

Physics 330, Spring 2009
Practice Exam 1

1. **Problem 1 (30 points)** A photon with energy $E = 4m_e c^2$ interacts with a very heavy atom. A positron, electron pair is created. What is the energy and momentum of the electron and positron if they have the same final velocity? What is the system's invariant rest energy? The system means the created electron and positron.
2. **Problem 2 (30 points)** In Rutherford scattering, we assumed scattering from thin metal foils. Come up with an expression that can be used to tell us when the foil can be considered 'thin'.
3. **Problem 3 (20 points)** For a finite square well with $E > V$, sketch a possible wave function and the corresponding probability distribution.
4. **Problem 4 (20 points)** For the ground state of a Harmonic Oscillator, what is the probability of finding a particle in the "classically forbidden" region. Setup the equations, but do not attempt to solve any integrals.