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NAME: \_\_\_\_\_

PHYSICS 4D  
SPRING 2010  
EXAM 2

**MAKE SURE TO SHOW ALL WORK IN COMPLETE DETAIL! NO CREDIT WILL BE GIVEN IF NO WORK IS SHOWN!**

1. Explain the following terms without using any mathematical definitions:

a. Heisenberg Uncertainty Principle (3 pts) -

b. Threshold Frequency (3 pts) –

c. Bohr Correspondence Principle(3 pts) –

d. Matter Waves (3 pts) –

e. Dispersive Medium (3 pts) -

2. Find the energy of an x-ray photon that can impart a maximum energy of 50 keV to an electron by Compton collision. (10 pts).

3. An electron in the hydrogen atom is in the  $n = 2$  state for  $10^{-6}$  s before falling to the  $n = 1$  state. (10 pts)
- Calculate the wavelength of emitted photon.
  - Estimate the recoil momentum and kinetic energy of the atom.
  - Calculate the uncertainty in the energy of the emitted photon.

5. When a pebble is tossed into a pond, a circular wave pulse propagates outward from the disturbance. If you are alert you will see a fine structure in the pulse consisting of surface ripples moving inward through the circular disturbance. Explain this effect in terms of group and phase velocity if the phase velocity of the ripples is given by  $v_p = \sqrt{\frac{2\pi S}{\lambda\rho}}$ , where  $S$  is the surface tension and  $\rho$  is the density of the liquid. (10 pts)

6. Suppose a beginning physics student asks you if it's possible for a particle to be at two different places at the same instant in time. Use the Double-Slit Experiment to answer the student's question. ( 5 pts)