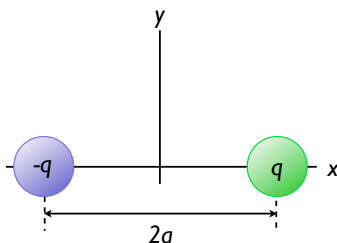


Problem Set 2: Electric Forces & Fields

Instructions:

- Answer all questions below. Show your work for full credit.
- Due before 5pm, 25 Jan 2008
- Problem sets may be turned in *via* email or hard copy
- Hard copies may be left in Dr. LeClair's mailbox (Gallalee 206) or office (Bevill 228)
- You may collaborate, but everyone must turn in their own work

- 1. 5 points.** Why must hospital personnel wear special conducting shoes while working around oxygen in an operating room? What might happen if they wore shoes with rubber soles?
- 2. 10 points.** Two solid spheres, both of radius R , carry identical total charges, Q . One sphere is a good conductor while the other is an insulator. If the charge on the insulating sphere is uniformly distributed throughout its interior volume, how do the electric fields outside these two spheres compare? Are the fields identical inside the two spheres?
- 3. 10 points.** Two charges of $15\ \mu\text{C}$ and $10\ \mu\text{C}$, respectively, lie along the x axis 1.0 m apart. Where can a third *negative* charge be placed on the x axis such that the resulting electric force on it is zero?
- 4. 15 points.** Two point charges q and $-q$ are situated along the x axis a distance $2a$ apart as shown below. Show that the electric field at a distant point along $|x| > a$ along the x axis is $E_x = 4k_e qa/x^3$.



- 5. 10 points.** At what distance below a proton would the upward force on an electron equal the electron's weight?
- 6. 10 points.** A proton accelerates from rest in a uniform electric field of $800\ \text{N/C}$. At some time later, its speed is $1.2 \times 10^6\ \text{m/s}$. What is the magnitude of the acceleration on the proton?
- 7. 20 points.** 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 90° apart rather than 120° . What must be the relative magnitude of the third charge?
- 8. 20 points.** A charge of $100\ \mu\text{C}$ is at the center of a cube of side $0.8\ \text{m}$. **(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?