ABLES KOTA

⟹ Maxwell

$E \rightarrow$ change $\rightarrow$ magnetic field.

$I_d \rightarrow$ displacement current.

$$I_d = C\frac{dV}{dt}$$

$$E = 10\sin(2\pi \times 10^6 t - \pi \times 10^{-2} x)$$

$$E = E_0 \sin(Kz - \omega t)$$

$E = E_0 \sin(\omega t - Kx)$ +x move

$E = E_0 \sin(Kx + \omega t)$ −x move

+z dir

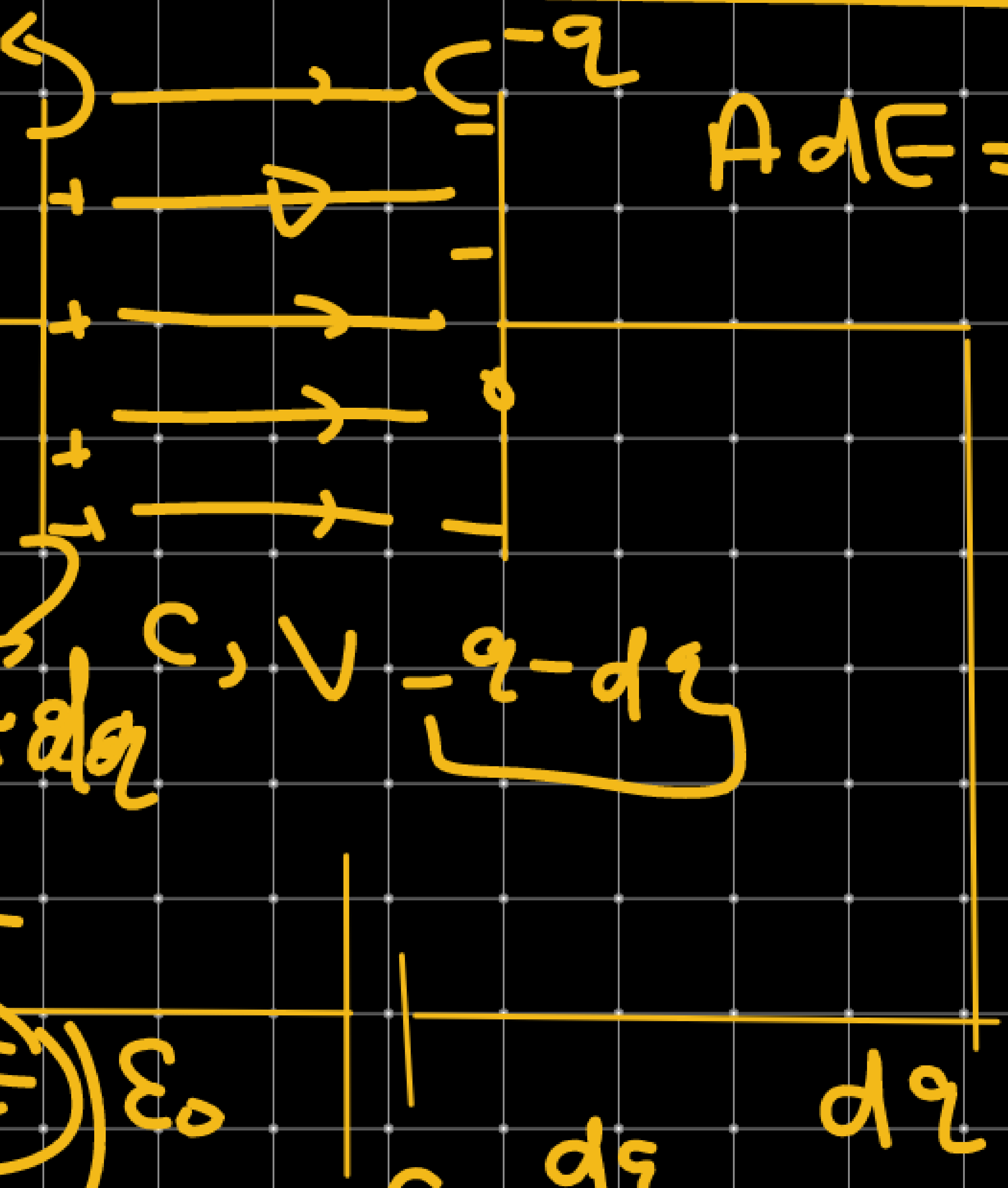
$E = E_0 \sin(Kx - \omega t)$ +x move

I_d → displacement Current

EA

$(E+dE)A$

$\boxed{d\phi = A\,dE}$



$A\,dE = d\phi$

At time t : q

$E = \dfrac{q}{A\varepsilon_0}$

$t+dt \longrightarrow q+dq$

$E+dE = \dfrac{q+dq}{A\varepsilon_0}$

$\cancel{\dfrac{q}{A\varepsilon_0}} + dE = \cancel{\dfrac{q}{A\varepsilon_0}} + \dfrac{dq}{A\varepsilon_0}$

$dE = \dfrac{dq}{A\varepsilon_0}$

$\dfrac{d}{dt}(dq) = \dfrac{d}{dt}(A\,dE)\,\varepsilon_0$

$\varepsilon\ \dfrac{dq}{dt} =$

$dq =$

$dq = A\varepsilon_0\,dE$

$$dq = AdE\,\varepsilon_0$$

$$\phi = E \cdot A$$

$$dq = \varepsilon_0 d\phi$$

$$\frac{dq}{dt} = \frac{d}{dt}\varepsilon_0 d\phi$$

$$i_d = \varepsilon_0 \boxed{\frac{d\phi}{dt}}$$

$d\phi \rightarrow$ Electric flux

$\frac{d\phi}{dt} \rightarrow$ Change in electric flux

$$i_d = C\frac{dV}{dt}$$

Energy density of E·M·W

1. Energy of E·M·W in form of magnetic field & Electric field.

11. *** Energy of EMW distributed Equally with Electric field & magnetic field.

Energy density of EMW.

$$E = E_0 \sin(kx - \omega t) \qquad B = B_0 \sin(kx - \omega t)$$

$$\langle \sin^2 \omega t \rangle = \frac{1}{2}$$

$$u = \frac{1}{2}\varepsilon_0 E^2 = \frac{1}{2}\varepsilon_0 \left[E_0^2 \sin^2(kx - \omega t)\right]$$

$$u = \frac{1}{2}\varepsilon_0 E_0^2 \sin^2(kx - \omega t)$$

Average value of Energy density

$$\langle u \rangle = \frac{1}{2}\varepsilon_0 E_0^2 \langle \sin^2(kx - \omega t) \rangle$$

$$\langle u \rangle = \frac{1}{2}\varepsilon_0 E_0^2 \times \frac{1}{2} = \boxed{\frac{1}{4}\varepsilon_0 E_0^2}$$

$$\Rightarrow \langle u \rangle = \frac{1}{4}\varepsilon_0 E_0^2$$

$E_0 \rightarrow$ Peak value of electric field.

$$\Rightarrow \langle u \rangle = \frac{1}{2\mu_0}B^2$$

$$\left[\, u = \frac{B^2}{2\mu_0} \right.$$

$$\langle u \rangle = \frac{1}{2\mu_0} \times B_0^2 \langle \sin^2(\omega t - kx) \rangle$$

$$\boxed{\langle u \rangle = \frac{B_0^2}{4\mu_0}}$$

$$\langle u \rangle_{Emw} = \frac{1}{4}\varepsilon_0 E_0^2 + \frac{1}{4\mu_0} B_0^2$$

$$= \frac{1}{4}\varepsilon_0 E_0^2 + \frac{1}{4}\varepsilon_0 E_0^2$$

$$\boxed{\langle u \rangle_{Emw} = \frac{1}{2}\varepsilon_0 E_0^2}$$

$$\boxed{\langle u \rangle = \frac{1}{2\mu_0} B_0^2}$$

$$\frac{\varepsilon_0 E_0^2}{\cancel{4}} = \frac{B_0^2}{\cancel{4}\mu_0}$$

$$\varepsilon_0 E_0^2 = \frac{B_0^2}{\mu_0}$$

Q) In EMW electric field is given by
$E = 10\sin(\omega t - kx)$. then find average value of

(i) Wave. (ii) Electric field.

(iii) Magnetic field.

Sol) $E_0 = 10$

$\langle u \rangle = \frac{1}{2}\varepsilon_0 E_0^2 = \frac{1}{2} \times \varepsilon_0 \times 100$

$= \underline{\underline{50\varepsilon_0}}$

(ii) $\langle u \rangle_E = \frac{1}{4}\varepsilon_0 E_0^2 = \underline{\underline{25\varepsilon_0}}$

$\langle u \rangle_B = 50\varepsilon_0$

$$\langle \sin^2 \omega t \rangle = \frac{1}{2}$$

$$\langle \sin\theta \rangle = 0$$

$$\langle \cos\theta \rangle = 0$$

$$\langle \sin^2\theta \rangle = \langle \cos^2\theta \rangle = \frac{1}{2}$$

$$E = E_0 \sin(\omega t - kx)$$

$$\Rightarrow \langle u \rangle = \frac{1}{2}\varepsilon_0 E^2$$

$$\langle u \rangle = \frac{1}{2}\varepsilon_0 E_0^2 \langle \sin^2(\omega t - kx) \rangle$$

$$\langle u \rangle_E = \frac{1}{4}\varepsilon_0 E_0^2$$

$$\langle u \rangle_B = \frac{1}{2\mu_0}\left[B_0 \sin(\omega t - kx)\right]^2$$

$$= \frac{B_0^2}{2\mu_0} \times \frac{1}{2} = \frac{1}{4\mu_0} B_0^2$$

$$\boxed{\frac{1}{4}\varepsilon_0 E_0^2 = \frac{1}{4\mu_0} B_0^2}$$

$$\Rightarrow \frac{1}{2}\varepsilon_0 E_0^2 = \frac{1}{2\mu_0} B_0^2 = \langle u \rangle_{EMW}$$

EMW Contain Energy & momentum.

$$\boxed{\boxed{P = \frac{h}{\lambda}}}$$

$h \rightarrow$ Plank's Constant.

$-[h] = [ML^2T^{-2}][T]$

$= [ML^2T^{-1}]$

$\lambda \rightarrow$ wavelength

$\Rightarrow E = \dfrac{hc}{\lambda} \Rightarrow h \rightarrow$ Plank's Constant $=$

$[h]$

6.67×10^{-34} J-sec

$C = 3 \times 10^8$ m/s

⇒ **Intensity :-**

E·M·W

$E = \frac{hc}{\lambda} = h\nu$

$\lambda \downarrow \quad \nu \uparrow \quad E \uparrow$

R·W | M·W | SR | V·R | U·V | X-Ray | γ-RAY

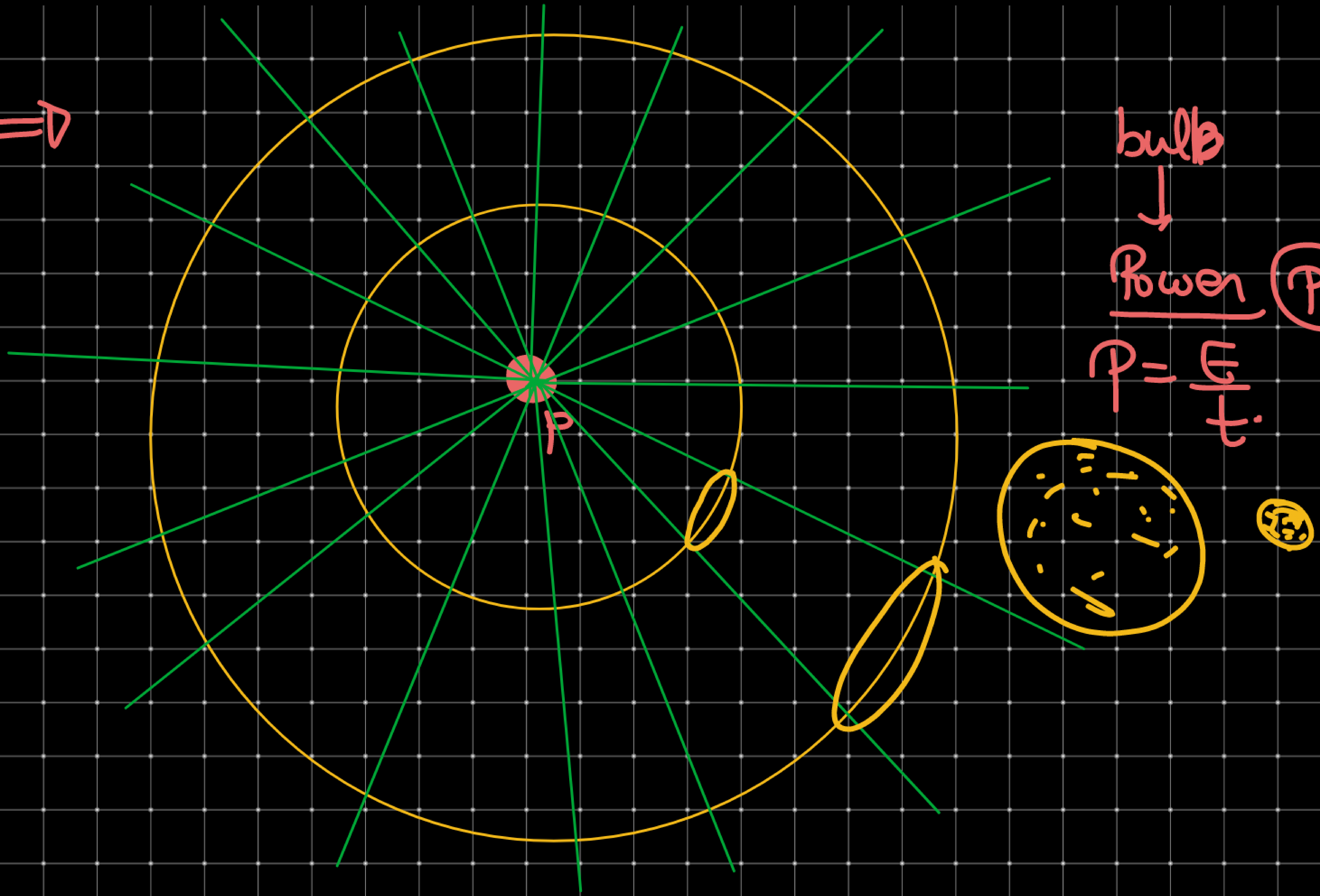
(100 – 1 Å)

1 – 0.1 Å

7800 Å
Red

4000 Å
Vo'

$\Rightarrow$



bulb

$\downarrow$

<u>Power</u> (P)

$P = \frac{E}{t}$

$$I = \frac{P}{A} = \frac{E}{tA}$$

SI Unit $= \dfrac{\text{Watt}}{m^2} = \boxed{\dfrac{J}{\text{sec}\cdot m^2}}$

④ **Poynting vector ($\bar{S}$):** It is energy passing through a Area per second.

$$\vec{S} = \vec{E} \times \vec{H}$$

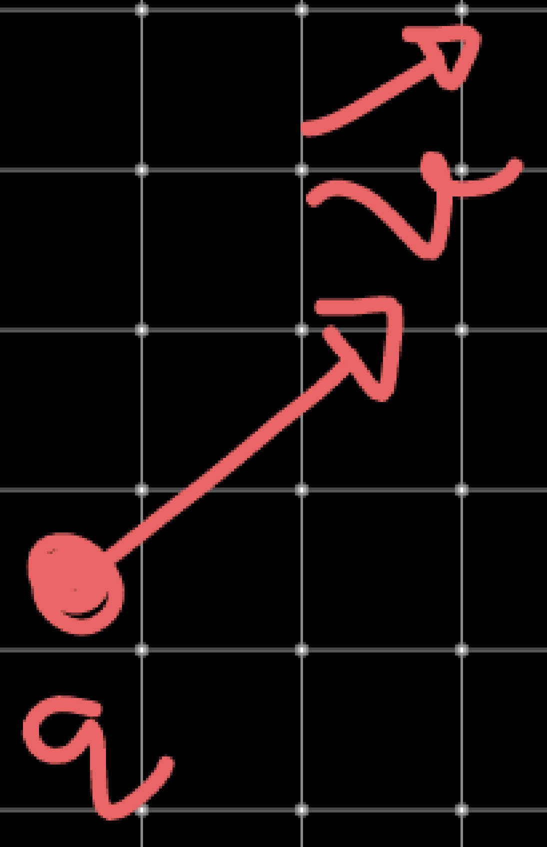
$$= \bar{E} \times \frac{\bar{B}}{\mu}$$

$$\bar{S} = \frac{\bar{E} \times \bar{B}}{\mu}$$

$$\vec{H} \rightarrow \frac{\bar{B}}{\mu}$$

#1 Lorentz force :-

Region → $\vec{E}$, $\vec{B}$



$$\vec{F} = \vec{F_e} + \vec{F_m}$$

$$\vec{F} = q\vec{E} + q(\vec{v} \times \vec{B})$$

$$\boxed{\vec{F} = q\left[\vec{E} + \vec{v} \times \vec{B}\right]}$$

NEET 2021

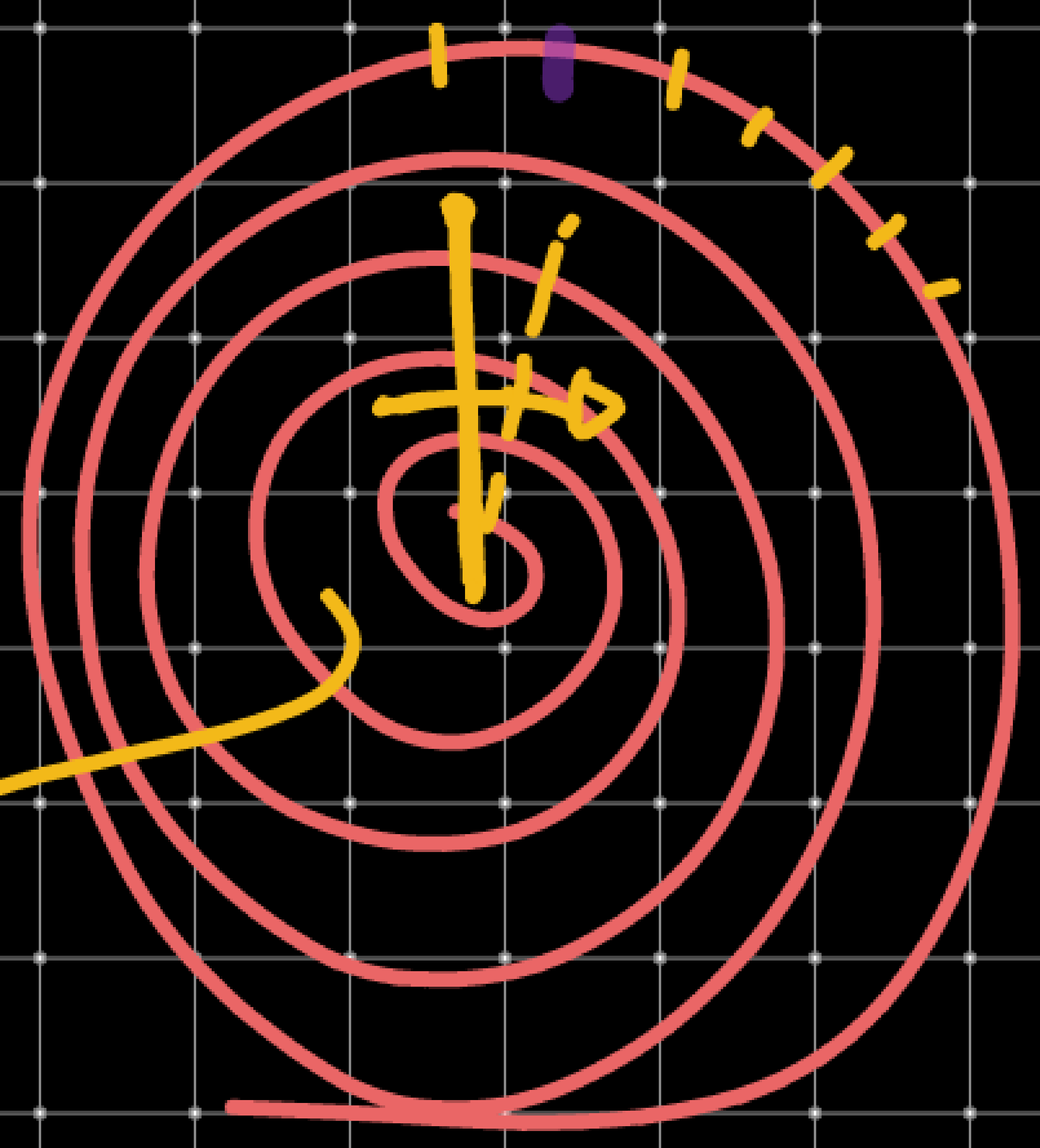
JEE

↳ Current Sen

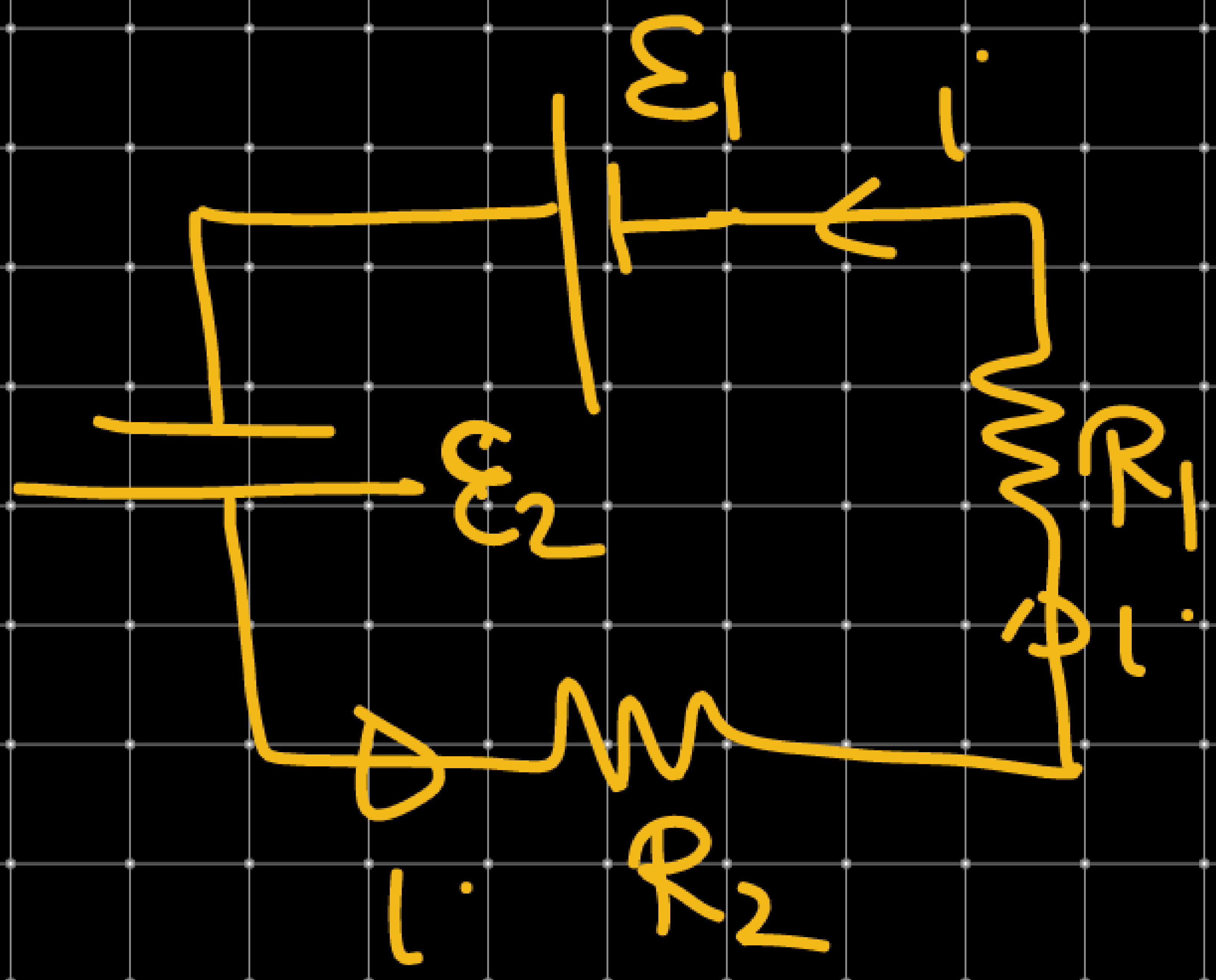
C - m

$I \rightarrow$ Rotate

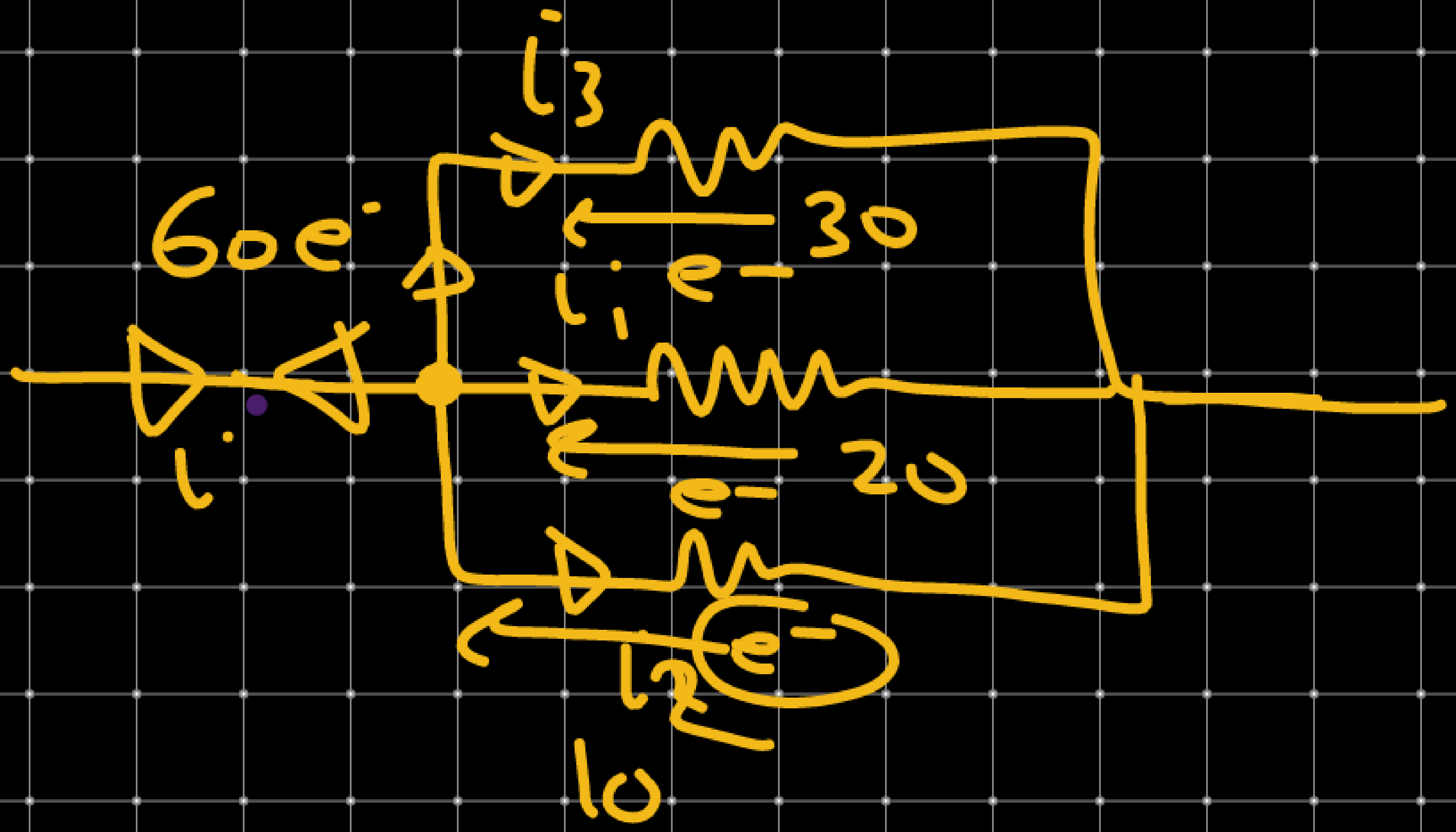
Spring constant very low → S. ↑ High.



↳ C



ε_1
i
ε_2
R_1
i
i
R_2



$60e^-$

$$\sum i = 0$$

$$i - i_1 - i_2 - i_3 = 0$$

$$i = i_1 + i_2 + i_3$$

$B = xi + 2j$

$a = 2i + 3j$

$\vec{a} \cdot \bar{B} = 0$

$\bar{B} \cdot \bar{a} = 0$

$2x + 6 = 0$

$x = -3$

$\bar{F}_m = q(\bar{v} \times \bar{B})$

$\bar{F}_m \perp \bar{B}$

$\bar{F}_m \perp \vec{v}$

$\bar{a} \perp \bar{B}$

$\bar{A} \cdot \bar{B} = AB\cos\theta$

$= AB\cos 90$

$\boxed{\bar{A} \cdot \bar{B} = 0}$