Homework #3

Due 10/18/2001

1. The maximum energy of photoelectrons from aluminum is 2.3eV for radiation of 2000Å and 0.9eV for radiation of 2580Å. Use these data to calculate Planck's constant and the work function of aluminum.

2. The smallest separation resolvable by a microscope is of the order of magnitude of the wavelength used. What energy electrons would one need in an electron microscope to resolve separation of (a) 150 Å, (b) 5 Å?

3. In the Bohr model of the H-atom, suppose we would like to design an experiment to measure the orbit number n in which the electron is located. Thus, the position measurement of the electron has to be done with an accuracy

$$\Delta x << R_n - R_{n-1} \cong n\frac{2\hbar^2}{me^2}.$$

By using Heisenberg's expression of the uncertainty principle

$$\Delta x \cdot \Delta p \geq \frac{\hbar}{2},$$

(a) Calculate the energy uncertainty $\Delta E \sim p\Delta p/m$ due to the above momentum uncertainty;
(b) Comparing ΔE with the binding energy of the electron in the orbit;
(c) Can you achieve the purpose of measuring the orbit number n through this experiment?

4. Two complex numbers z_1, and z_2, probe algebraically that

$$|z_1| - |z_2| \leq |z_1 + z_2| \leq |z_1| + |z_2|.$$

Interpret this result in terms of vectors.