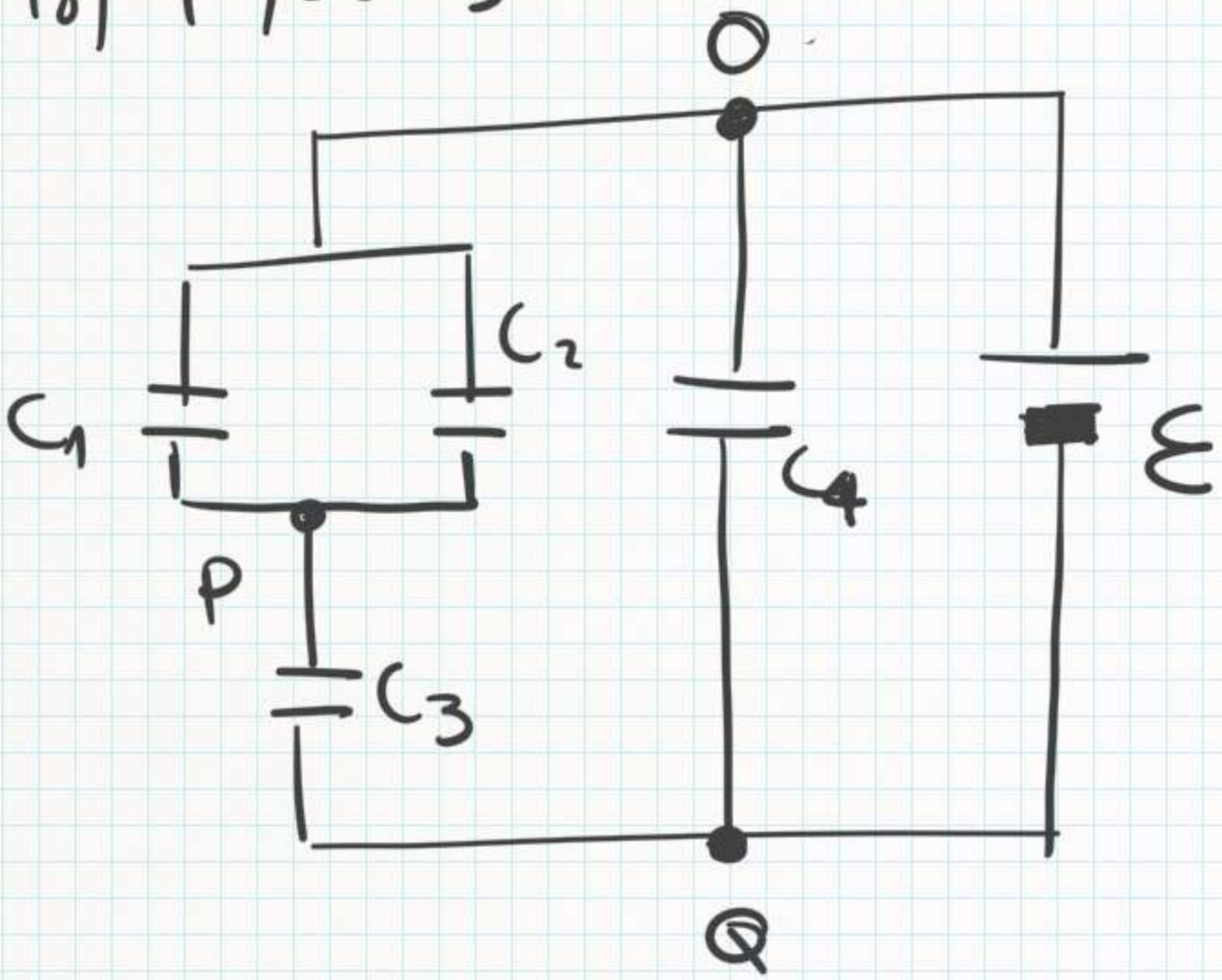
18/ 4 /2023



(1) C_{EQ}

(2) ΔV_{OP}

(3) $Q_{1,2,3,4}$

$C_1 = C_2 = 1\,nF$ $\quad \varepsilon = 10\,V$

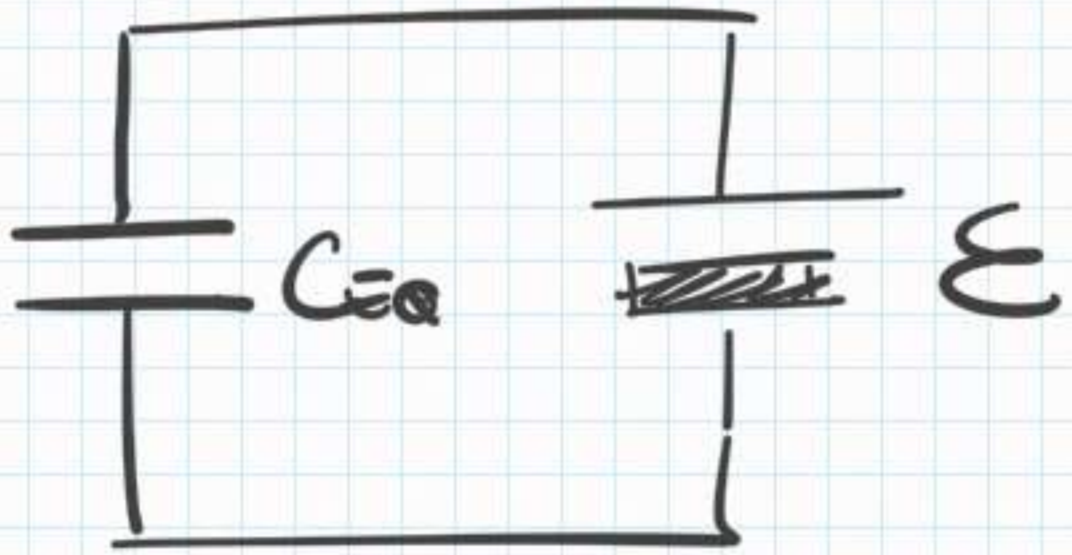
$C_3 = 2\,nF$

$C_4 = 3\,nF$

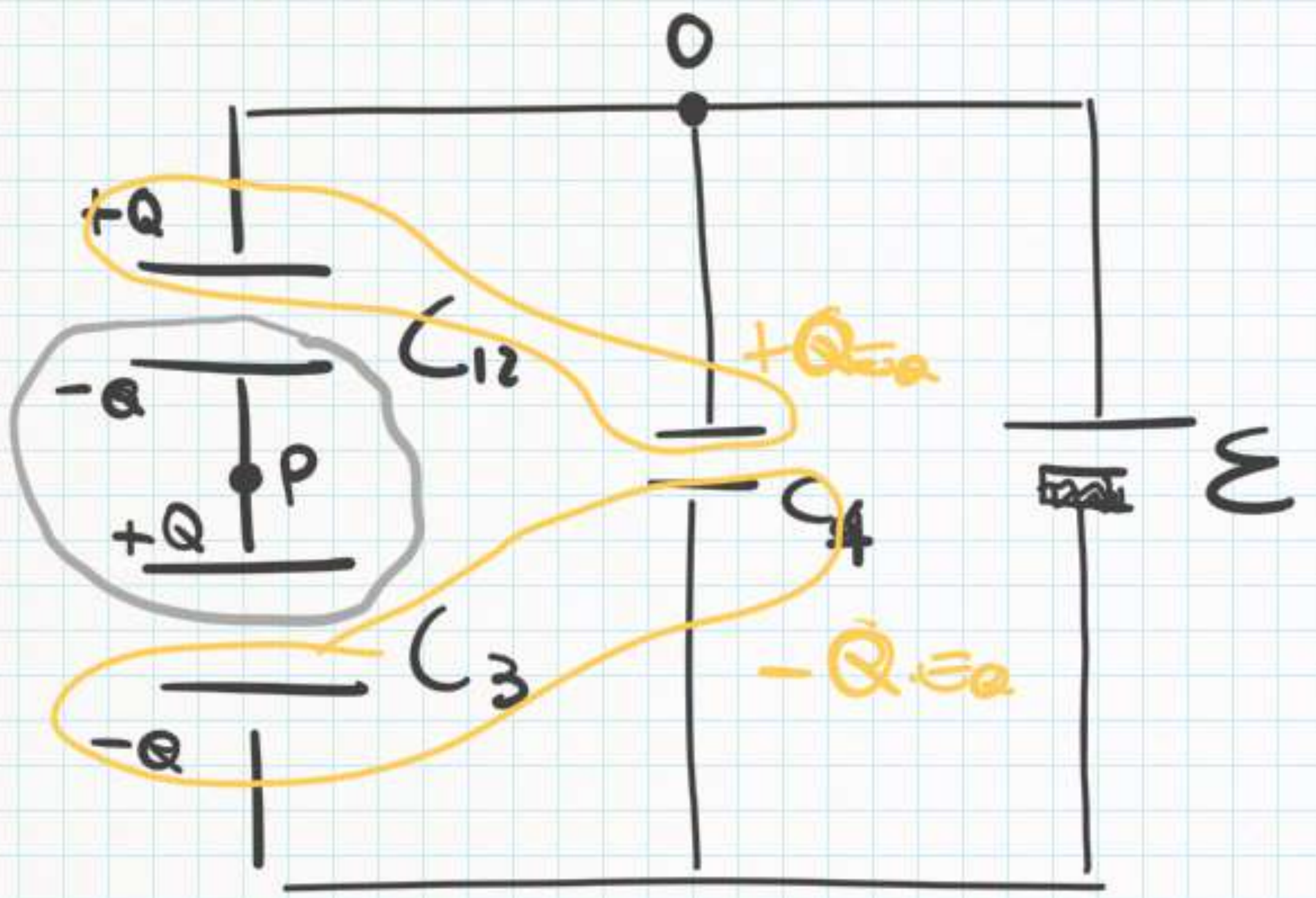
$$C_{12} = C_1 + C_2 = 2\,nF$$

$$C_{123} = \left(\frac{1}{C_{12}} + \frac{1}{C_3}\right)^{-1} = \frac{C_{12}C_3}{C_{12}+C_3} = \frac{4}{4}\,nF = 1\,nF$$

$$C_{EQ} = C_{123} + C_4 = 4\,nF$$



14/12/2023



$\cdot\ \mathcal{E} = \Delta V_4$

INCOGNITE:

$\Delta V_3\ ,\ \Delta V_{op}$

$$\begin{cases} \Delta V_4 + \Delta V_{op} + \Delta V_3 = 0 \\ C_{12}\,\Delta V_{op} = C_3\,\Delta V_3 \end{cases}$$

$$\downarrow$$

$$\begin{cases} \mathcal{E} + \Delta V_{op}\left(1 + \frac{C_{12}}{C_3}\right) = 0 \longrightarrow \Delta V_{op} = \dfrac{\mathcal{E}}{1 + \frac{C_{12}}{C_3}} = \dfrac{\mathcal{E}}{2} = 5V \\ \Delta V_3 = \Delta V_{op} \cdot \frac{C_{12}}{C_3} \end{cases}$$

$$\begin{cases} \Delta V_{op} = 5V \\ \Delta V_3 = 5V \cdot \dfrac{2nF}{2nF} = 5V \end{cases}$$

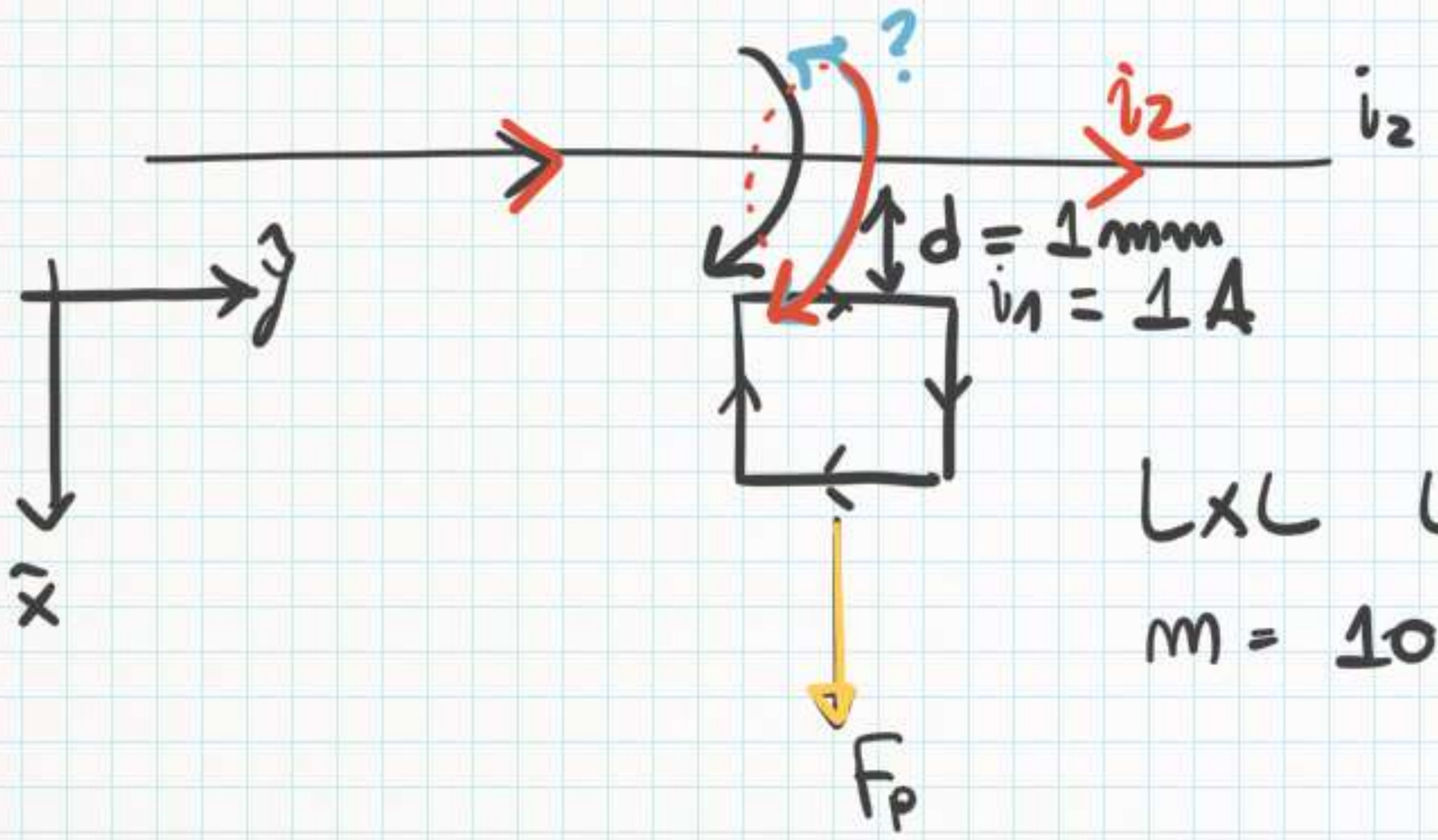
$Q_1 = \Delta V_{op} \cdot C_1 = 5V \cdot 1nF = 5nC$

$Q_2 = \Delta V_{op} \cdot C_2 = 5V \cdot 1nF = 5nC$

$Q_3 = \Delta V_3 \cdot C_3 = 5V \cdot 2nF = 10\,nC$

$Q_4 = \mathcal{E} \cdot C_4 = 10V \cdot 3nF = 30\,nC$

30/1/2023 EX. 2 ROVIGATTI



$L \times L \quad L = 10\,cm$

$m = 10\,\mu g$

(1) i_2 (VALORE E DIREZIONE) | spira ferma

$$\vec{F} = i_1 \vec{L} \times \vec{B} \qquad B = \frac{\mu_0 i_2}{2\pi x}$$

$$mg + i_1 L \frac{\mu_0 i_2}{2\pi(d+L)} = i_1 L \frac{\mu_0 i_2}{2\pi d}$$

$$\frac{i_1 L \mu_0 i_2}{2\pi}\left(\frac{1}{d} - \frac{1}{d+L}\right) = mg$$

$$i_2 = \frac{2\pi mg}{\mu_0 i_1 L} \frac{1}{\left(\frac{1}{d} - \frac{1}{d+L}\right)} =$$

$$= \frac{2\pi mg}{\mu_0 i_1 L} \frac{d(d+L)}{L} \simeq 4{,}95\,A$$

(2) $L \mapsto 2L$, i_1, i_2, m invariate

EQUILIBRIO d' ?

$$\frac{d(d+L)}{\cancel{L}} = \frac{d'(d'+2L)}{(2\cancel{L})^2}$$

$$4d(d+L) = d'^2 + 2Ld'$$

$$d'^2 + 2Ld' - 4d(d+L) = 0$$

$$d'^2 + 2Ld' - 4d(d+L) = 0$$

$$d'_{\pm} = \frac{-L \pm \sqrt{L^2 + 4d(d+L)}}{1} \overset{+}{=} \sqrt{L^2 + 4d(d+L)} - L \cong 2\,\text{mm}$$

LEACI 2-12-2016 Ex 2

$\vec{E}$, $\underline{\vec{D}}$, $\vec{P}$ $\qquad \chi_E = \epsilon_r - 1$

$$\begin{cases} \vec{P} = \vec{E} \cdot \epsilon_0 \chi_E \\ \vec{D} = \epsilon_0 \epsilon_r \vec{E} \end{cases}$$

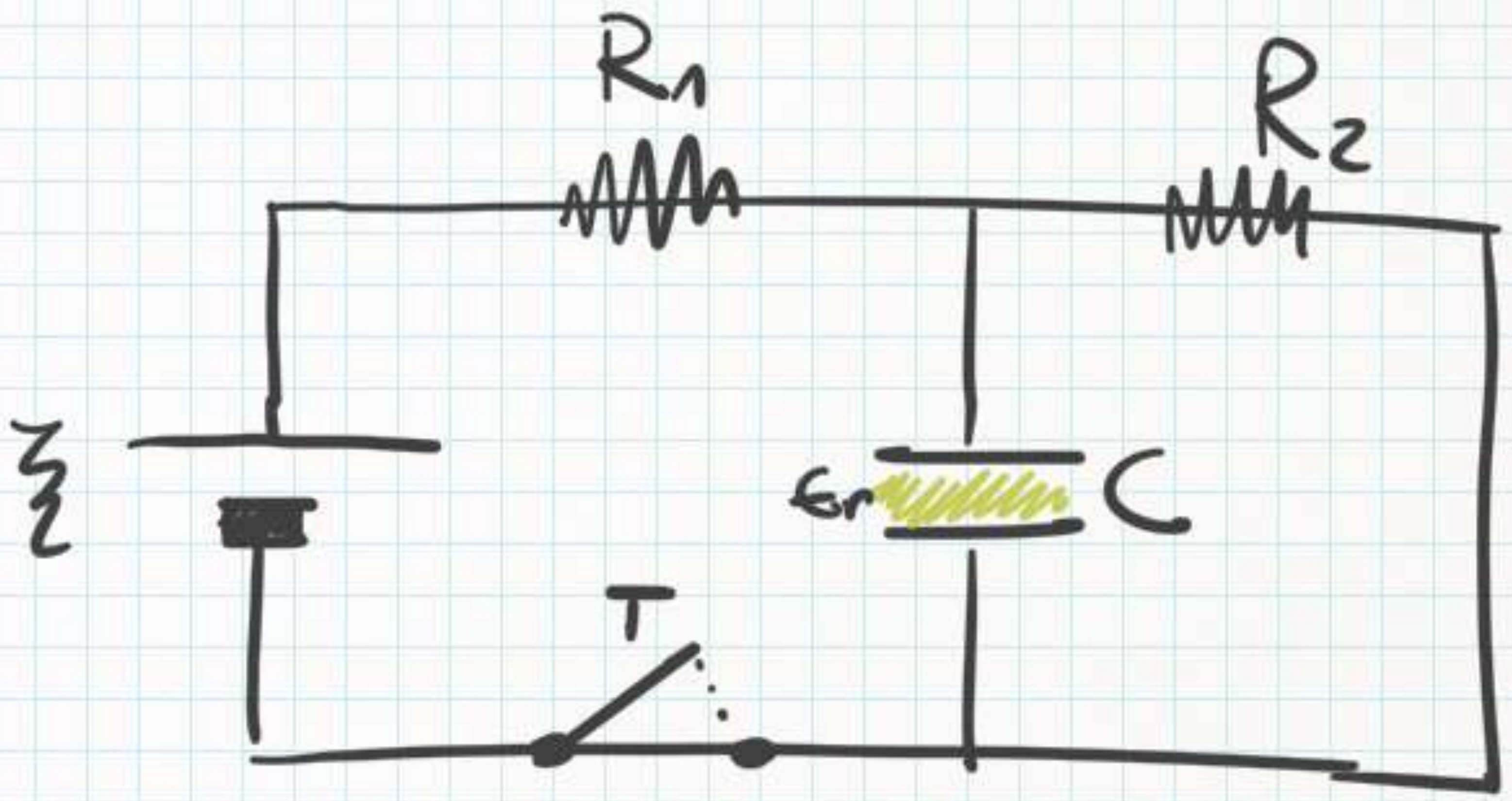
CARICHE DI POLARIZZ.

$$\begin{cases} \sigma_{POL} = \hat{n} \cdot \vec{P} & \text{superficiale} \\ \rho_{POL} = -\vec{\nabla} \cdot \vec{P} & \text{volumica} \end{cases}$$

(1) Q_{POL} sul dielettrico

(2) ΔV sul condensatore

(3) $\xi = ?$



$R_1 = 180\,\Omega$

$R_2 = 130\,\Omega$

$C_{VUOTO} = 3\,\mu F \qquad \epsilon_r = 3$

$$U = \frac{1}{2}\frac{Q^2}{C}$$

$$C_{VUOTO} = \frac{\epsilon_0 A}{d}$$

$$C_{DIEL} = \frac{\epsilon_0 \epsilon_r A}{d} = \epsilon_r C_{VUOTO}$$

$U = 3 \cdot 10^{-4}\,J$ dispersa

$$C = 3 C_{VUOTO} = 9\,\mu F$$

• $U = \frac{1}{2}\frac{Q^2}{C}$ $Q = \sqrt{2CU} = \boxed{73{,}4\ \mu C}$

$E \to P = \epsilon_0(\epsilon_r - 1)E$ $E = \frac{\sigma}{\epsilon_0 \epsilon_r}$ in un condensatore

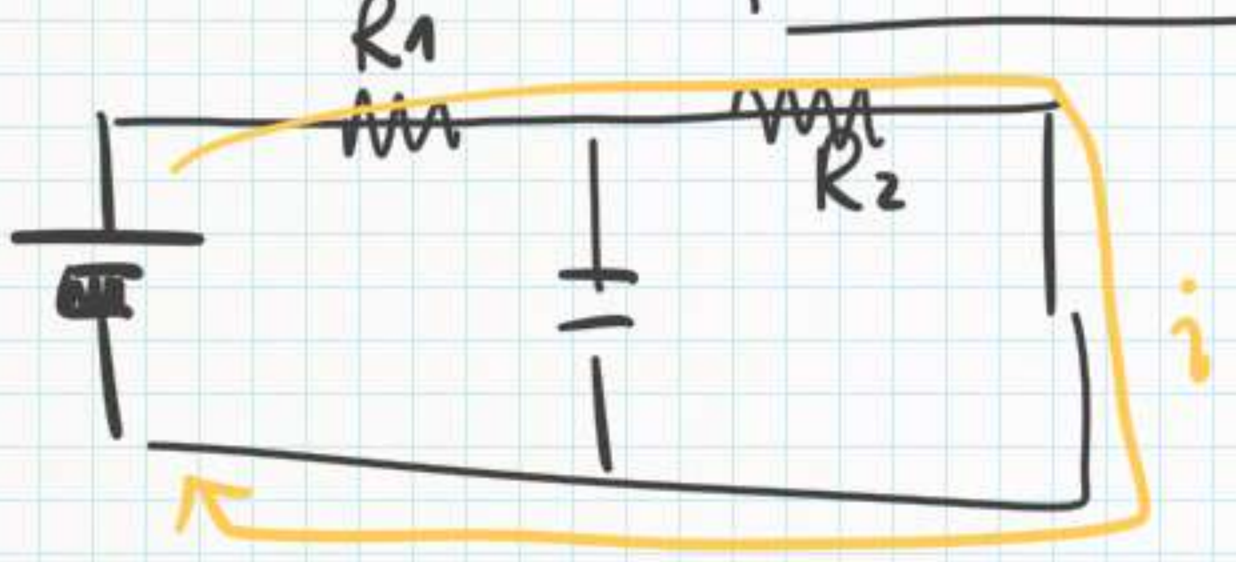
$P = \epsilon_0(\epsilon_r - 1)E = \frac{\epsilon_r - 1}{\epsilon_r}\cdot \sigma \to \sigma_{pol} = \vec{P}\cdot\hat{n} = \frac{\epsilon_r - 1}{\epsilon_r}\sigma$

$\cdot A$ $\cdot A$

$$\boxed{Q_{pol} = Q\,\frac{\epsilon_r - 1}{\epsilon_r}}$$

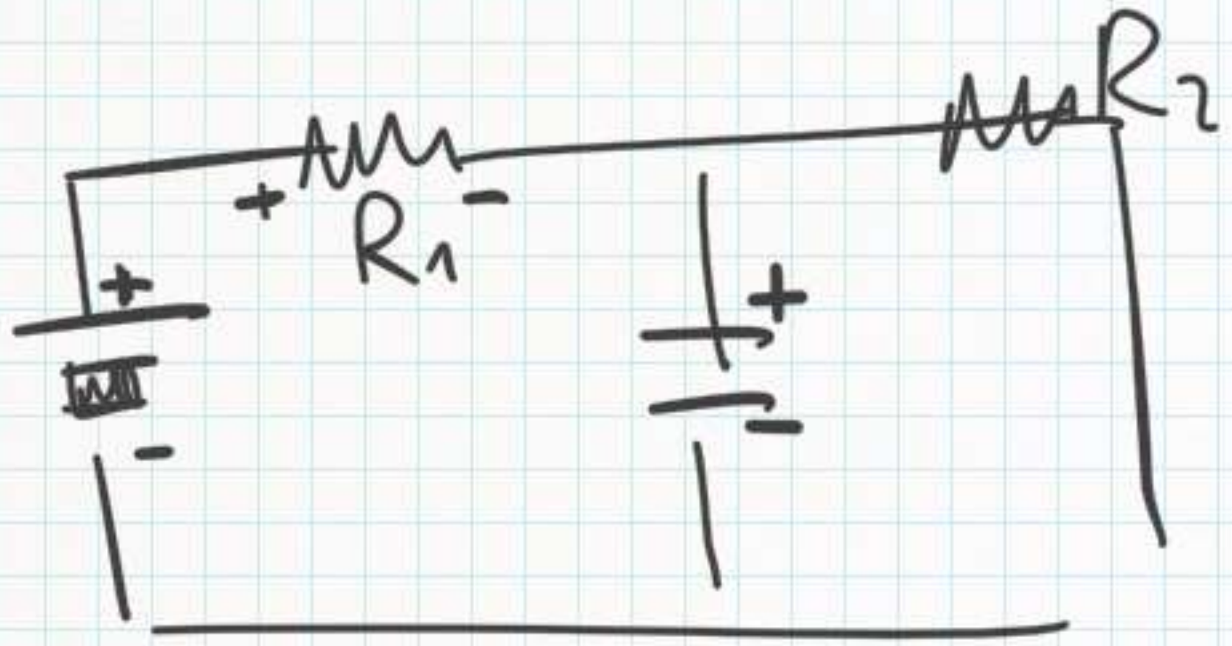
$$\boxed{Q_{pol} = \frac{2}{3}Q = 49\ \mu C}$$

• ΔV su C ? $\boxed{\Delta V = \frac{Q}{C} = 8{,}1\ V}$



$R_{EQ} = R_1 + R_2$ $i = \frac{\mathcal{E}}{R_1 + R_2}$

$\Delta V_1 = i R_1 = \mathcal{E}\frac{R_1}{R_1 + R_2}$



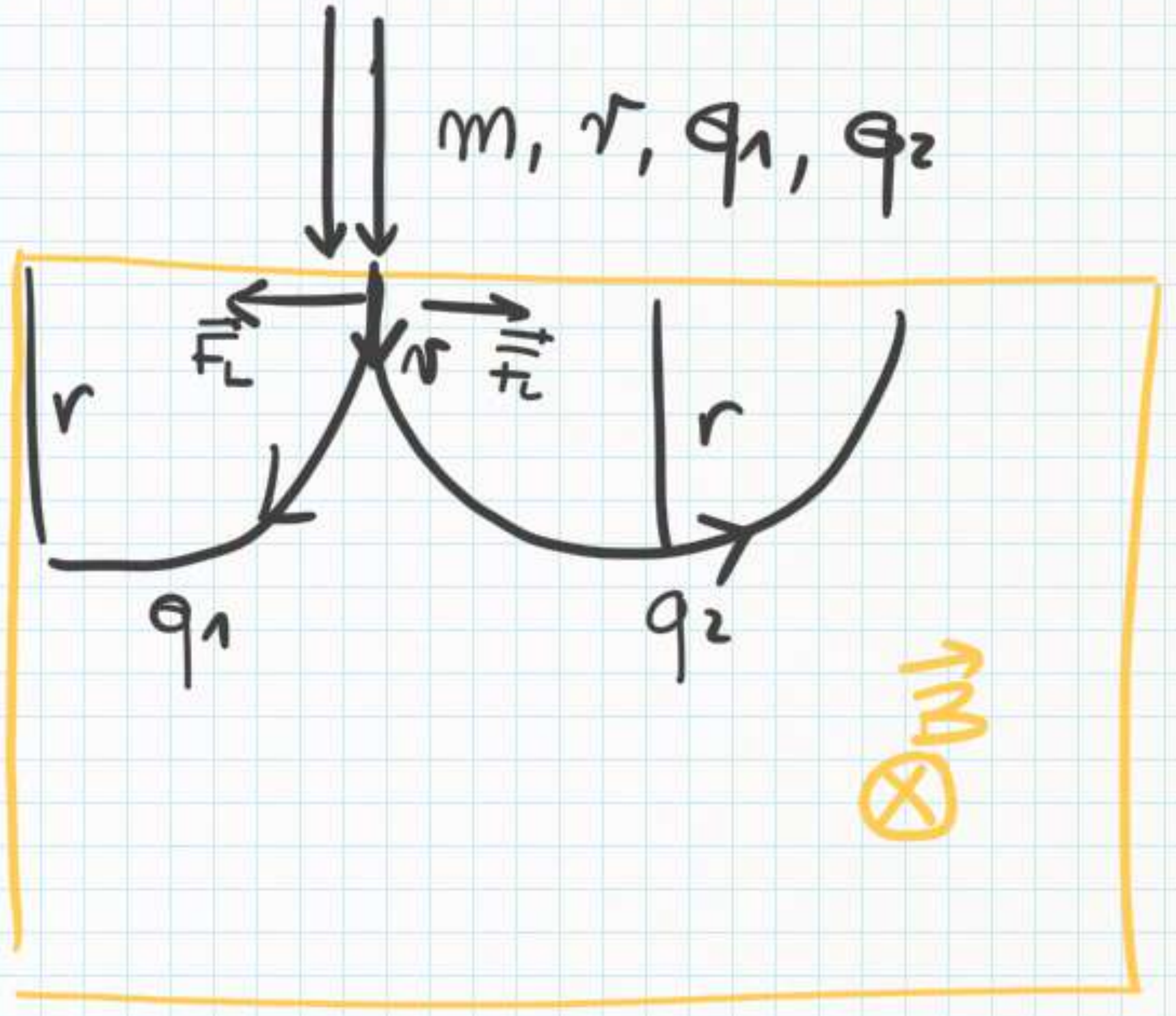
$$\Delta V_c + \Delta V_1 = \xi$$

$$\Delta V_c = \xi - \xi \frac{R_1}{R_1+R_2} = \xi \frac{R_2}{R_1+R_2}$$

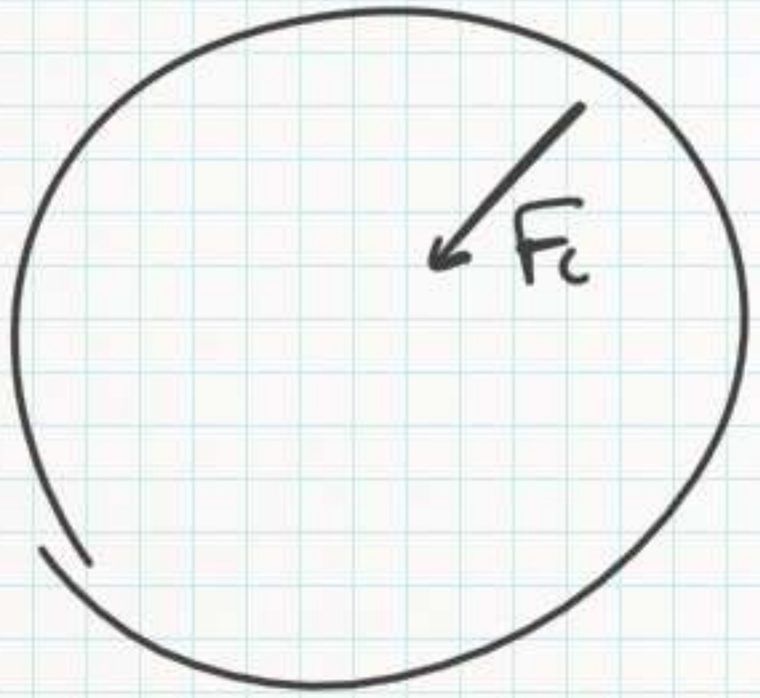
$$\xi = \frac{R_1+R_2}{R_2} \Delta V_c = 8{,}1\,V \cdot \frac{310\,\Omega}{130\,\Omega} = \boxed{19{,}3\ V}$$

ROVIGATTI 18/4/2023 Ex 2

$m = 10^{-20}$ kg, $v = 10^4$ m/s, q_1, q_2 ?, $B = 1$ T, $r = 0{,}50$ mm



- $q_{1,2} = ?$
- t_1, t_2
- $\vec{E}$



$F_c = m a_c = m \frac{v^2}{r}$

$\updownarrow$

$F_L = q v B$

$(q_1 \neq q_2)$

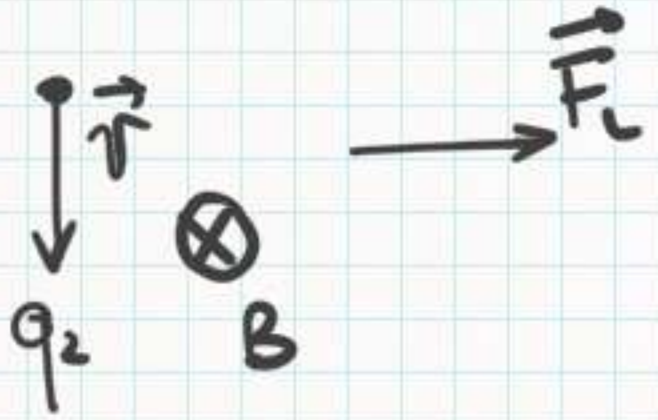
$q \cancel{v} B = m \frac{v^{\cancel{2}}}{r}$

$\boxed{q = \frac{m v}{r B}} = \frac{10^{-16}}{0{,}5}\,C = 2 \cdot 10^{-16}\,C$

$\begin{cases} q_2 = q \\ q_1 = -q \end{cases}$

- $v = \frac{\Delta s}{\Delta t}$ $\quad t_1 = \frac{\Delta s_1}{v} = \frac{1}{v}\frac{1}{4} 2\pi r = \frac{\pi r}{2 v} = 0{,}79 \cdot 10^{-4}$ s

$t_2 = 2 t_1 = 1{,}57 \cdot 10^{-4}$ s

- 

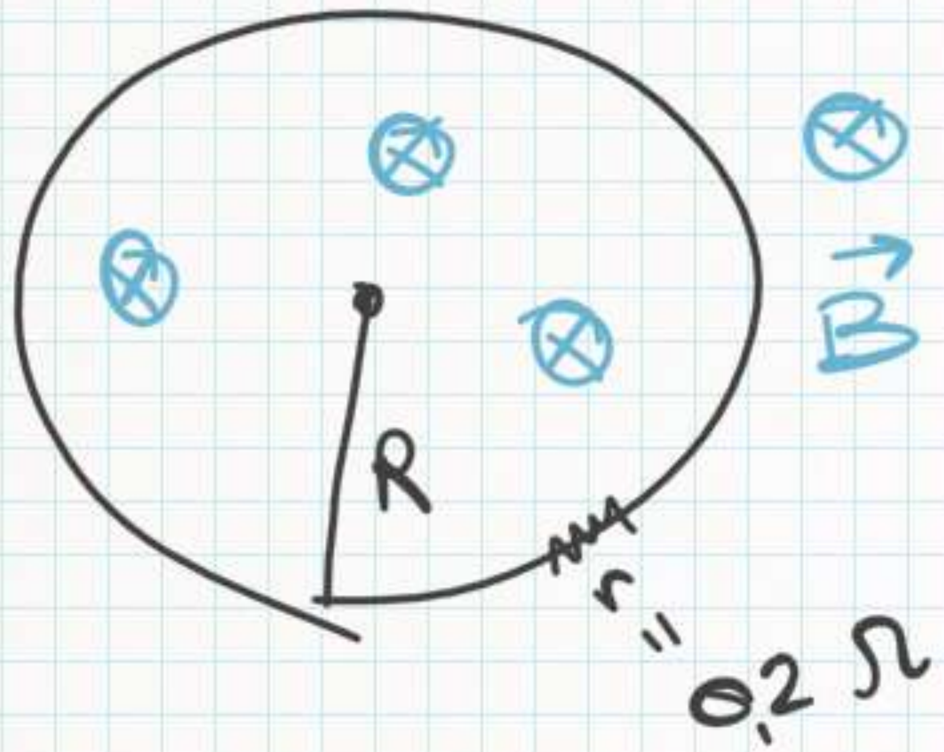
$\vec{F_E} = -\vec{F_L}$

$\vec{F_E} + \vec{F_L} = 0 = \hat{x}(q_2 v B - q_2 E)$

$\boxed{E = vB = 10^4 \text{ V/m}}$

$\vec{E} \uparrow\uparrow (-\hat{x})$

23-09-2015 PROBLEMA 2



$B_0 = 0,5 \ \frac{Wb}{m^2}$

• $R(t) = R_0 + a \sin(\omega t)$

$R_0 = 0,1 \ m$, $a = 0,06 \ m$, $\omega = 100 \ rad/s$

① i_{SPIRA} ?

② Potenza media dissipata in un periodo $T \left(= \frac{2\pi}{\omega} \right)$

• $i_{SPIRA} = \frac{\Delta V}{r} \qquad \Delta V \rightarrow f_{em.} = -\frac{d}{dt} \Phi(t)$

$$\Phi(t) = B_0 \cdot S(t) = B_0 \pi R^2(t) = B_0 \pi \left(R_0^2 + 2 R_0 a \sin(\omega t) + a^2 \sin^2(\omega t) \right)$$

$$f_{em} = -\frac{d}{dt} \Phi = -B_0 \pi \left[2 R_0 a \omega \cos(\omega t) + 2 a^2 \omega \sin(\omega t) \cos(\omega t) \right]$$

$$i(t) = \frac{-B_0 \pi}{r} \left[2 R_0 a \omega \cos(\omega t) + 2 \omega a^2 \sin(\omega t) \cos(\omega t) \right] \quad ①$$

② $\overline{P} = \frac{1}{T} \int_0^T P(t) \, dt$

$$P(t) = r\, i(t)^2 = \frac{B_0^2 \pi^2}{r} \Big[4R_0^2 a^2 w^2 \cos^2(wt) + 4w^2 a^4 \sin^2(wt) \cos^2(wt) + $$
$$+ 8R_0 a^3 w^2 \sin(wt) \cos^2(wt) \Big]$$

$$\overline{P} = \frac{1}{T} \frac{B_0^2 \pi^2}{r} \left\{ \int_0^T \Big(4R_0^2 a^2 w^2 \cos^2 wt + 4w^2 a^4 \sin^2 wt \cos^2 wt + 8R_0 a^3 w^2 \sin wt \cos^2 wt \Big) dt \right\} = \frac{B_0^2 \pi^2}{rT} \left(I_1 + I_2 + I_3 \right)$$

$$I_1 = \int_0^T dt \left(4R_0^2 a^2 w^2 \cos^2(wt) \right) = 4R_0^2 a^2 w \int_0^T \underbrace{\cos^2 wt}_{\cos^2 x} \underbrace{dt \cdot w}_{dx} = 4R_0^2 a^2 w \left(\frac{wt}{2} + \dots \cancel{\sin(wt)\cos(wt)}^{\,0} \right) \Big|_0^T$$

$$= 4R_0^2 a^2 w \pi$$

$$I_2 = \int_0^T 4w^2 a^4 \sin^2(wt) \cos^2(wt)\, dt = \left\{ 2 \sin(x) \cos(x) = \sin(2x) \right\} = w^2 a^4 \int_0^T \sin^2(2wt)\, dt\, \frac{2w}{2w} =$$

$$= \frac{a^4 w}{2} \int_0^T \sin^2(2wt)\, d(2wt) = \frac{w a^4}{2} \Big[wt + \cancel{\sin(2wt)\cos(2wt)}^{\,0} \Big]_0^T = \frac{w a^4}{2} \cdot 2\pi = w a^4 \pi$$

$$I_3 = 8R_0 a^3 w^2 \int_0^{T = \frac{2\pi}{w}} dt \left(\cos^2(wt) \sin(wt) \right) = \left\{ \begin{array}{l} \cos wt = x \\ dx = -w \sin wt\, dt \end{array} \right\} = -\frac{8R_0 a^3 w^{\cancel{2}}}{\cancel{w}} \int_1^1 x^2\, dx = 0$$

$$\bar{P} = \frac{B_0^2 \pi^2}{rT}(I_1 + I_2) = \frac{B_0^2 \pi^2}{r\,T}\left(4\pi R_0^2 a^2 w + \pi a^4 w\right) =$$

$$T \to \frac{2\pi}{w}$$

$$= \frac{B_0^2 \pi^{\cancel{2}}}{r\, 2\cancel{\pi}}\, w \left(4\underline{\pi} R_0^2\, \underline{a^2}\, \underline{w} + \underline{\pi}\, \underline{a^4}\, \underline{w}\right) =$$

$$= \frac{B_0^2 \pi^2 w^2 a^2}{2r}\left(4R_0^2 + a^2\right) = 9{,}7\ \mathrm{W}$$