Physics 492 homework due Fri Jan 10

Reading: Chapter 1.1
Supplementary Reading: *Prehistory of Nuclear Physics*, A. K. Wroblewski, Acta. Phys. Pol. B 33, 9 (2002), http://th-www.if.uj.edu.pl/acta/vol33/ps/v33p0009.ps.gz

Problems:

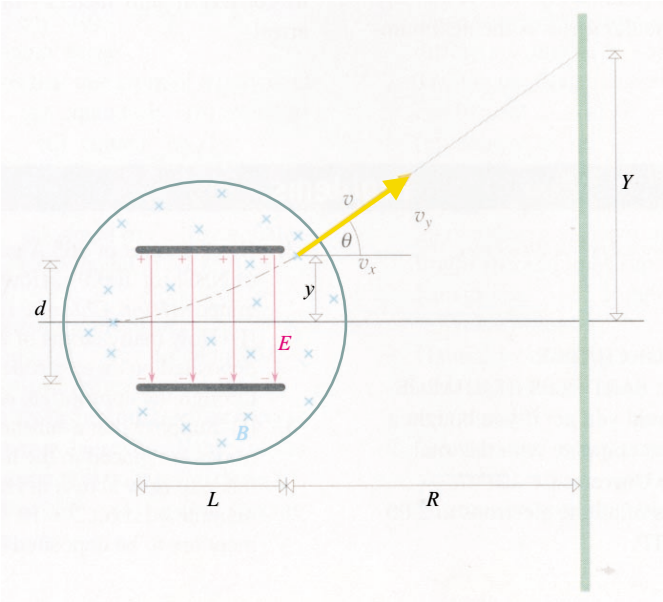
1. In the Millikan oil-drop experiment, a droplet of mass 1.111×10^{-15} kg is held motionless by an electric field of 34.0 kV/m. How many extra electrons is it carrying?

2. An oil droplet carrying a net charge Q and having a mass m falls in air at a steady vertical terminal speed between two vertical parallel plates separated by a distance d. When a potential difference V is applied across the plates, the droplet moves uniformly at an angle θ with the vertical. Find θ.

3. An electron in Thomson's apparatus moves under the influence of a B-field along a path with a radius of 15.00 cm. If an E-field of 20.0 kV/m makes the path straight and horizontal, find B.

4. Use the figure below, depicting Thomson's electron-beam apparatus, to show that the deflection without the B-field is:

$$Y = \left(\frac{e}{m}\right)\frac{B^2 L}{2E}(L + 2R)\,.$$



5. The figure below shows the Thomson atom model of helium ($Z = 2$). Two electrons, at rest, are embedded inside a uniform sphere of positive charge $2e$. Find the distance d between the electrons so that the configuration is in static equilibrium.