

Homework Problems due Fri Feb 10

Problem 16.

Equal time commutation relations.

Consider the second quantized Schroedinger equation.

We have, in the Schroedinger picture,

$$[\psi(\mathbf{x}) , \psi^\dagger(\mathbf{x}')] = \delta^3(\mathbf{x} - \mathbf{x}') ,$$

$$[\psi(\mathbf{x}) , \psi(\mathbf{x}')] = 0 , \text{ etc.}$$

(a) Show that in the Heisenberg picture, this commutation relation holds at all equal times.

(b) What is the commutation relation for *different* times?

Problem 17.

(a) Do problem 2.1 in Mandl and Shaw.

(b) Do problem 2.2 in Mandl and Shaw.

(c) Do problem 2.3 in Mandl and Shaw.

Problem 18.

For the free real scalar field (Section 3.1)

(A) Write H in terms of $\pi(\mathbf{x})$ and $\phi(\mathbf{x})$.

(B) Write H in terms of $a_{\mathbf{k}}$ and $a_{\mathbf{k}}^\dagger$.

Problem 19.

(A) Mandl and Shaw problem 3.1.

(B) Mandl and Shaw problem 3.2.

Problem 20.

The Yukawa theory problem.