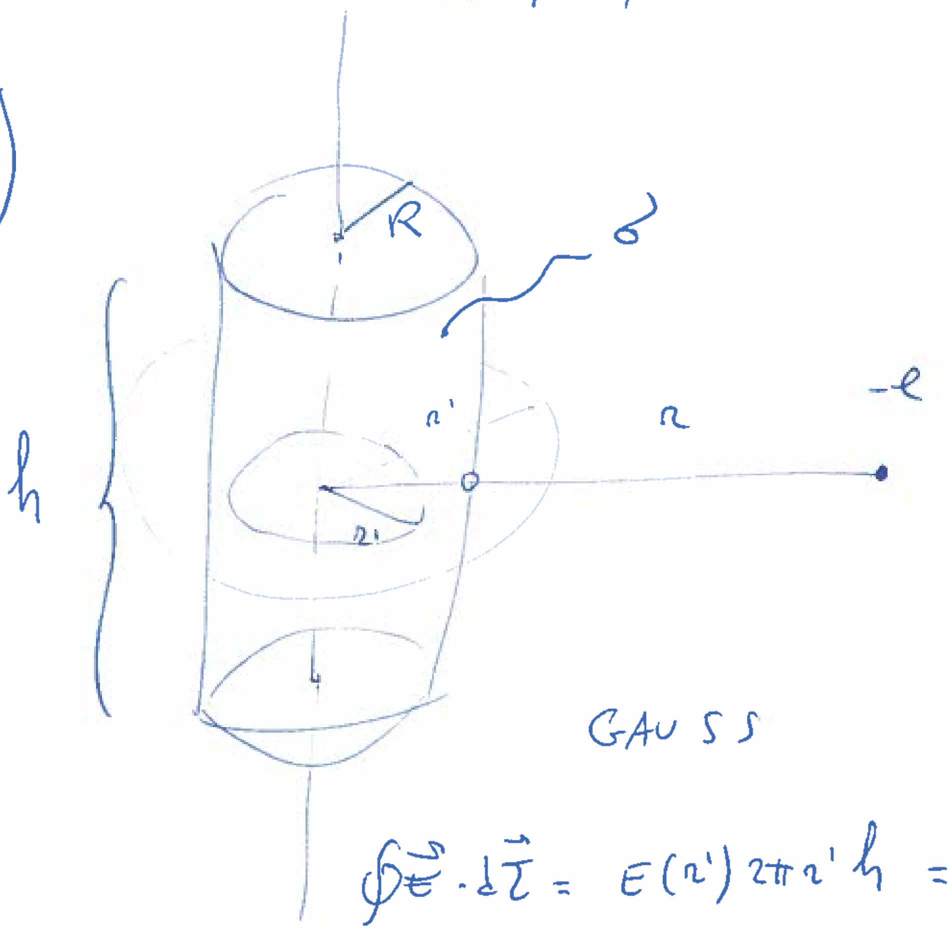
1)



$h \gg R$

GAUSS

$$\oint \vec{E}\cdot d\vec{\Sigma} = E(r')\,2\pi r' h = \frac{q_{INT}}{\varepsilon_0}$$

per $r' < R$ $\quad E(r')\,2\pi r' h = 0 \rightarrow E(r') = 0$

per $R < r' < +\infty$ $\quad E(r')\,2\pi r' \cancel{h} = \dfrac{\sigma\cdot 2\pi R \cancel{h}}{\varepsilon_0}$

$$E(r') = \frac{\sigma R}{\varepsilon_0}\frac{1}{r'}$$

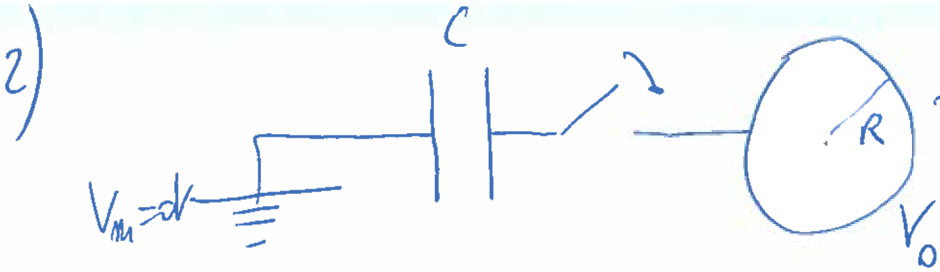
~~V REF~~ $\quad E_k(f) - \cancel{E_k(i)} = \Delta E_k = -\Delta V(-e)$

$E_k(f) = -\big(V(f) - V(i)\big)(-e) \qquad E_k(r'=0) = +e\left[V(r'=0) - V(r'=r)\right]$

$$V(0) - V(r) = -\int_r^0 E(r')\,dr' = -\int_r^R E(r')\,dr' - \cancel{\int_R^0 0\cdot dr'}$$

$$E_k(f) = +e\left[V(0) - V(r)\right] = -e\int_r^R E(r')\,dr' = -e\frac{\sigma R}{\varepsilon_0}\ln\left(R/r\right)$$

2)



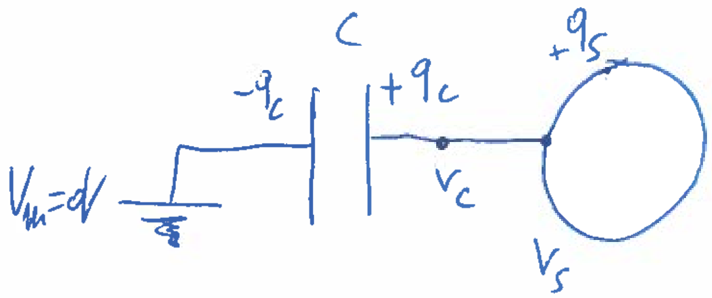
$$\xrightarrow{} q_0$$

$$\downarrow$$

$$V_0 = \frac{q_0}{4\pi\varepsilon}\,\frac{1}{R}$$

$$\downarrow$$

$$q_0 = 4\pi\varepsilon R V_0$$



$$q_0 = q_s + q_c \qquad \Delta V_c = V_c - V_m = V_c = \frac{q_c}{C}$$

$$V_c = V_s \qquad V_s = \frac{q_s}{4\pi\varepsilon}\,\frac{1}{R}$$

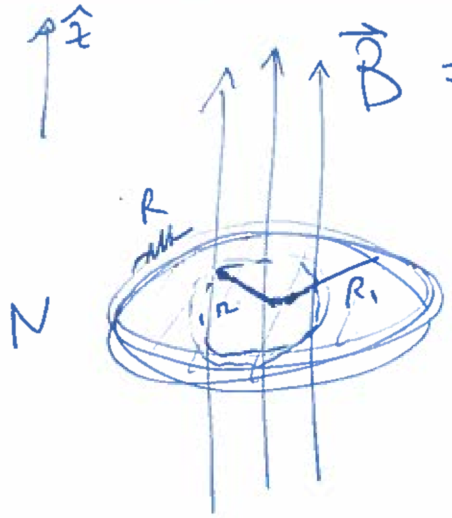
$$\downarrow$$

$$\begin{cases} \dfrac{q_c}{C} = \dfrac{q_s}{4\pi\varepsilon}\,\dfrac{1}{R} \rightarrow q_s = \dfrac{4\pi\varepsilon R}{C}\, q_c \\ \qquad\qquad\qquad\qquad\qquad\qquad \downarrow \\ q_0 = q_s + q_c \rightarrow 4\pi\varepsilon_0 R V_0 = 4\pi\varepsilon R\,\dfrac{q_c}{C} + q_c \end{cases}$$

$$q_c\left(1 + \frac{4\pi\varepsilon R}{C}\right) = 4\pi\varepsilon R V_0 \qquad q_c = \frac{4\pi\varepsilon R V_0 \cdot C}{4\pi\varepsilon R + C}$$

$$\Delta V_c = \frac{q_c}{C} = \frac{4\pi\varepsilon R V_0 \cdot \cancel{C}}{\cancel{C}\cdot(4\pi\varepsilon R + C)} = \frac{4\pi\varepsilon R V_0}{4\pi\varepsilon R + C} = \frac{V_0}{1 + \frac{C}{4\pi\varepsilon R}}$$

3) $\hat z$



$\vec B = \hat z\, a\, r^4 (t^3 - b)$

$fem_i = -\frac{d}{dt}\Phi(\vec B)$

$\Phi(\vec B) = N\int_0^{R_1} B(r)\, 2\pi r\,dr =$

$= \int_0^{R_1} a (t^3-b)\, r^4 N\, 2\pi r\,dr = \int_0^{R_1} N a (t^3-b)\, 2\pi r^5\, dr =$

$= a(t^3-b)\,2\pi N\int_0^{R_1} r^5\, dr = N\frac{R_1^6}{\cancel{6}_3}\, a \cdot \cancel{2}\pi (t^3-b) = \frac{aR_1^6}{3}\pi(t^3-b)N$

$fem = -\frac{d}{dt}\Phi(B) = -\frac{aR_1^6}{\cancel{3}}\pi\cdot\cancel{3} t^2 N = -aR_1^6\pi t^2 N$

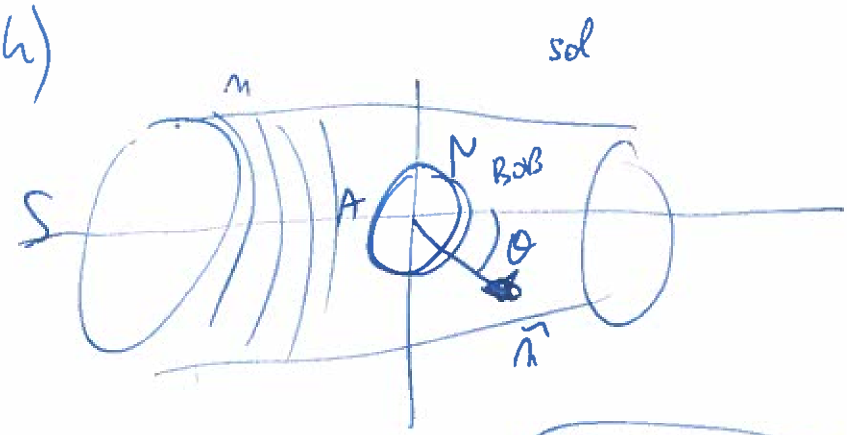
$fem(t=t_1) = -NaR_1^6\pi t_1^2$ $\quad i(t) = \frac{fem}{R} = +\frac{aNR_1^6\pi}{R}t^2$

$i(t=t_1) = \frac{aNR_1^6\pi t_1^2}{R}$

$q = \frac{1}{R}\left(\Phi(i) - \Phi(f)\right) = \frac{1}{R}\left[\frac{\pi N a R_1^6}{3}(-b) - \frac{\pi N a R_1^6}{3}(t_1^3-b)\right]$

$q = \frac{\pi N a R_1^6}{3R}\left[\cancel{-b} - t_1^3 \cancel{+b}\right] = \frac{\pi N a R_1^6}{3R}\left[-t_1^3\right]$

4)



$$\theta(t) = \omega t$$

$$i_{sol} = i$$

$$B_{sol} = \mu_0 n i$$

$$M = \frac{\Phi_{BOB}}{i_{sol}} = \frac{N \mu_0 n \cancel{i} \cos(\omega t) A}{\cancel{i}}$$

$$\Phi_{BOB} = N \cdot B_{sol} \cdot \cos(\omega t) A$$

$$M = \mu_0 N n A \cos(\omega t)$$

$$i_{BOB} = I \qquad fem_{i_{sol}} = -\frac{d}{dt} \Phi_{sol}$$

$$fem_{i_{sol}} = -\frac{d}{dt} M i_{BOB} = \frac{d}{dt} M I$$

$$fem_{i_{sol}} = -I \frac{d}{dt} M(t) = +I \mu_0 N n \omega A \operatorname{sen}(\omega t)$$