

Workbook



Table of Contents

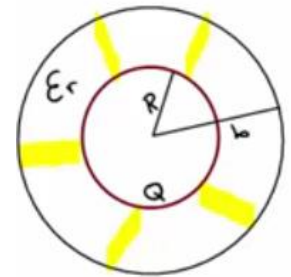
Dielectric Materials	2
Dielectric Materials	2

Dielectric Materials

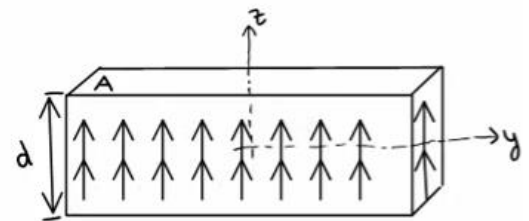
Dielectric Materials

Questions

- 1) A dielectric material is placed between two concentric spherical shells. The inner shell has radius R and charge Q , and the outer shell has radius b . Calculate the electric field.

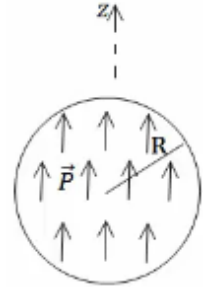


- 2) A box of area A and width d is polarized with a polarization density of $\vec{P} = P_0 \frac{z}{d} \hat{z}$. The origin is at the center of the box.
- Find the bound surface charge, as well as the bound volume charge.
 - What is the total bound charge in the box?



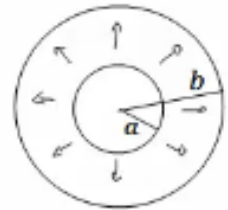
- 3) A sphere of radius R is polarised with polarisation density $\vec{P} = A\vec{r}$. A is a constant and \vec{r} is a vector from the center of the sphere.
- Calculate the bound charge densities.
 - Calculate the electric field inside and outside the sphere.
- 4) A cylinder of radius R and length L is uniformly polarised along its axis of symmetry. Calculate the bound charge densities and draw the field lines under the following circumstances:
- $R \ll L$
 - $L \ll R$
 - $R \approx L$

- 5) A sphere of radius R has polarisation vector $\vec{P} = P_0 \hat{z}$. Calculate the electric field.

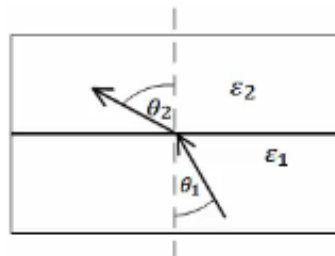


- 6) A spherical shell of inner radius a and outer radius b is made of dielectric material, of polarisation density $\vec{P}(\vec{r}) = \frac{A}{r} \hat{r}$.

A is a constant and r is the distance from the center of the shell. Calculate the electric field throughout, once by making use of the bound charges, and again by making use of the displacement vector.



- 7) A light ray is made up of an electric and magnetic field propagating in space. Show that if the ray passes from dielectric material of constant ϵ_1 into another dielectric material of constant ϵ_2 , then we get Snell's law. Snell's law: $\tan \theta_1 = \frac{\epsilon_1}{\epsilon_2} \tan \theta_2$



*For the solutions go see the videos