NOTAS: Pauta 1PP. Electro (ejercicio nº1)

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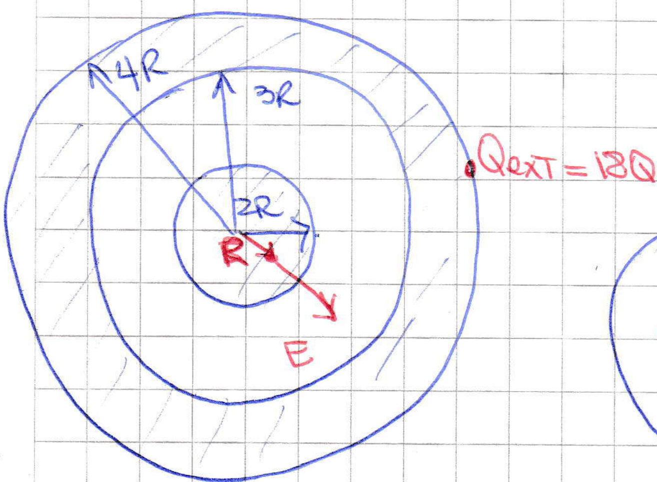
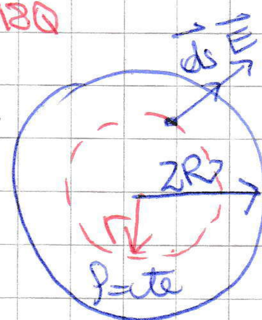


nos damos una sup Gauss con $r = R \rightarrow E = \frac{Q}{5\pi\varepsilon_0 R^2}$



$$\oint \vec{E} \cdot \vec{dS} = \frac{Q_{enc}}{\varepsilon_0}$$

$$\int E\, ds \cos 0 = \frac{Q_{enc}}{\varepsilon_0} \quad (1)$$

$$E(4\pi r^2) = \frac{Q_{enc}}{\varepsilon_0} \quad , \text{si } r = R$$

$$\frac{Q}{5\cancel{\pi}\cancel{\varepsilon_0}\cancel{R^2}}(4\cancel{\pi} \cdot \cancel{R^2}) = \frac{Q_{enc}}{\cancel{\varepsilon_0}}$$

$$Q_{enc} = \frac{4Q}{5} \quad (r = R) \quad (3)$$

como $\rho = cte$

$$\frac{Q_T}{V_T} = \frac{Q_{enc}}{V_{enc}} \rightarrow Q_T = V_T \cdot \frac{Q_{enc}}{V_{enc}} = \frac{\frac{4}{\cancel{3}}\pi \cdot (2R)^3 \cdot \frac{4Q}{5}}{\frac{4}{\cancel{3}}\pi R^3} \quad (1)$$

$Q_T = \frac{32Q}{5}$ (2) (carga Total esfera de Radio 2R).

a) $Q_{int} = -\frac{32Q}{5}$ (4) (carga interna del cascarón conductor).

b) $V_r = V_{\infty,4R} + V_{4R,3R}$

$$V_{\infty 4R} = -\int_{\infty}^{4R} E_{ext}\, dr \quad (1)$$

sigte.

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E_{ext}: Sup. Gauss con $r > 4R$

$$\oint \vec{E} \cdot d\vec{s} = \frac{Q_{enc}}{\varepsilon_0}$$

1-

$Q_{int} + Q_{ext}$

$$Q_{enc} = Q_{(aislante)} + Q_{T\,cascaron}$$

$$Q_{enc} = \frac{32Q}{5} + \left(-\frac{32Q}{5} + 18Q\right)$$

$$Q_{enc} = 18Q$$ 2

$$\oint \vec{E} \cdot d\vec{s} = \frac{Q_{enc}}{\varepsilon_0}$$

2

$$E(4\pi r^2) = \frac{18Q}{\varepsilon_0} \rightarrow E_{ext} = \frac{18Q}{4\pi r^2 \varepsilon_0} = \frac{9Q}{2\pi r^2 \varepsilon_0} \text{ (N/C) } r > 4R$$

$$V_{\infty 4R} = -\int_{\infty}^{4R} \frac{9Q}{2\pi r^2 \varepsilon_0} dr = \frac{-9Q}{2\pi\varepsilon_0}\int_{\infty}^{4R} \frac{dr}{r^2} = \frac{9Q}{2\pi\varepsilon_0 \cdot 4R}$$

$$V_{\infty 4R} = \frac{9Q}{8\pi\varepsilon_0 R} \text{ (V)}$$ 3

9

$$V_{4R,34} = -\int_{4R}^{34} E_{(3R<r<4R)} \cdot dr$$

1

$E_{(3R<r<4R)}$: Sup. Gauss con $3R < r < 4R$

$$\oint \vec{E} \cdot d\vec{s} = \frac{Q_{enc}}{\varepsilon_0}$$

$$Q_{enc} = Q_{T\,aislante} + Q_{int \text{ del cascaron}}$$

$$Q_{enc} = \frac{32Q}{5} - \frac{32Q}{5}$$ 2

3

$Q_{enc} = 0$ (conductor) $\rightarrow$ $E = 0$ $\rightarrow$ $V_{4R,34} = 0$ (V)

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$$V_r = \frac{9Q}{8\pi\varepsilon_0 R} \quad (V) \qquad (3R < r < 4R) \qquad 4$$

Mtecte.

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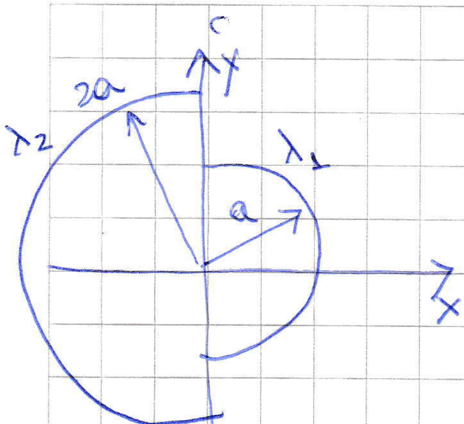

a) $\vec{E}_0 = \vec{E}_{\lambda_1} + \vec{E}_{\lambda_2}$

$\underline{\vec{E}_{\lambda_1}:}$

$\vec{r} = \vec{0}$ 1

$\vec{r}\,' = a\cos\theta\,\hat{\imath} + a\,\text{sen}\,\theta\,\hat{\jmath}$ 1

$\left.\begin{matrix} \vec{r}-\vec{r}\,' = -a\cos\theta\,\hat{\imath} - a\,\text{sen}\,\theta\,\hat{\jmath} \\ |\vec{r}-\vec{r}\,'|^3 = a^3 \end{matrix}\right.$ 1 1

$\left.\begin{matrix} dq = \lambda_1\, dl \\ dl = a\, d\theta \end{matrix}\right\}\ dq = \lambda_1 a\, d\theta$ 1

$3\pi/2 \le \theta \le \pi/2$ 1

$$\vec{E}_{\lambda_1} = K\int_{3\pi/2}^{\pi/2} \frac{\lambda_1 \cancel{a}\, d\theta\,(-\cancel{a}\cos\theta\,\hat{\imath} - \cancel{a}\,\text{sen}\,\theta\,\hat{\jmath})}{a^{\cancel{3}}}$$

$$= -\frac{K\lambda_1}{a}\int_{3\pi/2}^{\pi/2} (\cos\theta\,\hat{\imath} + \text{sen}\,\theta\,\hat{\jmath})\, d\theta$$

$$\int_{3\pi/2}^{\pi/2} \cos\theta\, d\theta\,\hat{\imath} = \left(\text{sen}\,\frac{\pi}{2} - \text{sen}\,\frac{3\pi}{2}\right)\hat{\imath} = 2\hat{\imath}$$ 1

$$\int_{3\pi/2}^{\pi/2} \text{sen}\,\theta\, d\theta\,\hat{\jmath} = \left(-\cos\frac{\pi}{2} + \cos\frac{3\pi}{2}\right)\hat{\jmath} = 0\,\hat{\jmath}$$ 1

$$\boxed{\vec{E}_{\lambda_1} = \frac{-2K\lambda_1}{a}\,\hat{\imath} \quad (N/C)}$$ 3

$\underline{\vec{E}_{\lambda_2}:}$

$\vec{r}\,' = 2a\cos\theta\,\hat{\imath} + 2a\,\text{sen}\,\theta\,\hat{\jmath}$ 1

$\vec{r} - \vec{r}\,' = -2a\cos\theta\,\hat{\imath} - 2a\,\text{sen}\,\theta\,\hat{\jmath}$ 1

$\left.\right\}\ |\vec{r}-\vec{r}\,'|^3 = (2a)^3$ 1

$\left.\begin{matrix} dq = \lambda_2\, dl \\ dl = 2a\, d\theta \end{matrix}\right\}\ dq = \lambda_2 \cdot 2a\, d\theta$ 1

$\pi/2 \le \theta \le 3\pi/2$ 1

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$$\vec{E}_{\lambda_2} = K \int_{\pi/2}^{3\pi/2} \lambda_2 \cdot \frac{\cancel{2a}\, d\theta \left(-\cancel{2a}\cos\theta\, \hat{\imath} - \cancel{2a}\,\mathrm{sen}\theta\, \hat{\jmath}\right)}{(2a)^{\cancel{3}}}$$

$$= -\frac{K\lambda_2}{2a} \int_{\pi/2}^{3\pi/2} (\cos\theta\, \hat{\imath} + \mathrm{sen}\theta\, \hat{\jmath})\, d\theta$$

$$\int_{\pi/2}^{3\pi/2} \cos\theta \cdot d\theta\, \hat{\imath} = \left(\mathrm{sen}\frac{3\pi}{2} - \mathrm{sen}\frac{\pi}{2}\right)\hat{\imath} = -2\,\hat{\imath} \quad ①$$

$$\int_{\pi/2}^{3\pi/2} \mathrm{sen}\theta\, d\theta\, \hat{\jmath} = \left(-\cos\frac{3\pi}{2} + \cos\frac{\pi}{2}\right) = 0\,\hat{\jmath} \quad ①$$

③

$$\vec{E}_{\lambda_2} = \frac{\cancel{2}K\lambda_2}{\cancel{2}a}\,\hat{\imath} \rightarrow \boxed{\vec{E}_{\lambda_2} = \frac{K\lambda_2}{a}\,\hat{\imath} \ (N/C)}$$

$$\vec{E}_0 = \frac{K}{a}(-2\lambda_1 + \lambda_2)\,\hat{\imath} \quad (N/C) \quad ④$$

b) $\vec{F}_Q = \vec{E}_0 \cdot Q$

$$\vec{F}_Q = \frac{KQ}{a}(-2\lambda_1 + \lambda_2)\,\hat{\imath} \quad (N) \quad ⑤$$