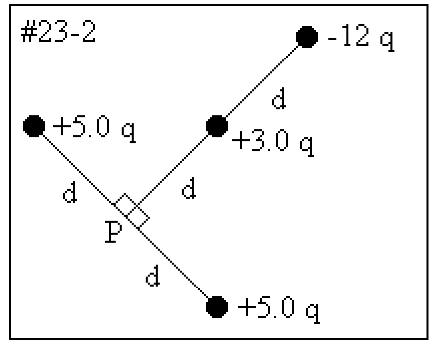
Phsx 2220 — Homework #2

23-1. What is the magnitude of a point charge that would create an electric field of 1.00 N/C at points 1.00 m away?

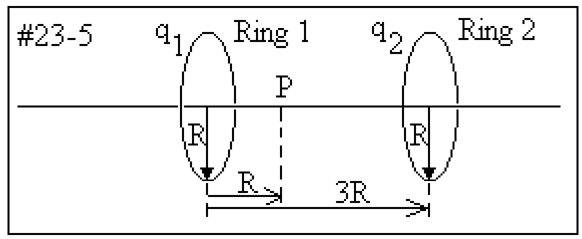
23-2. In the figure at right, what is the electric field at point P due to the four point charges shown?



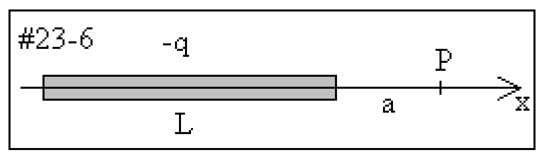
23-3. A proton and an electron form two corners of an equilateral triangle of side length 2.0×10^{-6} m. What is the magnitude of their net electric field at the third corner?

23-4. Calculate the electric dipole moment of an electron and a proton 4.30 nm apart.

23-5. The figure at right shows two parallel nonconducting rings arranged with their central axes along a common line. Ring 1 has uniform charge q_1 and radius R; ring 2 has uniform charge q_2 and the same radius R. The rings are separated by a distance 3R. The net electric field at point P on the common line, at distance R from ring 1, is zero. What is the ratio q_1/q_2?

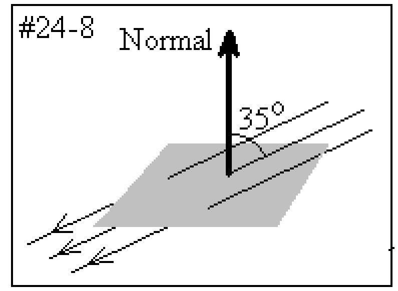


23-6. In the figure at right, a nonconducting rod of length L has charge -q uniformly distributed along its length. (a) What is the linear charge density of the rod? (b) What is the electric field at point P, a distance a from the end of the rod? (c) If P were very far from the rod compared to L, the rod would look like a point charge. Show that your answer to (b) reduces to the electric field of a point charge for a >> L.



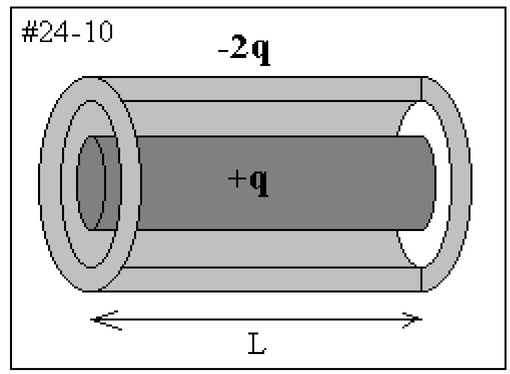
23-7. At some instant the velocity components of an electron moving between two charged parallel plates are $v_x = 1.5 \times 10^5$ m/s and $v_y = 3.0 \times 10^3$ m/s. Suppose that the electric field between the plates is given by **E** = (120 N/C)**j** (**E** is a vector and **j** is a unit vector). (a) What is the acceleration of the electron? (b) What will be the velocity of the electron after its x coordinate has changed by 2.0 cm?

24-8. The square surface shown at right measures 3.2 mm on each side. It is immersed in a uniform electric field with magnitude E = 1800 N/C. The field lines make an angle of 35^o with a normal to the surface, as shown. Take the normal to be "outward," as though the surface were one face of a box. Calculate the electric flux through the surface.

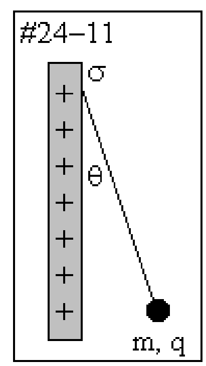


24-9. The electric field just above the surface of the charged drum of a photocopying machine has a magnitude E of 2.3×10^5 N/C. What is the surface charge density on the drum, assuming that the drum is a conductor?

24-10. A very long conducting cylindrical rod of length L with a total charge +q is surrounded by a conducting cylindrical shell (also of length L) with total charge -2q, as shown at right. Use Gauss; law to find (a) the electric field at points outside the conducting shell, (b) the distribution of charge on the conducting shell, and (c) the electric field in the region between the shell and rod.



24-11. In the figure at right, a small, nonconducting ball of mass m = 1.0 mg and charge q = 2.0×10^{-8} C (distributed uniformly through its volume) hangs from an insulating thread that makes an angle θ = 30^o with a vertical, uniformly charged nonconducting sheet (shown in cross section). Considering the weight of the ball and assuming that the sheet extends far vertically and into and out of the page, calculate the surface charge density σ of the sheet.



24-12. In the figure at right a sphere, of radius a and charge +q uniformly distributed throughout its volume, is concentric with a spherical conducting shell of inner radius b and outer radius c. This shell has a net charge of -q. Find expressions for the electric field, as a function of the radius r, (a) within the sphere r < a); (b) between the sphere and the shell (a < r < b); (c) inside the shell (b < r < c); and (d) outside the shell (r > c). What are the charges on the inner and outer surfaces of the shell?