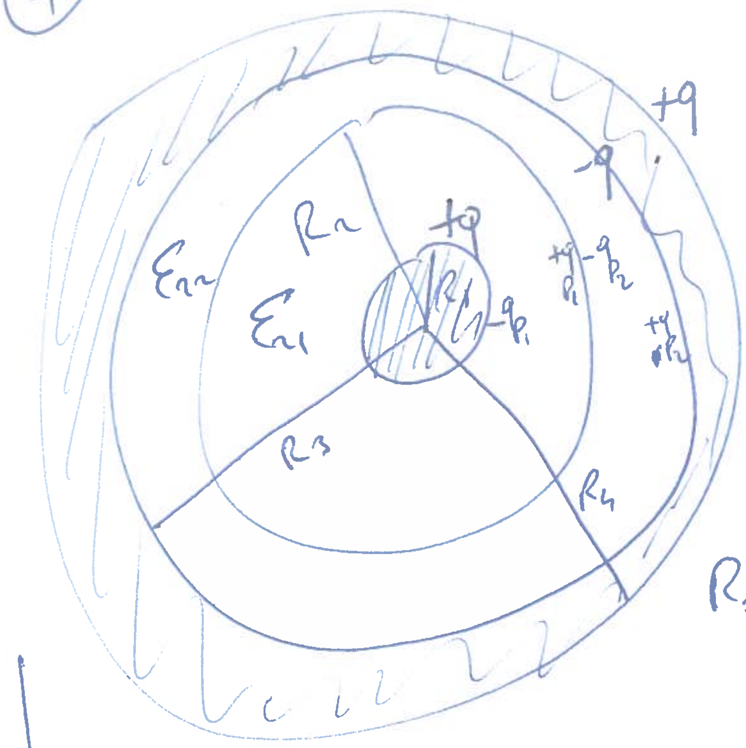
1



GAUSS CON $\vec{D}$

$0 < r < R_1$

$4\pi r^2 D_0(r) = 0$

$D_0(r) = 0 \rightarrow E_0(r) = \frac{D_0(r)}{\varepsilon} = 0$

$R_1 < r < R_2$

$4\pi r^2 D_1(r) = q$

$D_1(r) = \frac{q}{4\pi r^2}$

$E_1(r) = \frac{D_1(r)}{\varepsilon_0 \varepsilon_{r1}} \longrightarrow E_1(r) = \frac{q}{4\pi\varepsilon\varepsilon_{r1} r^2}$

$D_2(r) 4\pi r^2 = q$

$R_2 < r < R_3$

$D_2(r) = \frac{q}{4\pi r^2}$

$E_2(r) = D_2(r)/\varepsilon_0\varepsilon_{r2} \rightarrow E_2(r) = \frac{q}{4\pi\varepsilon\varepsilon_{r2} r^2}$

$R_3 < r < R_4$ | $D_3(r) = 0$ $E_3(r) = 0$

$r > R_4$ | $D_4(r) 4\pi r^2 = q \rightarrow D_4(r) = q/4\pi r^2$

$E_4(r) = D_4(r)/\varepsilon_0 \rightarrow E_4(r) = \cancel{q/4\pi\varepsilon r^2}$

$$\Delta V = V(R_1) - V(R_3) =$$

$$= -\int_{R_3}^{R_1} \vec{E}\cdot d\vec{r} = -\int_{R_3}^{R_2} \vec{E}_2 \cdot d\vec{r} - \int_{R_2}^{R_1} \vec{E}_1 \cdot d\vec{r} =$$

$$= -\int_{R_3}^{R_2} \frac{q}{4\pi\varepsilon_0 \varepsilon_{r2}} \frac{dr}{r^2} - \int_{R_2}^{R_1} \frac{q}{4\pi\varepsilon_0 \varepsilon_{r1}} \frac{dr}{r^2} =$$

$$= + \frac{q}{4\pi\varepsilon_0 \varepsilon_{r2}} \left(\frac{1}{R_2} - \frac{1}{R_3} \right) + \frac{q}{4\pi\varepsilon_0 \varepsilon_{r1}} \left(\frac{1}{R_1} - \frac{1}{R_2} \right) =$$

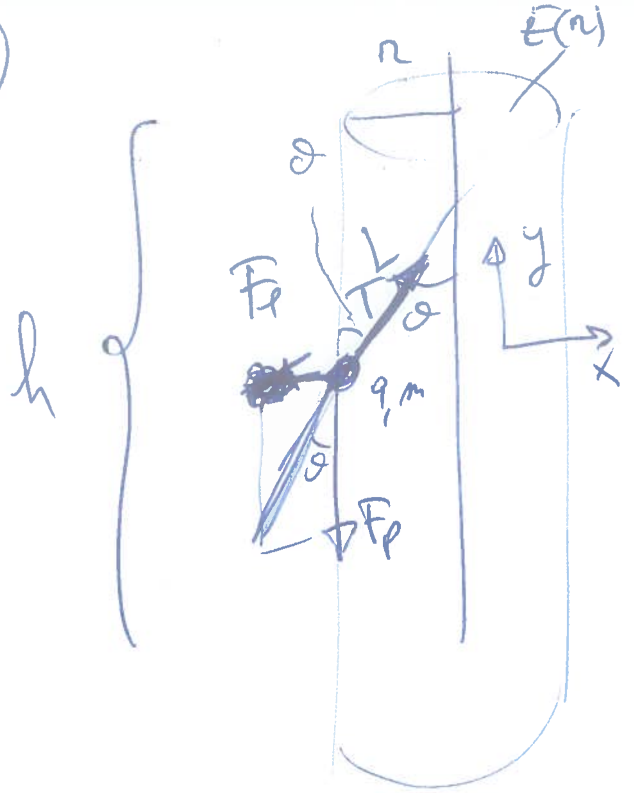
$$= \frac{q}{4\pi\varepsilon_0} \left[\frac{1}{\varepsilon_{r2}} \left(\frac{1}{R_2} - \frac{1}{R_3} \right) + \frac{1}{\varepsilon_{r1}} \left(\frac{1}{R_1} - \frac{1}{R_2} \right) \right]$$

Su R_1 $\rightarrow$ $-q_{p1} = -q \dfrac{\varepsilon_{r1} - 1}{\varepsilon_{r1}}$

Su R_3 $\rightarrow$ $q_{p2} = q \dfrac{\varepsilon_{r2} - 1}{\varepsilon_{r2}}$

Su R_2 $\rightarrow$ $\Delta q_p = q_{p1} - q_{p2} = q \dfrac{\varepsilon_{r1} - 1}{\varepsilon_{r1}} - q \dfrac{\varepsilon_{r2} - 1}{\varepsilon_{r2}}$

2



$$F_p = mg$$

$$F_e = qE(r)$$

GAUSS

$$E(r)\, 2\pi r h = \frac{q_{int}}{\varepsilon_0}$$

$$E(r)\, 2\pi r \cancel{h} = \frac{\lambda \cancel{h}}{\varepsilon_0}$$

$$E(r) = \frac{\lambda}{2\pi\varepsilon_0 r} = \frac{\lambda}{2\pi\varepsilon_0 L \operatorname{sen}\theta} \qquad r = L \operatorname{sen}\theta$$

$$\frac{1}{\sqrt{3}} = \operatorname{tg}\theta = \frac{F_e}{F_p} = \frac{qE}{mg} = \frac{q\lambda}{2\pi\varepsilon_0 L \frac{1}{2} mg} = \frac{2q\lambda}{2\pi\varepsilon_0 L mg}$$

$$\boxed{q = \frac{2\pi\varepsilon_0 L mg}{2\sqrt{3}\lambda}}$$

oppure

$$\hat{x} \; T \operatorname{sen}\theta = F_e = qE \;\rightarrow\; \frac{\operatorname{sen}\theta}{\cos\theta} = \operatorname{tg}\theta = \frac{F_e}{F_p}$$

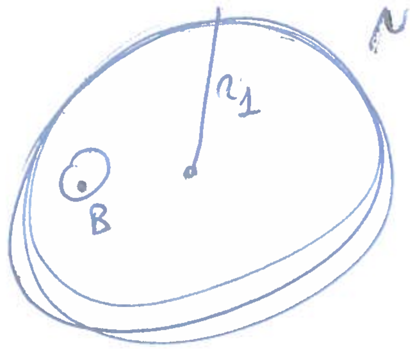
$$\hat{y} \; T \cos\theta = F_p = mg$$

oppure $T = F_p/\cos\theta = mg/\cos\theta$

$$\frac{mg}{\cos\theta} \operatorname{sen}\theta = F_e \rightarrow mg \operatorname{tg}\theta = F_e = qE$$

③

$N = 10$



$$\phi_{1\,spire}(B) = \int_0^{r_1} B(r)\, 2\pi r\, dr = \int_0^{r_1} a r^3 (t^2 - b)\, 2\pi r\, dr =$$

$$= a(t^2-b)2\pi \int_0^{r_1} r^4\, dr = \frac{a}{5}(t^2-b)2\pi R_1^5$$

$$\phi(B) = N\, \phi_{1\,spire}(B) = \frac{aN}{5}(t^2-b)\, 2\pi r_1^5$$

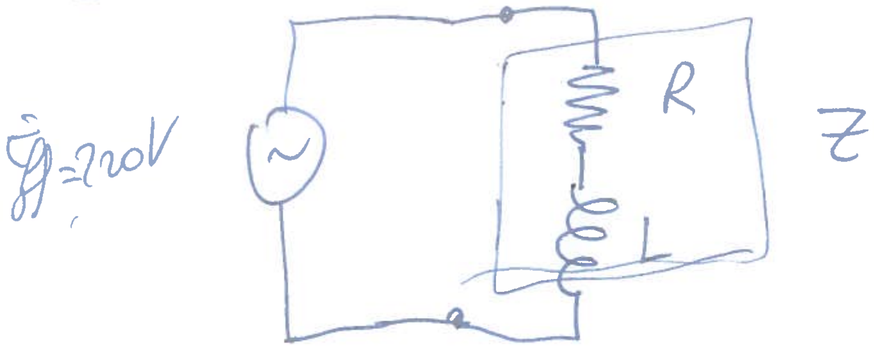
$$fem(t) = -\frac{d\phi(B)}{dt} = 2t\frac{aN}{5} 2\pi r_1^5 = \frac{4}{5}\pi r_1^5 a N t$$

$$fem(t = 2s) = \frac{4}{5} a N \pi r_1^5 (2\,sec.)$$

$$i(t) = \frac{fem(t)}{R} = \frac{4\, aN\pi r_1^5 t}{5R} \qquad i(2\,sec) = \frac{4}{5R} a N \pi R_1^5 (2\,sec)$$

$$q = \frac{1}{R}\, \phi_{0\,sec} - \phi_{2\,sec} = \frac{1}{R}\left[\frac{aN}{5} 2\pi r_1^5 (-b) - \frac{aN}{5} 2\pi r_1^5 \left((2\,sec)^2 - b\right)\right]$$

(4)



$f = 50Hz$

$\omega = 2\pi f$

$$\tilde{Z} = R + j\omega L$$

$$Z = \sqrt{R^2 + \omega^2 L^2} \qquad \varphi_Z = \arctg \frac{\omega L}{R}$$

$$Z_R = R \qquad Z_L = \omega L$$

$$\boxed{i_{eff} = \frac{\mathcal{E}_{eff}}{Z}}$$

$$P_m = \mathcal{E}_{eff}\, i_{eff} \cos\phi = \mathcal{E}_{eff} \frac{\mathcal{E}_{eff}}{Z} \cos\phi$$

$$\boxed{\cos\phi = \frac{R}{Z}}$$

$$P_m = \mathcal{E}_{eff}^2 \frac{\cos\phi}{Z} = \mathcal{E}_{eff}^2 \frac{R}{Z^2} = \mathcal{E}_{eff}^2 \frac{R}{R^2 + \omega^2 L^2}$$

$$P_m = i_{eff}\, Z\, i_{eff} \cos\phi = Z\, i_{eff}^2 \cos\phi = Z\, i_{eff}^2 \frac{R}{Z} = R\, i_{eff}^2$$