

Series 12

I. Creation and annihilation operators for the free boson on the cylinder

1. Verify Eq. (4.21) for the Hamiltonian in the notes.
2. Verify the commutation relation Eq. (4.22) in the notes.
3. Verify the form of the Fourier modes Eq. (4.23) in terms of a_n, \bar{a}_{-n} .

II. OPEs with vertex operators

1. Verify the OPE $\partial\phi(z)\mathcal{V}_\alpha(w, \bar{w})$ Eq. (4.35).
2. Verify the OPE $T(z)\mathcal{V}_\alpha(w, \bar{w})$ Eq. (4.36).

III. The free fermion

1. Verify the OPE $T(z)T(w)$ Eq. (4.66).
2. Verify Eq. (4.36).