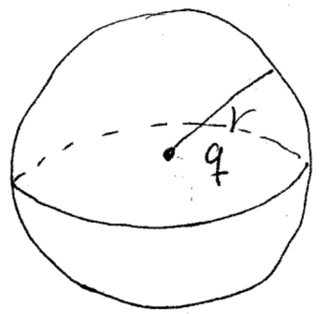
- ## Teorema de Gauss

▷ CAMPO ELÉCTRICO CREADO POR UNA CARGA PUNTUAL

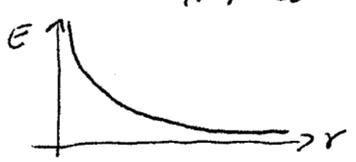


$$\oint \bar{E} \cdot d\bar{s} = \frac{q_{enc}}{\epsilon_0}$$

$$E \oint d\bar{s} = \frac{q_{enc}}{\epsilon_0}$$

$$E \cdot S = \frac{q_{enc}}{\epsilon_0}$$

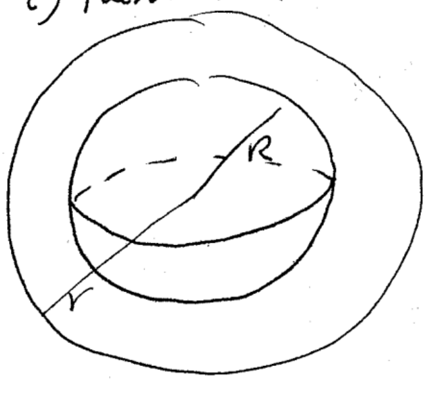
$$E = \frac{q}{4\pi r^2 \epsilon_0} = k\,\frac{q}{r^2} \rightarrow \boxed{\vec{E} = k\,\frac{q}{r^2}\,\vec{u}_r}$$



▷ CAMPO ELECTRICO CREADO POR UNA ESFERA HUECA (Dieléctrica ó conductora)

hueca o cargada $\sigma = \dfrac{Q}{4\pi R^2} \quad \left(\dfrac{C}{m^2}\right)$

i) Fuera $r > R$

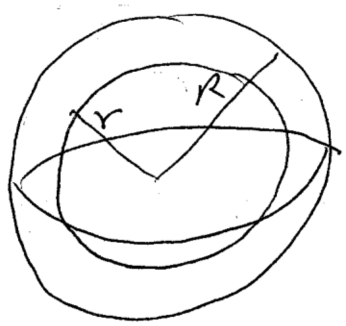


$$\oint \bar{E} \cdot d\bar{s} = \frac{q_{enc}}{\epsilon_0}$$

$$E \cdot S = \frac{Q}{\epsilon_0}$$

$$\boxed{\vec{E} = \frac{Q}{4\pi\epsilon_0 r^2}\,\vec{u}_r}$$

(i) Dentro : $r < R$



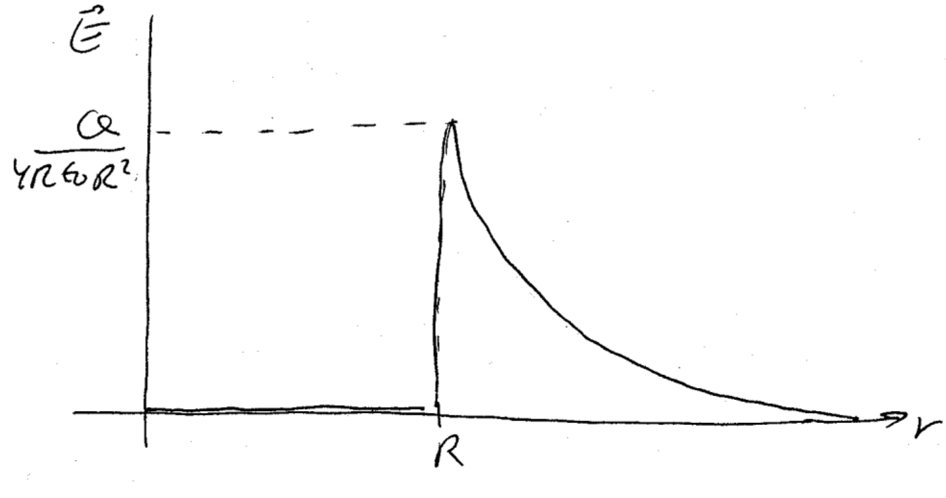
$$\oint \bar{E}\, d\bar{s} = \frac{q_{enc}}{\epsilon_0}$$

$$E \cdot S = \frac{q_{enc}}{\epsilon_0}$$

$$E = \frac{q_{enc}}{\epsilon_0 S} = \frac{0}{\epsilon_0 S} = 0$$

(ii) Superficie $r \to R$

$$E_{fuera} = \frac{Q}{4\pi\epsilon_0 r^2} \xrightarrow[r \to R]{} \frac{Q}{4\pi\epsilon_0 R^2}$$



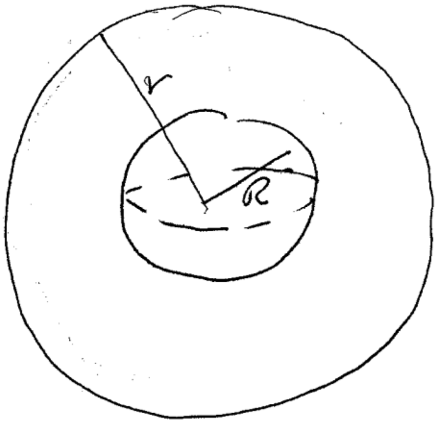
▷ CAMPO ELECTRICO PARA UNA ESFERA MACIZA CONDUCTORA

$\vec{E} = \bar{E}_{hueca}$ porque al ser conductora la carga está repartida solo en superficie.

1) CAMPO ELECTRICO DE UNA ESFERA MACIZA DIELECTRICA

i) Fuera $r > R$

$$\rho = \frac{Q}{\frac{4}{3}\pi R^3}$$

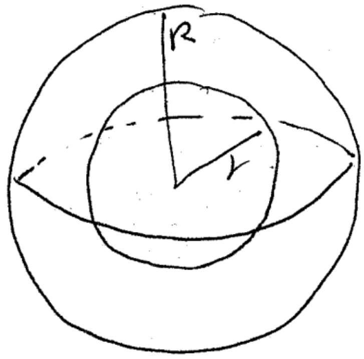


$$\oint \bar{E}\, d\bar{s} = \frac{q_{enc}}{\epsilon_0}$$

$$\boxed{\vec{E} = \frac{Q}{4\pi\epsilon_0 r^2}\,\vec{u}_r}$$

ii) Dentro $r < R$

$$\oint \bar{E}\, d\bar{s} = \frac{q_{enc}}{\epsilon_0}$$



$$E \cdot S = \frac{\rho \cdot \frac{4}{3}\pi r^3}{\epsilon_0}$$

$$E = \frac{\rho\, \frac{4}{3}\pi r^3}{4\pi r^2 \epsilon_0} = \frac{\frac{Q}{4/3\, \pi R^3}\, \frac{4}{3}\pi r^3}{4\pi r^2 \epsilon_0}$$

$$E = \frac{Q\, \frac{r^3}{R^3}}{4\pi r^2 \epsilon_0} = \frac{Q r}{4\pi\epsilon_0 R^3}$$

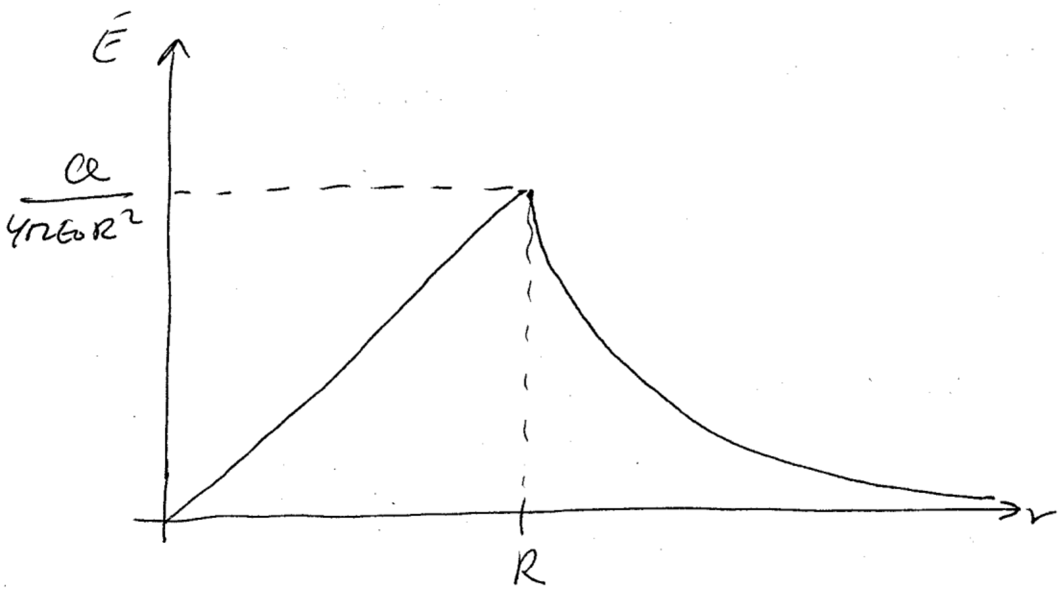
$$\boxed{\vec{E} = \frac{Q r}{4\pi\epsilon_0 R^3}\,\bar{u}_r}$$

(ii) Superficie $r \to R$.

Desde fuera $\quad E = \dfrac{Q}{4\pi\varepsilon_0 r^2} \xrightarrow[r \to R]{} \dfrac{Q}{4\pi\varepsilon_0 R^2}$

Desde dentro $\quad E = \dfrac{Q r}{4\pi\varepsilon_0 R^3} \xrightarrow[r \to R]{} \dfrac{Q}{4\pi\varepsilon_0 R^2}$

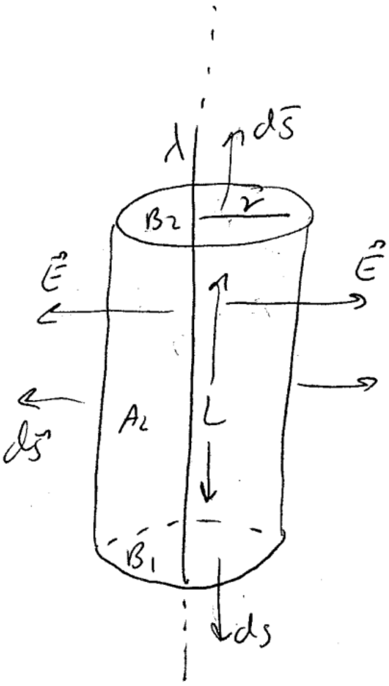
$$\boxed{\vec{E} = \frac{Q}{4\pi\varepsilon_0 R^2}\,\vec{u}_r}$$



$$\vec{V} = -\int \vec{E}\,d\vec{r} = -\int \frac{Q}{4\pi\varepsilon_0 r^2}\,dr = \frac{Q}{4\pi\varepsilon_0 r}$$

$$V_S = \frac{Q}{4\pi\varepsilon_0 R}$$

D Campo Eléctrico creado por una línea cargada indefinida



$$\lambda = \frac{Q}{l}$$

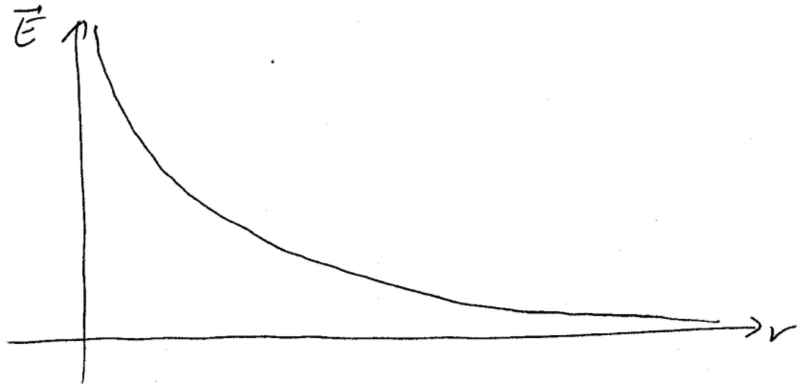
$$\oint \vec{E} d\vec{s} = \frac{q_{enc}}{\varepsilon_0}$$

$$\oint \vec{E} d\vec{s} = \int_{A_L} \vec{E} d\vec{s} + \int_{B_1} \underbrace{\vec{E} d\vec{s}}_{0} + \int_{B_2} \underbrace{\vec{E} d\vec{s}}_{0}$$

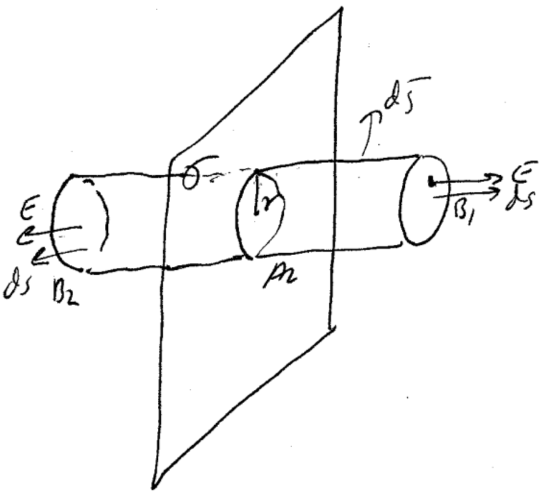
en B_1 y B_2 $\quad \vec{E} \perp d\vec{s}$

$$\Rightarrow \oint \vec{E} d\vec{s} = \int_{A_L} \vec{E} \cdot d\vec{s} = E \cdot S = E\, 2\pi r \cdot l$$

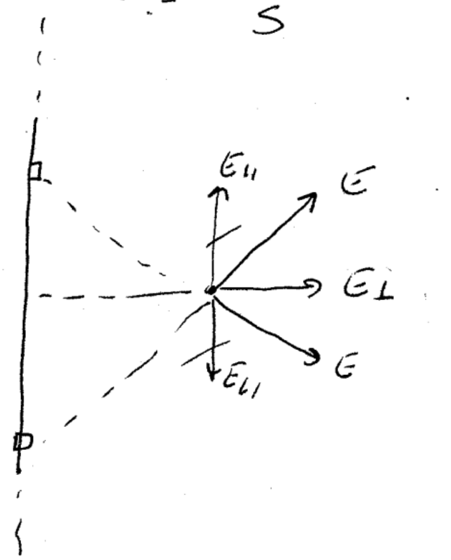
$$\rightarrow E\, 2\pi r\, l = \frac{\lambda\, l}{\varepsilon_0} \quad \rightarrow \boxed{\vec{E} = \frac{\lambda}{2\pi\varepsilon_0 r}\,\vec{u}_r}$$



⇒ CAMPO ELECTRICO CREADO POR UN PLANO CARGADO UNIFORMEMENTE INDEFINIDO



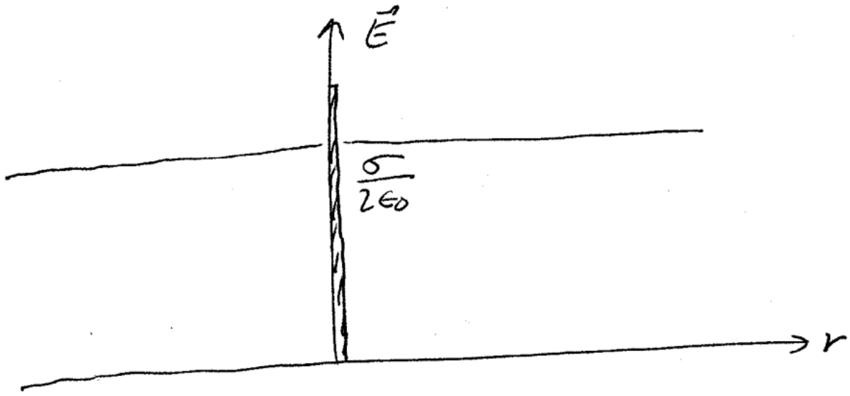
$$\sigma = \frac{Q}{S}$$



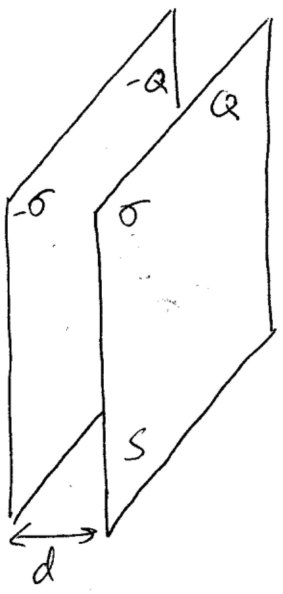
$$\oint \vec{E}\, d\vec{S} = \frac{q_{enc}}{\epsilon_0} \Rightarrow \oint \vec{E}\, d\vec{S} = \int_{B_1} \vec{E}\, d\vec{S} + \int_{B_2} \vec{E}\, d\vec{S} + \underbrace{\int_{A_L} \vec{E}\, d\vec{S}}_{\substack{0 \\ \vec{E} \perp d\vec{S}}}$$

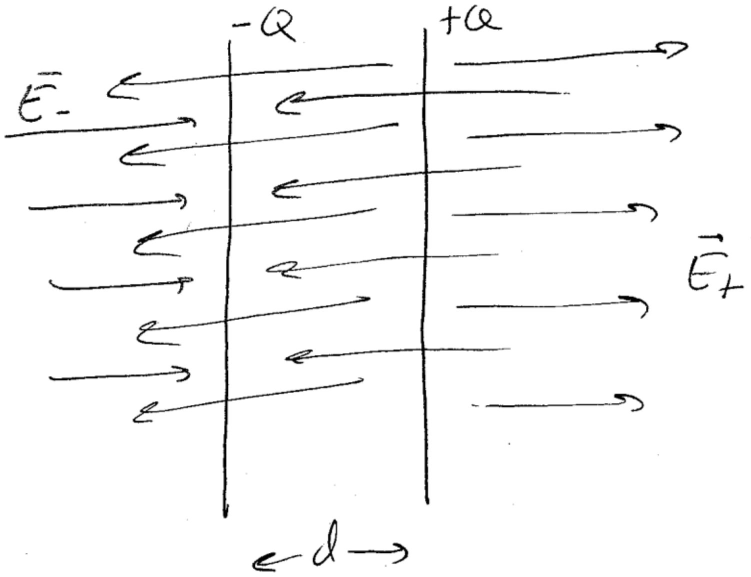
$$E S_{B_1} + E S_{B_2} = \frac{q_{enc}}{\epsilon_0}$$

$$2 E \pi r^2 = \frac{\sigma \pi r^2}{\epsilon_0} \rightarrow \boxed{\vec{E} = \frac{\sigma}{2\epsilon_0} \vec{u}_\perp} \text{ cte}$$



D CAMPO ELECTRICO EN UN CONDENSADOR.





$$\bar{E}_{fuera} = \bar{E}_- + \bar{E}_+ = 0$$

$$\bar{E}_{dentro} = \bar{E}_+ + \bar{E}_- = 2\,\bar{E} = 2\,\frac{\sigma}{2\varepsilon_0} = \frac{\sigma}{\varepsilon_0}$$

dirigido de la placa negativa a la positiva.

$$\boxed{E = \frac{\sigma}{\varepsilon_0}}$$

$$V = \frac{E}{d}$$