EEC 130A: Homework 7

Due: 3:30 pm, Feb. 26th, 2013

1. (FAE P4.22) Given the electric flux density

$$\mathbf{D} = \hat{\mathbf{x}}2(x+y) + \hat{\mathbf{y}}(3x-2y) \qquad (C/m^2)$$

determine

(a) ρ_v by applying the differential form of Gauss's law.

(b) The total charge Q enclosed in a cube 2 m on a side, located in the first octant with three of its sides coincident with the x-, y-, and z-axes and one of its corners at the origin.

(c) The total charge Q in the cube, obtained by applying the integral form of Gauss's law.

2. (FAE P4.27) An infinitely long cylindrical shell extending between $r = 1$ m and $r = 3$ m contains a uniform charge density ρ_{v0}. Apply Gauss's law to find D in all regions (i.e. for $0 < r \leq 1\ m$, $1\ m < r \leq 3\ m$, and $r > 3\ m$)

3. (FAE P4.32) A circular ring of charge of radius a lies in the x-y plane and is centered at the origin. Assume also that the ring is in air and carries a uniform density ρ_l

(a) Show that the electrical potential at $(0, 0, z)$ is given by

$$V = \frac{\rho_l a}{2\epsilon_0\sqrt{a^2+z^2}}.$$

(b) Find the corresponding electric field $\boldsymbol{E}$.

4. (FAE P4.48) With reference to Fig. 1, find $\mathbf{E}_1$ if $\epsilon_1 = 2\epsilon_0$, $\epsilon_2 = 18\epsilon_0$, $\mathbf{E_2} = \hat{\mathbf{x}}3 - \hat{\mathbf{y}}2 + \hat{\mathbf{z}}2$ (V/m), and the boundary has a surface charge density $\rho_s = 3.54 \times 10^{-11}$ (C/m^2). What angle does $\mathbf{E_2}$ make with the z-axis. (Hint: Read through Example 4-10 in the textbook.)

5. (FAE P4.52) Determine the force of attraction in a parallel-plate capacitor with $A = 5$ cm^2, $d = 2$ cm, and $\epsilon_r = 4$ if the voltage across it is 50 V. (Hint: Read through Section 4-10 in the textbook.)

6. (FAE P4.54) An electron with charge $Q_e = -1.6 \times 10^{-19}$ C and mass $m_e = 9.1 \times 10^{-31}$ kg is injected at a point adjacent to the negatively charged plate in the region between the plates of an air-filled parallel-plate capacitor with separation of 1 cm and rectangular plates each 10 cm^2 in area (Fig. 2). If the voltage across the capacitor is 10 V, find the following:

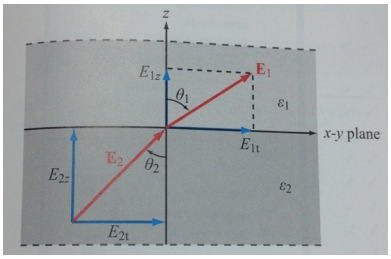

Figure 1: (FAE Fig. 4.19) Application of boundary conditions at the interface between two dielectric media (Example 4-10).

(a) The force acting on the electron.

(b) The acceleration of the electron.

(c) The time it takes the electron to reach the positively charged plate, assuming that it starts from rest.

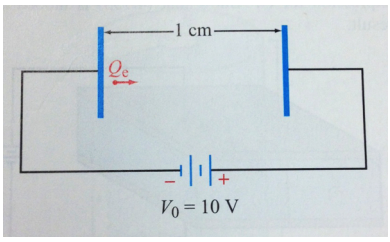

Figure 2: (FAE Fig. P4.54) Electron between charged plates of Problem 3.