# 國立中央大學八十五學年度碩士班研究生入學試題卷

所別: 光電科學研究所　不分組　科目: 電磁學　共 2 頁 第 1 頁

(1) Show that for dielectric materials

$$-\rho_b = \left(\frac{\varepsilon_r - 1}{\varepsilon_r}\right)\rho_f$$

10%

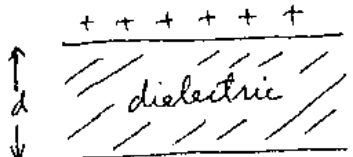
where $\rho_b$ is the volume bound charge density, $\rho_f$ the volume free charge density, and $\varepsilon_r$ is the relative permittivity (also called dielectric constant) of the material considered. You may use the formula relating the bound charge density and the electric polarization without proof.

(2) It is known in a dielectric material $\vec{P} = \epsilon_0 \chi \vec{E}$, where P is the electric polarization; $\varepsilon_0$, the permittivity in vacuum; $\chi$, the susceptibility and $\vec{E}$ is the induced electric field.

a) Is this $\vec{E}$ a precise quantity at a point in space and at an instant of time or a quantity of space-and-time average?

18%

b) Consider 2 charged conducting plates filled with a dielectric material in between. (see Fig.1), how do you find $\vec{E}$ experimentally? c) Is $\vec{E}$ the field that is felt by the molecules in the dielectric material? Tell me what you know about this question.



Fig

(3) The atomic polarizability of Argon atom is $2.026 \times 10^{-29}$ in MKS unit. At the condition of standard temperature and pressure, there are $2.69 \times 10^{25}$ atoms in one cubic meter. Find the index of refraction of the argon gas in this condition.

14%

(4) Consider the H-field and B-field in magnetostatics. To what quantities in electrostatics do the H-field and B-field correspond, respectively? Give reasons. 14%

(5) Fig. 2 is a cross-sectional view in the x-y plane of a conducting plate which is held at constant potential $V_0$. The setup extends to $+\infty$ and $-\infty$ in the z-direction. a) Show that the electric potential near the bottom of the wedge portion can be approximated by $C_1(x^2-y^2)+V_0$. 20%

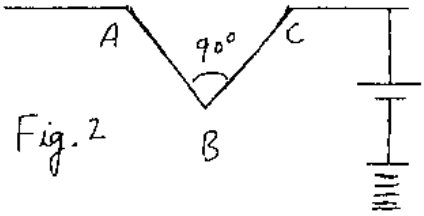


Fig. 2

b) Find the expression for the surface charge density on the portion AB.

(6) A beam of laser light is incident normally into a glass cylinder, find the ratio of the electric field in the air to that in the glass. Given the $\varepsilon_r$ (relative permittivity) of glass equal to 2.25 at optical frequency. 14%

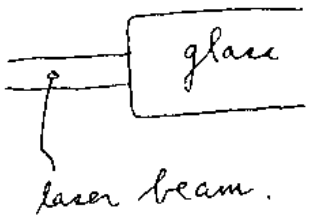


Fig. 3

(7) A piece of dielectric material is subjected to a non-uniform electrostatic field as shown in Fig. 4. Thus, the electric field inside the dielectric material is also non-uniform. Does this non-uniform electric field give rise to some non-zero bound charge? 10%

Fig. 4