

PHYS 7326: Running Homework

Professor Halverson

January 23, 2025

Homework will be posted on a rolling basis as lectures are developed and given. This is hopefully helpful for you, and it is also more natural for me, as assignment ideas come on a rolling basis.

Instructions: Due dates will be listed throughout the document in bold letters. For the first assignment, complete all problems by the first due date. For the n^{th} assignment, complete all problems between the $(n-1)^{\text{th}}$ and n^{th} due date. I will also organize according homeworks according to topic.

All problems are worth 5 points, unless otherwise noted.

1 Conformal Field Theory

1. Derive Ginsparg (1.3).
2. Prove that an infinitesimal conformal transformation quadratic in x must be of the form

$$\epsilon^\mu = b^\mu x^2 - 2x^\mu b \cdot x. \quad (1)$$

3. Prove the unitarity bound for any scalar operator \mathcal{O} , i.e. that $\Delta_{\mathcal{O}} \geq \frac{d-2}{2}$.
4. Do exercise 8.2 of 1602.07982.
5. Consider a field $\phi(z, \bar{z})$ of weight (h, \bar{h}) , and the state

$$|h, \bar{h}\rangle = \phi(0, 0)|0\rangle. \quad (2)$$

Derive the properties analogous to 3.18(a) in Ginsparg that it satisfies.

6. Using the conventions in Ginsparg for the free fermion, compute the $T(z)\psi(w)$ OPE to read off the dimension h , and the $T(z)T(w)$ OPE to read off the central charge c .

Homework 1. Due February 10.