If you put a polarizable material (a dielectric) in an external field $\mathbf{E}_e$, it polarizes, adding a new field, $\mathbf{E}_p$ (from the bound charges). These superpose, making a total field, $\mathbf{E}_T$. What is the vector equation relating these three fields?

A. $\mathbf{E}_T + \mathbf{E}_e + \mathbf{E}_p = 0$
B. $\mathbf{E}_T = \mathbf{E}_e - \mathbf{E}_p$
C. $\mathbf{E}_T = \mathbf{E}_e + \mathbf{E}_p$
D. $\mathbf{E}_T = -\mathbf{E}_e + \mathbf{E}_p$
E. Something else

ANNOUNCEMENTS

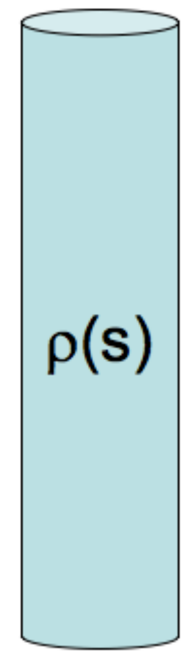
- Exam 2 (Wednesday, November 8th 7-9pm)
- Covers through Homework 9 (solutions posted after class)
- "Comprehensive" exam (need to remember old stuff)
- 1 sheet of your own notes; formula sheet posted

WHAT'S ON EXAM 2?

- Using Legendre polynomials and separation of variables in spherical coordinates, solve for the potential and distribution of charge in a boundary value problem
- Using the multipole expansion, find the approximate form of the potential for a distribution of charge
- Determine the bound charge in a material with a given polarization
- Find the electric potential for a 1D Laplace problem and explain how you would determine it using the method of relaxation
- (BONUS) Solve a 3D Laplace problem in Cartesian coordinates

A solid non-conducting dielectric rod has been injected ("doped") with a fixed, known charge distribution $\rho(s)$. (The material responds, polarizing internally.)

When computing D in the rod, do you treat this $\rho(s)$ as the "free charges" or "bound charges"?



A. "free charge"
B. "bound charge"
C. Neither of these - $\rho(s)$ is some combination of free and bound
D. Something else.

We define "Electric Displacement" or "D" field,

$$\mathbf{D} = \varepsilon_0 \mathbf{E} + \mathbf{P}$$

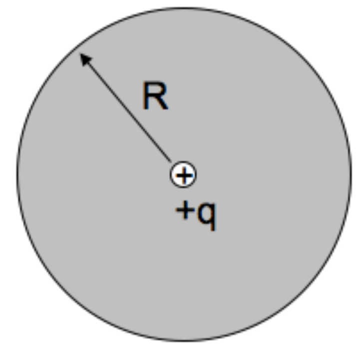
If you put a dielectric in an **external** field, it polarizes, adding a new **induced** field (from the bound charges). These superpose, making a **total** electric field. Which of these three E fields is the "E" in the formula for D above?

A. $\mathbf{E}_{ext}$
B. $\mathbf{E}_{induced}$
C. $\mathbf{E}_{tot}$

We define $\mathbf{D} = \varepsilon_0 \mathbf{E} + \mathbf{P}$, with

$$\oint \mathbf{D} \cdot d\mathbf{A} = Q_{free}$$

A point charge $+q$ is placed at the center of a dielectric sphere (radius R). There are no other free charges anywhere. What is $|\mathbf{D}(r)|$?



A. $q/(4\pi r^2)$ everywhere

B. $q/(4\varepsilon_0 \pi r^2)$ everywhere

C. $q/(4\pi r^2)$ for $r < R$, but $q/(4\varepsilon_0 \pi r^2)$ for $r > R$

D. None of the above, it's more complicated

E. We need more info to answer!

For linear dielectrics the relationship between the polarization, $\mathbf{P}$, and the total electric field, $\mathbf{E}$, is given by:

$$\mathbf{P} = \varepsilon_0 \chi_e \mathbf{E}$$

where X_e is typically a known constant. Think about what happens if (1) $X_e \rightarrow 0$ or if (2) $X_e \rightarrow \infty$. What do each of these limits describe?

A. (1) describes a metal and (2) describes vacuum
B. (1) describes vacuum and (2) describes a metal
C. Any material can gave either $X_e \rightarrow 0$ or $X_e \rightarrow \infty$