Physics 711, Symmetry Problems in Physics Fall 2005

Suggestions for the delayed midterm exam

1. This is group theory in the language of particle physics. The pions are an $I = 1$ multiplet; the nucleons are an $I = 1/2$ multiplet. The s-channel has the quantum numbers of the initial and final states. You must use the Wigner-Eckart theorem in Georgi and/or Tung to see how the various charge states couple to the possible total isospin. Needless to say, isospin here behaves in close analogy to ordinary angular momentum.

2. There is a misprint in line 2. It should read
$(SU(3)_c, SU(3)_f, SU(2)_s)$ where c=color, f=flavor, s=spin. This is also mostly pure group theory. If a quix is a color 6, you must find what color multiplet can bind to make a color singlet and for each part what quarks, antiquarks, etc. can form the needed multiplet.

3. Here again the problem is group theory with the added feature of making some comparison with data. The one fact you might not realize is that if the space wavefunction of the quarks in the P-state is symmetric that corresponds to center-of-mass motion and is not an excited state of the baryon at rest. So you must choose a space wavefunction that is orthogonal to the symmetric space state. Since, with color taking account of antisymmetry, the permutation of the (space, $SU(6)$) wavefunction of the quarks must be symmetric, you must choose a combination of space and $SU(6)$ wavefunctions that is symmetric. Once you have that you must find the $SU(3)_f$ and $SU(2)_s$ content, reduce the $SU(3)_f$ to hypercharge and isospin states, and finally couple the quark and orbital angular momenta to get the observed spins of the resonances. Then you can compare with the data in Manley, item under Manley on SPIRES. The paper doesn't print as a pdf; you must print it as an image.