UNIVERSITY OF ALABAMA
Department of Physics and Astronomy

PH 102 / LeClair Summer II 2009

Problem Set 2: Electrostatics

Instructions:

1. Answer all questions below. Show your work for full credit.
2. Due before the end of the day, 13 July 2009
3. Email: leclair.homework@gmail.com; hard copies: Gallalee 110 or Bevill 228.
4. You may collaborate, but everyone must turn in their own work

1. At each corner of a square is a particle with charge q. Fixed at the center of the square is a point charge with opposite sign, of magnitude Q. What value must Q have to make the total force on each of the four particles zero? With Q set at that value, the system, in the absence of other forces, is in equilibrium. Do you think the equilibrium is stable?

2. A charge of $100\,\mu$C is at the center of a cube of side 0.8 m. **(a)** Find the total flux through each face of the cube. **(b)** Find the flux through the whole surface of the cube. **(c)** Would your answers to the first two parts change if the charge were not at the center of the cube?

3. A pyramid has a square base of side a, and four faces which are equilateral triangles. A charge Q is placed on the center of the base of the pyramid. What is the net flux of electric field emerging from one of the triangular faces of the pyramid?

4. Suppose three positively charged particles are constrained to move on a fixed circular track. If all the charges were equal, an equilibrium arrangement would obviously be a symmetrical one with the particles spaced $120°$ apart around the circle. Suppose two of the charges have equal charge q, and the equilibrium arrangement is such that these two charges are $60°$ apart rather than $120°$. What must be the relative magnitude of the third charge?

5. Two small spheres, each of mass 2.00 g, are suspended by light strings 10.0 cm in length. A uniform electric field is applied in the horizontal (x) direction. The spheres have charges equal to -5×10^{-8} C and $+5 \times 10^{-8}$ C. Determine the electric field that enables the spheres to be in equilibrium at an angle $\theta = 10.0°$.