Conductors + Qualitative Electrostatics

Conductor - Material in which a net charge can move a macroscopic distance.

$\Rightarrow$ If there is a non-zero electric field in a conductor, then there is a force on the mobile (free) charge, and therefore an electric current.

$\Rightarrow$ Therefore in electrostatic situations the electric field in a conductor is **zero**.

$\Rightarrow$ So that no surface current will flow, the electric field must be $\perp$ to the surface of the conductor.

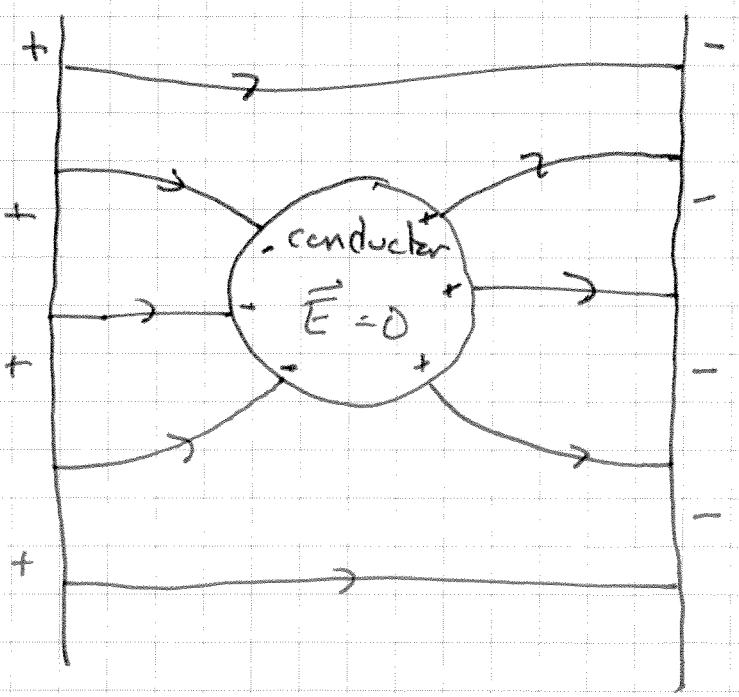
$\Rightarrow$ There can be no net charge interior to the conducting material. (If there were Gauss' Law would imply a non-zero field.

$\Rightarrow$ If the conductor contains no cavities containing net charge, all net charge is at the outer surface

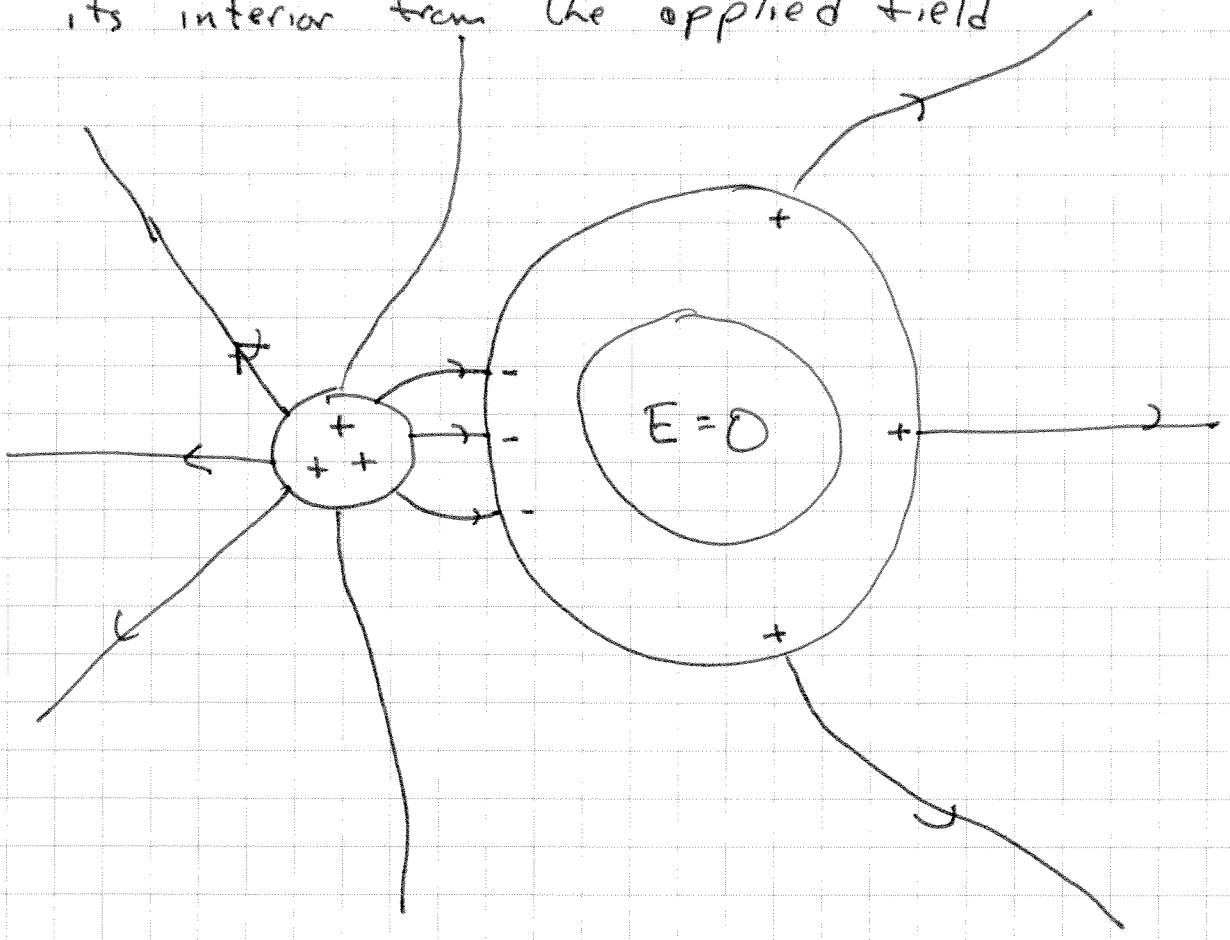
Reminder of Qualitative Electrostatics

- Since $\vec{F} = Q\vec{E}$, the electric field points in the direction of the electric force on a positive test charge.
- We can represent the electric field with a field map where field lines point in the direction of the field and line spacing is inversely proportional to field strength.
- Field lines begin on + end on − (by Gauss)

Ex

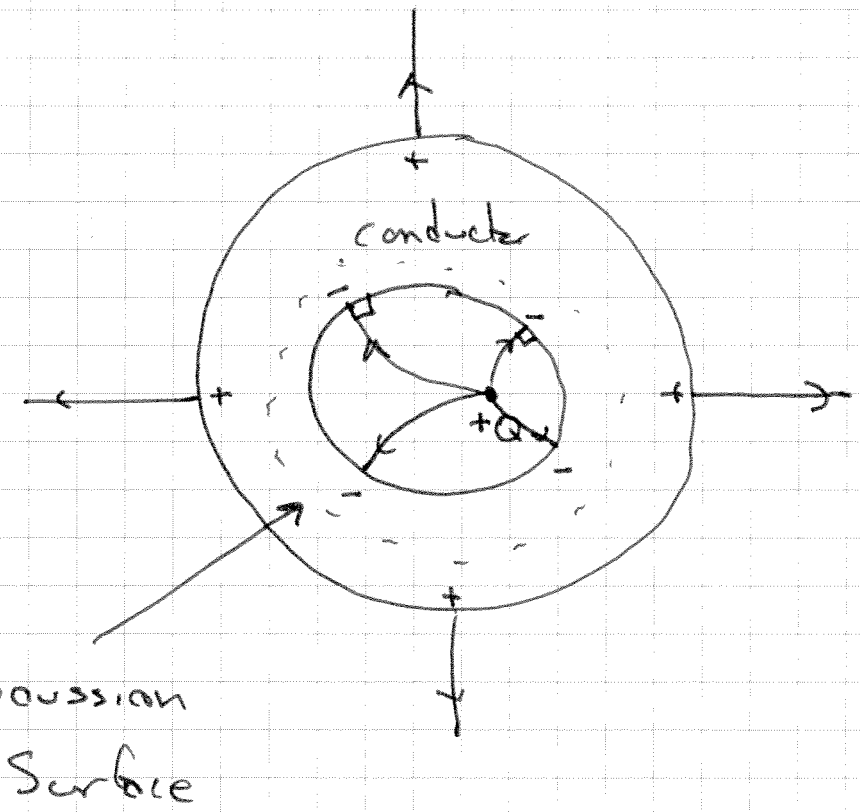


A conductor in an external electric field produces a separated surface charge that shields its interior from the applied field



⇒ Note, induced charge on outer surface

There can be charge on the inner surface if the conductor is hollow and there is a net charge in the hollow.



By Gauss' Law, for the field to be zero in the conductor, there must be net charge $-Q$ on the surface of the cavity.