

If you put 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

WHAT'S ON EXAM 2?

- Determine the potential everywhere and charge on surface given a boundary condition on surface of sphere.
- Determine the leading order contribution to the potential for a charge distribution; discuss changes that can affect contribution.
- Determine how bound charges are distributed given a particular polarization.
- Explain the process of solving Laplace's equation in Cartesian coordinates and the consequences of the solutions.

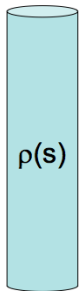
ANNOUNCEMENTS

- Exam 2 (Wednesday, October 2nd in class)
 - Danny will be out; Dennis is in charge
- Covers through Homework 7 (solutions posted after class)
- "Comprehensive" exam (need to remember old stuff)
- 1 sheet of your own notes; formula sheet posted

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,

$$\mathbf{D} = \epsilon_0 \mathbf{E} + \mathbf{P}$$

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}

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

$$\mathbf{P} = \epsilon_0 \chi_e \mathbf{E}$$

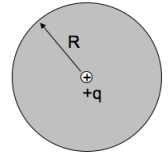
where χ_e is typically a known constant. Think about what happens if (1) $\chi_e \rightarrow 0$ or if (2) $\chi_e \rightarrow \infty$. What do each of these limits describe?

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

We define $\mathbf{D} = \epsilon_0 \mathbf{E} + \mathbf{P}$, 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. $q/(4\epsilon_0\pi r^2)$ everywhere
- C. $q/(4\pi r^2)$ for $r < R$, but $q/(4\epsilon_0\pi r^2)$ for $r > R$
- D. None of the above, it's more complicated
- E. We need more info to answer!