ECE 341 HW #9

1. Problem 4.33 in 7/E and 6/E (i.e. 4.30 in Answer Sheet and 5/E)

Problem 4.30 Show that the electric potential difference V_{12} between two points in air at radial distances r_1 and r_2 from an infinite line of charge with density ρ_l along the z-axis is $V_{12} = (\rho_l/2\pi\varepsilon_0)\ln(r_2/r_1)$.

2. Problem 4.39 in 7/E and 6/E (i.e. 4.35 in Answer Sheet and 5/E)

4.35* An infinitely long line of charge with uniform density $\rho_l = 9$ (nC/m) lies in the x–y plane parallel to the y-axis at $x = 2$ m. Find the potential V_{AB} at point $A(3\text{ m}, 0, 4\text{ m})$ in Cartesian coordinates with respect to point $B(0, 0, 0)$ by applying the result of Problem 4.30.

3. Problem 4.48 in 7/E and in 6/E (i.e. 4.43 in Answer Sheet and 5/E).

Problem 4.43 With reference to Fig. 4-19, find $\mathbf{E}_1$ if $\mathbf{E}_2 = \hat{\mathbf{x}}3 - \hat{\mathbf{y}}2 + \hat{\mathbf{z}}2$ (V/m), $\varepsilon_1 = 2\varepsilon_0$, $\varepsilon_2 = 18\varepsilon_0$, 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?

4. Problem 4.53 in 7/E and 6/E (i.e. 4.49 in Answer Sheet and 5/E).

Problem 4.49 Dielectric breakdown occurs in a material whenever the magnitude of the field $\mathbf{E}$ exceeds the dielectric strength anywhere in that material. In the coaxial capacitor of Example 4-12,

(a) At what value of r is $|E|$ maximum?

(b) What is the breakdown voltage if $a = 1$ cm, $b = 2$ cm, and the dielectric material is mica with $\varepsilon_r = 6$?

5. Problem 4.56 & 4.57(a,b) in 7/E and 6/E (i.e. 4.52 & 4.53 in Answer Sheet and 5/E).

Problem 4.53 Use the result of Problem 4.52 to determine the capacitance for each of the following configurations:

(a) conducting plates are on top and bottom faces of rectangular structure in Fig. 4-35(a) (P4.53(a)),

(b) conducting plates are on front and back faces of structure in Fig. 4-35(a) (P4.53(a)),

6. Problem 4.58 & 4.59 in 7/E and in 6/E (i.e. 4.54 & 4.55 in Answer Sheet and 5/E).

Problem 4.55 Use the expressions given in Problem 4.54 to determine the capacitance for the configurations in Fig. 4.35(a) (P4.55) when the conducting plates are placed on the right and left faces of the structure.

7. Problem 4.61 in 7/E and in 6/E (i.e. 4.56 in Answer Sheet and 5/E). Explain carefully.

Problem 4.56 With reference to Fig. 4-37 (P4.56), charge Q is located at a distance d above a grounded half-plane located in the x–y plane and at a distance d from another grounded half-plane in the x–z plane. Use the image method to

(a) establish the magnitudes, polarities, and locations of the images of charge Q with respect to each of the two ground planes (as if each is infinite in extent), and

(b) then find the electric potential and electric field at an arbitrary point $P(0,y,z)$.

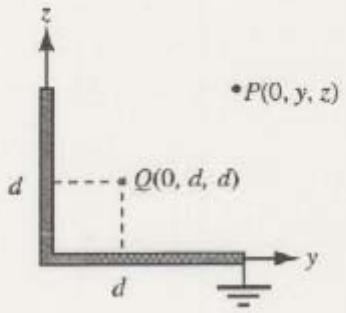

Figure P4.56: Charge Q next to two perpendicular, grounded, conducting half planes.