Problem 3.20.

(a) Suppose the potential is a *constant* V_0 over the surface of the sphere. Use the results of Exs. 3.6 and 3.7 to find the potential inside and outside the sphere. (Of course, you know the answers in advance – this is just a consistency check on the method.)

(b) Find the potential inside and outside a spherical shell that carries a uniform surface charge σ_0, using the results of Ex. 3.9.

Problem 3.21. The potential at the surface of a sphere (radius R) is given by

$$V_0 = k\cos 3\theta,$$

where k is a constant. Find the potential inside and outside the sphere, as well as the surface charge density $\sigma(\theta)$ on the sphere. (Assume there's no charge inside or outside the sphere.)

Problem 3.32. In Ex. 3.9, we derived the exact potential for a spherical shell of radius R, which carries a surface charge $\sigma = k\cos\theta$.

(a) Calculate the dipole moment of this charge distribution.

(b) Find the approximate potential, at points far from the sphere, and compare the exact answer (Eq. 3.87). What can you conclude about the higher multipoles?

Problem 3.34. Two point charges, $3q$ and $-q$, are separated by a distance a. For each of the arrangements in Fig. 3.35, find (i) the monopole moment, (ii) the dipole moment (with respect to the origin of coordinates), and (iii) the approximate potential (in spherical coordinates) at large r (include both the monopole and dipole contributions).

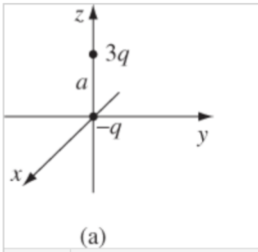

Fig. 3.35

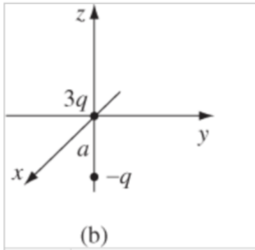

Fig. 3.35

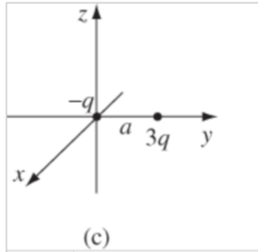

Fig. 3.35

Problem 3.37. A solid sphere, radius R, is centered at the origin. The “northern” hemisphere carries a uniform charge density ρ_0, and the “southern” hemisphere a uniform charge density $-\rho_0$. Find the approximate field $\mathbf{E}(r, \theta)$ for points far from the sphere ($r \gg R$).