DAY 24

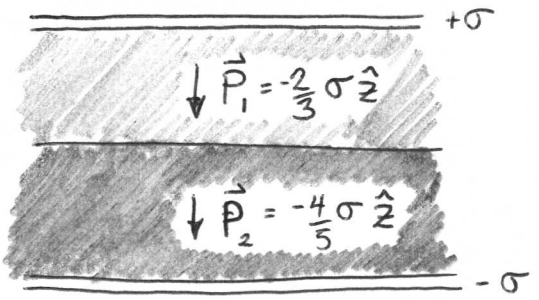
PH631

2015

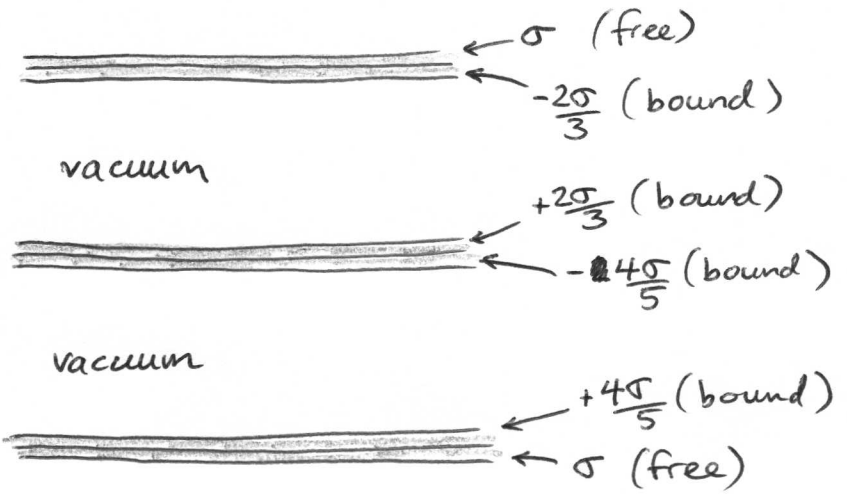
Instructor: Ethan Minot

Last time: A new version of Gauss's Law that works with or without polarized materials present

$$\int_{\text{Gaussian surface}} \vec{D} \cdot d\vec{a} = Q_{\text{free, enc}} \qquad \text{where } \vec{D} = \epsilon_0 \vec{E} + \vec{P}$$

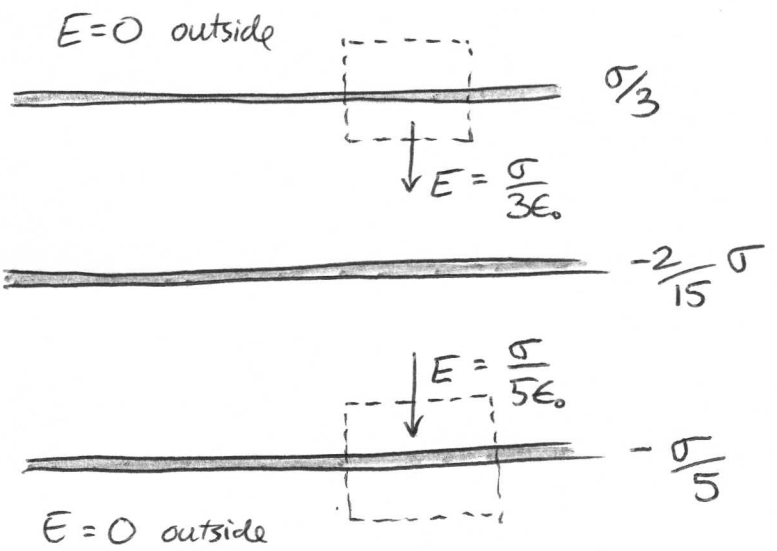


using $\sigma_b = \vec{P} \cdot \hat{n}$ we can map this system onto an equivalent system with only charge density (replace $\vec{P}$ with bound charge)



Using this equivalent charge distribution I can calculate $\vec{E}$ in the different regions of space.

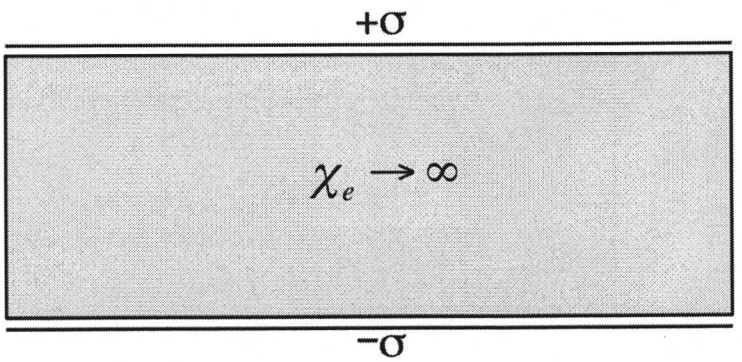
First, superimpose the charge densities that lie on top of each other, then use "standard Gauss's law".



(3)

PH631 Pop Quiz, Day 24

Name:

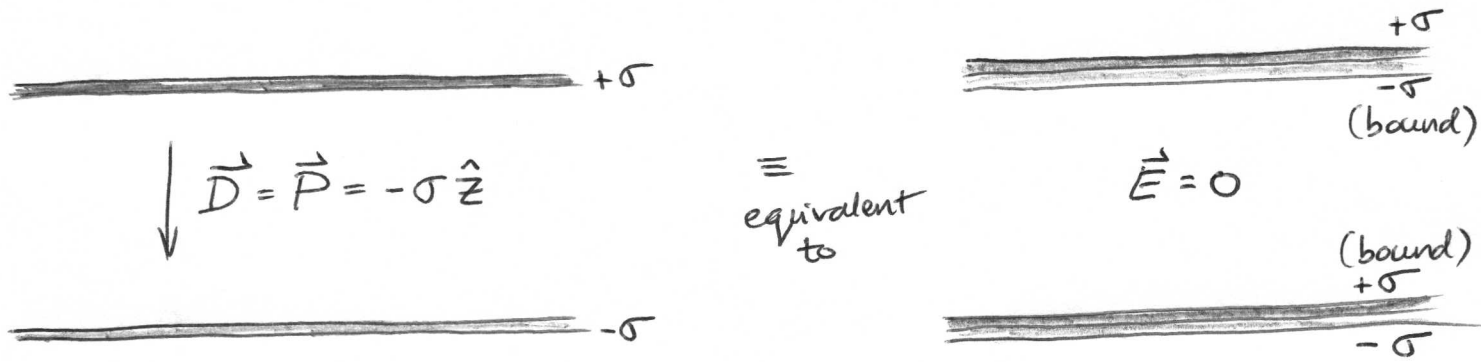


A slab of polarizable material is placed between two sheets of charge, as shown above. The electric susceptibility of the slab is infinite.

b) Find the electric field **E** and polarization **P** inside the slab

d) Find the location and amount of all bound charge.

Discussion of pop quiz.



when $\chi_e \to \infty$, polarization can be maintained in material even as $\vec{E} \to 0$.

Metals are an example of a material with $\chi_e \to \infty$.

Note: $\vec{P}$ does not become infinite.
This would violate physics (infinite energy density and ~~etc~~ related issues!)