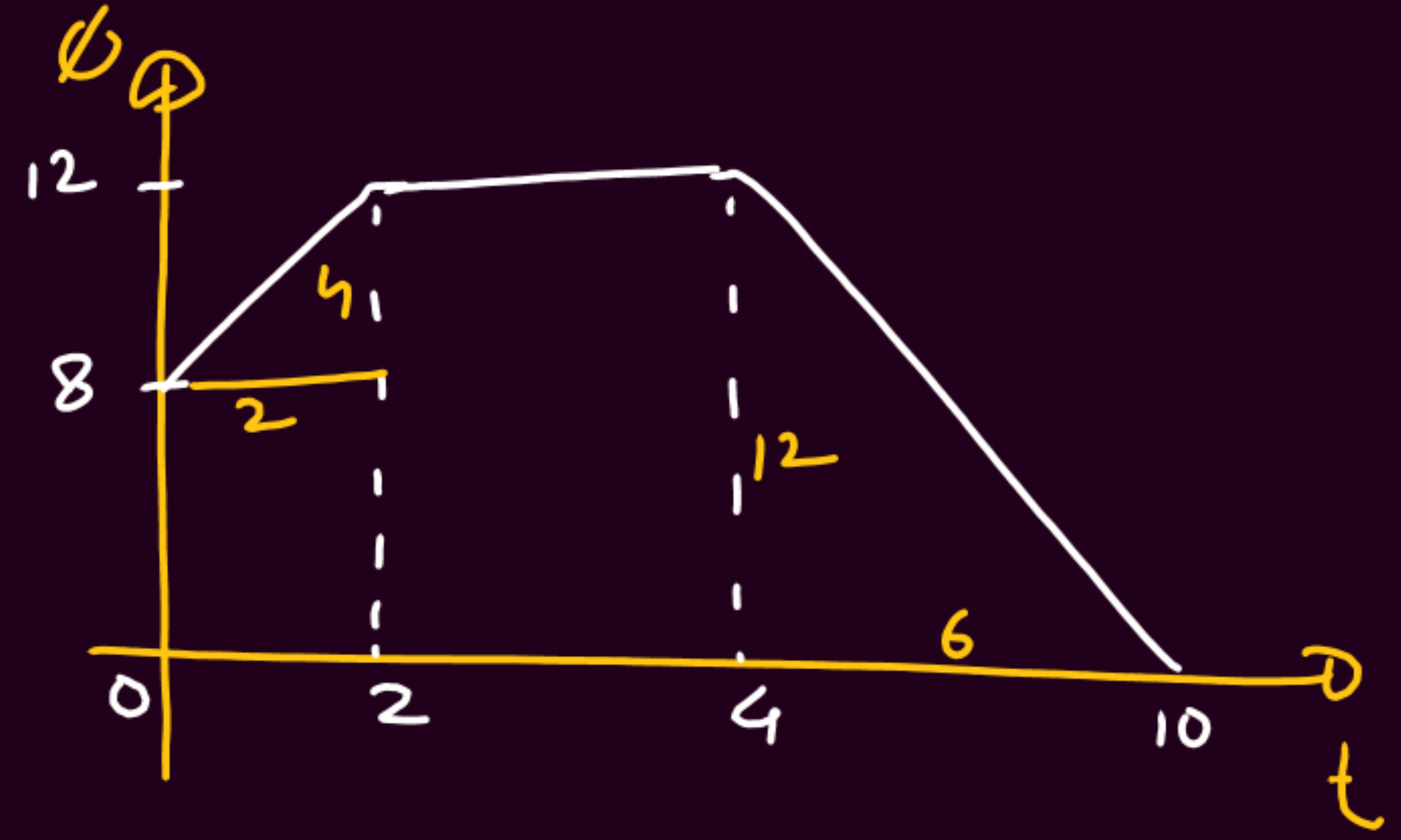
$$\frac{d\phi}{dt} = 0$$

$$2t - 4 = 0$$

$$t = 2s$$

$$\phi = (2)^2 - 4(2) + 3 = -1 \text{ Wb}$$

Q

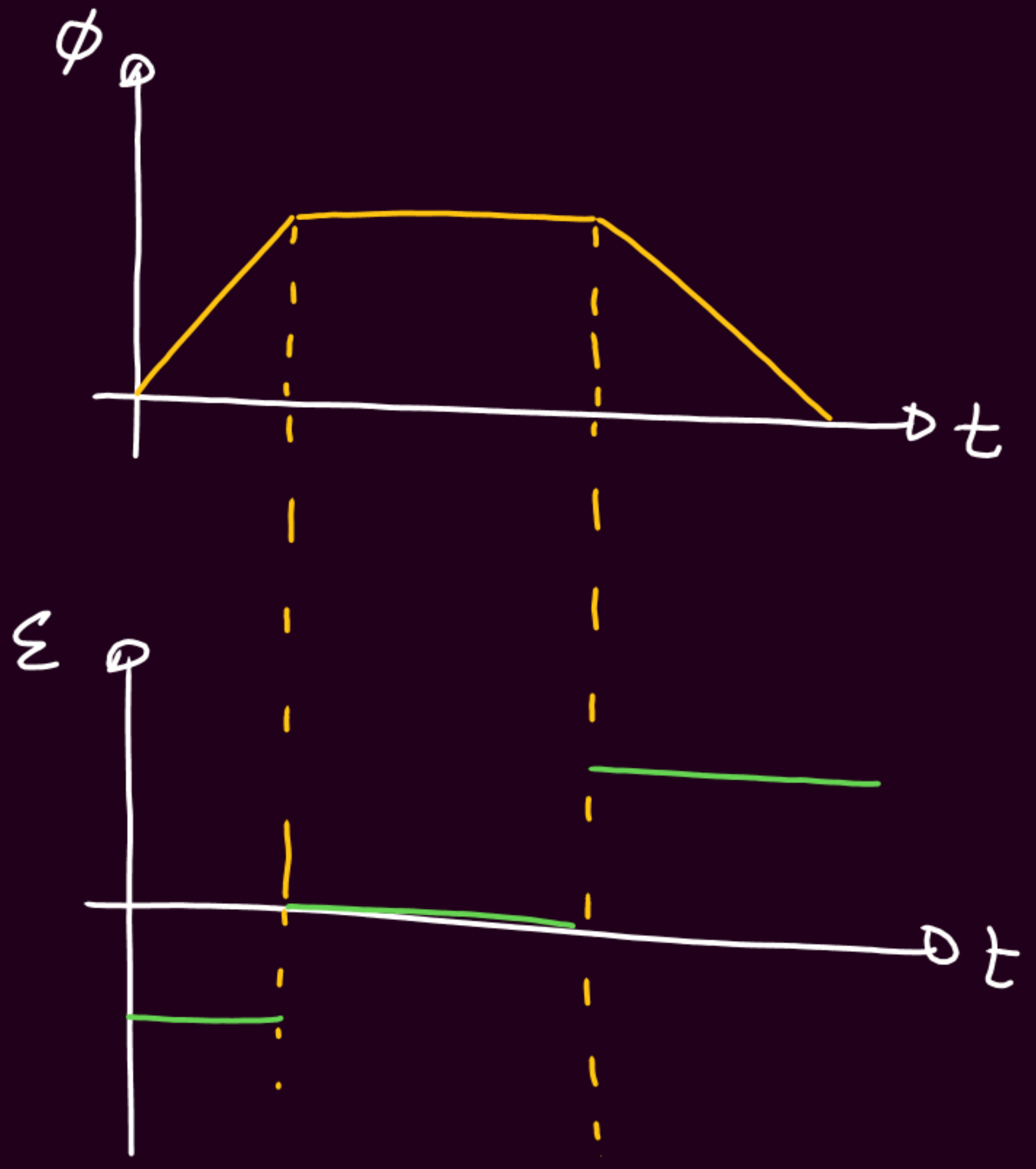


$t = 1s \qquad \varepsilon = -\left(\frac{4}{2}\right) = -2V$

$t = 3s \qquad \varepsilon = -\left(\ 0\ \right) = 0$

$t = 8s \qquad \varepsilon = -\left(-\frac{12}{6}\right) = +2V$

Q:



$$\boxed{\phi = NBA\cos\theta}$$

Q

$N = 100$

$B = 10^{-3}\ T$

$A = 5\ cm^2$

Transverse $\vec{B}$

① $\underline{B \longrightarrow 0 \quad \text{in } 2s}$

$$\mathcal{E} = -\left(\frac{0 - NBA}{\Delta t}\right)$$

$$\mathcal{E} = \frac{100 \times 10^{-3} \times (5\times10^{-4})}{2}$$

$$\mathcal{E} = 2.5\times10^{-5}\ V$$

② Dir of B is reversed in 2s

or [Coil is rotated by 180° about dia]

$$\mathcal{E} = -\frac{(-NBA) - (NBA)}{\Delta t} = \frac{2NBA}{\Delta t}$$

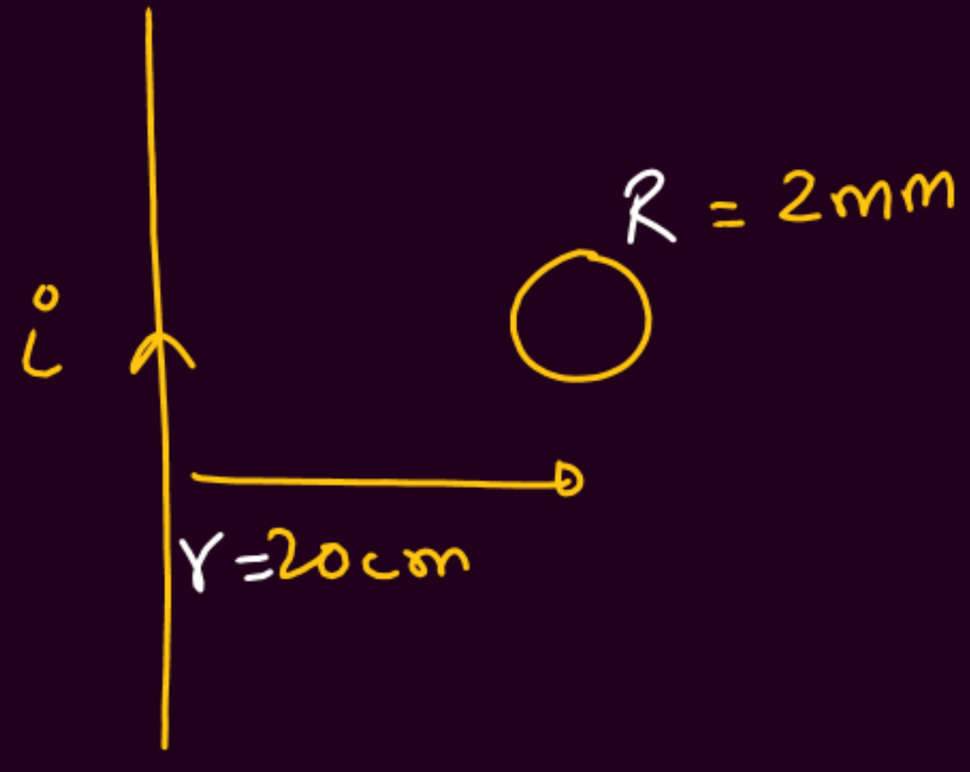
$$\mathcal{E} = 5\times10^{-5}\ V$$

③ B $(10^{-3}\ T) \longrightarrow (0.2\times10^{-3}\ T)$ in 2ms

$$\mathcal{E} = -\frac{NB_2A - NB_1A}{\Delta t} = \frac{NA}{\Delta t}(B_1 - B_2) = \frac{10\cancel{0}\times(5\times10^{-4})\,(0.\cancel{8}^{\,4}\times\cancel{10^{-3}})}{\cancel{2}\times\cancel{10^{-3}}}$$

$$= \underline{0.02V}$$

Q



given i 4A to 1A

in 0.2s

$\mathcal{E} = ?$

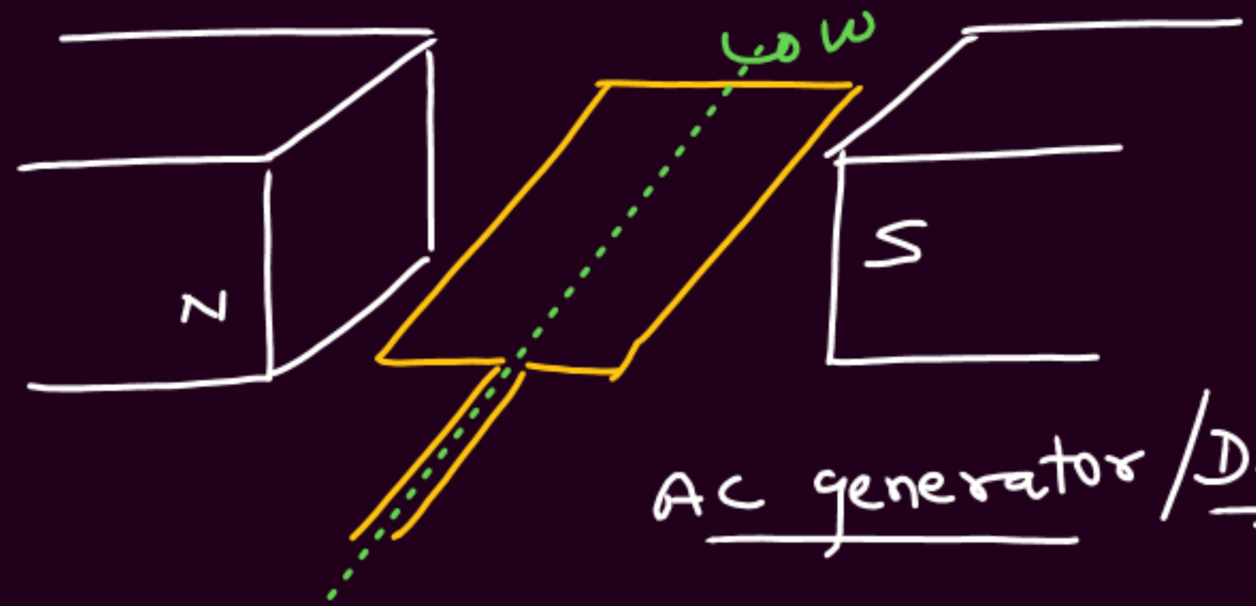
$$\phi = NBA = \frac{\mu_0 i}{2\cancel{\pi} r}(\cancel{\pi} R^2)$$

$$\mathcal{E} = \frac{\mu_0 R^2}{2r}\frac{(i_2 - i_1)}{\Delta t}$$

$$\mathcal{E} = \frac{(\overset{2}{\cancel{4}}\pi \times 10^{-7})(\cancel{4} \times \overset{-4}{\cancel{10^{-6}}})(3)}{\cancel{2} \times \cancel{0.2} \times \cancel{0.2}}$$

$$\underline{\mathcal{E} = 6\pi \times 10^{-11}} \checkmark$$

Periodic EMI

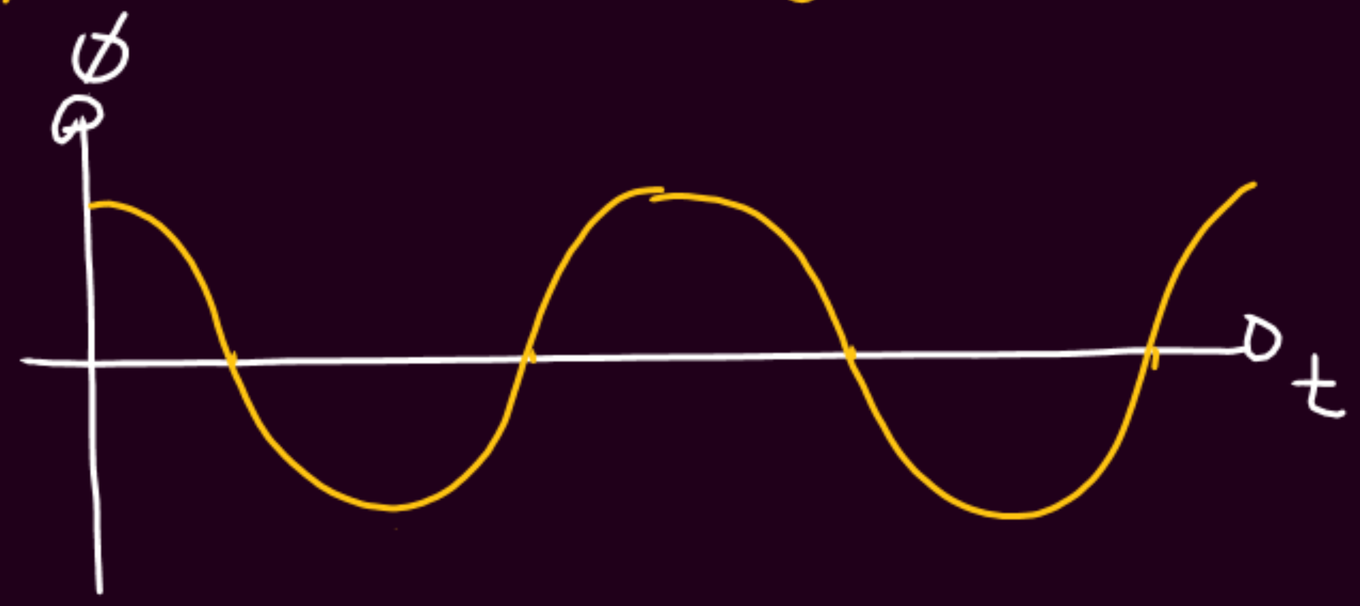


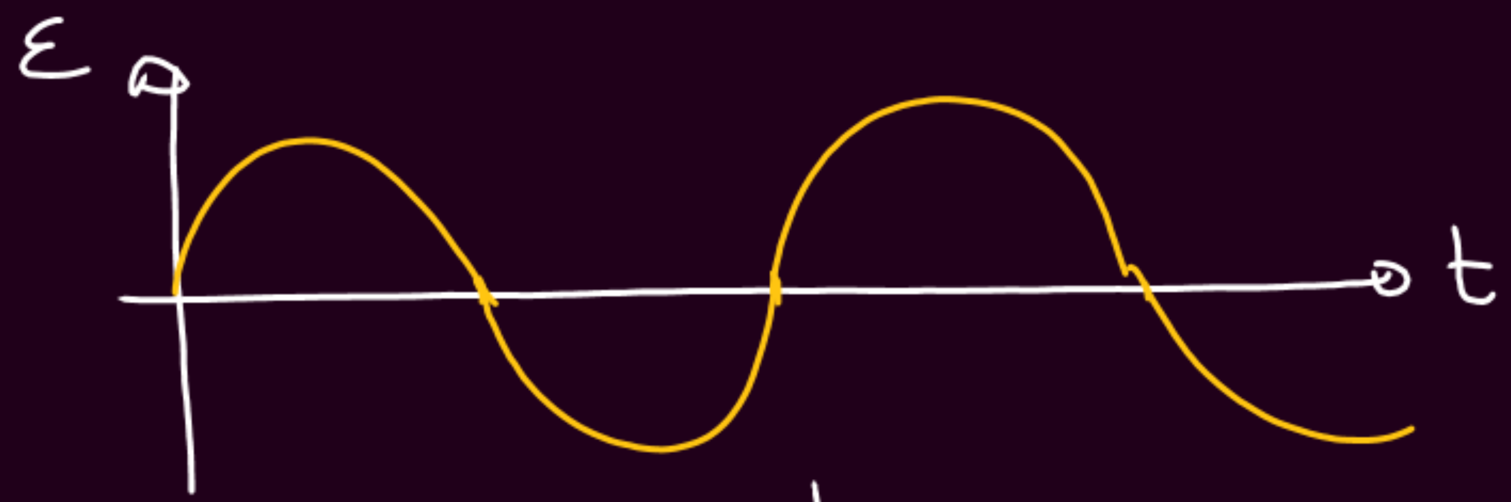
AC generator / Dynamo

1. $\theta = \omega t$
2. $\phi = (NBA)\cos(\omega t)$
3. $\mathcal{E} = (NBA\omega)\sin(\omega t)$
4. $i = \left(\frac{NBA\omega}{R}\right)\sin(\omega t)$

Peak / max. / Amplitude

1. $\mathcal{E}_p = \phi_p \omega$
2. ϕ leads $\mathcal{E}$ by $\pi/2$
3.

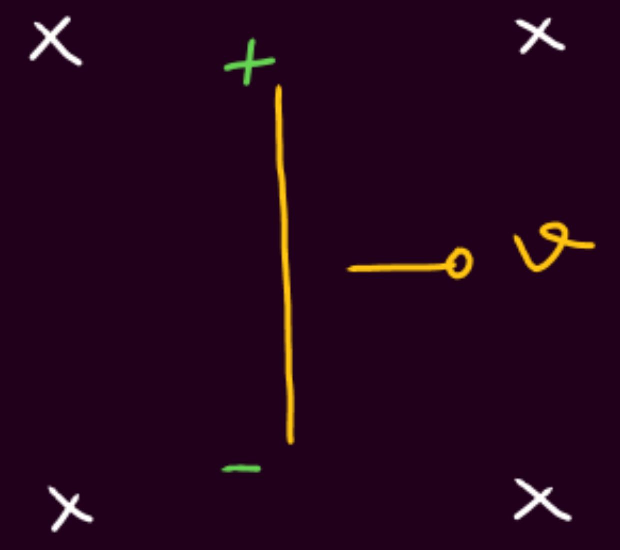




4. Inst. $\phi = 0$ | $\mathcal{E}_{max} = NBA\omega$

$\phi_{max} = NBA$ | $\mathcal{E} = 0$

Motional EMF [only for conductors]

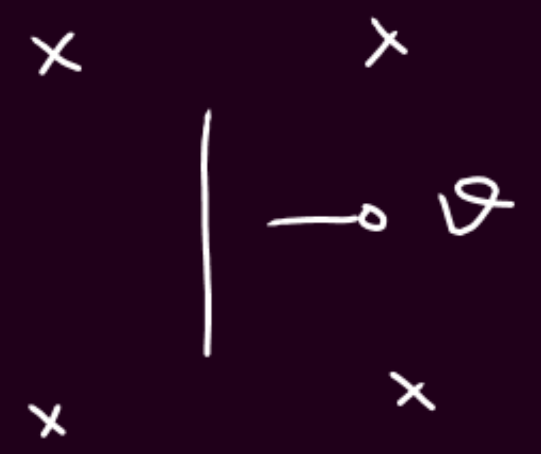


$$\boxed{\mathcal{E} = B l v}$$ $B \perp l \perp v$

$\oplus$ polarity $\Rightarrow (\vec{v} \times \vec{B})$

$\Rightarrow \mathcal{E} = 0$ if any two of $B / l / v$ are parallel

Q.



$B = 10^{-2}\,T$

$l = 10\,cm$

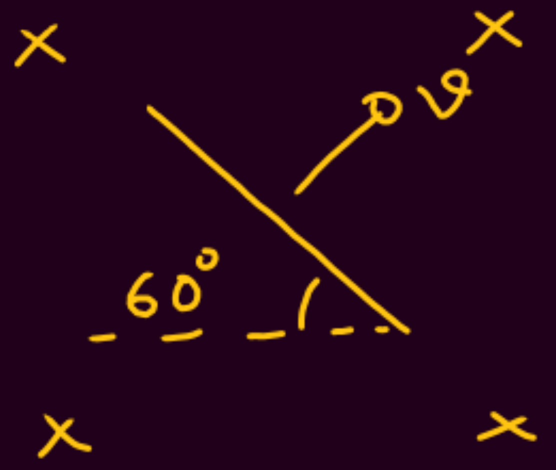
$v = 10\,m/s$

$\mathcal{E} = ?$

$\mathcal{E} = 10^{-2}(0.1)(10)$

$\mathcal{E} = 10^{-2}\,V$

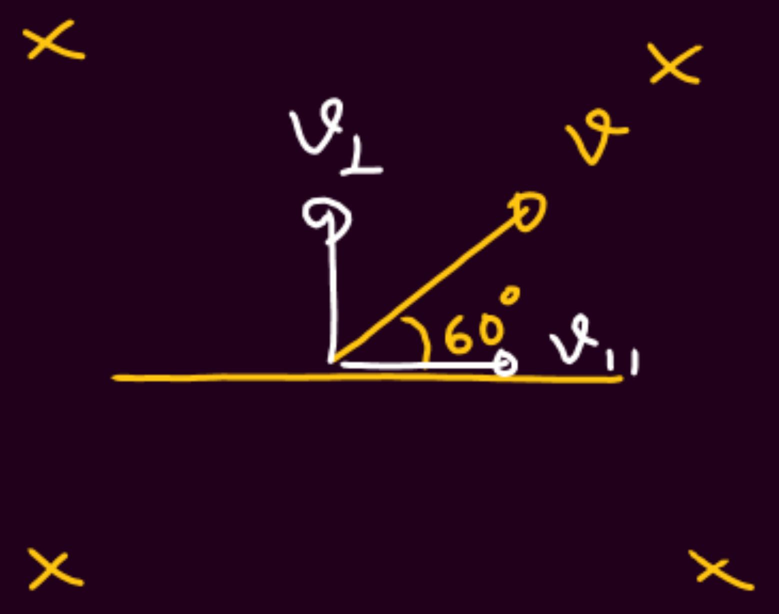
Q.



$B \perp l \perp v$

Same

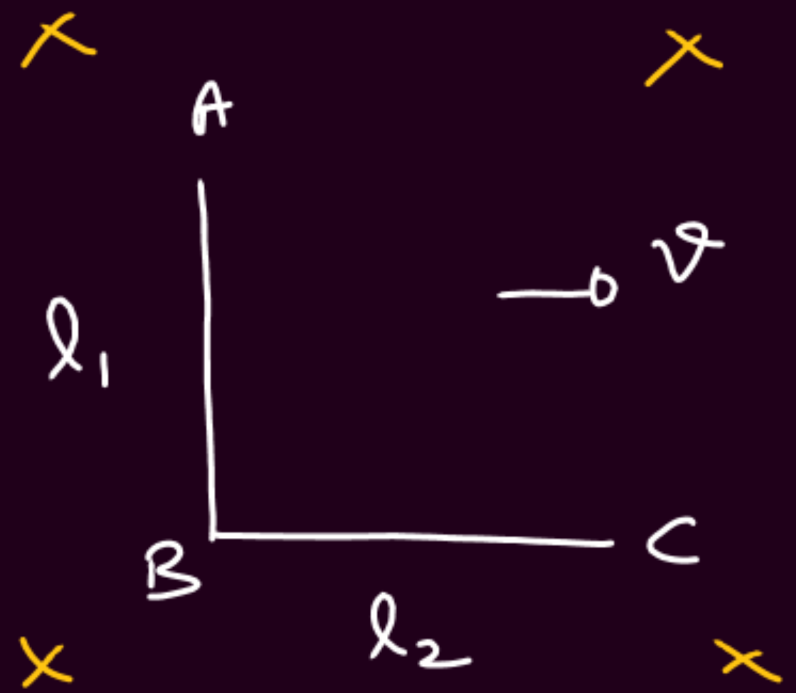
Q



$$\varepsilon = B l v_\perp$$

$$= B l v \sin 60^\circ$$

Q

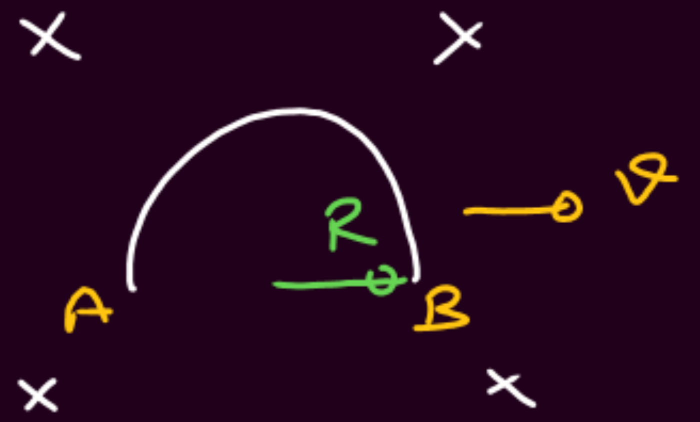


$$\varepsilon_{AB} = B l_1 v$$

$$\varepsilon_{BC} = 0$$

$$\varepsilon_{AC} = B l_1 v$$

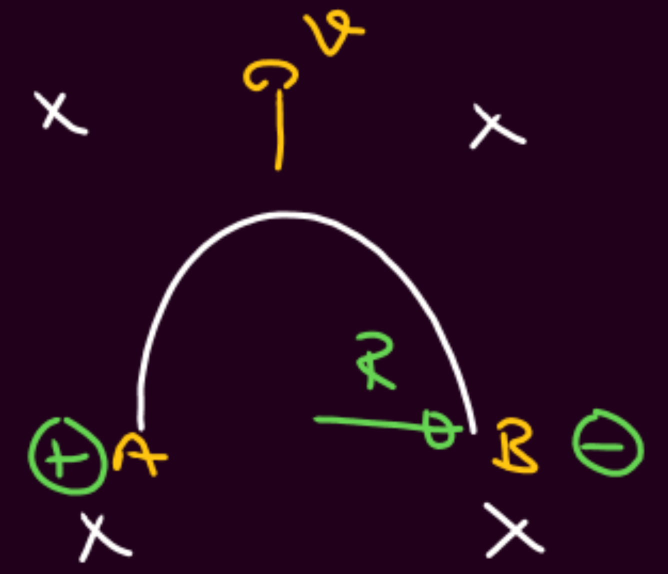
Q.



$$\varepsilon = 0$$

$$(l = v)$$

Q.

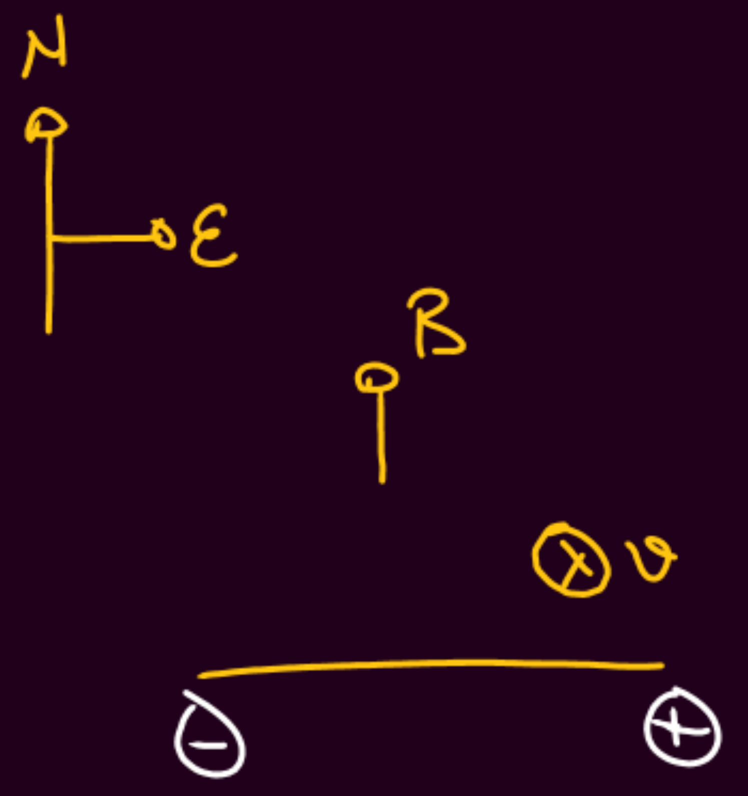


$$\varepsilon = B(2R)v$$

Q. Horizontal along E-W falling vertically

Which end is at H.P.?

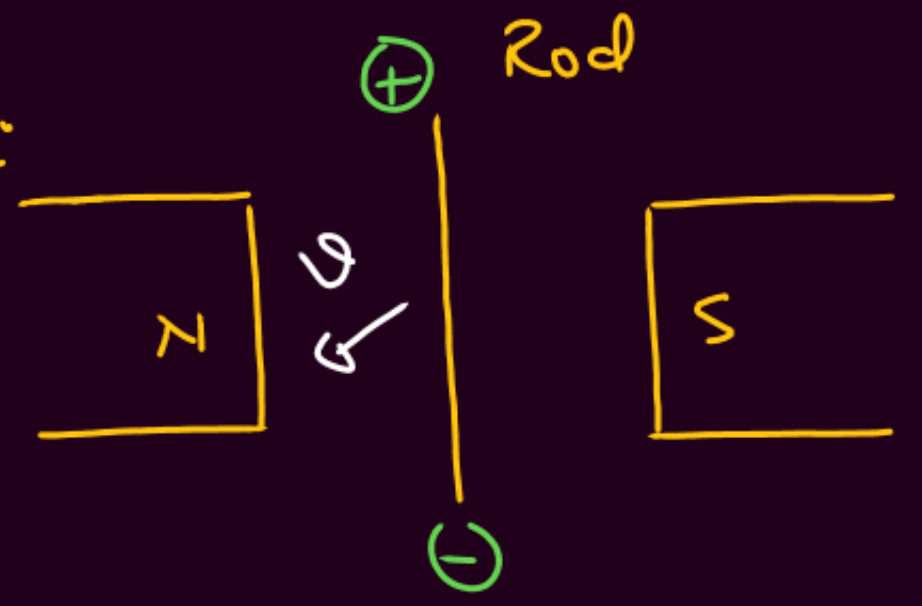
East

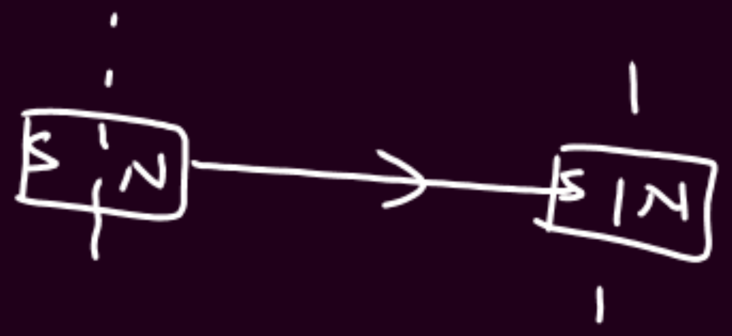


Q.

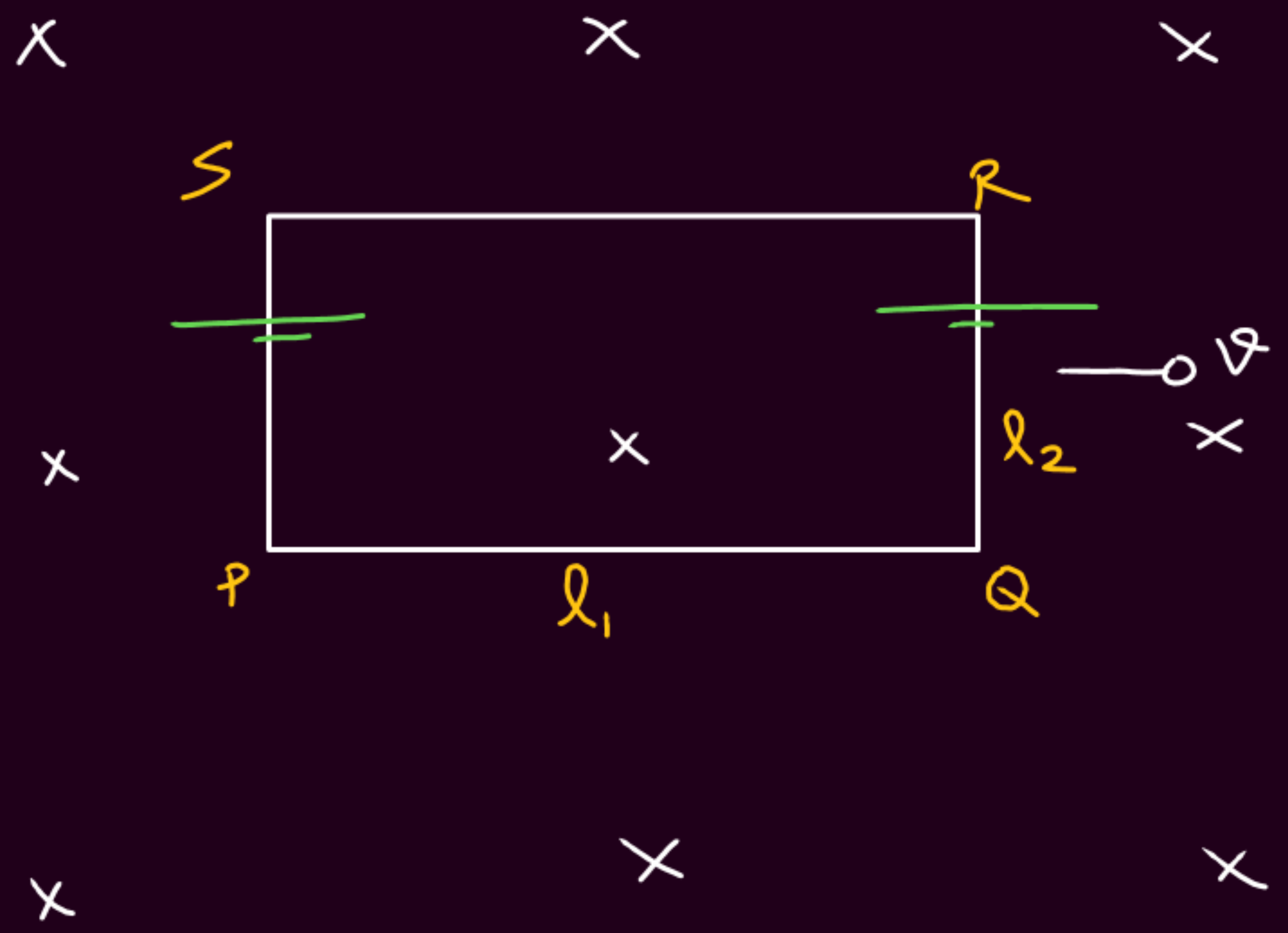
Vertical Rod

Q.





Q



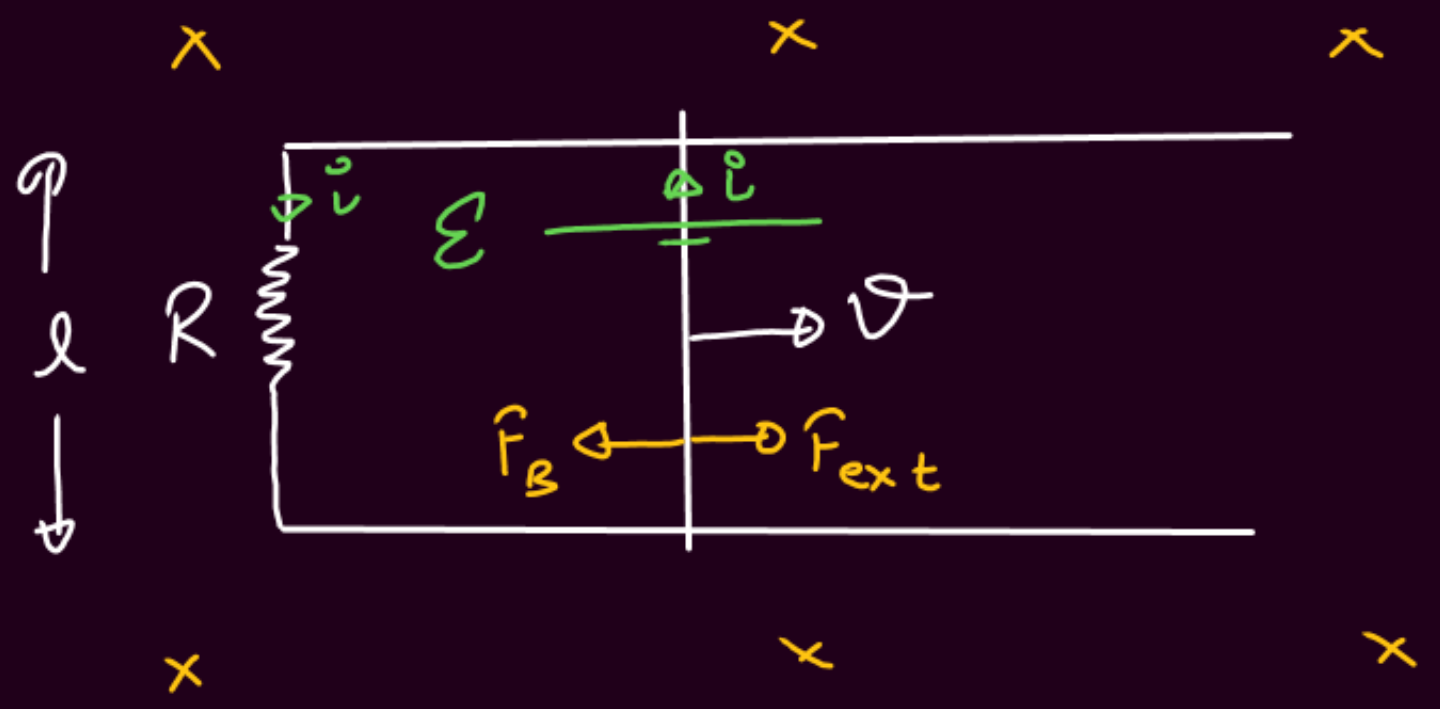
$\varepsilon_{loop} = 0$

$\varepsilon_{PQ} = 0$

$\varepsilon_{QR} = -Bl_2 v$

$\varepsilon_{RS} = 0$

$\varepsilon_{SP} = +Bl_2 v$



① $\mathcal{E} = Blv$

② $i = \dfrac{\mathcal{E}}{R} = \dfrac{Blv}{R}$

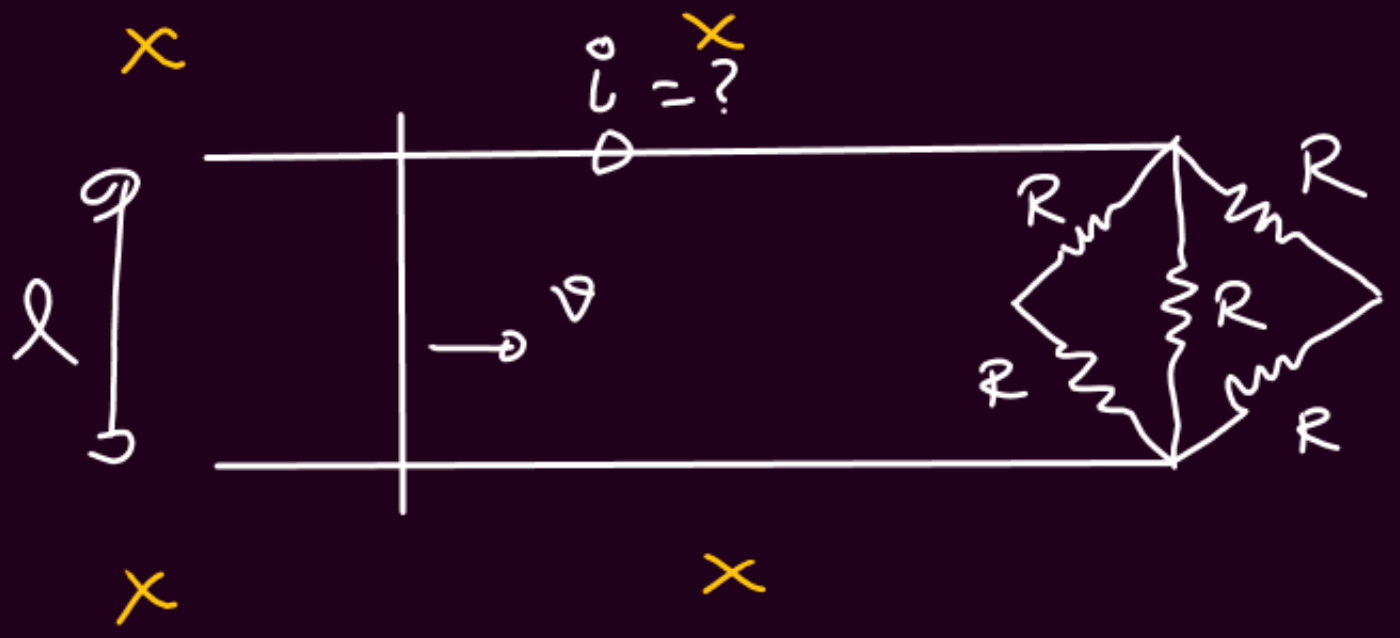
③ Power Dissipated $= \dfrac{\mathcal{E}^2}{R} = \dfrac{B^2 l^2 v^2}{R}$

④ Force req to move with v = const

$$F_{ext} = F_B = Bil = B\left(\frac{Blv}{R}\right)l = \frac{B^2 l^2 v}{R}$$

⑤ Power req to move with const. vel

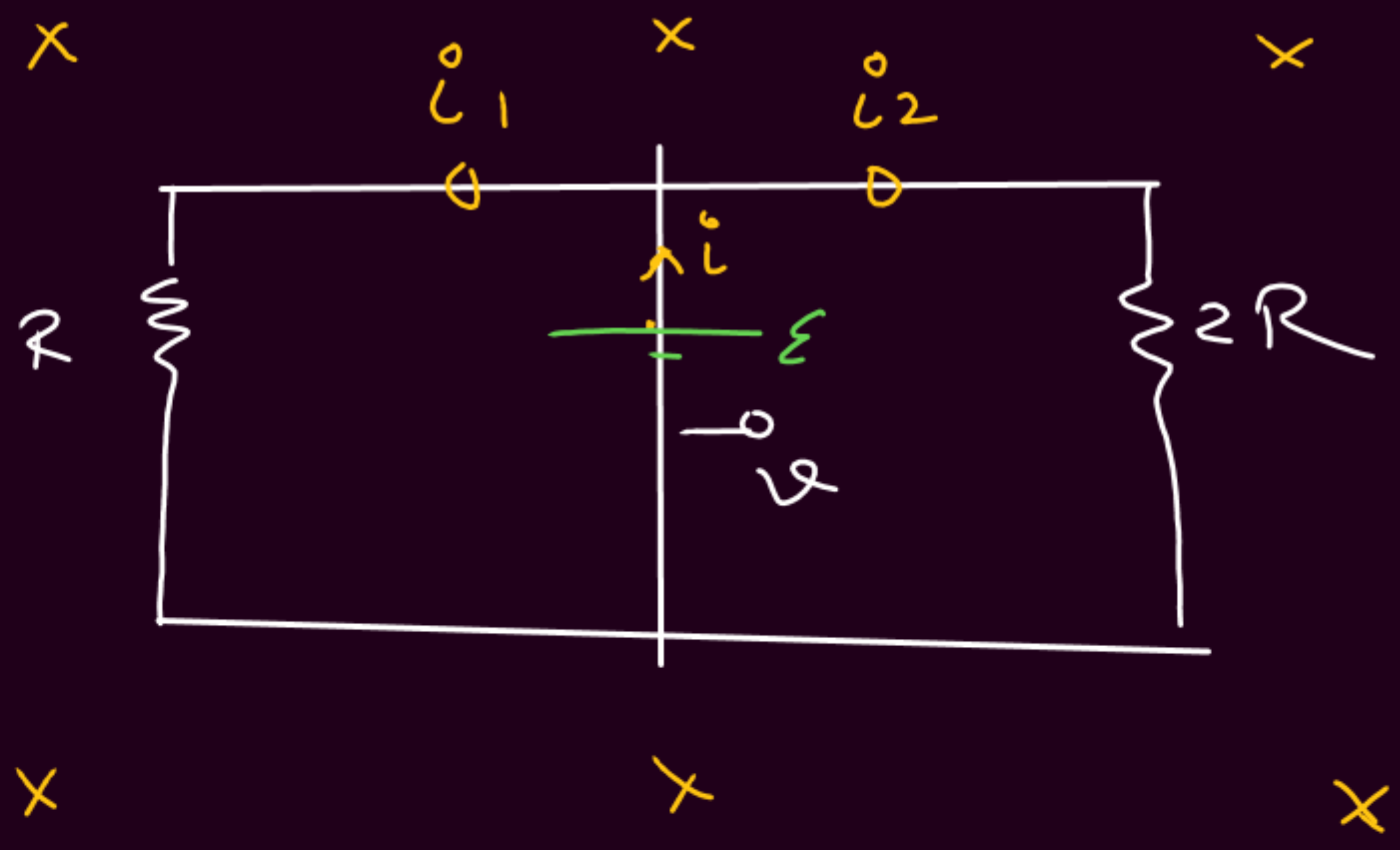
$$P = (\text{Force})(\text{vel.})$$



$$\mathcal{E} = Blv$$

$$R_{eq} = \frac{R}{2}$$

$$i = \frac{2Blv}{R}$$

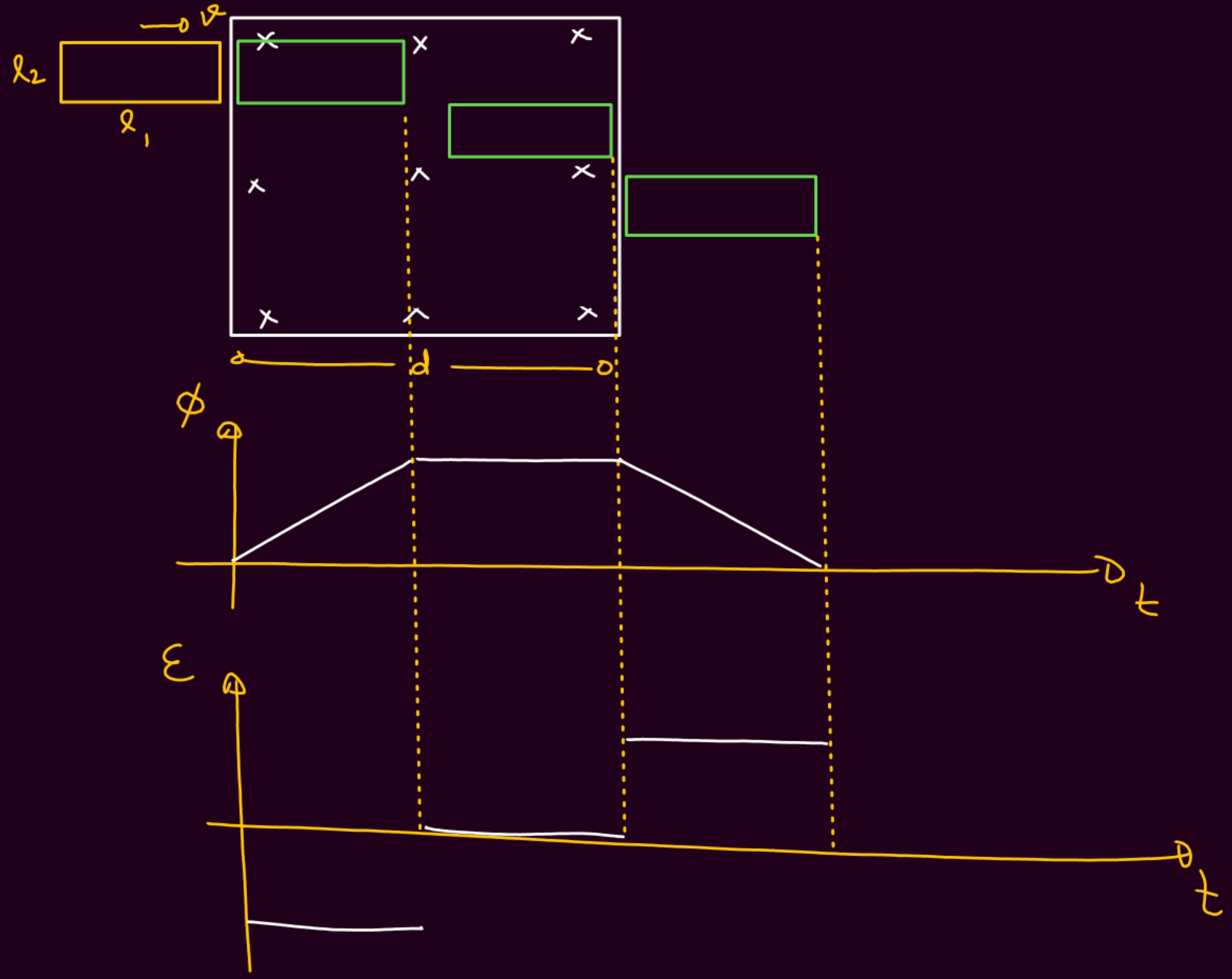


$$\mathcal{E} = Blv$$

$$i_1 = \frac{Blv}{R}$$

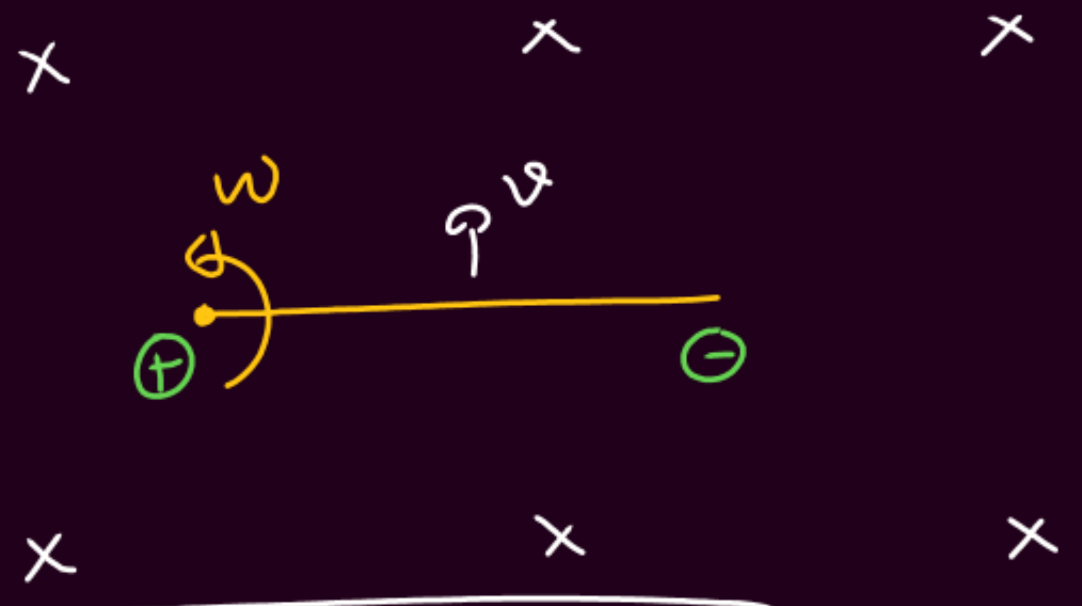
$$i_2 = \frac{Blv}{2R}$$

$$i = \frac{3Blv}{2R}$$

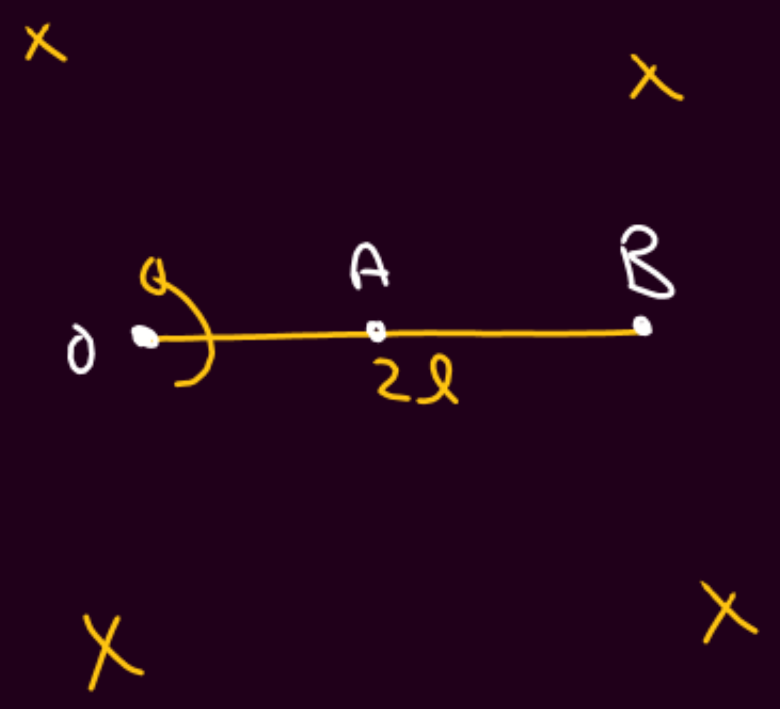


v
l_2
l_1
d
ϕ
t
ε
t

Rotating Rod



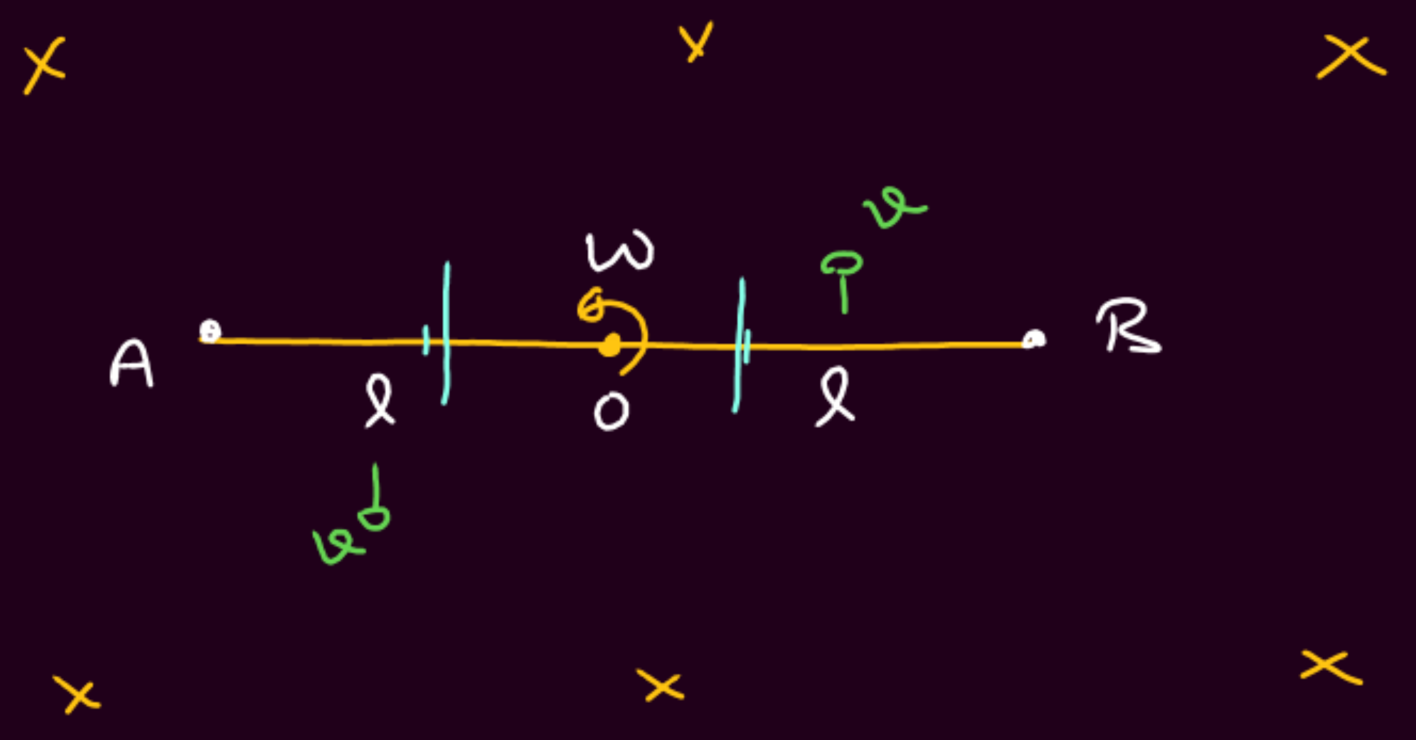
$$\boxed{\mathcal{E} = \frac{B\omega R^2}{2}}$$



$$\mathcal{E}_{OB} = \frac{B\omega(2l)^2}{2}$$

$$\mathcal{E}_{OA} = \frac{B\omega l^2}{2}$$

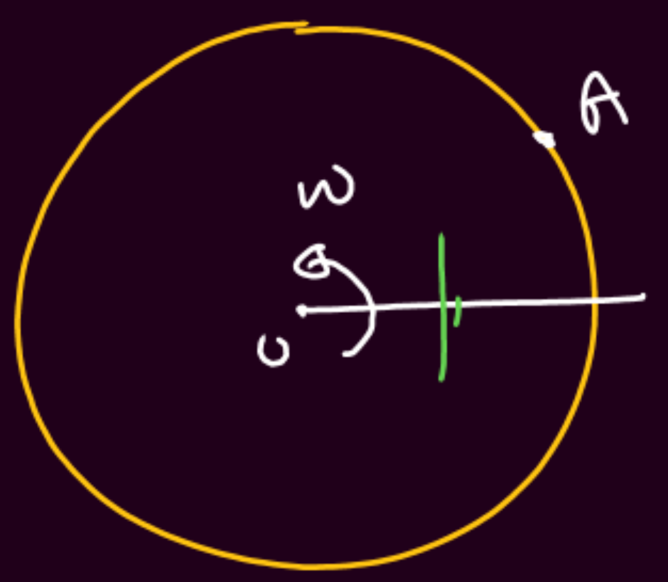
$$\mathcal{E}_{AB} = \frac{B\omega\left[(2l)^2 - l^2\right]}{2}$$

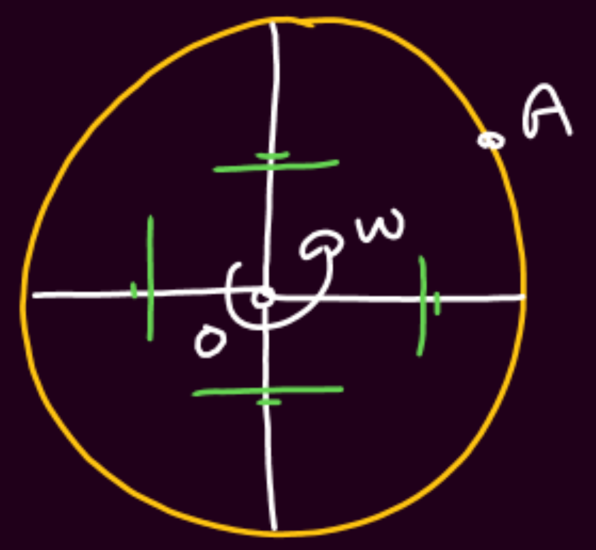


$$\mathcal{E}_{OB} = \frac{B\omega l^2}{2}$$

$$\mathcal{E}_{AO} = -\frac{B\omega l^2}{2}$$

$$\mathcal{E}_{AB} = 0$$





Disc

Ring

$$\varepsilon = \frac{B\omega R^2}{2}$$

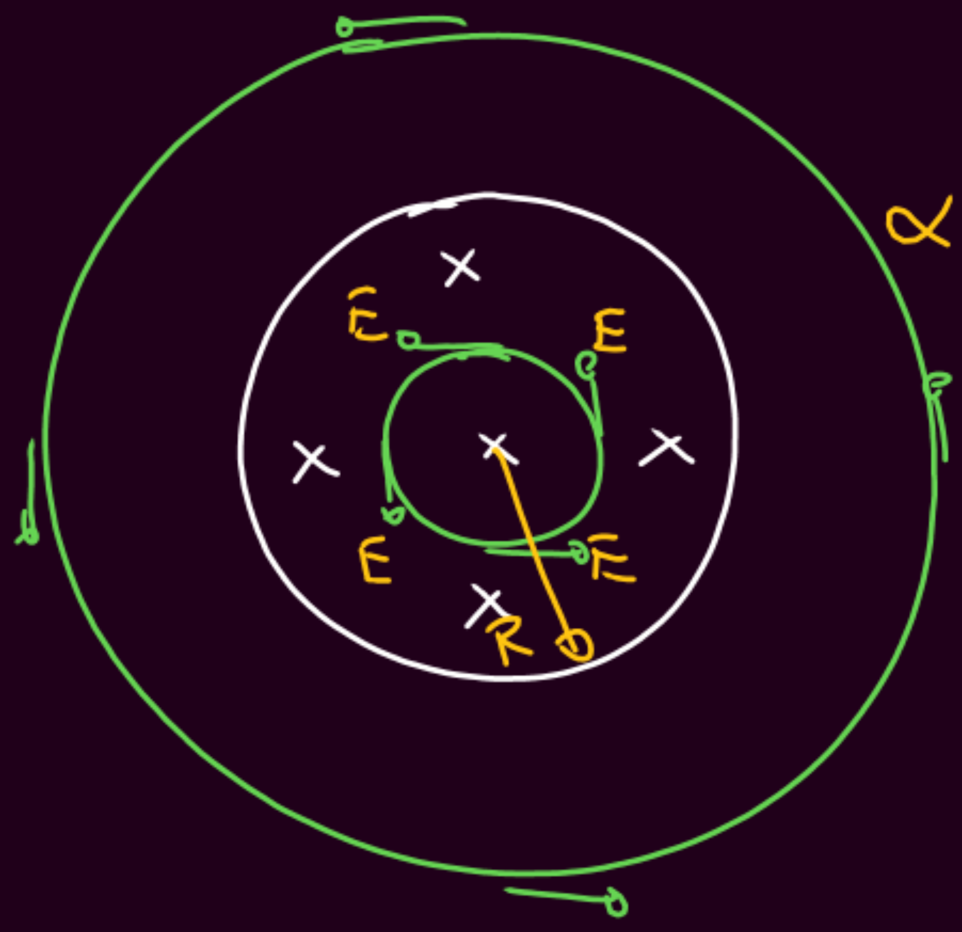
$$\varepsilon_{eq} = \frac{B\omega R^2}{2}$$

$$\varepsilon = \frac{B\omega R^2}{2}$$

$$\varepsilon = 0$$

Induced $\vec{E}$

$$\vec{F} = q\vec{E}$$



$$\alpha = \frac{dB}{dt}$$

$$\mathcal{E} = \oint \vec{E}\cdot d\vec{l} = -\frac{d\phi}{dt}$$

① Inside

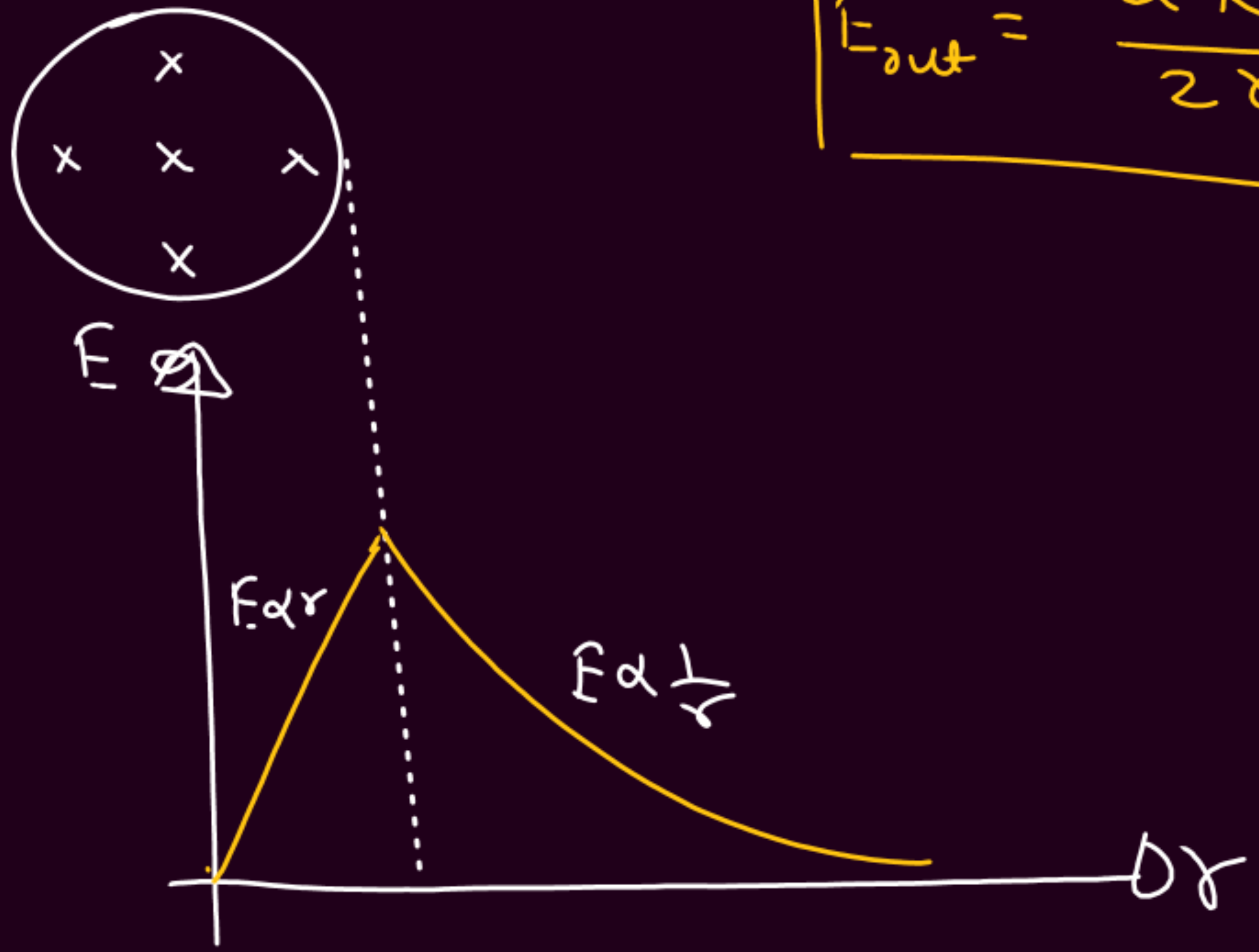
$$E(2\pi r) = \pi r^2\left(\frac{dB}{dt}\right)$$

$$\boxed{E_{in} = \frac{\alpha r}{2}}$$

② Outside

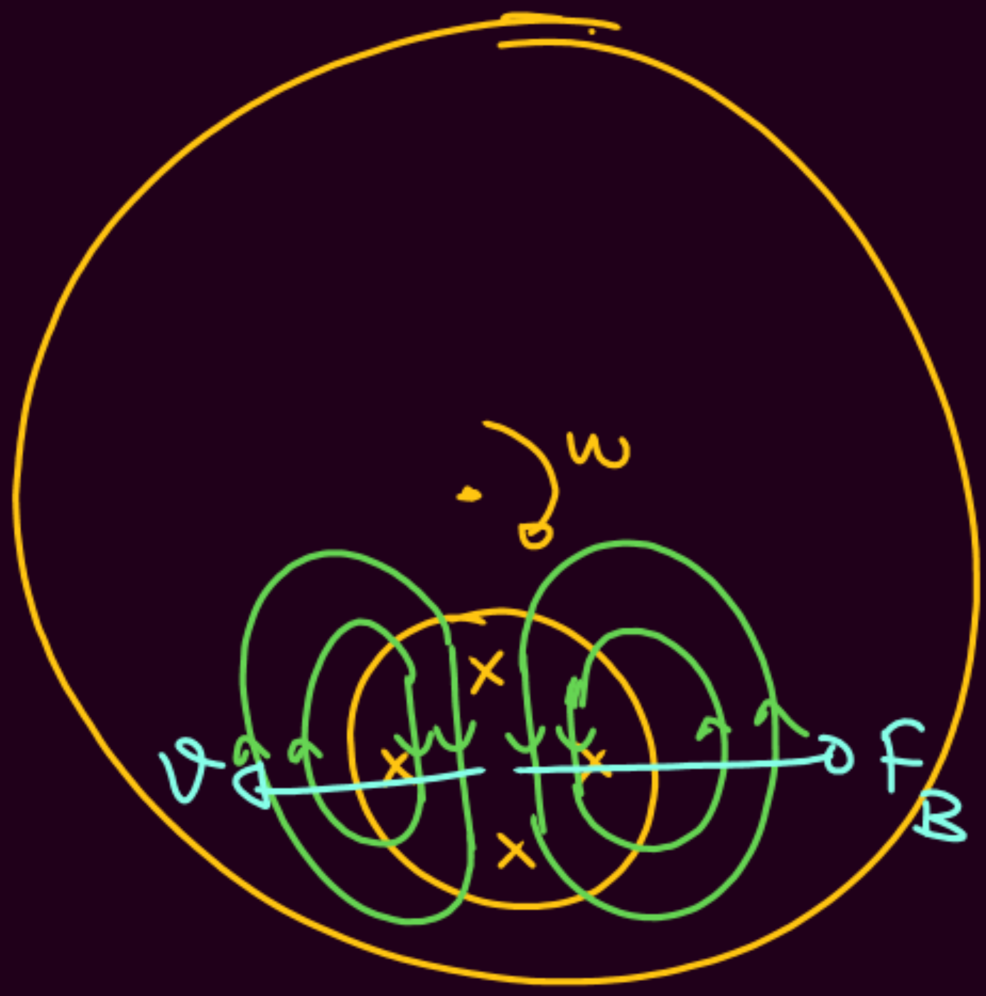
$$E(2\pi r) = \pi R^2\left(\frac{dB}{dt}\right)$$

$$\boxed{E_{out} = \frac{\alpha R^2}{2r}}$$



Eddy Currents

i → swirling Eddies



① Braking of Train

② Electromagnetic Damping

③ Induction furnace

④ Metal Detectors

⑤ Moving coil galvanometer

To reduce damping → slots

Self Inductance (L)

$$\phi \propto i$$

$$\boxed{\phi = Li}$$

$$-\frac{d\phi}{dt} = -L\frac{di}{dt}$$

$$\boxed{\varepsilon = -L\frac{di}{dt}}$$

Unit $\quad H = Wb/A = \Omega\text{-}s$

(Henry)

Solenoid

$$N\left(\frac{\mu_0 N i}{l}\right)A = Li$$

Medium

N

A & l

$$\boxed{L = \frac{\mu_0 N^2 A}{l} = \mu_0 n^2 (Al)}$$

$$\boxed{L = \mu_0 \mu_r n^2 (Al)}$$

$$\boxed{L \propto N^2}$$

L_0

$L = 2L_0$

Q iron core $\mu_r = 100$

coil $\longrightarrow N = 200$

$l = 10\,cm$

$r = 2\,mm$

$L = ?$

$$L = (4\pi \times \cancel{10^{-7}})(1\cancel{00})\frac{(2\cancel{00})(2\cancel{00})}{(\cancel{0.1})}\pi(4\times 10^{-6})$$

$$= 64 \times 10^{-5}\ H$$

$$L = 0.64\ mH$$

Q $L = 10\,mH$

1A to 3A in 0.2s

$$\varepsilon = -(10\times 10^{-3})\left(\frac{2}{0.2}\right)$$

$$\boxed{\varepsilon = -0.1\,V}$$

Energy Stored in L

$$\boxed{U = \frac{1}{2} L i^2}$$

$$U = \frac{1}{2} \phi i = \frac{\phi^2}{2L}$$

Energy Density $= \dfrac{B^2}{2\mu_0}$

Inductor / Solenoid / choke coil

Dimension

$$[L] = \frac{\text{Energy}}{i^2} = \frac{ML^2T^{-2}}{A^2}$$

$$[L] = [M L^2 T^{-2} A^{-2}]$$

Q.

$L = 10\,mH$

$i = 2\,A$

$$U = \frac{1}{2}(10 \times 10^{-3})(2)^2$$

$$U = 0.02\,J$$

Mutual Inductance (M)

$$\phi_2 \propto i_1$$

$$\phi_2 = M_{21}\, i_1$$

$$\boxed{\text{unit} \Rightarrow H}$$

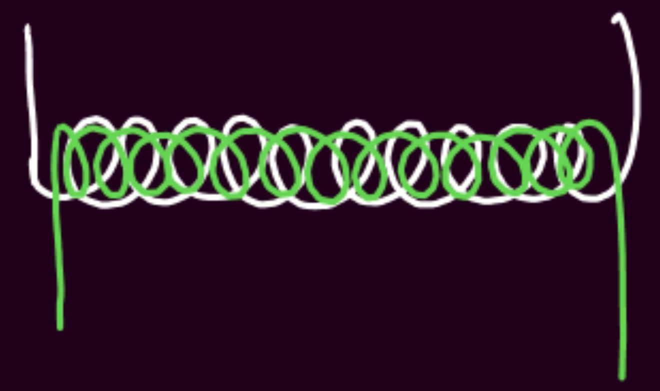
$$\boxed{M_{21} = M_{12}}$$

$$\phi_2 = M\, i_1$$

$$\boxed{N_2 B_1 A_c = M\, i_1}$$

$$\boxed{\mathcal{E}_2 = -M \frac{di_1}{dt}}$$

Two solenoids tightly wound over each other



$$\boxed{M = \frac{\mu_0 N_1 N_2 A}{l} = \mu_0 n_1 n_2 A l}$$

$$\boxed{M = \sqrt{L_1 L_2}}$$

$$L_1 = \frac{\mu_0 N_1^2 A}{l}$$

$$L_2 = \frac{\mu_0 N_2^2 A}{l}$$

$$\boxed{M = k\sqrt{L_1 L_2}}$$

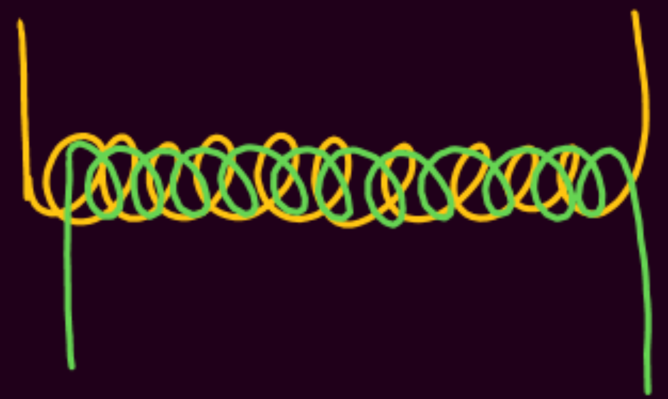
k = coeff of coupling / coupling factor

$$0 \le k \le 1$$

① $\underline{\underline{k = 1}}$ 'Max Linkage / No leakage'

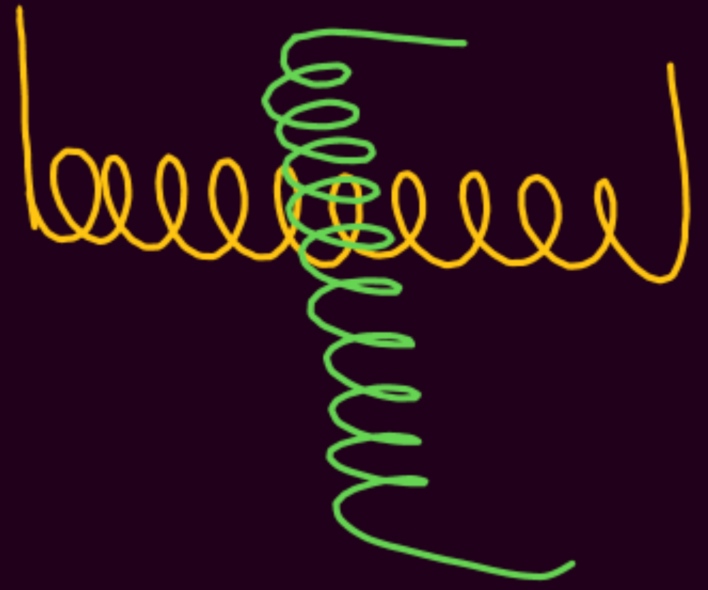
(Tightly wound over each other)

$$\boxed{M = \sqrt{L_1 L_2}}$$



② $\underline{\underline{k=0}}$

$$\boxed{M = 0}$$



① Series Combination (Extra)

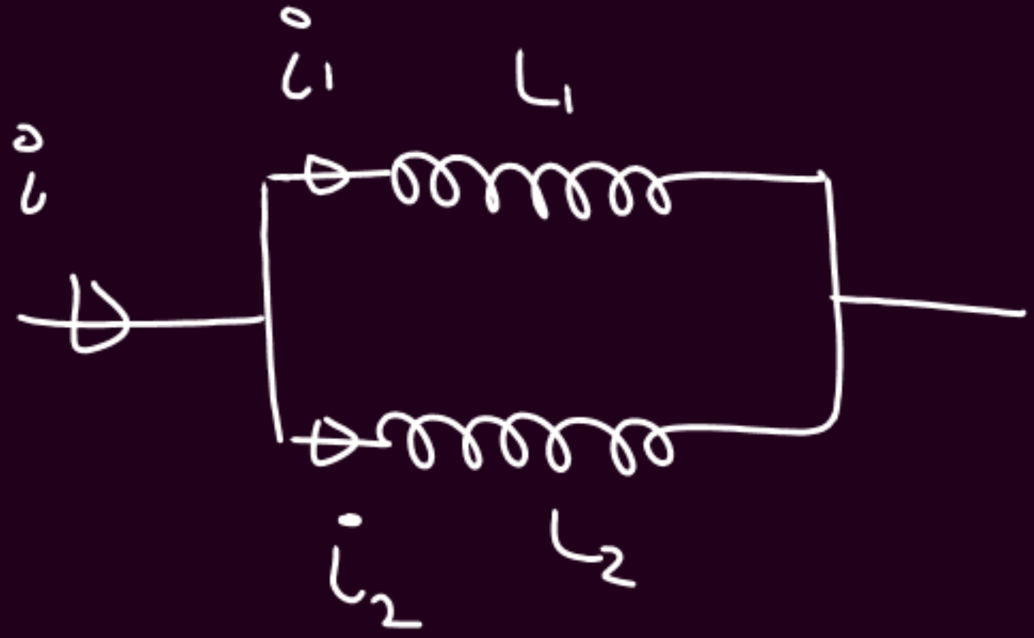
Ⅰ 

$$L_{eq} = L_1 + L_2 + 2M$$

Ⅱ 

$$L_{eq} = L_1 + L_2 - 2M$$

② Parallel Combination



Ⅰ $$L_{eq} = \frac{L_1 L_2}{L_1 + L_2}$$

Ⅱ $$i_1 L_1 = i_2 L_2$$

Ⅲ $$\varepsilon = -L_1 \frac{di_1}{dt} = -L_2 \frac{di_2}{dt}$$

$$i_1 = \frac{i L_2}{L_1 + L_2}$$

Q i_1 [$0 \rightarrow 2A$ in $0.5 sec$]

& $\mathcal{E}_2 = 0.02\ V$

$$\mathcal{E} = -M \frac{di}{dt}$$

$$0.02 = M\left(\frac{2}{0.5}\right)$$

$$M = 0.005\,H = 5\,mH$$

Q. $i_1 = i_0 \cos(\omega t)$

M

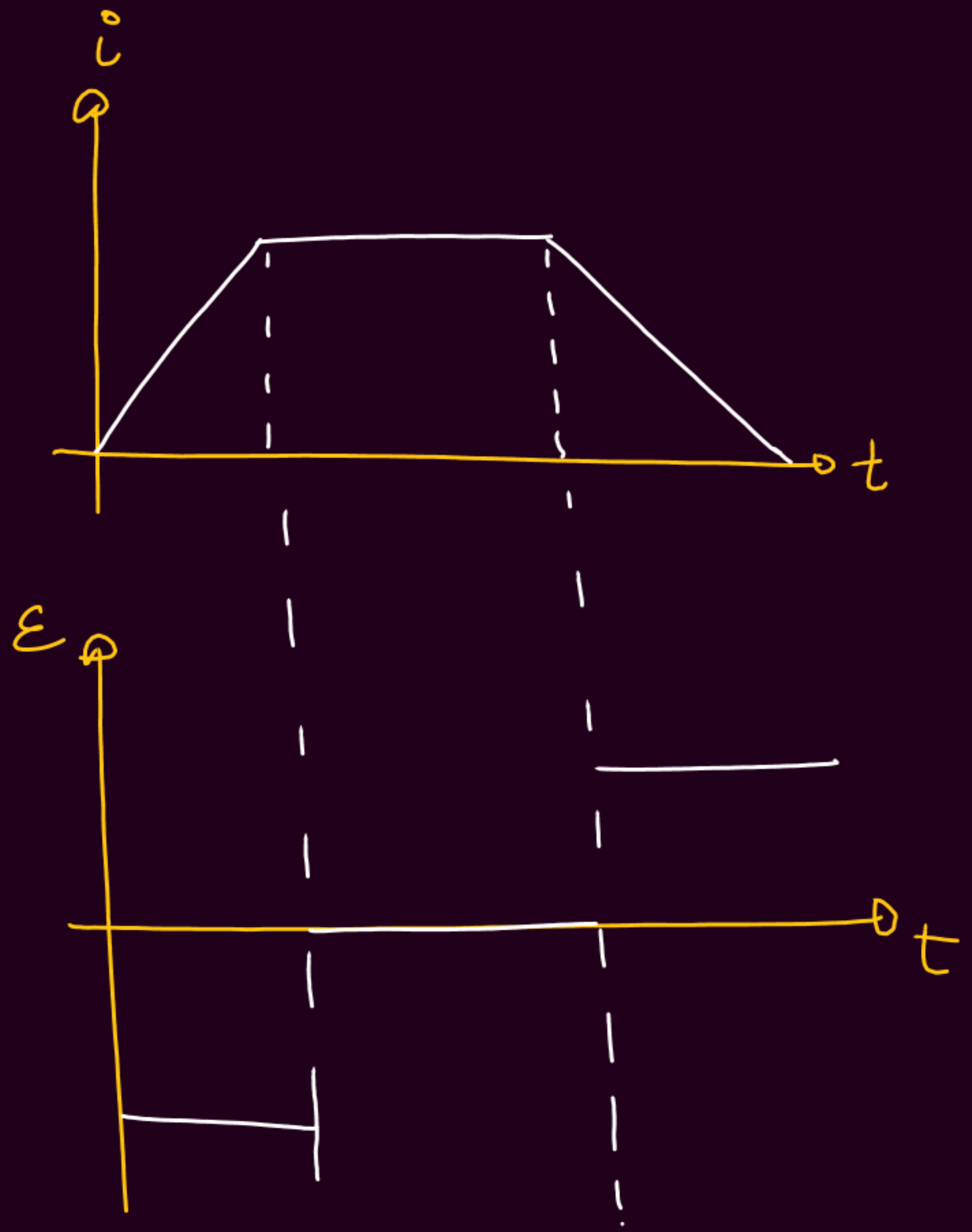
$\mathcal{E}_{peak,2} = ?$

$$\mathcal{E} = -M\left(\frac{di}{dt}\right)$$

$$\mathcal{E} = +(M\, i_0\, \omega) \sin(\omega t)$$

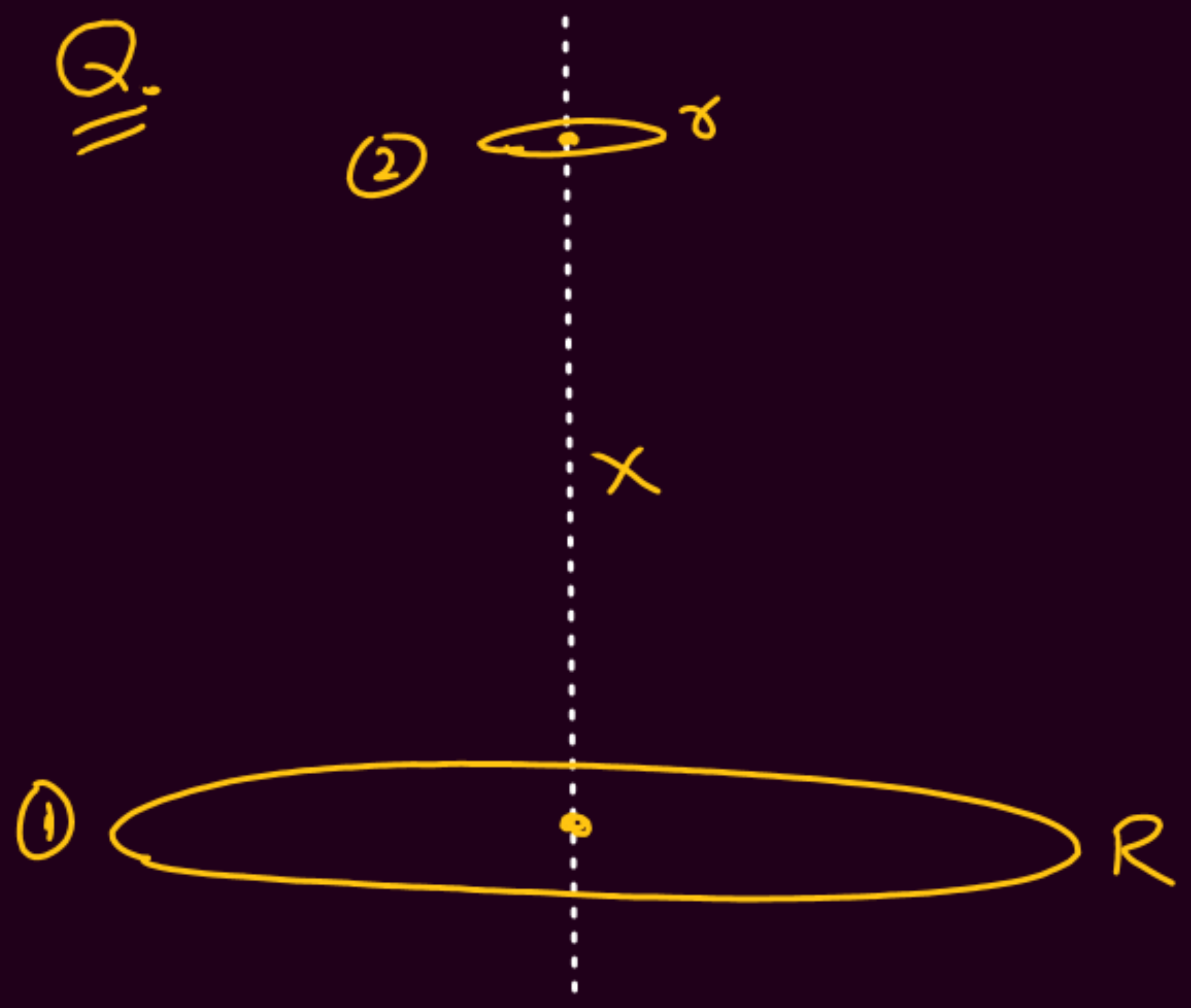
$$\mathcal{E}_{peak} = M\, i_0\, \omega$$

Q.



$$\varepsilon = -L\left(\frac{di}{dt}\right)$$

Q.



[R >> r]

M = ?

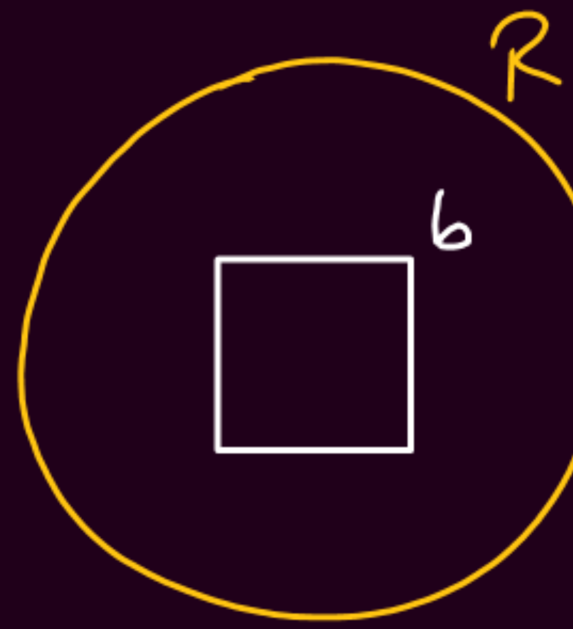
$$\phi_2 = M i_1$$

$$N_2 B_1 A_2 = M i_1$$

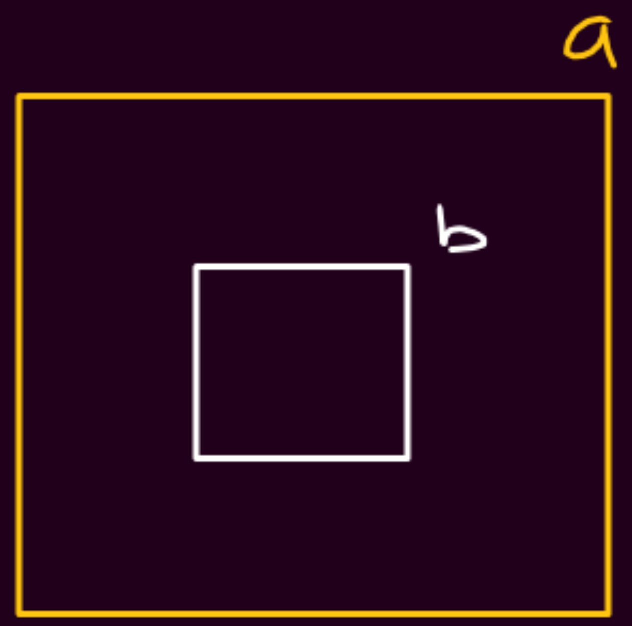
$$N_2 \frac{\mu_0 N_1 i_1 R^2}{2(x^2+R^2)^{3/2}} \pi r^2 = M i_1$$

$$M = \frac{\mu_0 N_1 N_2 \pi r^2 R^2}{2(x^2+R^2)^{3/2}}$$

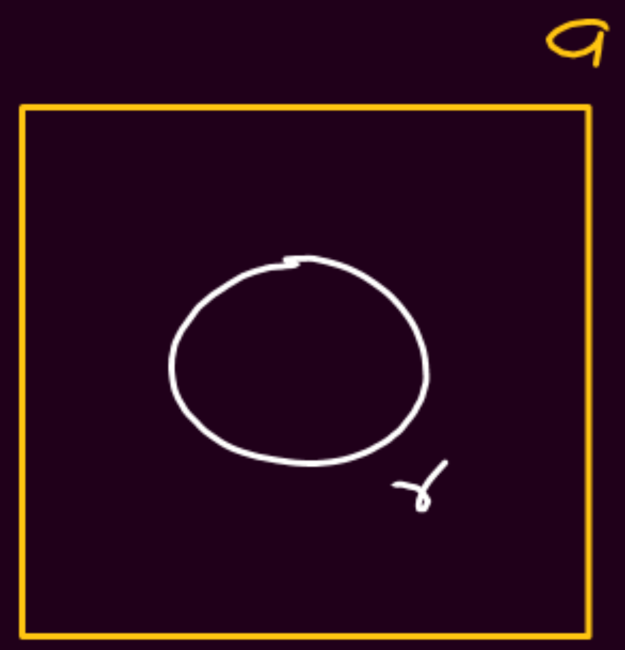
$$M \propto \frac{N_1 N_2 r^2}{R}$$



$$M \propto \frac{N_1 N_2 b^2}{R}$$



$$M \propto \frac{N_1 N_2 b^2}{a}$$



$$M \propto \frac{N_1 N_2 r^2}{a}$$

Sign Convention

$$\varepsilon_{AB} = L\frac{di}{dt}$$

① in the dir of i $\quad \varepsilon = -L\frac{di}{dt}$

② opp to dir of i $\quad \varepsilon = L\frac{di}{dt}$

Q.

$i = 2A$

$L = 10mH$

$i \downarrow$ at the rate $2A/s$

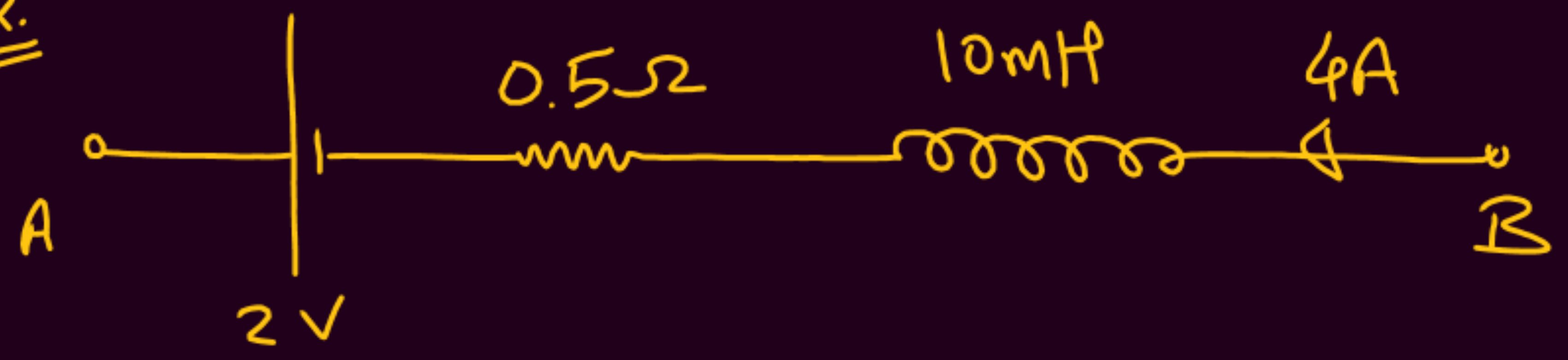
$\varepsilon_{AB} = ?$

$$\varepsilon = L\frac{di}{dt}$$

$$\varepsilon = (10\times10^{-3})(-2)$$

$$\underline{\varepsilon = -0.02V}$$

Q.



i is increasing at rate of $200 A/s$

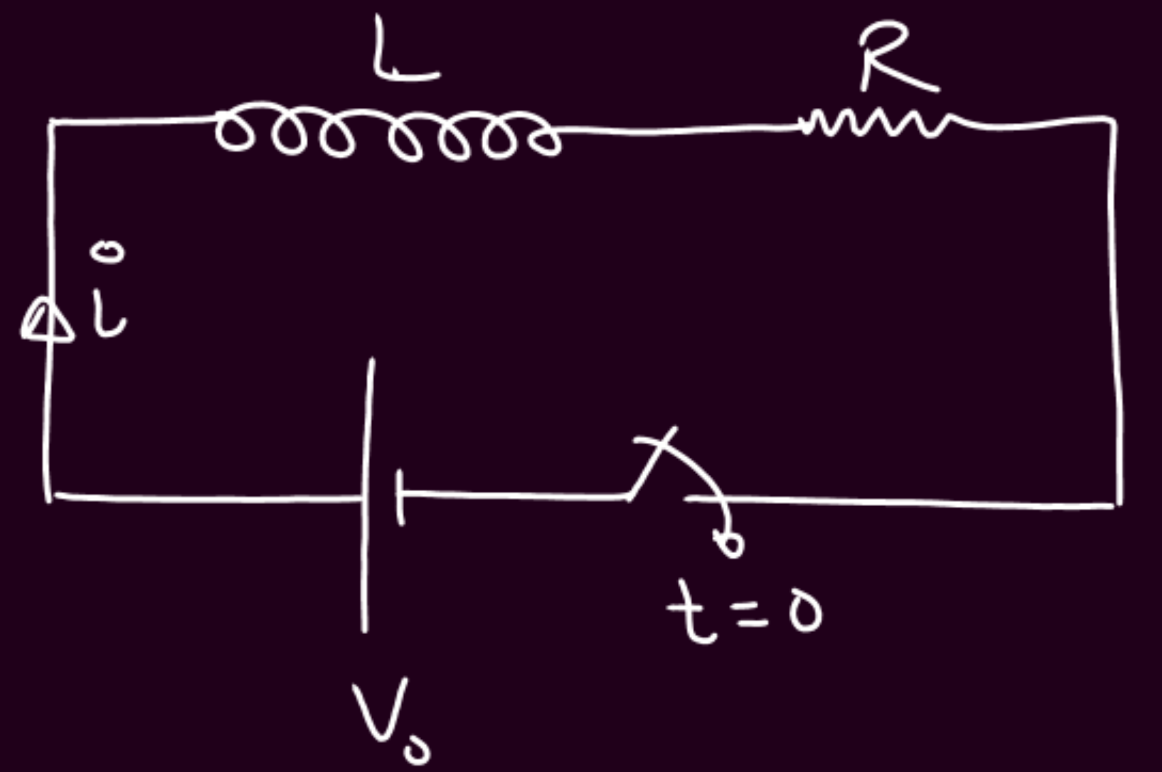
$$V_{AB} = -L\frac{di}{dt} - iR + \varepsilon$$

$$V_{AB} = -(10^{-2})(200) - 4(0.5) + 2$$

$$\boxed{V_{AB} = -2V}$$

L-R Circuit

① Growth of i



① $V_0 = V_L + V_R$

$$V_0 = L\left(\frac{di}{dt}\right) + iR$$

④ Time Constant $\tau = \frac{L}{R}$

⑤ $t_{1/2} = \tau \ln(2)$ | $i \to \frac{i_0}{2}$; $U \to \frac{U_0}{4}$

② $t=0$ (initially)

$i = 0$

$V_R = 0$

$V_L = V_0 = L\left(\frac{di}{dt}\right)$

[initially $L \to$ open circuit]

③ $t \to \infty$ (finally)

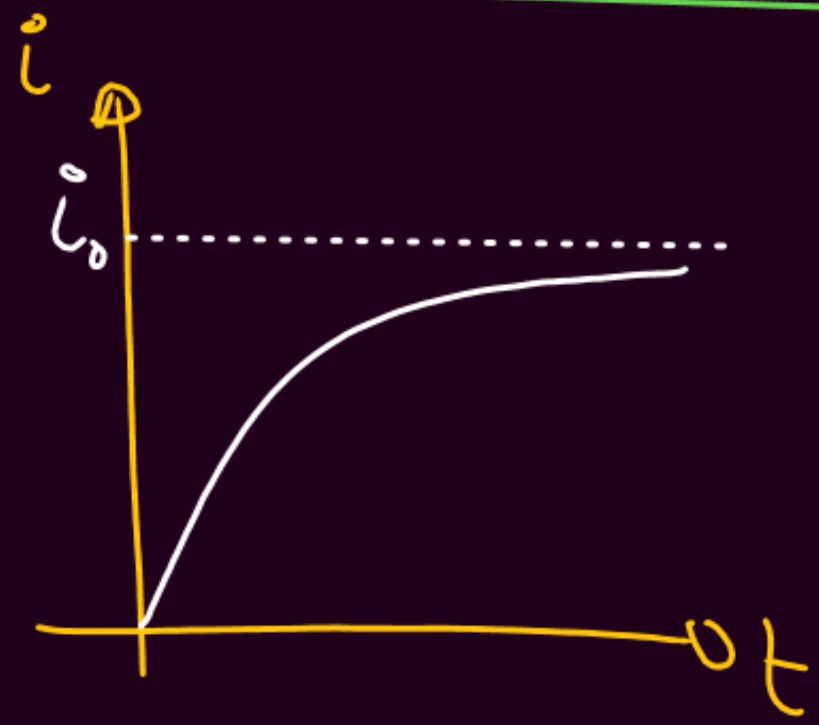
$i_{max} = \frac{V_0}{R}$

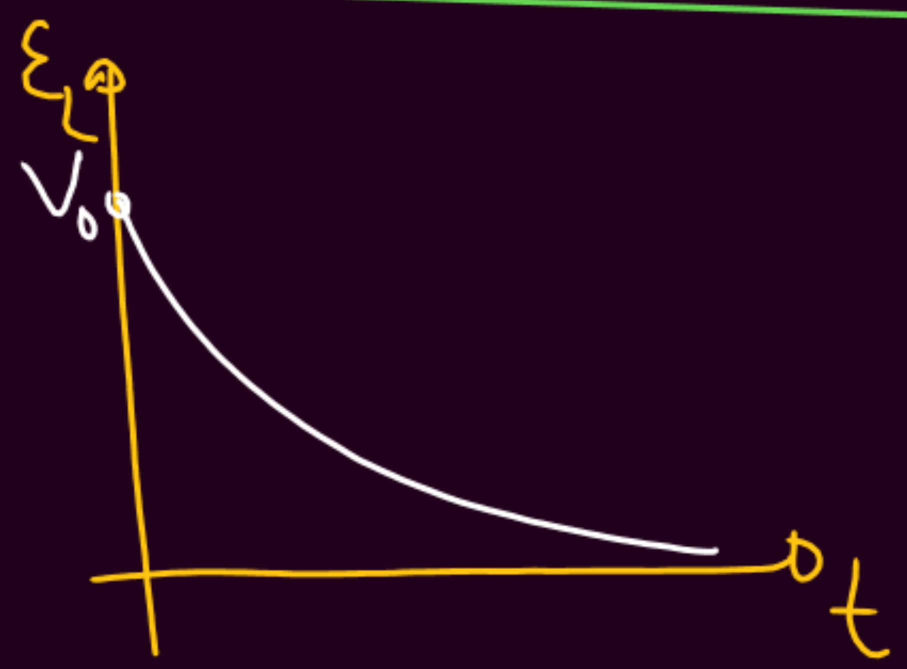
$V_R = V_0$

$\frac{di}{dt} = 0$

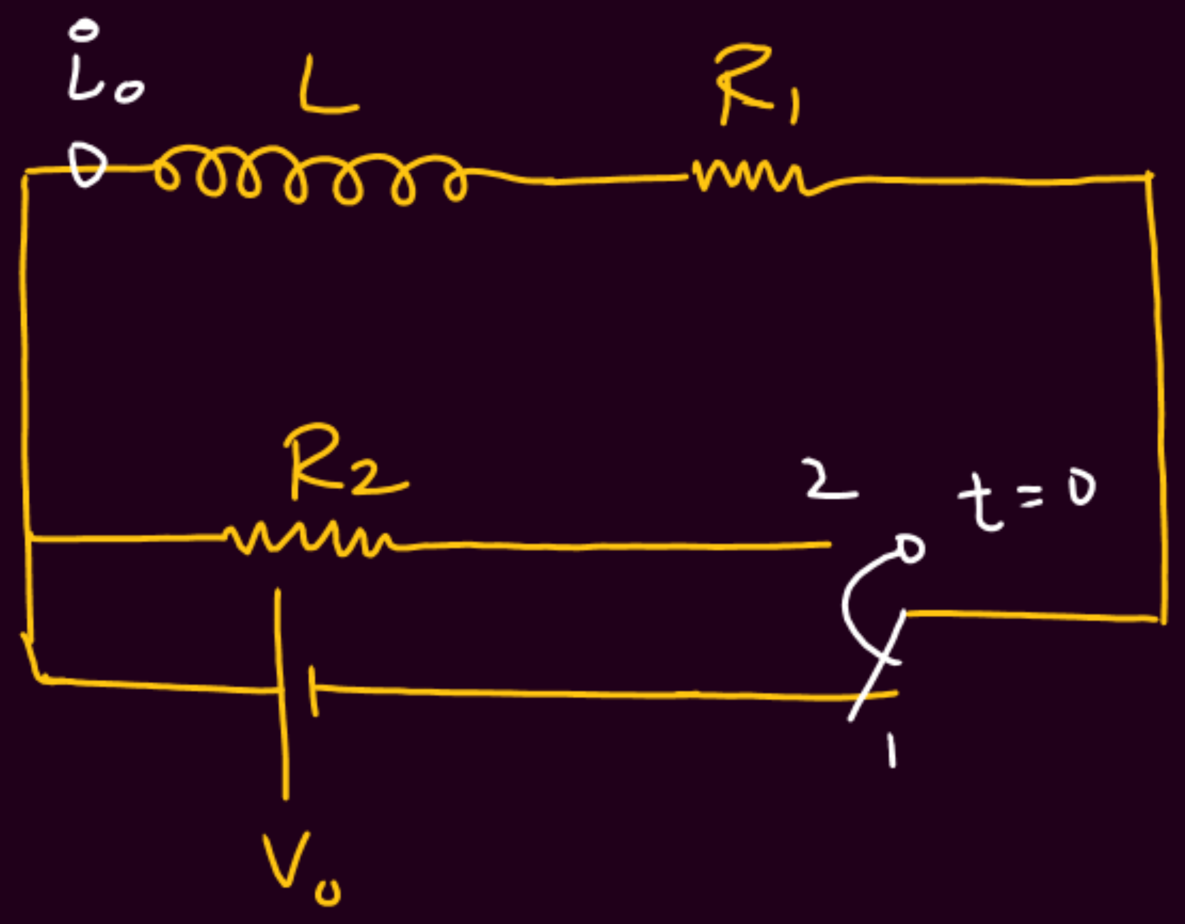
$V_L = 0$

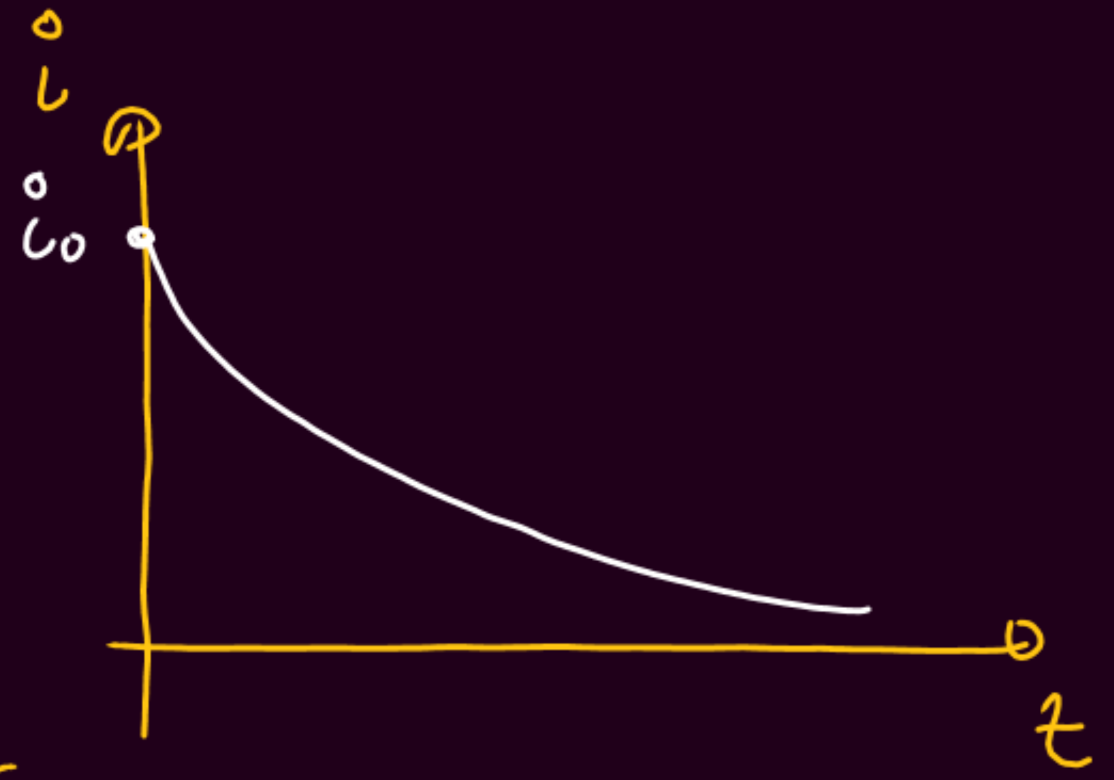
[finally $L \to$ short circuit]

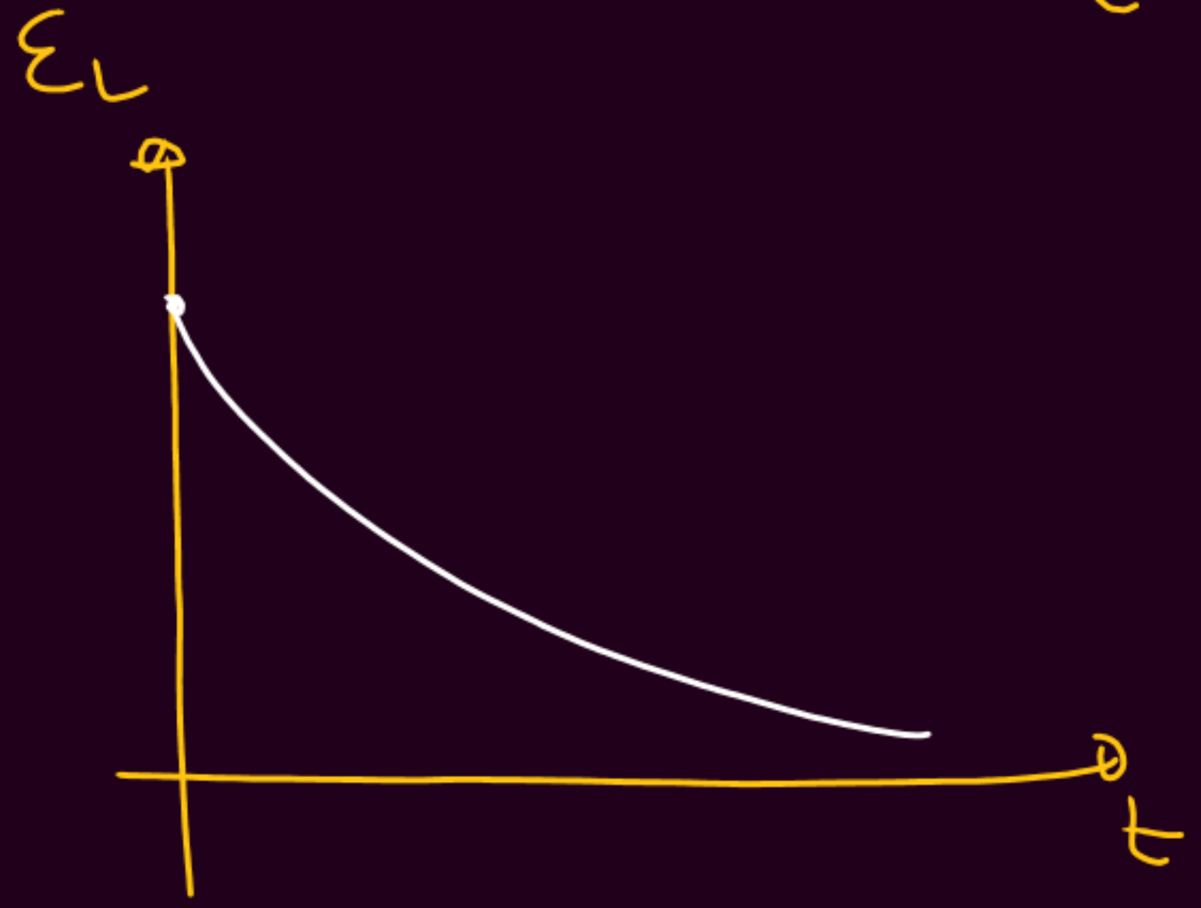




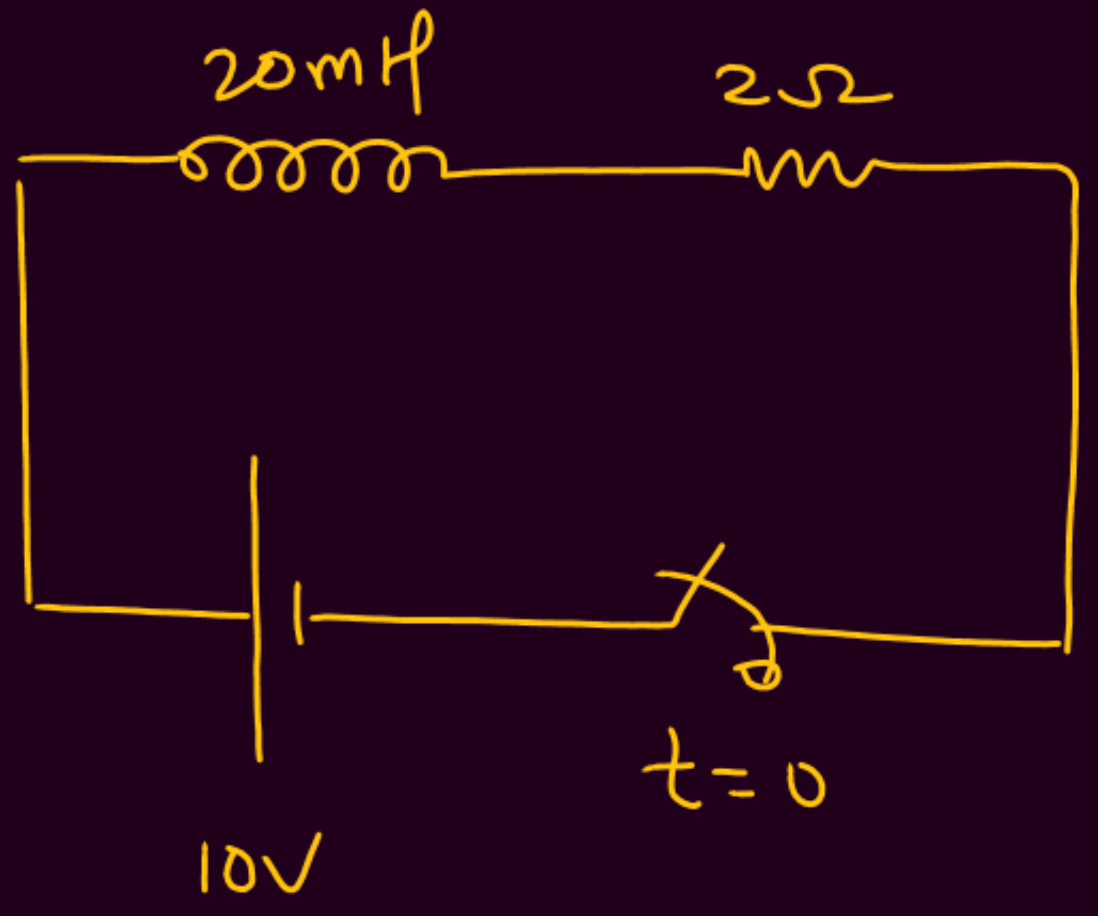
② Decay of i







Q



① Find initial Rate of change of i

$$V_0 = V_L + V_R$$

$$10 = (20\times10^{-3})\left(\frac{di}{dt}\right) + 0$$

$$\frac{di}{dt} = 500\ A/s$$

② Find rate of change of i when $i = 2A$

$$10 = (20\times10^{-3})\left(\frac{di}{dt}\right) + (2\times2)$$

$$\frac{6}{20\times10^{-3}} = \left(\frac{di}{dt}\right)$$

$$\boxed{\frac{di}{dt} = 300\ A/s}$$

③ Find $i = ?$ when it is 100 A/s

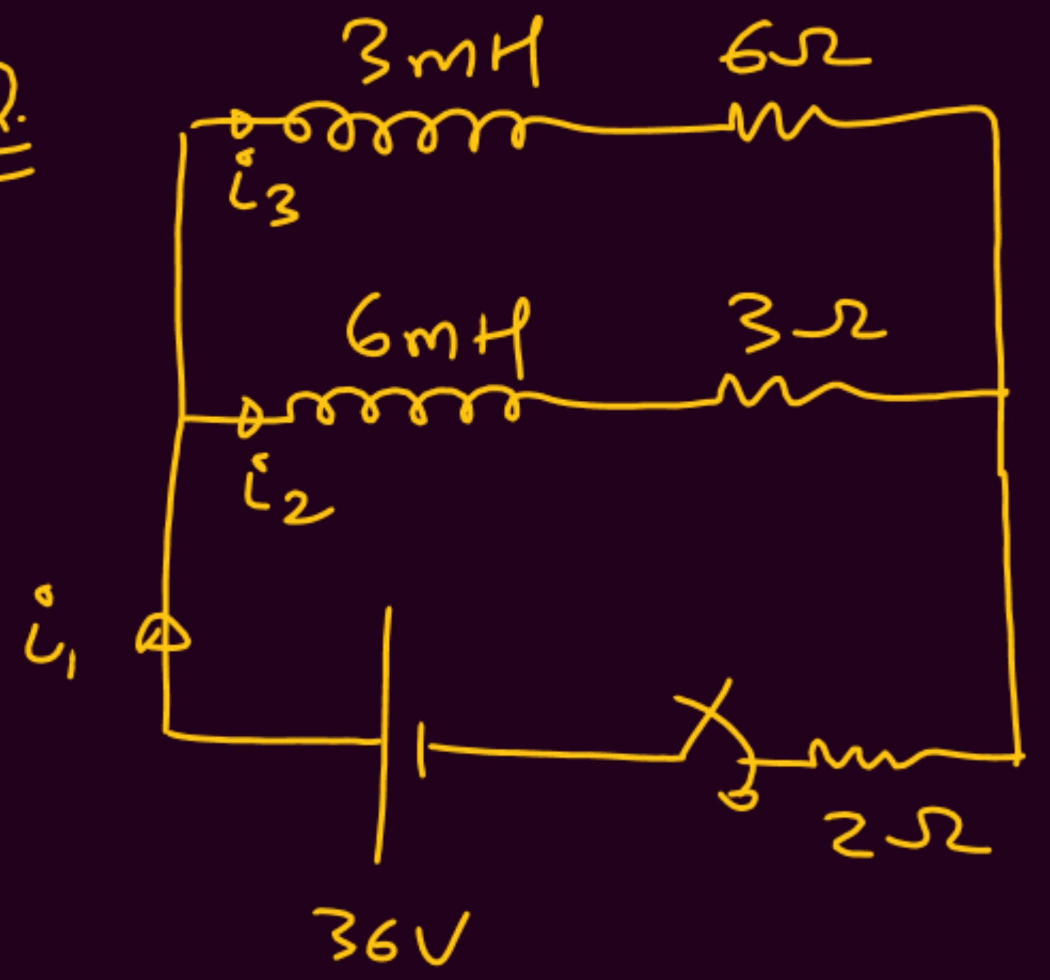
$$10 = (20\times10^{-3})(100) + i(2)$$

$$10 = 2 + 2i$$

$$8 = 2i$$

$$\boxed{i = 4A}$$

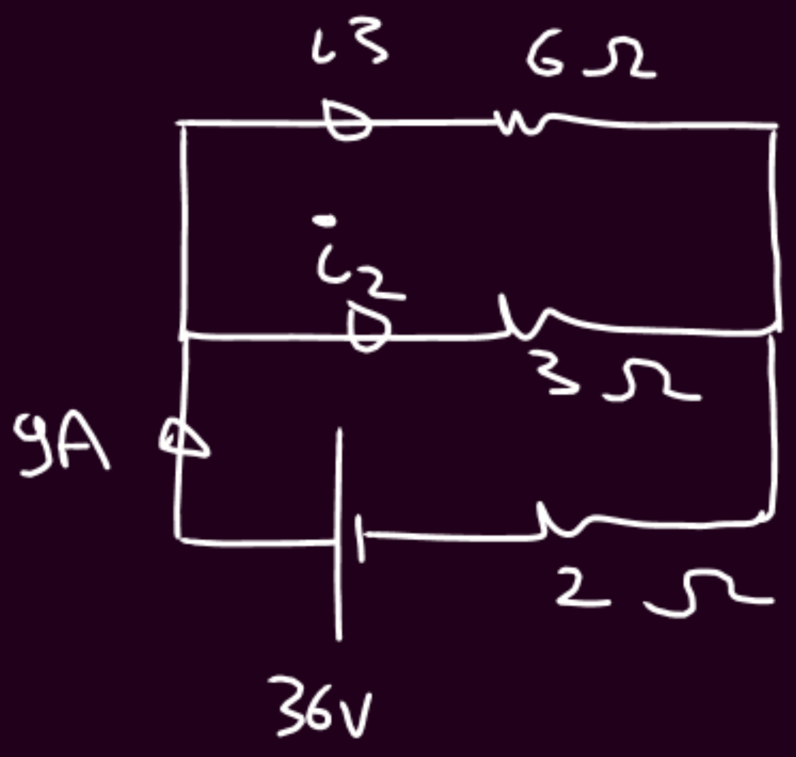
Q.



1. Initial Current

$i_1 = i_2 = i_3 = 0$

2. Final Current



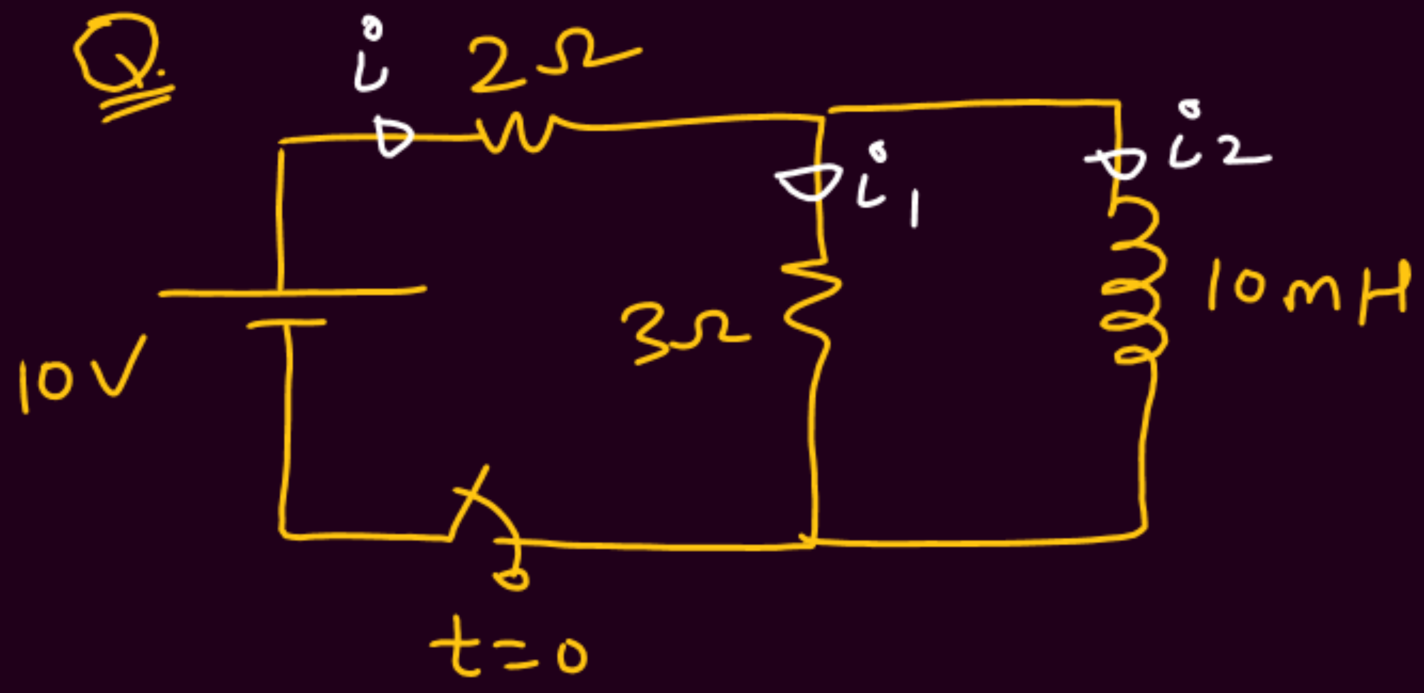
$R_{eq} = 4\Omega$

$i_1 = 9A$

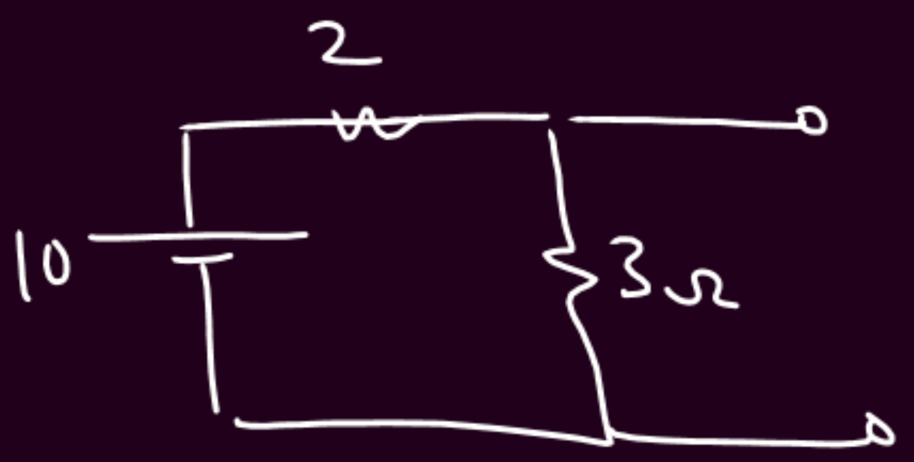
$$i_2 = \frac{9 \times 6}{6+3} = 6A$$

$i_3 = 3A$

Q.



① Initial Current (t = 0)



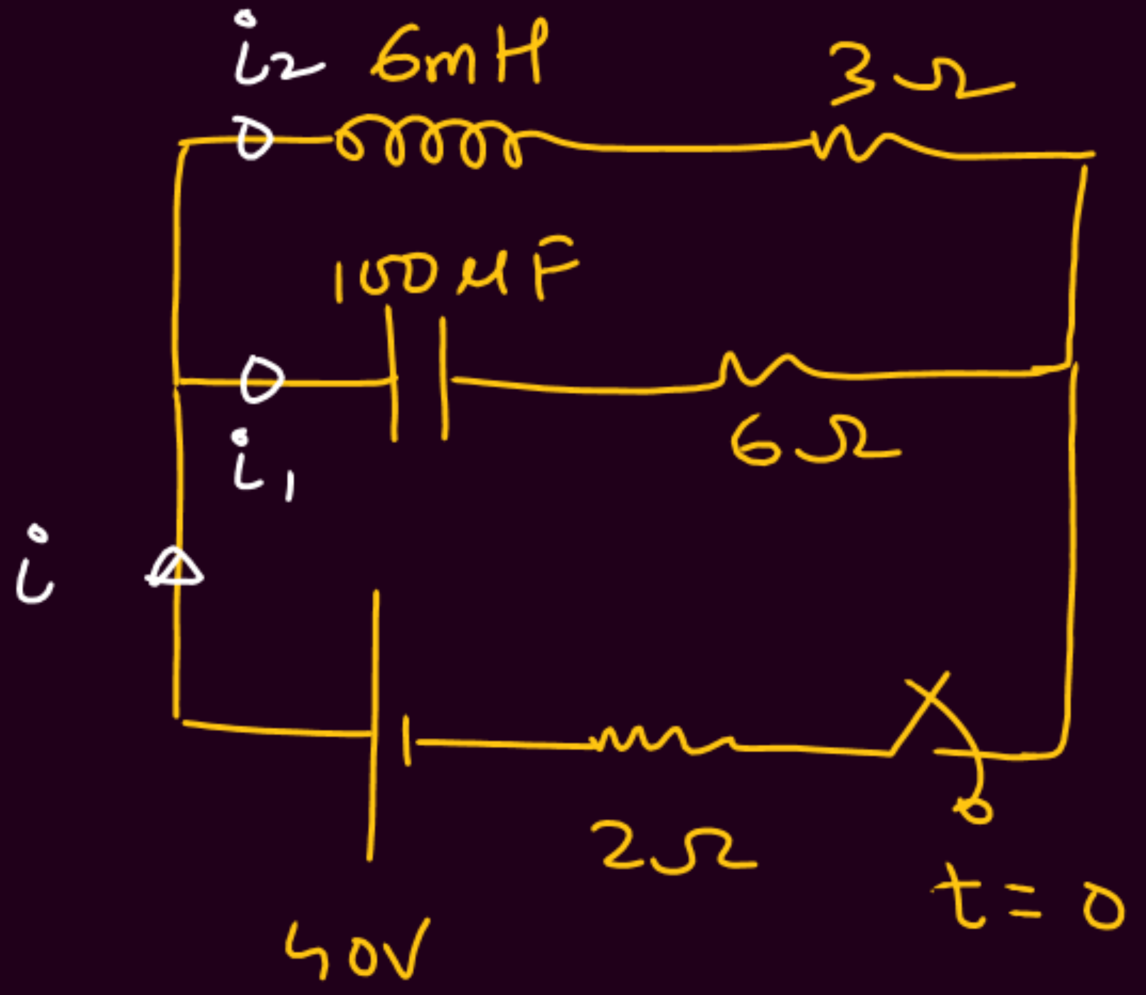
$$i_1 = i = \frac{10}{5} = 2A$$

$$i_2 = 0$$

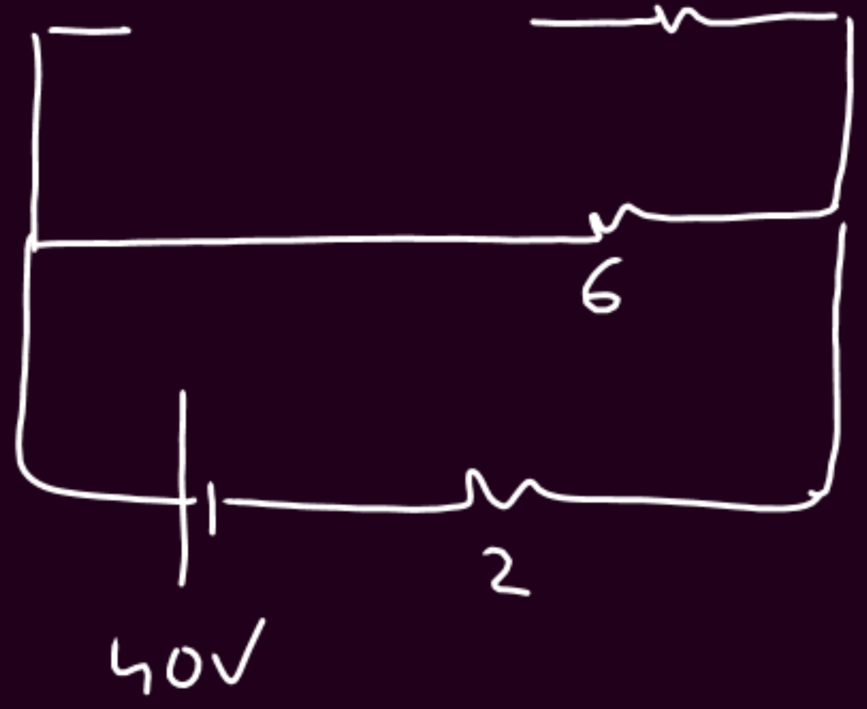
② Final Current

$$R_{eq} = 2\Omega$$

Q.



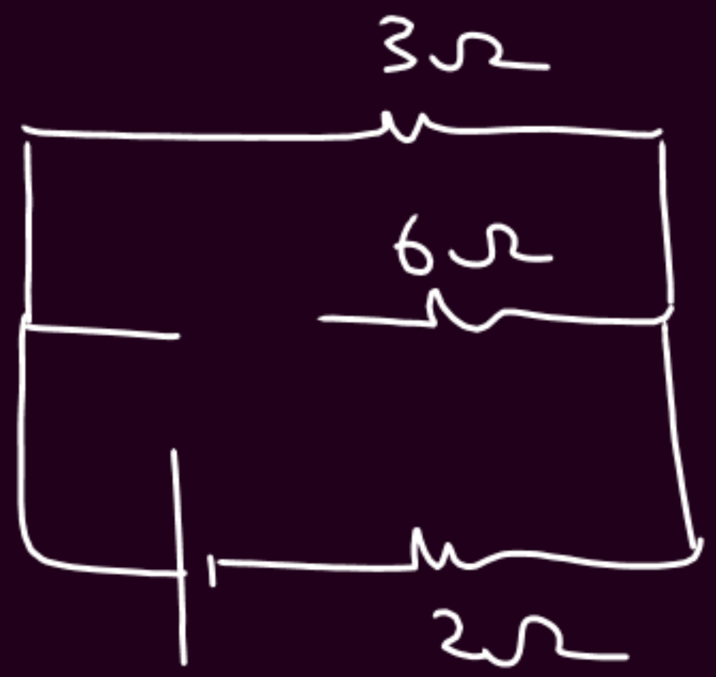
① Initial Current



$$i_2 = 0$$

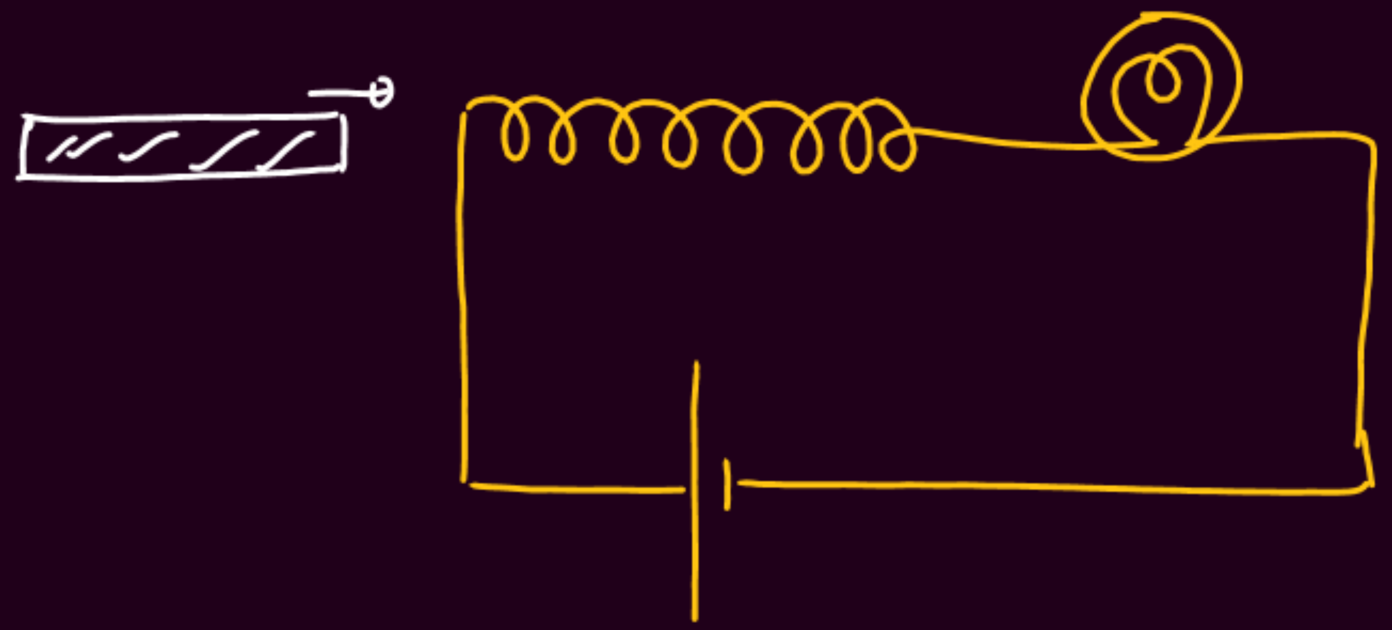
$$i = i_1 = \frac{40}{8} = 5A$$

② Final Current



$$i_1 = 0$$

$$i = i_2 = \frac{40}{5} = 8A$$



① Cu

Diamag.

$\phi \downarrow$

$i \uparrow$

Brightness $\uparrow$

then same as initial

② Fe

Ferromag.

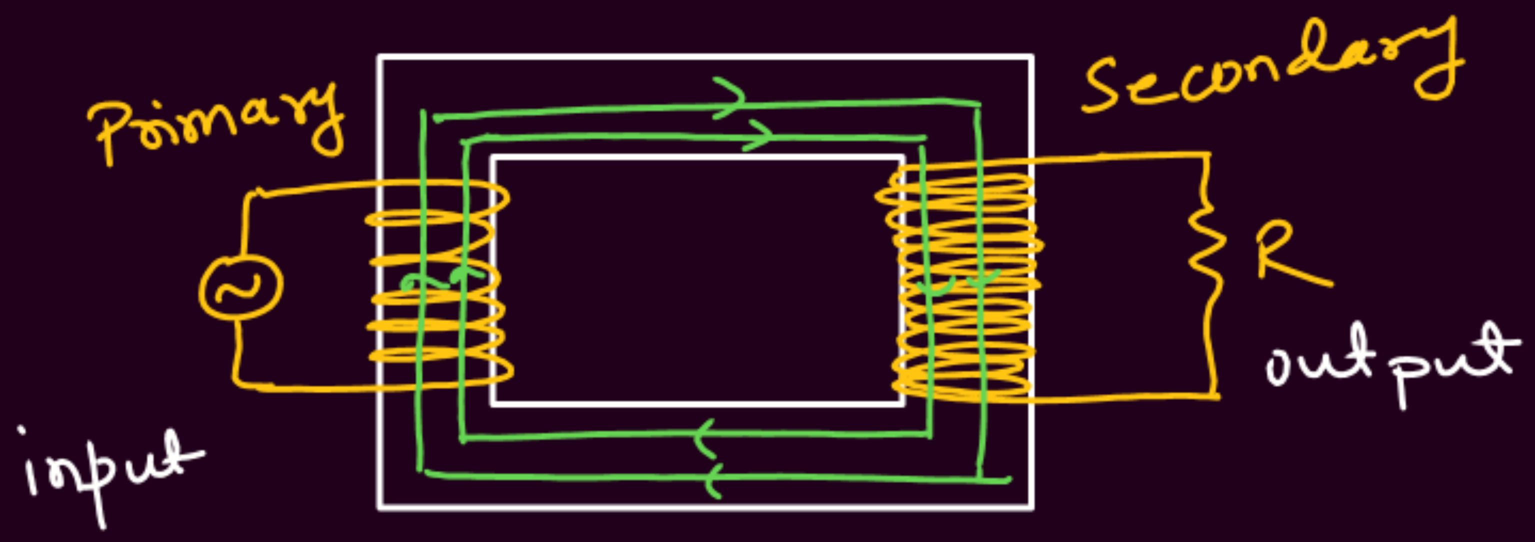
$\phi \uparrow\uparrow$

$i \downarrow\downarrow$

Brightness $\downarrow$

then same as initial

Transformer



Soft iron core → Laminated sheets

Concept ϕ per turn is same

$$\frac{\mathcal{E}_s}{N_s} = \frac{\mathcal{E}_p}{N_p} \quad [\text{EMF per turn}]$$

$$\boxed{\frac{\mathcal{E}_s}{\mathcal{E}_p} = \frac{N_s}{N_p}} = \text{turn ratio (Transformer)}$$

Step - up

$N_s > N_p$

$\mathcal{E}_s > \mathcal{E}_p$

$i_s < i_p$

Step - Down

$N_s < N_p$

$\mathcal{E}_s < \mathcal{E}_p$

$i_s > i_p$

Efficiency $\eta = \frac{\text{output Power}}{\text{Input Power}} = \frac{\varepsilon_s i_s}{\varepsilon_p i_p}$

Assuming no power loss

$$\boxed{\varepsilon_s i_s = \varepsilon_p i_p}$$

$$\frac{\varepsilon_s}{\varepsilon_p} = \frac{N_s}{N_p} \rightarrow \text{Always}$$

$$\frac{i_s}{i_p} = \frac{N_p}{N_s} \rightarrow \text{only when no Power loss}$$

Losses in Transformer

① Cu loss ($i^2 R t$)

② Flux leakage

③ Iron Losses

→ Hysteresis (soft Fe core)

→ Eddy (laminated)

④ Line loss

[High tension line] $i \downarrow\downarrow$

Power generate — Town

Step-Up — Step down

Q. $N_p = 100$ turns

$N_s = 500$

① 50V battery

$$\mathcal{E}_s = 0$$

② 200V mains (RMS)

$$\frac{\mathcal{E}_s}{200} = \frac{500}{100}$$

$$\mathcal{E}_s = 1000\text{ V} \quad (\text{RMS})$$

Q. Transformer

input (100V, 2A)

output (500V, 0.2A)

$$\eta = \frac{500 \times 0.2}{100 \times 2} = \frac{1}{2} = 50\%$$

Q. Input (100W, 2A)

primary → 200

Secondary → 50

① $\mathcal{E}_s$

$$\frac{\mathcal{E}_s}{50} = \frac{50}{200}$$

$$\boxed{\mathcal{E}_s = 12.5\,V}$$

$$100 = \mathcal{E}_p i_p$$

$$100 = \mathcal{E}_p (2)$$

$$\mathcal{E}_p = 50V$$