$\oint \vec{E} \cdot d\vec{l}$

$\vec{E} = 0$ inside conductors (static case)

Sheilding

$\oint \vec{E} \cdot d\vec{S} = \frac{q_{encl}}{\varepsilon_0} = 0$

b/c $\vec{E} = 0$ on the surface

$\oint \vec{E} \cdot d\vec{l} = 0$

This is for the question: What is an empty cavity of a conductor, for any Shape!?

$$= \int_{\substack{\text{inside}\\\text{cavity}}} \vec{E} \cdot d\vec{l} + \int_{\substack{\text{inside}\\\text{conductor}}} \vec{E} \cdot d\vec{l}$$

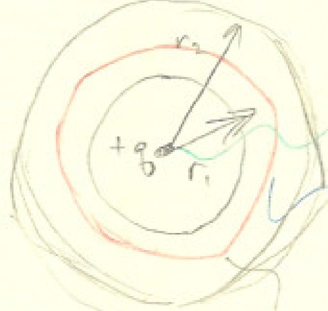
$\rightarrow 0$ inside cavity

$$= \int_{\substack{\text{inside}\\\text{cavity}}} \vec{E} \cdot d\vec{l} = 0$$

Holds for any path inside empty conductor

$E = \emptyset$ always.

EX



We have $+q_0$ in the center

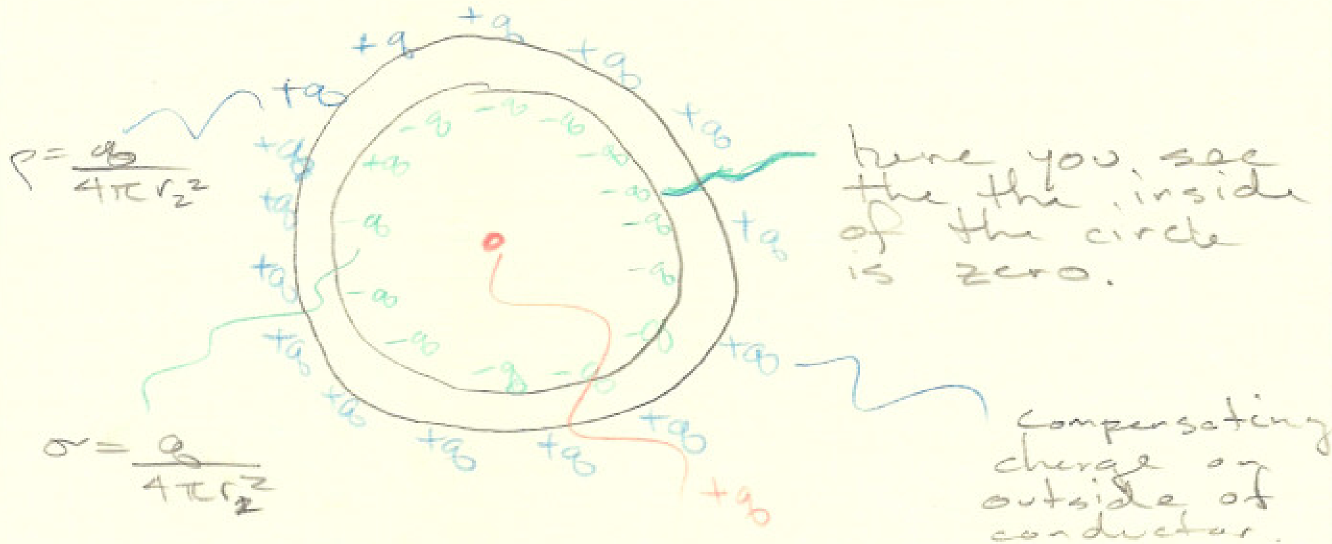
conductor

perfect sphere around origin

$$\oint \vec{E} \cdot d\vec{S} = \frac{q_{enci}}{\varepsilon_0} \qquad q_{enci} = \emptyset$$

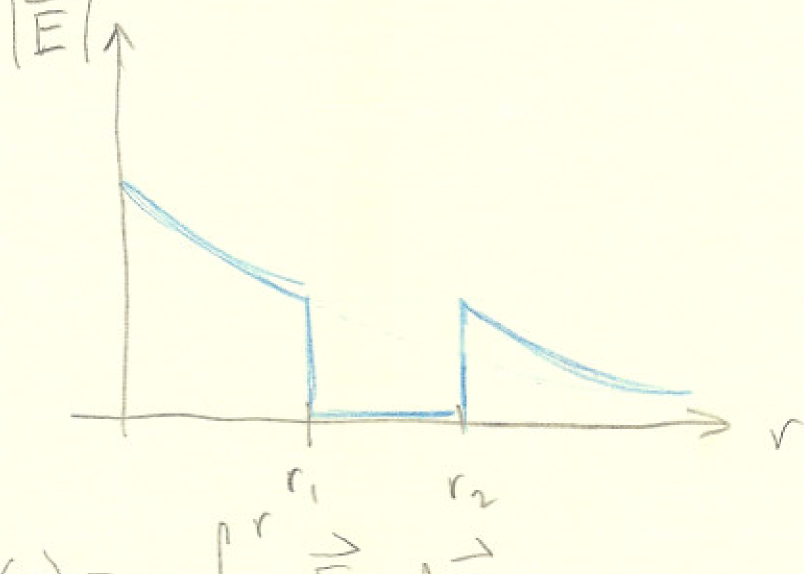
how do we solve this problem

There must exist a net charge $-q_0$ sowhere in the circle. For this perfect sphere conductor, we can uniformly place the electrons around the ~~center~~ of the surface of the conductor.



But then of course we must circle the outside of the conductor. To keep the net charge the same

The inside of the surface



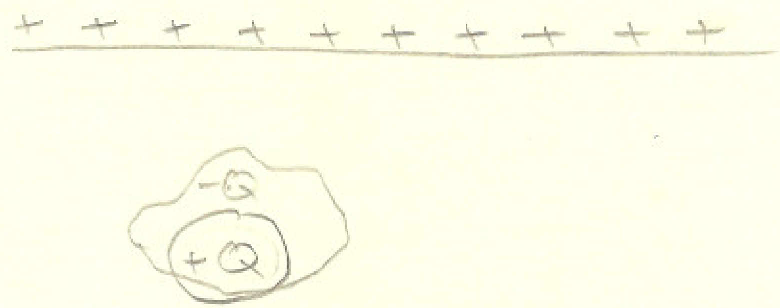
$$V(r) = -\int^{r} \vec{E} \cdot d\vec{l}$$

$$= -\int_{\infty}^{r_2} \vec{E} \cdot d\vec{l} - \int_{r_2}^{r_1} \vec{E} \cdot d\vec{l} - \int_{r_1}^{r} \vec{E} \cdot d\vec{l}$$

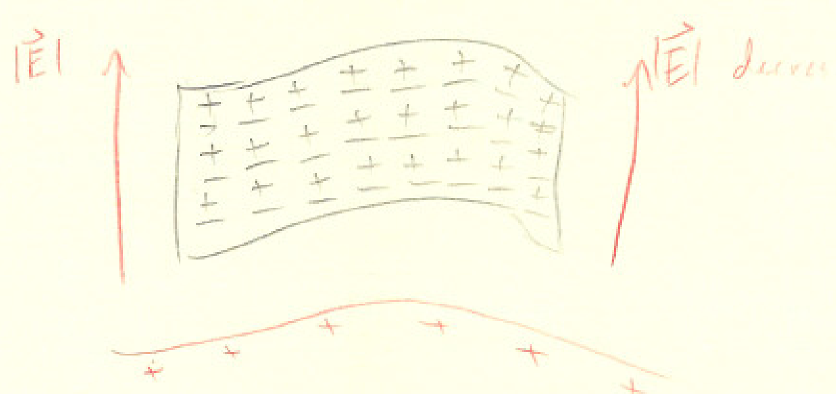
Dielectrics

(Ideally = ∅)

Here there is no net charge
Now if we observe what happens
where we place an infinite line
of electric feild.



The free moving electrons are scattered towards the + surface.
∴ inside of a conductor.



$\vec{E}_{net}$ inside the dialectric

$= E_{xt} + E_{CAPLET.}$

$|\vec{E}_{net}| < |\vec{E}_{ext}|$

In Vacuum, $\vec{D} = \varepsilon_0 \vec{E}$

$\oint \vec{D} \cdot d\vec{S} = q_{encircled.}$

$\vec{D} = \varepsilon \vec{E}$

note: not ε_0

Such that $\vec{D}$ in the dielectric still satisfied

$\oint \vec{D} \cdot d\vec{S} = q_{encircled} = \varepsilon \oint \vec{E} \cdot d\vec{S}$

$\oint \vec{E} \cdot d\vec{S} = \frac{q_{encircled}}{\varepsilon}$ $\quad \varepsilon > \varepsilon_0$

in dielectric

$$\vec{D} = (1 + \chi_e)\varepsilon_0 \vec{E}$$

χ_e: electric susceptibity of material.

$$\varepsilon = (1 + \chi_e)\varepsilon_0$$

$$\frac{\varepsilon}{\varepsilon_0} = (1 + \chi_e) = \varepsilon_r > 1$$

ε_r: relative permability

$$\vec{D} = \varepsilon \vec{E}$$