Homework 1, due 10-20

1. Using isospin symmetry, compute the ratio

$$R = \frac{\sigma(p + d \to \pi^0 + {}^3\mathrm{He})}{\sigma(p + d \to \pi^+ + {}^3\mathrm{H})}.$$

   Here, d is the deuteron (a bound state of p and n), and ^{3}He,^{3}H are three nucleon bound states with charge $Q = +e$ and $+2e$, respectively. You can use the fact that there are no two or three neutron bound states.

2. ^{4}He is a bound state of two protons and two neutrons with $I = 0$. Explain why the reaction

$$d + d \to {}^4\mathrm{He} + \pi^0$$

   is forbidden by isospin symmetry.

3. The ρ meson is a spin one meson (a "vector" meson) with $I = 1$. Using isospin symmetry compute the ratios

$$R = \frac{\rho^0 \to \pi^0 + \pi^0}{\rho^0 \to \pi^+ + \pi^-}$$

   and

$$R = \frac{\rho^+ \to \pi^+ + \pi^0}{\rho^0 \to \pi^+ + \pi^-}.$$