

Physics 330, Spring 2009
HW#2 25 points

Problems from Tipler and Llewellyn:

1. **3.3 (5 points)** Equation 3-3 suggests how a velocity selector for particles or mixtures of different particles all having the same charge can be made. Suppose you wish to make a velocity selector that allows undeflected passage for electrons whose kinetic energy is 5.0×10^4 eV. The electric field available to you is 2.0×10^5 V/m. What magnetic field is needed?
2. **3.11 (5 points)** A charged oil droplet falls 5.0 mm in 20.0 s at terminal speed in the absence of an electric field. The specific gravity of air is 1.35×10^{-3} and that of oil is 0.75. The viscosity of air is 1.80×10^{-5} Ns/m². (a) What are the mass and radius of the drop? (b) If the droplet carries two units of electric charge and is in an electric field of 2.5×10^5 V/m, what is the ratio of the electric force to the gravitational force on the droplet? (See the online content for our book for more information. Click the picture of our book on our class page.)
3. **3.15 (5 points)** As noted in the chapter, the cosmic microwave background radiation fits the Planck equation for a blackbody at 2.7 K. (a) What is the wavelength at the maximum intensity of the spectrum of the background radiation? (b) What is the frequency of the radiation at the maximum? (c) What is the total power incident on Earth from the background radiation?
4. **3.26 (5 points)** The work function for cesium is 1.9 eV, the lowest of any metal. (a) Find the threshold frequency and wavelength for the photoelectric effect. Find the stopping potential if the wavelength of the incident light is (b) 300 nm and (c) 400 nm.
5. **3.36 (5 points)** Gamma rays emitted by radioactive nuclei also exhibit measurable Compton scattering. Suppose a 0.511 MeV photon from a positron-electron annihilation scatters at 110° from a free electron. What are the energies of the scattered photon and the recoiling electron? Relative to the initial direction of the 0.511 MeV photon, what is the direction of the recoiling electron's velocity vector?