Physics 330 Example Exam 1
100 points
For all problems, first find the algebraic solution, then evaluate numerically if you have time.

1) A very fast moving electron has a total energy of $E=2m_ec^2$.

   a) (10 pts) What is the electron's kinetic energy?
   b) (10 pts) What is its velocity? Express in terms of c.
   c) (10 pts) What is the momentum?
   d) (10 pts) What is wavelength?

2) An electron is trapped in a region that has a potential of $V(x)=1/2\ m\omega^2$.

   a) (10 pts) Write the Schrodinger equation.
   b) (10 pts) Draw the potential and wave function for the first two lowest energy levels.
   c) (10 pts) Draw the potential and the spatial probability distribution for the two lowest energy levels.
   d) (10 pts) For the lowest energy level, $\Psi(x) = C\ exp(-\alpha x^2)$ what is the probability that the particle is found a classically forbidden region. Express in terms of m, ω, C and α. Setup the integral, but don't attempt to solve.
   e) (10 pts) If the transition from the first excited state to the ground state emits a 500 nm wavelength photon, what is ω (of $1/2\ m\omega^2$)? How is this related to the angular frequency of the photon?

3) A proton has momentum of exactly p.

   a) (5 pts) What is $\Psi(x)$?
   b) (5 pts) Where is the proton most likely to be found?