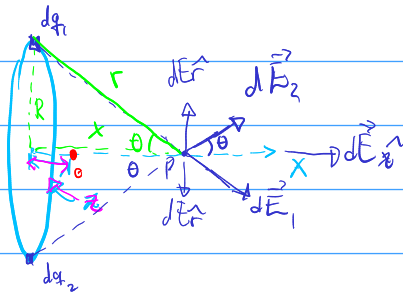


Actividad 2

1.



$$\Rightarrow \vec{E}(P) = \vec{E}_x \quad dq = \lambda dl$$

$$d\vec{E} = \frac{k \cdot dq \cdot \vec{r}}{r^3}$$

$$\vec{r} = -R(\hat{r}) + x(\hat{i})$$

$$r = \sqrt{R^2 + x^2}$$

$$dE = \frac{k \cdot \lambda dl}{(R^2 + x^2)^{3/2}} (-R\hat{r} + x\hat{i})$$

$$d\vec{E} = \frac{k \lambda x}{(R^2 + x^2)^{3/2}} dl (\hat{i}) \rightarrow \vec{E} = \frac{k \lambda x}{(R^2 + x^2)^{3/2}} \int_0^L dl (\hat{i})$$

$$\vec{E}(P) = \frac{k \frac{Q}{L} x}{(R^2 + x^2)^{3/2}} \hat{i}$$

$$\vec{F}_E = q\vec{E}$$

$$\vec{F}_E = -e\vec{E}$$

$$E(P) = \frac{k Q x}{(R^2 + x^2)^{3/2}} \hat{i}$$

$$\vec{F}_E = - \frac{keQx}{(R^2 + z^2)^{3/2}} \hat{i} \quad (a)$$

b) Podemos ver la expresión de \vec{F}_E

$$\vec{F}_E = - \frac{keQx}{R^3} \cdot \frac{R^3}{(\sqrt{R^2 + z^2})^3} \hat{i} \quad \text{como } R \gg z$$

$$\approx 1$$

$$\vec{F}_E = - \frac{keQx}{R^3} \hat{i}$$

$$\vec{F}_E = - \frac{eQx}{4\pi\epsilon_0 L^3} \hat{i}$$

tiene forma de una fuerza restauradora

$$\sum F = ma$$

$$\frac{-eQ}{4\pi\epsilon_0 R^3} x = m_e x''$$

↑
masa electron

$$m_e x'' + \frac{eQ}{4\pi\epsilon_0 R^3} x = 0$$

$$x'' + \frac{k e Q}{m_e R^3} x = 0 \quad (6)$$

$$c) \quad x'' + \frac{k \cdot e Q}{m_e R^3} x = 0 \quad \rightarrow \quad x'' + \omega^2 x = 0$$

$$\omega^2 = \frac{k e Q}{m_e R^3} \rightarrow \omega = \sqrt{\frac{k e Q}{m_e R^3}} \rightarrow f = \frac{1}{2\pi} \sqrt{\frac{k e Q}{m_e R^3}}$$

$$f = 49,05 \text{ MHz}$$

$$T = \frac{1}{f} = 20,4 \text{ ns}$$

$$d) \quad x(t) = A \cos(\omega t + \phi) \quad \phi = 0^\circ \text{ porque } v_0 = 0$$

$$A = 5 \mu\text{m} \quad \rightarrow \quad x(t) = 5 \cos(3,08 \times 10^8 t) [\mu\text{m}]$$

$$v(t) = -A\omega \sin(\omega t)$$

$$\rightarrow v(t) = -1,54 \times 10^3 \sin(3,08 \times 10^8 t) [\text{m/s}]$$

$$a(t) = -A\omega^2 \cos(\omega t)$$

$$\rightarrow a(t) = -4,75 \times 10^{11} \cos(3,08 \times 10^8 t) [\text{m/s}^2]$$

$$e) \quad \begin{array}{ll} \max x = 5 \mu\text{m} & a = 4,75 \times 10^{11} \text{ m/s}^2 \\ v = 1,54 \times 10^3 \text{ m/s} & \end{array}$$

f) luego de 10 ns

$$x(10 \text{ ns}) = -4.99 \times 10^{-6} \text{ m}$$

$$v(10 \text{ ns}) = -9.19 \times 10^4 \text{ m/s}$$

$$a(10 \text{ ns}) = 4.75 \times 10^{11} \text{ m/s}^2$$

g) $dV = \frac{k dq}{r}$

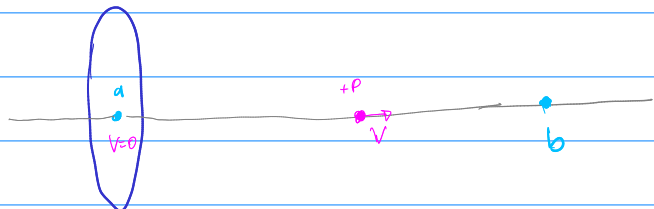
$$r = \sqrt{R^2 + z^2}$$

$$\Rightarrow dV = \frac{k dq}{\sqrt{R^2 + z^2}} \Rightarrow V = \frac{k}{\sqrt{R^2 + z^2}} \int_0^a dq \Rightarrow V = \frac{kQ}{\sqrt{R^2 + z^2}}$$

La energía Pot. elc. = $V \cdot q \Rightarrow E_p = V \cdot q = \frac{k \cdot Q}{\sqrt{R^2 + z^2}} \cdot +e$

$$E_p = 2.16 \times 10^{-14} \text{ J}$$

h) $E_{ma} = E_{mb}$



$$E_{pa} + \cancel{E_{ca}} = E_{pb} + \cancel{E_{cb}}$$

$$E_{pa} = E_{cb}$$

$$2.16 \times 10^{-14} = \frac{1}{2} m_p v^2$$

$$\sqrt{\frac{2 \cdot 2.16 \times 10^{-14}}{m_p}} = v_f$$

$$v_f = 5.09 \times 10^6 \text{ m/s}$$