

Due Tuesday 10/26/04

Finish reading Chapter 8.

**Part 1**

(1) In class, we constructed the  $T^2/Z_2$  orbifold. For a torus with a  $Z_3$  symmetry, we find that  $T^2/Z_2$  is a tetrahedron, with the topology of a sphere. What is the shape of  $T^2/Z_3$ ? How many fixed points does it have?

**Part 2:**

(2) Starting with the same torus, find the shape and the number of fixed points in the  $T^2/Z_6$  orbifold. Start with a square torus, find the shape and the number of fixed points in the  $T^2/Z_2$  and  $T^2/Z_4$  orbifolds. Note that there can be different types of fixed points in an orbifold.

(3) A  $Z_2$  twist on  $S^1$  yields the  $S^1/Z_2$  orbifold. Show that the partition function  $Z'$  Eq.(8.5.11) is that of  $S^1/Z_2$  CFT. Use Eq.(7.2.37) to write it in terms of the  $\Theta$  functions given in Homework 3. Show that it is modular invariant.

Argue that a  $Z_2$  twist on  $S^1/Z_2$  gives back the  $S^1$ .

Now go back to the partition function (8.2.9). Check that twisting the compactified  $X^{25}$  with the inclusion of the twisted sectors gives a modular invariant  $Z'$  for the bosonic string theory.

(4) Check Eq.(8.5.21).

(5) If you have not derived Eq.(2.9.19), do it now.