Physics 4820 - Homework #1
Griffiths Ch. 1: 4, 7, 10*, 12, 13 and A-D below

*The table of mesons mentioned in in Problem 10 is posted under Handouts.

Other exercises:
A. The muons created by cosmic rays in the upper atmosphere rain down more-or-less uniformly on the earth's surface, although some of them decay on the way down, with a half-life of about 2.2 μs (measured in their rest frame). A muon detector is carried in a balloon to an altitude \( h = 2000 \) m, and in the course of an hour detects 650 muons travelling at 0.99c toward the earth. If an identical detector remains at sea level, how many muons should it register in one hour? Calculate the answer using both classical physics and taking into account the relativistic time dilation. Needless to say, the relativistic answer agrees with experiment.

B. Write down a set of equations that represent the parity transformation in Cartesian coordinates. (You could do this with a matrix equation, if you like). Describe in words the reason that some vectors (momentum, for example) are affected differently by a parity transformation than others (angular momentum, for example).

C. A high energy electron collides with an atomic electron which can be considered at rest. What is the threshold energy for producing an electron-positron pair?

D. Decays of the spin–1/2 baryons: Most of the spin–1/2 baryons in the “baryon octet” (p, n, \( \Lambda \), \( \Sigma \), \( \Xi \)) decay weakly to another spin–1/2 baryon plus a pion. The two exceptions are the \( \Sigma^0 \) (which decays electromagnetically) and the neutron (which decays weakly to proton, electron and electron antineutrino).
   a. Show that none of the particles in the octet can decay strongly.
   b. Show that the \( \Sigma^0 \) is the only particle in the octet that can decay electromagnetically.
   c. Explain the unusual decay pattern for the neutron.