Physics 201, Fall 2007 Josh Erlich
Problem Set 5
Due Wednesday, October 10.

Problems from Taylor, Zafiratos and Dubson:

2.28, 2.35a, 2.35b, 2.39, 2.41, 2.44

Additional Problem

1. *D-T Fusion*

A deuterium nucleus D contains 1 proton (p) and 1 neutron (n). Its mass is $m_D = 1875.62$ MeV/c^2.

A tritium nucleus T contains 1 proton and 2 neutrons. Its mass is $m_T = 2808.92$ MeV/c^2.

An α-particle (also known as a Helium-4 nucleus) contains 2 protons and 2 neutrons. Its mass is 3727.38 MeV/c^2.

A neutron has mass 939.57 MeV/c^2.

Consider the fusion reaction D+T$\rightarrow$ α+n. It is called a fusion reaction because the two smaller nuclei *fuse* to become a heavier α-particle.

Assume the deuterium and tritium nuclei are at rest. What are the energies of the resulting α-particle and neutron? How much energy is released in the form of kinetic energy?

Comment: In reality, in order to get such a fusion reaction to occur requires some initial energy to overcome the Coulomb repulsion of the positively charged nuclei while the nuclei get close enough together that the strong interaction can take over and bind them together. This is the reason that fusion often requires a high temperature environment: That way the average kinetic energy of the fusing particles is high enough to get the reaction started. For D-T fusion the required energy is around 0.01 MeV.