

## Problem Set 4 - Final

Physics 445

Due June 6

Some abbreviations: P&S - Peskin & Schroeder

**Please work alone on this problem set.**

You are free to use any reference materials you like.

1. Supersymmetric extensions of the Standard Model typically contain two or more Higgs doublets. With this motivation, work out P&S 20.5.
2. What would be the classical spectrum of gauge bosons if the Standard Model gauge symmetry were broken by a real triplet of  $SU(2)$  instead of a complex doublet?
3. The Standard Model has a global baryon number symmetry and a global lepton number symmetry.
  - (i) Compute the anomalies of the associated currents in the Standard Model.
  - (ii) Are there any non-anomalous, continuous global symmetries in the Standard Model?
  - (iii) Ignoring anomalies now, it is also interesting to ask which higher dimension operators can violate baryon or lepton number in the Standard Model. Such interactions might be induced in a more complete grand unified theory which contains the Standard Model. With this in mind, see if you can find a dimension 5 operator which violates lepton number. Can you construct one that violates baryon number? How about for dimension 6 operators? Make sure that the operators you construct are gauge invariant and Lorentz invariant.