4.7 PROBLEMS

Problem 4.7.1. Find the electric field and electric potential everywhere from a uniformly charged long metal cylindrical shell of inner radius R_1 and outer radius R_2 with charge per unit length λ. Ans: $(\lambda/2\pi\epsilon_0)\ln(r)$ for $r < R$.

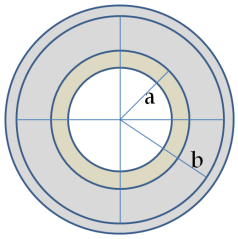

Figure 4.31: Exercise 4.7.2.

Problem 4.7.2. Consider a spherical capacitor consisting of two concentric metallic spherical shells. The outer radius of the smaller shell is a and the inner radius of the external shell is b. The space between the shells is empty. Find the formula for capacitance of this arrangement of two conductors. Ans: $\frac{1}{C} = \frac{1}{4\pi\epsilon_0}\left(\frac{1}{b} - \frac{1}{a}\right)$.

Problem 4.7.3. Find the capacitance of one spherical shell of radius R in empty space. Hint: The other conductor pair is at infinity. Ans: $C = 4\pi\epsilon_0 R$.

Problem 4.7.4. Consider a cylindrical capacitor consisting of a long cylinder (considered infinite for purposes of calculation) of radius a. Surrounding the cylinder and coaxial to it is a cylindrical shell of inner radius b. The space between the cylinder and the shell is empty. Find the capacitance per unit length. Ans: $2\pi\epsilon_0/\ln(b/a)$.

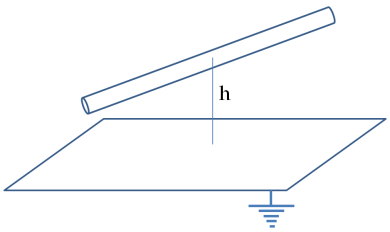

Figure 4.32: Exercise 4.7.5.

Problem 4.7.5. Consider a uniformly charged long and thin wire with line charge density λ at a height h to a grounded metal plate and parallel to it. Find the electric potential at all points on the same side of the plate as the charged wire.

Problem 4.7.6. A charge $+q$ is at a distance a from the center of a grounded uncharged spherical conductor of radius R. (a) Find the image charge, magnitude and location (inside the space occupied by the conductor). (b) Find an expression of the potential at a point outside the conductor. (c) Find the force on $+q$ by the uncharged conductor. (d) Find the electric field outside the conductor. (e) Deduce the electric charge distribution induced on the spherical conductor.

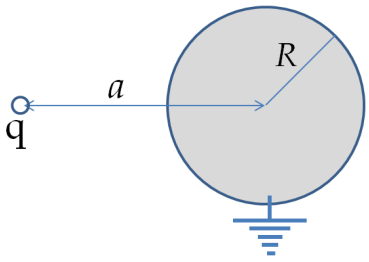

Figure 4.33: Exercise 4.7.6.