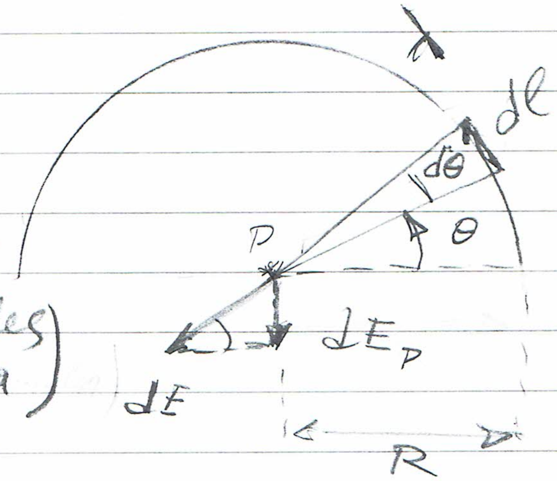
Física 2 — 1er parcial. Mayo 2020

SOLUCIONES.

Problema 1



a) $dE = \dfrac{dq}{4\pi\varepsilon_0 R^2} = \dfrac{\lambda\, d\ell}{4\pi\varepsilon_0 R^2}$

$dE_p = dE \operatorname{sen}\theta$, $d\ell = R\, d\theta$

(las componentes horizontales se anulan por simetría)

$dE_p = \dfrac{\lambda R\, d\theta}{4\pi\varepsilon_0 R^2} \operatorname{sen}\theta$

$dE_p = \dfrac{\lambda}{4\pi\varepsilon_0 R} \operatorname{sen}\theta\, d\theta \Rightarrow E_p = \dfrac{\lambda}{4\pi\varepsilon_0 R}\displaystyle\int_0^{\pi} \operatorname{sen}\theta\, d\theta$

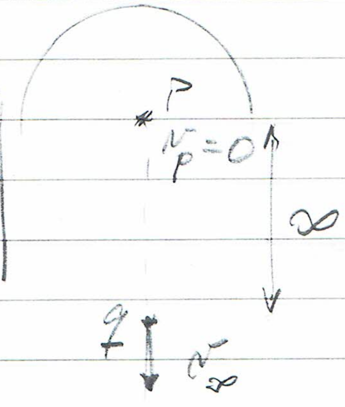
$E_p = \dfrac{\lambda}{4\pi\varepsilon_0 R}\Big[-\cos\theta\Big]_0^{\pi} = \dfrac{2\lambda}{4\pi\varepsilon_0 R} \Rightarrow \boxed{E_p = \dfrac{\lambda}{2\pi\varepsilon_0 R}}$

Sentido hacia afuera del semicírculo

b) $dV_p = \dfrac{dq}{4\pi\varepsilon_0 R} = \dfrac{\lambda\, d\ell}{4\pi\varepsilon_0 R} = \dfrac{\lambda R\, d\theta}{4\pi\varepsilon_0 R} = \dfrac{\lambda\, d\theta}{4\pi\varepsilon_0}$

$V_p = \dfrac{\lambda}{4\pi\varepsilon_0}\displaystyle\int_0^{\pi} d\theta \Rightarrow \boxed{V_p = \dfrac{\lambda}{4\varepsilon_0}}$

c) $qV_p + \underbrace{\tfrac{1}{2} m v_p^2}_{0} = \underbrace{qV_\infty}_{0} + \tfrac{1}{2} m v_\infty^2$

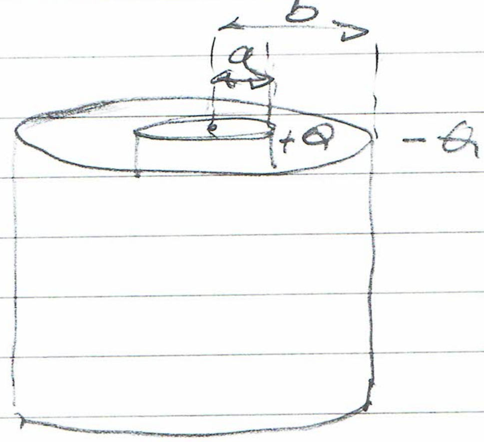


$\dfrac{q\lambda}{4\varepsilon_0} = \dfrac{1}{2} m v_\infty^2 \Rightarrow \boxed{v_\infty = \sqrt{\dfrac{q\lambda}{2\varepsilon_0 m}}}$

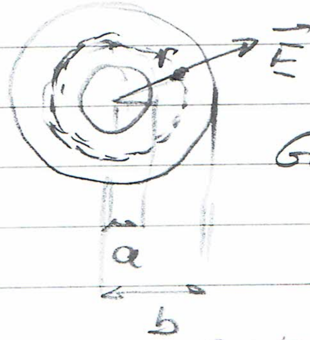
Problema 2

a)

$r < a \Rightarrow \boxed{E = 0}$ (es interior al conductor)



$a \leq r \leq b$



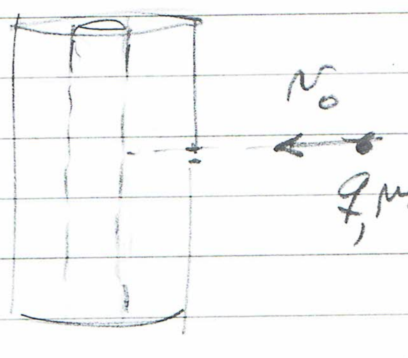
Gauss: $2\pi r E = \dfrac{Q}{\varepsilon_0} \Rightarrow \boxed{E = \dfrac{Q}{2\pi\varepsilon_0 r}}$

$b < r$ $\boxed{E = 0}$ (Gauss)

b) $V_a - V_b = \displaystyle\int_a^b E\,dr = \frac{Q}{2\pi\varepsilon_0}\int_a^b \frac{dr}{r} \Rightarrow$

$$\boxed{V_a - V_b = \frac{Q}{2\pi\varepsilon_0}\ln\left(\frac{b}{a}\right)}$$

c) v_0 = constante hasta que llege al cilindro exterior. (porque $E = 0$)



Conservación de la energía.

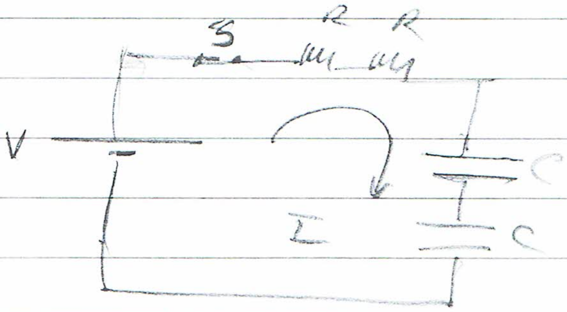
$$q V_b + \frac{1}{2} m v_{0m}^2 = q V_a + \frac{1}{2} m v_a^2$$

v_{0m}: v_0 mínima; v_a: 0 (se detiene allí)

$$q(V_a - V_b) = \frac{1}{2} m v_{0m}^2 \Rightarrow \boxed{v_{0m} = \sqrt{\frac{2q(V_a - V_b)}{m}}}$$

Problema 3

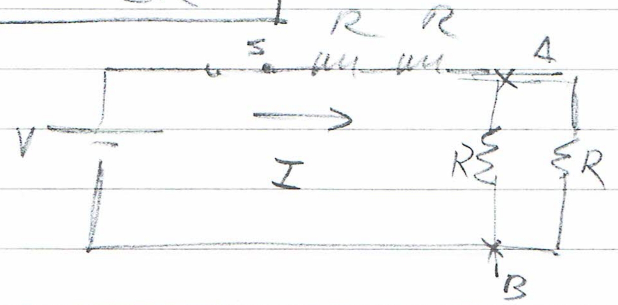
a)



Los C están sin carga y actúan como un cortocircuito $(R_c = 0) \Rightarrow$ No hay corriente en la R en paralelo.

$$\boxed{I = \frac{V}{2R}}$$

b)

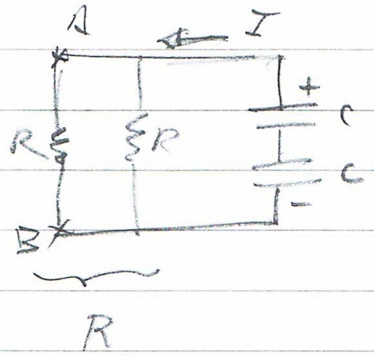


Los C están cargados y forman circuito abierto $(R_c \Rightarrow \infty)$

$$\frac{1}{R_p} = \frac{1}{R} + \frac{1}{R} \Rightarrow R_p = \frac{R}{2} \Rightarrow I = \frac{V}{R+R+R_p}$$

$$\boxed{I = \frac{2V}{5R}}$$

c)



$$R_{eq} = \frac{R}{2} \qquad \frac{1}{C_{eq}} = \frac{1}{C} + \frac{1}{C} = \frac{2}{C}$$

$$C_{eq} = \frac{C}{2}$$

$$q = C_{eq} V_{AB} \qquad I = \frac{V_{AB}}{R_{eq}} = -\frac{dq}{dt}$$

$$q(t) = -C_{eq} R_{eq} \frac{dq}{dt} \Rightarrow q(t) = q(0) e^{-t/\tau}$$

$$\tau = C_{eq} R_{eq} = \frac{C}{2} \cdot \frac{R}{2} = \frac{CR}{4} \Rightarrow q(t) = q(0) e^{-\frac{4t}{RC}}$$

sigue →

$$q(0) = C_{eq} V_{AB}(0) = \frac{C}{2} V_{AB}(0) \qquad V_{AB}(0) = V_{AB} \text{ (parte b)}$$

$$V_{AB}(0) = R_{eq} I_{\text{parte b}} = \frac{R}{2}\frac{2V}{5R} = \frac{V}{5} \Rightarrow q(0) = \frac{CV}{10}$$

$$\boxed{q(t) = \frac{CV}{10} e^{-4t/RC}} \qquad I_C(t) = \frac{V_{AB}}{R_{eq}} = \frac{q/C_{eq}}{R_{eq}} = \frac{4q(t)}{RC}$$

$$I_C(t) = \frac{4}{RC}\frac{CV}{10} e^{-4t/RC} = \frac{2V}{5R} e^{-4t/RC}$$

$$I_R = \frac{I_C}{2} \Rightarrow \boxed{I_R(t) = \frac{V}{5R} e^{-4t/RC}}$$

$\downarrow$

corriente por una R