P114 - PROBLEM SET 1

Homework to be handed in to your workshop instructor by 1800 hours on Tuesday 28 January 2014.

[1] Electric and gravitational forces.
   a) What would be the proton’s mass if the gravitational force between two protons at rest were to equal the electric force? How does this compare with its actual mass?
   b) What would be the electric force between two dimes (each of mass 2gm) placed at opposite ends of a 10 meter lecture table if their nuclear and electronic charges were unbalanced by 1%. Can you think of some object whose “weight” equals that force?

[2] A $2 \times 10^{-6}C$ charge is at the center of a cube of side 20 cm. What is the electric flux through one of the faces of the cube?

[3] Four charges of equal magnitude, $|q| = 2 \times 10^{-18}C$, are arranged at the four corners of a square of side $L = 5$ cm as shown in the figure. Calculate the magnitude, in Newtons, and the direction of the force acting on the lower-left corner charge due to the presence of the other charges.

[4] Two charges $+q$ and $-3q$ are separated by a small distance. Draw the electric-field lines for this system.

[5] Three point charges are placed on the $y$-axis; a charge $q$ at $y = a$, a charge $-2q$ at the origin, and a charge $q$ at $y = -a$. Such an arrangement is called an electric quadrupole. Find the magnitude and direction of the electric field on the $y$-axis for $y > a$. 