Physics 7c
Fall 2000
Midterm 2
R. Packard

Name:_____ SID_____

Discussion section day and time_____

Work all the problems. They are weighted equally. If you don't understand the question ask the proctor for clarification. Do not perform any numerical work until you have a "boxed" algebraic answer. Do a dimension check on your final answer.

1._____

2._____

3._____

4._____

Total_____

1. An engineer travelling on a train at v=150km/hr sees two lamps on the ground flash at the same time. In the rest frame of the lamps, they are spaced a distance d=100m apart, parallel to the train tracks.
   A) Which of the lamps, the first one the train passed (#1) or the second one (#2), flashed first in the rest frame of the lamps?
   B) How much earlier did it flash?

2. In the Compton effect a 0.1nm photon strikes a free electron at rest, in a head-on collision and knocks it in the forward direction. The rebounding photon recoils directly backwards. Use conservation of (relativistic) energy and momentum to compute the **kinetic energy** of the recoiling electron.

3. Suppose an electron was bound to a proton as in the hydrogen atom, by the gravitational force rather than the electric force. What would then be the energy of the first Bohr orbit? $G=6.67\times10^{-11}$(SI units), $m_e=9\times10^{-31}$kg, $m_p=1836m_e$.

4. A particle of mass m is bound in a simple harmonic oscillator potential, $V=kx^2/2$. Use the uncertainty relation to estimate the average ground state energy.[Hint: for a symmetric potential, the average value of $p^2=(\Delta p)^2$, and the average value of x^2 is $(\Delta x)^2$. Write the total average energy and minimize it.]