Introduction to supergravity 2015: Exercise 8.

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The bosonic sector of the generic coupling of a chiral superfield to supergravity (with no higher derivatives) is [1]

$$e^{-1}\mathcal{L} = -\frac{1}{2}R - K_{A\bar{A}}\partial A\partial\bar{A} - e^{K}\left[\frac{1}{K^{A\bar{A}}}(W_A + K_A W)(\bar{W}_{\bar{A}} + K_{\bar{A}}\bar{W}) - 3W\bar{W}\right]. \tag{1}$$

The Polonyi model is given by

$$\begin{aligned} K &= \Phi\bar{\Phi} \\ W &= \mu(\Phi + \beta). \end{aligned} \tag{2}$$

If we set

$$\beta = 2 - \sqrt{3} \tag{3}$$

we saw that the model has a supersymmetry breaking vacuum with vanishing vacuum energy [2].

1. Find the scalar potential for the Polonyi model with generic β.
2. Verify that for $\beta = 2 - \sqrt{3}$ supersymmetry is broken and that the vacuum is Minkowski.
3. Investigate what happens for small deviations from $\beta = 2-\sqrt{3}$: What happens if $\beta \gtrsim 2-\sqrt{3}$ or $\beta \lesssim 2 - \sqrt{3}$? Is supersymmetry broken? What is the vacuum energy?

References

[1] J. Wess and J. Bagger, "Supersymmetry and supergravity," Princeton, USA: Univ. Pr. (1992).

[2] J. Polonyi, "Generalization of the massive scalar multiplet coupling to the supergravity," Hungary Central Inst. Res. - KFKI-1977-93.