PHY 801: SUSY - Spring 2008

Homework 2

Due Feb 29, 2008

1. Prove the identities:

$$\begin{aligned}
\overline{\psi}\gamma_5\chi &= \overline{\chi}\gamma_5\psi \\
\overline{\psi}\gamma_\mu\chi &= -\overline{\chi}\gamma_\mu\psi \\
\overline{\psi}\gamma_\mu\gamma_5\chi &= \overline{\chi}\gamma_\mu\gamma_5\psi \\
\overline{\psi}\sigma_{\mu\nu}\chi &= -\overline{\chi}\sigma_{\mu\nu}\psi
\end{aligned}$$

   where ψ and χ are Majorana fermions. Hint: Taking transpose of the LHS and noting that spinors are Grassmanian, Use $\gamma_5^T = \gamma_5$ and $C^{-1}\gamma_\mu^T C = -\gamma_\mu$. Discusss the subtlety with $\mu = 0$ for the second identity above and explain why it is still valid if the field product is interpreted as normal ordered.

2. Show that for the Wess-Zumino Model:

$$\delta\mathcal{L}_{mass} = \partial^\mu \left(mA\overline{\alpha}\gamma_5\gamma_\mu\psi + imB\overline{\alpha}\gamma_\mu\psi\right)$$

3. Consider adding the following interactions to the WZ model:

$$\mathcal{L} = k(A^3 - 3AB^2)$$

   (a) Show that these terms violate SUSY.

   (b) Consider the contribution of these terms to the one-point function of A. Show that no new quadratic divergences are generated.

   (c) Do the same for the two-point function of A.