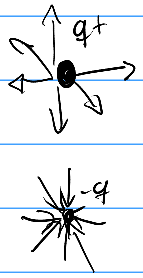
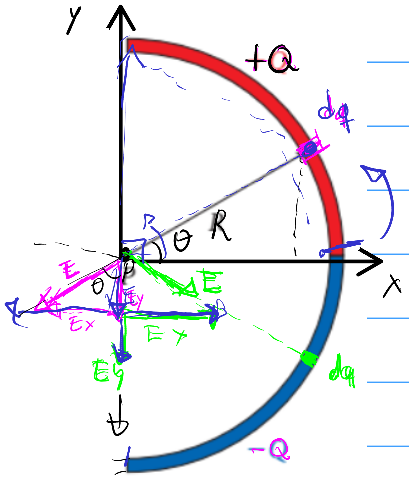
Pregunta 1





$\vec{u}$ $\quad u_x = |u|\cos\theta$, $\quad u_y = |u|\,\text{sen}\,\theta$

Por simetría $\quad E_p = \underbrace{E_{px}}_{\text{se cancela}} + \underbrace{E_{py}}_{\text{Duplica}}$

$\Rightarrow E(p) = 2E(p)_y$

$\cancel{E = k\frac{Q}{r^3}\vec{r}}$

$$\boxed{E = k\frac{Q}{r^2}\hat{r}}$$

dq

$$\vec{E}(p) = 2E(p)\cdot \text{sen}\,\theta\,(-\hat{j})$$

$\Rightarrow dq = \lambda\, dl$

$dq = \lambda R\, d\theta$

$$\Rightarrow d\vec{E}(p) = 2K\frac{dq}{r^2}\,\text{sen}\,\theta\,(-\hat{j})$$

$$\boxed{\lambda = \frac{Q}{l} = \frac{Q}{\frac{\pi R}{2}}}$$

$$\vec{E} = \int 2K\frac{\lambda R\, d\theta}{R^2}\,\text{sen}\,\theta\,(-\hat{j})$$

$$\boxed{\lambda = \frac{2Q}{\pi R}}$$

$$\vec{E} = \frac{2K}{R}\lambda \underbrace{\int_0^{\pi/2} \text{sen}\,\theta\, d\theta}_{1}\,(-\hat{j})$$

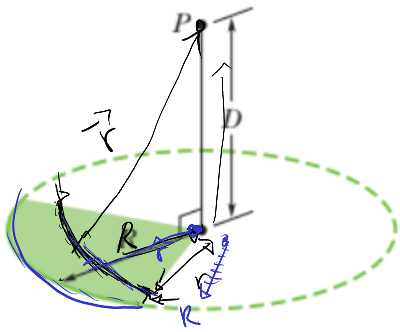
$$\Rightarrow \vec{E}(p) = \frac{2K}{R}\cdot\frac{2Q}{\pi R}\cdot 1\,(-\hat{j})$$

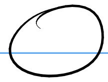
$$\boxed{\Rightarrow \vec{E}(p) = \frac{4QK}{\pi R^2}(-\hat{j})\ \frac{N}{C}}$$

$$\boxed{K = \frac{1}{4\pi\epsilon_0}}$$

$K = \frac{1}{4\pi\epsilon_0}$

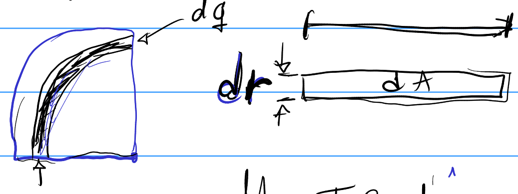
Problema 2





$\ell = 2\pi r$

$\ell = \frac{2\pi r}{4} = \frac{\pi R}{2}$



$$dA = \frac{\pi R}{2}\, dr$$

$$\vec{r} = -r(\hat{r}) + D\,\hat{k}$$

$$r = \sqrt{r^2 + D^2}$$

$$dV = K \cdot \frac{dq}{r} = K \cdot \frac{\sigma \frac{\pi R}{2} dr}{\sqrt{r^2 + D^2}}$$

$$dq = \sigma \cdot dA \qquad \sigma = \frac{Q}{A}$$

$$dq = \sigma \frac{\pi R}{2} dr$$

$$V = \frac{K\sigma\pi R}{2} \int_0^R \frac{dr}{\sqrt{r^2 + D^2}}$$

$$V = \frac{K\sigma\pi R}{2} \cdot \left[\ln\left(r + \sqrt{r^2 + D^2}\right)\right]_0^R$$

$$\boxed{V(P) = \frac{K\sigma\pi R}{2}\left[\ln\left(R + \sqrt{R^2 + D^2}\right) - \ln(D)\right]} \quad \text{(a)}$$

b) $E_{potencial} = V \cdot Q$

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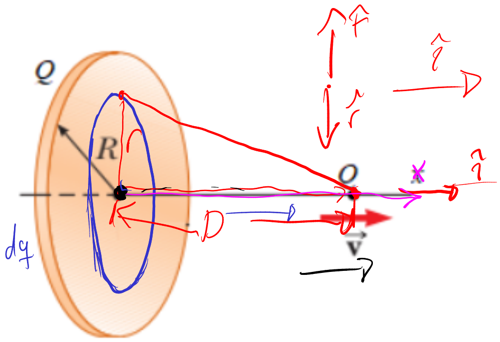
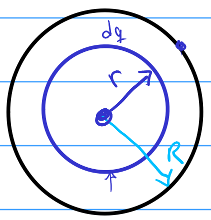
$$E_{pot} = \frac{K\sigma\pi R}{2}\left[\ln\left(R + \sqrt{R^2 + D^2}\right) - \ln(D)\right] \cdot Q$$

Pregunta 3



$$V_f = \sqrt{\frac{Q^2}{\pi \epsilon_0 M R}}$$

$$dV = \frac{k\,dQ}{r} = \frac{k\,\sigma\, 2\pi r\,dr}{\sqrt{r^2+D^2}}$$



$dq = \sigma\, dA$

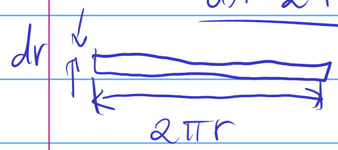
$dq\ \sigma 2\pi r\,dr$

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

$r = \sqrt{r^2+D^2}$

$$V = \underset{\frac{1}{4\pi\epsilon}}{K}\sigma \cdot 2\pi \int_0^R \frac{r\,dr}{\sqrt{r^2+D^2}}$$

$dA = 2\pi r\,dr$



$$V = \frac{\sigma}{2\epsilon_0}\left[\sqrt{D^2+R^2} - D\right]$$

$$E_p = \frac{\sigma Q}{2\epsilon_0}\left[\sqrt{D^2+R^2} - D\right]$$

$$E_p\,\text{centro} + \underset{0}{\cancel{E_c\,\text{centro}}} = \underset{0}{\cancel{E_p\,\text{inf}}} + E_c\,\text{inf}$$

$$\frac{\sigma Q}{\cancel{2}\epsilon_0}\left[\sqrt{0^2+R^2} - 0\right] = \frac{1}{\cancel{2}} M V^2$$

$$\frac{Q/\pi R^2 \cdot Q/R}{\epsilon_0} = M V^2$$

$$\frac{Q^2}{\pi \epsilon_0 R M} = V^2$$

$$V = \sqrt{\frac{Q^2}{\pi \epsilon_0 R M}}$$