PHYS420 (Spring 2002)
Riq Parra

Homework # 9
(due Monday, April 22nd , 2002)

Problems

1. **(10 points) Wavelengths**. What is the approximate wavelength of
   (a) a car moving at 60 miles per hour?
   (b) a cell moving at 1mm per hour?
   (c) an electron with an energy of 10 eV?
   (d) a photon with an energy of 10 eV?
   (e) a neutron with an energy of 0.1 eV?

2. Show that the de Broglie wavelength of an electron accelerated from rest through a small potential difference V is given by $\lambda = \frac{1.226}{\sqrt{V}}$, where λ is in nanometers and V is in volts.

3. **SMM, Chapter 4, problem 22.**

4. **SMM, Chapter 4, problem 27.**

5. **SMM, Chapter 4, problem 28.** *To keep this calculation as a general estimate, assume* $\Delta x \Delta p \approx \hbar$ *and that the momentum is roughly of the same order of magnitude as the uncertainty in the momentum (i.e.* $p \approx \Delta p$*).*

6. **The width of spectral lines**. Although an excited atom can radiate at any time, the average time after excitation at which a group of atoms radiates is called the **lifetime**, τ. (a) If τ = 10 nsec, use the uncertainty principle to compute the line width produced by this finite lifetime. (b) If the wavelength of the spectral line involved in this process is 500 nm, find the fractional broadening $\Delta f / f$.