Homework 9: Due November 12

1. Scattering in quantum mechanics depends on the various quantum numbers of the states involved. For strongly interacting particle this includes isospsin. Suppose one knows the proton-proton scattering amplitude (for our purposes it doesn't matter what the scattering amplitude actually means in detail---however it tells us all we can know about a scatteing process) Suppose further that we can argue that to very good approximation the scattering depends on physics which is isospin invariant---non-isospin conserving contributions (such as electromagnetic effects) can be neglected

   a. Somebody claims that the neutron-neutron scattering amplitude should be identical to the proton-proton scattering amplitude (with all other quantum numbers such as spin the same). Are they right?. Hint: Determine the decomposition in to states with good I^2 and I_z for the proton-proton and neutron-neutron systems.
   b. Somebody else claims that the proton-neutron scattering amplitude should be identical. Are they right? Hint: Determine the decomposition of a proton-neuron state into states with good I^2 and I_z for the proton-neutron systems.

2. This problem also concerns isospin. There is a baryon called the Δ(1700). It is an isospin 3/2 state meaning it has 4 four different charge states ++, +, 0,-. Suppose one has a reaction which creates the charge + state. It can decay in various ways.

   a. One possible decay is into a Δ (isospin 3/2) and a pion (isospin 1). What is the relative probability that the final state is : $\Delta^{++}+\pi^-$, $\Delta^{+}+\pi^0$ or $\Delta^{0}+\pi^+$?
   b. Another possible decay is into a nucleon (isospin ½) and a pion: What is the relative probability that the final state is : $p+\pi^0$ or $n+\pi^+$.

Sakurai: Chapter 3: 18, 19, 21