

MID-TERM -1

Physics 751
Advanced Solid State Physics
Fall, 2001

1. Starting from

$$\chi(q) = -e^2 \int d\vec{k} \frac{n_{\vec{k}-q/2} - n_{\vec{k}+q/2}}{\epsilon_{\vec{k}+q/2} - \epsilon_{\vec{k}-q/2}} \quad (1)$$

find $\chi(q)$ in a two-dimensional electron gas.

2. Obtain the results for the mass renormalization and the spin susceptibility using the expression for the quasiparticle interaction function to second order in $a_0 p_F$.

3. Suppose that the density of external charge depends on time as $\rho^{ext} \propto e^{i\omega t}$. Derive the expressions for $\chi(q, \omega)$ and $\epsilon(q, \omega)$ and show that at $q = 0$,

$$\epsilon(\omega) = 1 - \frac{\omega_p^2}{\omega^2}. \quad (2)$$

Find ω_p .