Physics Problems (show explicitly all your work for full credit):

1. Bloomfield: Exercise 1, page 459
2. Bloomfield: Problem 1, page 461
3. Bloomfield: Problem 2, page 461
4. Bloomfield: Problem 4, page 461

5. The human eye can see light between wavelengths of 0.4 and 0.7 \( \mu \text{m} \). What is the range of photon energies (in electron volts) the eye can see?

6. Calculate the wavelength of a gamma-ray photon with an energy of 1 billion eV.

7. At what speed would an electron \( m = 9.1 \times 10^{-31} \text{ kg} \) have to move in order to have the same wavelength as a photon of red light (about 650 nanometers)?

8. Find the de Broglie wavelength for a 100 kg running back moving at 8 m/sec. Do you think this wavelength would be useful to illustrate diffraction? Discuss.

9. What is the minimum uncertainty in the position along the highway of a Ford Escort (mass = 1150 kg) traveling at 20 m/sec (45 miles/hour)? Assume that the uncertainty in the momentum is equal to 1% of the momentum. Explain why the uncertainty in the position of the car due to its wave nature will not affect your ability to locate the car.

10. (a) If you confine an electron to a smaller and smaller region of space, what happens to its velocity?
    (b) Consider an electron confined to a diameter of 0.1 nm, about the size of a hydrogen atom. If the electron’s speed is on the order of the uncertainty in its speed, approximately how fast is it traveling?
    (c) Assuming that the electron can still be treated without making relativistic corrections, find its kinetic energy (in electron volts).