1. trivial by scattering

$$R_{k\to k'} = W_q(k,k')n_k(1-n_{k'})$$

2. (a): $H = -\frac{\hbar^2}{2m}\nabla^2 + \sum_i V(r-R_i)$

$$H = \frac{P^2}{2m} + V_q \rho_q$$

$$\therefore W_{k\to k'} = \frac{2\pi}{\hbar}|V(k-k')\rho_{k-k'}|^2 f(k)(1-f(k'))\delta(\varepsilon_k - \varepsilon_{k'})$$

(b): $\langle \rho_q \rho_{-q} \rangle = \langle \sum_{i,j} e^{i(k-k')\cdot(R_i - R_j)} \rangle$

(e): screened Coulomb form.

$\therefore N_{imp} = V n_{imp} \Rightarrow V(k) \sim V(0)$

$$\therefore T\text{-}F: V(q) = -\frac{4\pi Z e^2}{V k_{TF}^2} = -\frac{Z}{N(0)V}$$

$$\therefore W_{k\to k'} = \frac{2\pi n_{imp}}{\hbar N(0)^2 V} f(k)(1-f(k'))\delta(\varepsilon_k - \varepsilon_{k'})$$

(c): $\frac{df(k)}{dt} = \sum_{k'}(\langle W_{k\to k'}\rangle - \langle W_{k'\to k}\rangle)$

drift velocity ansatz: $f(k) = f_0(k - mV_d)$:

$$\frac{df(k)}{dt} = \frac{f_0(k-mV_d) - f_0(k)}{\tau}$$

$$\therefore \frac{d}{dt}\langle k\rangle = \frac{2}{V}\sum_k k\frac{df(k)}{dt}$$

$\therefore$ we have: $\frac{2}{V}\sum_k k\frac{f_0(k-mV_d) - f_0(k)}{\tau} = \sum_{k,k'} k\,(\langle W_{k\to k'}(\{k_i\})\rangle - \langle W_{k'\to k}\rangle)$

$\because$ LHS $= -\frac{mV_d}{\tau} ne$, RHS $= \ldots$

(d): $S(q) = \frac{4\pi\hbar}{n_e V} \sum_k f_0(k)(1-f_0(k))\,\delta(\underbrace{\varepsilon_k - m v_d - \varepsilon_{k+q} - m v_d}_{\varepsilon_k - \varepsilon_{k+q} + q\cdot v_d})$

$S(q)$ 는 $S(q, -q\cdot v_d)$

$= \frac{-m^2\, q\cdot v_d}{2\pi\hbar^2 n_e q}$

$\text{RHS} = \frac{n_{imp} n_e m^2 Z^2}{2\pi\hbar^4 N(0) V} \sum_q q(q\cdot v_d)/q$

$=$. — — — .

trivial