

## Physics 331 – Problem Set # 4

(due Wednesday, February 15)

1. In the previous problem set, you computed the differential cross section for  $q\bar{q} \rightarrow gg$  in a general Yang-Mills theory with massless fermions. Specialize your answer to QCD and show that it produces eq. (17.75) of Peskin and Schroeder. Using crossing appropriately (being careful to average over initial state colors but sum over final state colors), derive eqs. (17.76) and (17.77).
2. The various fermion-fermion scattering cross sections in QCD can be derived from QED results by multiplying by appropriate color factors. Using this strategy, derive eqs. (17.64), (17.65), (17.70), and (17.71) of Peskin and Schroeder.
3. Compute the differential cross section  $d\sigma/d\cos\theta$  for  $gg \rightarrow gg$ , averaged over initial spins and colors and summed over final spins and colors. Use the method of Peskin and Schroeder, Problem 17.3(b). Derive eq. (17.78) of Peskin and Schroeder. This completes the set of  $2 \rightarrow 2$  parton cross sections needed to compute the cross sections for hard-scattering processes at hadron colliders.