Quantum Field Theory III

HS 10, Exercise sheet 6

Due date: 3.11.2010

Exercise 1:
Show that in a renormalizable theory with one chiral superfield with a superpotential of the form $W(\Phi) = a\Phi + m\Phi^2 + g\Phi^3$ one can always eliminate the $a\Phi$-term by a redefinition of the field (assuming that m and/or g are non-vanishing).
Hint: Look at a theory with m chiral superfields with $W(\Phi) = a_i\Phi_i + m_{ij}\Phi_i\Phi_j + g_{ijk}\Phi_i\Phi_j\Phi_k$. How does this superpotential change under a transformation $\Phi_i \to \Phi_i + b_i$?

Exercise 2:
In exercise sheet 5 you showed that the component expanded chiral superfield is

$$\Phi(x,\theta,\bar{\theta}) = z(x) + \sqrt{2}\theta\psi(x) - \theta\theta F(x) + i\theta\sigma^\mu\bar{\theta}\partial_\mu z(x) - \frac{i}{\sqrt{2}}(\theta\theta)\partial_\mu\psi(x)\sigma^\mu\bar{\theta} - \frac{1}{4}(\theta\theta)(\bar{\theta}\bar{\theta})\Box z(x).$$

Calculate $\Phi|_{\theta=\bar{\theta}=0}$, $D_\alpha\Phi|_{\theta=\bar{\theta}=0}$ and $D^2\Phi|_{\theta=\bar{\theta}=0}$.