

Physics 412: Introduction to Electrodynamics

Homework 1

Due: Friday, 9 October, 2009

1. Problem 2.1

2. Problem 2.4

3. Problem 2.41

4. For the dipole electric field,

$$E(r, \theta) = \frac{C_o}{r^3} (2 \cos\theta \hat{r} + \sin\theta \hat{\theta}) \quad (1)$$

find and sketch the field lines.

5. Electric field of and force on continuous charge distributions

- a. Find the electric field for a charged sphere of radius  $R$  with spherically symmetric charge distribution. Find the field both inside and outside the sphere.
- b. Place another charged sphere of radius  $R$  with an identical spherically symmetric charge distribution such that the distance between the centers of the two spheres is  $D$ , where  $D > 2R$ . Find the total force between the two charged spheres.

6. An infinitesimally thin flat disk with radius  $R$  and surface charge density  $\sigma > 0$  is placed so that its center lies at the origin of a Cartesian coordinate system.

- a. Find the electric field of the disk on its symmetry axis. For this problem let the  $z$ -axis be the symmetry axis of the disk.
- b. A charge  $q$ , where  $q\sigma < 0$ , is placed at the center of the disk. What is the force on charge  $q$ ?
- c. If charge  $q$  is constrained to move only along the  $z$ -axis find and describe its subsequent motion if it is pushed off the origin an amount  $h \ll R$ .