## SoSe 2010

## ÜBUNGEN ZUR VORLESUNG Feynman Path Integral in Solid State Physics Blatt 5

## Feynman Diagrams for Interacting Theories

Consider the Hamiltonian of interacting spinless electron lattice

$$\mathcal{H} = \sum_{\mathbf{k}} \epsilon_{\mathbf{k}} c_{\mathbf{k}}^{\dagger} c_{\mathbf{k}} + \frac{1}{2} \sum_{\mathbf{k}, \mathbf{k}', \mathbf{q}} V(\mathbf{k}) c_{\mathbf{k}+\mathbf{q}}^{\dagger} c_{\mathbf{k}'-\mathbf{q}}^{\dagger} c_{\mathbf{k}'} c_{\mathbf{k}}.$$

- 1. Draw all the connected Feynman graphs for free energy to:
- a) first order in the interaction.
- b) second order in the interaction.
- c) third order in the interaction.

2. Draw all the one particle irreducible Feynman graphs for self energy to:

- a) first order in the interaction.
- b) second order in the interaction.
- c) third order in the interaction.

3. Draw all the Feynman graphs contributing to the two particle Green's function to: a) first order in the interaction.

b) second order in the interaction.

c) third order in the interaction.

4. Draw all the Feynman graphs contributing to the two particle vertex function to:

- a) first order in the interaction.
- b) second order in the interaction.
- c) third order in the interaction.

Which one of these diagrams are two particle irreducible?