

KING FAHD UNIVERSITY OF PETROLEUM AND MINERALS  
Particle Physics (Phys. 441)

**Assignment # 2**  
**Due to Monday November 1, 2004**

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1. Problem 4.11 in Griffiths (page 138). (10 pts)
2. Problem 4.37 in Griffiths (page 141). (15 pts)
3. Find the CP-Parity of the three-pion system  $\pi^+ \pi^- \pi^0$ . (10 pts)
4. Show that if the system is invariant under rotation then the angular momentum is conserved. (10 pts)
5. Find a relation between the total cross-sections (at a given energy) for the reactions
  - (a)  $\pi^- P \rightarrow K^0 \Sigma^0$
  - (b)  $\pi^- P \rightarrow K^+ \Sigma^-$
  - (c)  $\pi^+ P \rightarrow K^+ \Sigma^+$ . (10 pts)
6. What are the possible isospin values for two pions? Use Clebsch-Gordan tables to write all possible isospin states. (15 pts)
7. Consider a meson that decays strongly into  $\pi^0 \pi^0$ . What are the possible values of  $J$  for that meson. For each value of  $J$ , what are the possible values of the parity and the charge conjugation? Write it in the form  $J^{PC}$ . What are the possible isospin values? (15 pts)
8. Consider the pion decay

$$\pi^+ \rightarrow l^+ + \nu_l \quad (l = e, \mu)$$

- (a) What is the helicity of the charged lepton?
- (b) Using parity arguments, show that the ratio of the decay rates

$$\frac{\Gamma(\pi^+ \rightarrow e^+ + \nu_e)}{\Gamma(\pi^+ \rightarrow \mu^+ + \nu_\mu)} \simeq 10^{-4}$$

(15 pts)