

**Question One.**

Explain why the projection of the spin  $\sigma \cdot q$  is not an appropriate expression for the spin projectors in quantum space as alluded to on Strange page 158. Why is a projection in real space of the spin operator not equal to the projection in quantum spin space? (Hint: you can check explicitly that the properties of the projector are not satisfied, or you can compare what "orthogonality" means in both cases. )

**Question Two.**

Apply the charge conjugation operator on the four linear independent Dirac solutions and do so twice. Do you get the original states back?

**Question Three.**

Check explicitly whether the charge conjugation, time reversal and parity operations commute with each other.

**Question Four.**

Use Strange Eqs. (6.89) and (6.90) for boson operators to check the validity (Strange calls it consistency) of Eqs. (6.85a), (6.85b) and (6.85c) in both cases where  $i = j$  and  $i \neq j$ .

**Question Five.**

What can you say about the commutation of the two number operators  $\hat{N}_i$  and  $\hat{N}_j$ ? Consider the cases  $i = j$  and  $i \neq j$  and consider the case of boson number operators and the case of fermion number operators.