PHYS 401: Electricity & Magnetism I
Due date: Wednesday, March 31, 2021

Problem set #7

1) Problem 3.50

2) Problem 3.41

3) Problem 3.19

4) Two hemispheres

Consider a spherical conducting shell (radius R) which is divided into two hemispheres at the equator by a thin insulating ring. A potential V_0 is applied to one hemisphere, while a potential $-V_0$ is applied to the other.

a) Write down the boundary condition for the potential in this electrostatic system.

b) Calculate the potential inside the sphere by expanding the potential in powers of the radial variable *r*. Calculate the first two non-zero terms explicitly.

c) Calculate the potential outside the sphere by expanding the potential in powers of the radial variable *r*. Calculate the first two non-zero terms explicitly.

d) Determine the dipole moment vector and quadrupole moment term for this electrostatic system.

5) Ring of charge

Consider a uniformly charged ring of radius R and total charge Q.

a) Model the ring as a very thin equatorial band of a spherical shell. Shows that in spherical coordinates the charge density can be written as $\sigma(\theta) = \frac{Q}{2\pi R^2}\delta(\theta - \pi/2)$.

b) Calculate the potential $V(r, \theta)$ everywhere due to this ring of charge using separation of variables.

c) Use the multipole expansion to calculate the potential $V(r, \theta)$ for the ring.