Announcements

- Test Results
  - Trying to hand things back on Wednesday
  - Definitely by next Monday
  - Some people still need to take it so don't be too chatty about it yet please!
- Homework 7 is posted! Due next Monday
- No class on Friday!

Q1

If you put a polarizable material (a dielectric) in an external field $\vec{\mathbf{E}}_{ext}$, it polarizes, adding a new field, $\vec{\mathbf{E}}_{pol}$. These superpose, making a total field $\vec{\mathbf{E}}_{tot}$. What is the vector equation relating these fields?

A. $\vec{\mathbf{E}}_{tot} + \vec{\mathbf{E}}_{ext} + \vec{\mathbf{E}}_{pol} = 0$

B. $\vec{\mathbf{E}}_{tot} = \vec{\mathbf{E}}_{ext} - \vec{\mathbf{E}}_{pol}$

C. $\vec{\mathbf{E}}_{tot} = \vec{\mathbf{E}}_{ext} + \vec{\mathbf{E}}_{pol}$

D. $\vec{\mathbf{E}}_{tot} = -\vec{\mathbf{E}}_{ext} + \vec{\mathbf{E}}_{pol}$

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Q2

We define the "Electric Displacement" or "D" field:

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

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

A. $\vec{\mathbf{E}}_{external}$
B. $\vec{\mathbf{E}}_{induced}$
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Q3

A solid non-conducting dielectric rod has been injected ("doped") with a fixed, known charge distribution $\rho(s)$. The material then 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! $\rho(s)$ is some combination of the two
D. Something else

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Q4

We define $\vec{\mathbf{D}} = \epsilon_0 \vec{\mathbf{E}} + \vec{\mathbf{P}}$ with

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

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

A. $\dfrac{q}{4\pi r^2}$

B. $\dfrac{q}{4\pi\epsilon_0 r^2}$

C. $\dfrac{q}{4\pi r^2}$ for $r < R$, but $\dfrac{q}{4\pi\epsilon_0 r^2}$ for $r > R$

D. None of the above, we need more information to answer.

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Q5

When there are no free charges ($\rho_{free} = 0$) in a dielectric material, does the electric potential V in that material satisfy Laplace's Equation?

$$\nabla^2 V = 0$$

A. Yes
B. No
C. Sometimes

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Q6

An "electret" is the electric equivalent of a bar magnet. Say you have a cylindrical electret whose baked in polarization points along the cylinder's axis, going as:

$$\vec{\mathbf{P}} = P_0 \hat{\boldsymbol{z}}$$

There are no free charges present. Which of the following would be a true statement?

A. $\vec{\mathbf{E}} = 0$ everywhere
B. $\vec{\mathbf{D}} = 0$ everywhere
C. $|\vec{\mathbf{P}}| = P_0$ everywhere
D. None of the above

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