

SC1.203 :: Quiz-II

Time 40 Mins

6 × 5

- 1) In the Stern-Gerlach experiment, the electron beam (moving \perp to the z axis) undergoes a Hamiltonian of the following type:

$$H(t) = \begin{cases} 0, & \text{for } t \leq 0, \\ -\gamma(B_0 + \alpha z)S_z, & \text{for } 0 \leq t \leq T, \\ 0, & \text{for } t \geq T. \end{cases}$$

Obtain the z component of the momentum of the spin down component at a time $t \geq T$.

- 2) What is meant by the statement — all electrons are identical? Argue that it leads to the Pauli exclusion principle.
- 3) Suppose we have three noninteracting fermions in a one-dimensional box of width L . Two of them are identical (type A) and the other is distinguishable (type B), but all have the same mass. What would be the ground state wave function (composite)?
- 4) Electrons are fermions, yet they can form covalent bonds. Explain how.
- 5) Obtain the relation between k_F (the wave vector of the Fermi surface) and the electron density in the electron gas model.
- 6) Explain: “The first order correction to the energy is the expectation value of the perturbation in the unperturbed state.”