Homework No. 12 (2018 Fall)

PHYS 320: Electricity and Magnetism I

Due date: Friday, 2018 Nov 30, 2:00 PM, in class

1. (**20 points.**) The monopole moment, the dipole moment, and the quadrupole moment, of a charge distribution $\rho(\mathbf{r})$ is given by

$$Q = \int d^3r\, \rho(\mathbf{r}), \tag{1a}$$

$$\mathbf{d} = \int d^3r\, \rho(\mathbf{r})\, \mathbf{r}, \tag{1b}$$

$$\mathbf{q} = \int d^3r\, \rho(\mathbf{r}) \Big[3\mathbf{rr} - r^2\mathbf{1}\Big], \tag{1c}$$

   respectively. Consider a charge distribution consisting of a single point charge. If it is placed at the origin calculate the monopole moment, dipole moment, and quadrupole moment, of the charge distribution. Repeat the calculation if the position of the point charge is $(a, 0, 0)$.

2. (**20 points.**) A positive charge q is placed at $(a, 0, 0)$. Two negative charges of charge $-q$ each are placed at $(-a/2, a\sqrt{3}/2, 0)$ and $(-a/2, -a\sqrt{3}/2, 0)$. Find the monopole moment, dipole moment, and the quadrupole moment of this configuration of charges.