

## Homework 4: Due at class on Oct 14

### 1 Derivations

#### 1.1 Commutation relations in free boson

Derive the commutation relations (4.7) and (4.8) from (4.6).

#### 1.2 Hamiltonian in free boson

Derive the Hamiltonian (4.10) from (4.9).

#### 1.3 Action of free fermion

Derive (4.33) from (4.30).

#### 1.4 $TT$ OPE in free fermion

Compute  $TT$  OPE (4.45) in the free fermion.