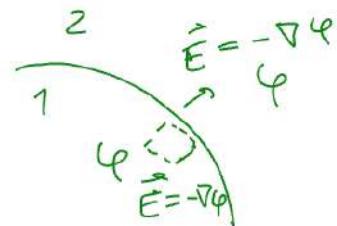


4) a) close pasada

$$\varphi(r, \theta) = \begin{cases} \frac{q}{4\pi\epsilon_0} \left(\frac{1}{\sqrt{r^2 + a^2 - 2ar\cos\theta}} - \frac{\frac{R}{a}}{\sqrt{r^2 + \frac{R^4}{a^2} - 2rR^2 \cos\theta}} \right) & \text{si } r > R \\ 0 & \text{si } r \leq R \end{cases}$$

b)

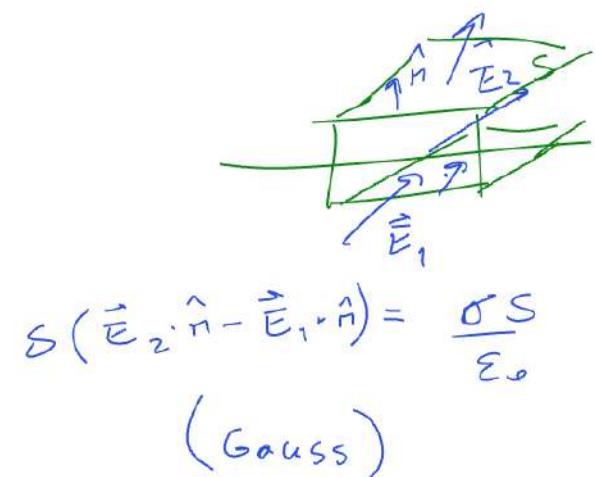


$$E_{\perp 2} - E_{\perp 1} = \frac{\sigma}{\epsilon_0}$$

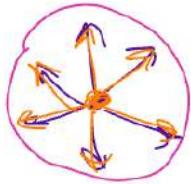
$$E_{\perp 1} = 0 \quad (\text{porque } \nabla(\downarrow \phi) = 0)$$

$$\Rightarrow \sigma = \epsilon_0 \left[\frac{\partial \phi}{\partial r} \Big|_2 \right]$$

$$\nabla \phi \cdot \hat{e}_r = \frac{\partial \phi}{\partial r} \rightarrow \underbrace{E_{\perp 2}}$$



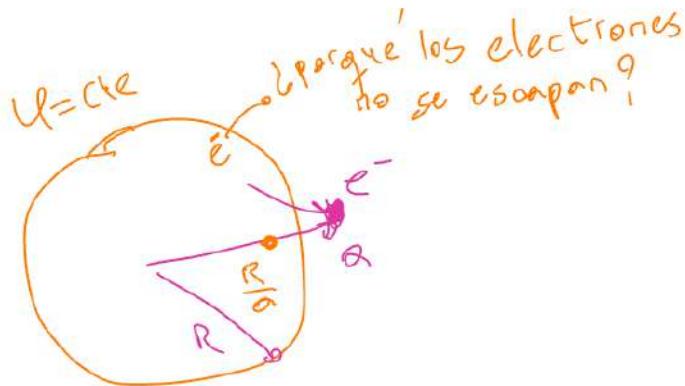
c)



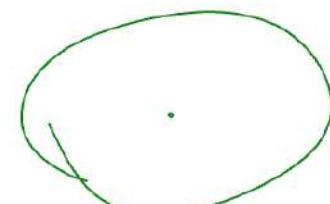
la forma
de cambiar

el potencial en una cte
en el cascarón es
poner una carga virtual en
el centro de la esfera

d)



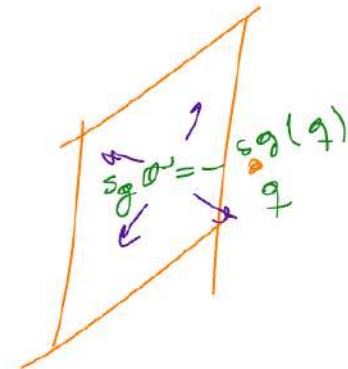
$$\nabla^2 \varphi = 0 \rightarrow \boxed{\nabla^2 \varphi' = 0}$$



$$C \cdot B \Rightarrow \varphi = \text{cte} = \varphi_0$$

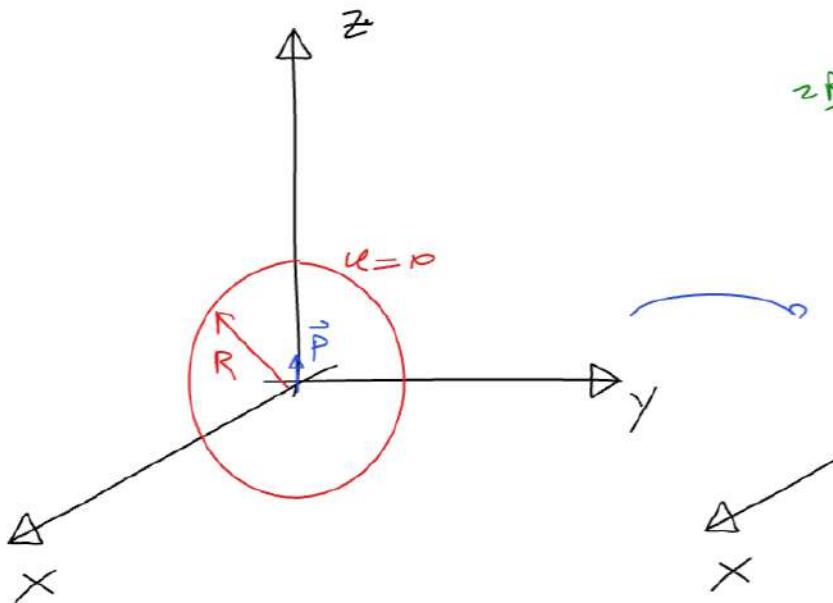
$$\varphi' = \varphi - \varphi_0$$

$$\boxed{C \cdot B \Rightarrow \varphi' = 0}$$



5. Un dipolo puntual se localiza en el centro de un cascarón esférico conductor conectado a tierra.

Hallar el potencial en el interior de la esfera.



$$q \rightarrow -q$$

$$\frac{d}{2} \rightarrow -\frac{d}{2}$$

$$2\frac{R^2}{a} = a \cdot \tilde{\vec{q}} = -\frac{2R}{d} q$$

$$r < R$$

$$\psi(r, \theta) = \frac{q}{4\pi\epsilon_0} \left(\frac{1}{\sqrt{r^2 + (\frac{dR}{2})^2 - 2r\frac{d}{2}\cos\theta}} + \frac{2\frac{R}{d}}{\sqrt{r^2 + \frac{4R^4}{d^2} - 4r\frac{R^2}{d}\cos\theta}} \right)$$

$$d > 0$$



Tex 1 or

$$q \rightarrow -\frac{R}{a} \tilde{\vec{q}} \Rightarrow \tilde{\vec{q}} = -\frac{R}{R} q = -\frac{q}{d} \hat{z}$$

$$\frac{R^2}{a} \rightarrow \frac{d}{2}$$

$$a \rightarrow 2\frac{R^2}{d}$$

$$| \frac{1}{| r + d \hat{z} |} |$$

$$-\frac{q}{4\pi\epsilon_0} \left(\frac{1}{\sqrt{r^2 + (\frac{dR}{2})^2 + 2r\frac{d}{2}\cos\theta}} - \frac{2\frac{R}{d}}{\sqrt{r^2 + \frac{4R^4}{d^2} + 4r\frac{R^2}{d}\cos\theta}} \right)$$

$$r < R \quad \Phi_{\text{dip}}(r, \theta) = \frac{q}{4\pi\epsilon_0} \left(\frac{1}{\sqrt{r^2 + \left(\frac{d^2}{2}\right)^2 - 2r\frac{d}{2}\cos\theta}} + \frac{\frac{2R}{d}}{\sqrt{r^2 + \frac{R^4}{d^2} - 4r\frac{R^2}{d}\cos\theta}} \right) - \frac{q}{4\pi\epsilon_0} \left(\frac{1}{\sqrt{r^2 + \left(\frac{d^2}{2}\right)^2 + 2r\frac{d}{2}\cos\theta}} + \frac{\frac{2R}{d}}{\sqrt{r^2 + \frac{4R^4}{d^2} - 4r\frac{R^2}{d}\cos\theta}} \right)$$

$q \rightarrow -q$
 $\frac{d}{2} \rightarrow -\frac{d}{2}$

Taylor

$$5) \quad \Phi_{\text{dip}} = \lim_{d \rightarrow 0} \Phi_{\text{dip}} = \frac{q}{4\pi\epsilon_0} \left[\left(\frac{1}{r} + \frac{1}{2} \frac{rd\cos\theta}{r^3} + o(d^2) \right) - \left(\frac{1}{r} - \frac{1}{2} \frac{rd\cos\theta}{r^3} + o(d^2) \right) \right] - 2R \left(\frac{1}{2R^2} + \frac{2drR^2\cos\theta}{8R^6} + o(d^2) \right) + 2R \left(\frac{1}{2R^2} - \frac{2drR^2\cos\theta}{8R^6} + o(d^2) \right)$$

$$\frac{1}{\sqrt{x+x}} \approx \frac{1}{\sqrt{d}} + \frac{1}{2d^{3/2}} X + o(X^2)$$

$$\boxed{\Phi_{\text{dip}} = \frac{qd}{4\pi\epsilon_0} \left[\frac{\cos\theta}{r^2} - \frac{r\cos\theta}{R^3} \right] = \frac{qd\cos\theta}{4\pi\epsilon_0} \left\{ \frac{1}{r^2} - \frac{r}{R^3} \right\}}$$