

Problem set #9

1) Anomalies in 6 dimensions.

- a) Determine the various fields which can contribute to the anomaly in 6 dimensions for chiral supersymmetric theories. How many such supersymmetric theories are there in 6 dimensions?
- b) Write down the matter content of the (0,2) gravity multiplet and of the (0,2) tensor multiplet.
- c) Using the coefficients of the anomaly polynomial in 6 dimensions (recall it is an 8 form), find the number of tensor multiplets which are needed to cancel the anomaly for a (0,2) supersymmetric theory. Show the cancellation for both $\text{tr}(R^4)$ and $(\text{tr}(R^2))^2$.
- d) Using the same coefficients as in c) derive the formula for the cancellation of gravitational anomalies for (0,1) supersymmetry in 6 dimensions. Comment on the reducible part of the anomaly.
- e) Compare the result of c) with the toroidal compactification of the Heterotic String to 5 dimensions.
- f) Find the matter spectrum of the (2,1) supersymmetric theory. Compute the contribution to the gravitational anomalies from these multiplets. What can you conclude?

2) Three dimensional gauge theories with 16 supercharges.

- a) Find all possible interacting RG fixed points for gauge theories with rank 2: A_2, B_2, C_2, D_2 .

3) Supersymmetric multiplets for theories with 8 supercharges.

- a) Write down the fields in the 4 supersymmetric massless multiplets of (0,1) supersymmetry in 6 dimensions, including their transformation rules under the little group and the R symmetry group.
- b) Perform dimensional reduction to 5 dimensions and write down the transformation rules under the little group in 5 dimensions and under the R symmetry group. Write down the different multiplets in 6 dimensions decompose to the 5 dimensional supermultiplets. What is the R symmetry group of 5 dimensions?
- c) Perform another dimensional reduction to 4 dimensions and write down the supersymmetry multiplets by specifying their transformation rules. What is the R symmetry group in this case? How many different multiplets are there? How do 5 dimensional multiplets decompose into 4 dimensional multiplets?
- d) Repeat the analysis by dimensional reduction to 3 dimensions.