

FYS-MENA3110 Problem set #3

Problem 3.1:

Show explicitly that the Slater determinant for two fermions is antisymmetric.

Problem 3.2:

Three imaginary spinless fermions are confined to a one-dimensional box of length L . The confinement potential is

$$V(x) = 0 \quad \text{for } 0 \leq x \leq L$$

$$V(x) = \infty \quad \text{otherwise}$$

and there is no interaction between the particles.

- a) What is the ground state configuration of the system and the total energy of the ground state?
- b) Find the state (wave function) of the system.

Problem 3.3:

Let the three fermions in problem 3.2 be ordinary electrons, but with no electron-electron Coulomb interaction.

- a) What is now the ground state configuration of the system and the energy of the ground state?
- b) What are the possible wave functions of the ground state?

Problem 3.4:

A system is composed of two fermions with spin $1/2$. Find the “two particle probability density” (i.e., the probability that one particle is at position \mathbf{r}_1 and the other at \mathbf{r}_2) and the “one particle probability density” (i.e., the probability of finding a particle at \mathbf{r}_1).

- a) Assume first that the electrons have opposite spins.
- b) Find the same densities when they have equal spins.