

PHY 415
Homework 3

Due October 5, 2009

1. a) Calculate the dipole moment for the following configuration of charges: three, each of value q , located at $(x = 0, y = 0, z = d)$, $(x = R, y = 0, z = 0)$, $(x = -R, y = 0, z = 0)$, as well as a charge of $-3q$ located at $(x = 0, y = 0, z = -d)$.

b) Calculate the quadrupole moment for the charge configuration where two charges of value q are at $(x = 0, y = 0, z = R)$ and $(x = 0, y = 0, z = -R)$, while two other charges of value $-q$ are at $(x = R, y = 0, z = 0)$ and $(x = -R, y = 0, z = 0)$.

2. Two long cylindrical conductors (wires) of radii a_1 and a_2 respectively are separated by a distance $d \gg a_1, a_2$. Find the capacitance *per unit length* for the system. If $d = 0.5\text{cm}$ and $a_1 = a_2 = a$, what must be the diameter of the wires to give a capacitance per unit length of 9×10^{-3} ?

3. Consider a point charge q at a distance d from the center of a conducting sphere of radius R , where $d > R$. The surface of the sphere is maintained at a constant potential Φ_0 .

a) Determine the “image” charges needed to study this problem.

b) Determine the potential at any point outside the sphere.

c) Determine the induced surface charge density as well as the total induced charge.