FINAL EXAM – JUNE 13, 2014

The following equations and constants may be helpful to you. You may fill the double-sided page with handwritten notes.

$$E(\vec{k}) = \sum_R e^{i\vec{k}\cdot\vec{R}} \langle \vec{0} | \hat{H} | \vec{R} \rangle \qquad E(\vec{k}) = \frac{\hbar^2 k^2}{2m^*} \qquad v(\vec{k}) = \frac{1}{\hbar}\nabla_k E(\vec{k})$$

$$D_{\updownarrow}(E) = \frac{V}{2\pi^2}\left(\frac{2m}{\hbar^2}\right)^{3/2} E^{1/2} \qquad dS = D(E)dE \qquad m^*(\vec{k}) = \frac{\hbar^2}{\nabla_k^2 E(\vec{k})}$$

$$e^{i\theta} = \cos\theta + i\sin\theta$$

$$\hbar = \frac{h}{2\pi} = 1.05\times10^{-34}\ \text{Js} = 6.58\times10^{-16}\ \text{eVs} \qquad hc = 1240\ \text{eVnm}$$

$$k_B = 1.38\times10^{-23}\ \text{J/K} = 8.6\times10^{-5}\ \text{eV/K} \qquad e = 1.6\times10^{-19}\ \text{C}$$

$$m_e = 9.1\times10^{-31}\ \text{kg} = 9.1\times10^{-28}\ \text{g} = 0.511\ \text{MeV/c}^2 \qquad N_A = 6.02\times10^{23}\ \text{atom/mol}$$

$$\mu_B = \frac{e\hbar}{2m_e} = 9.27\times10^{-24}\ \text{J/T} = 5.8\times10^{-5}\ \text{eV/T} \qquad \varepsilon_0 = 8.85\times10^{-12}\ \text{F/m}$$

$$\mu_0 = 4\pi\times10^{-7}\ \text{H/m}$$

$$f_{FD}(E,T) = \frac{1}{e^{(E-E_F)/k_BT}+1} \qquad f_{MB}(E,T) = Ae^{-E/k_BT} \qquad f_{BE}(E,T) = \frac{1}{e^{E/k_BT}+1}$$

$$\vec{g}_1 = 2\pi\frac{\vec{t}_2\times\vec{t}_3}{\vec{t}_1\cdot(\vec{t}_2\times\vec{t}_3)} \qquad \vec{g}_2 = 2\pi\frac{\vec{t}_3\times\vec{t}_1}{\vec{t}_1\cdot(\vec{t}_2\times\vec{t}_3)} \qquad \vec{g}_3 = 2\pi\frac{\vec{t}_1\times\vec{t}_2}{\vec{t}_1\cdot(\vec{t}_2\times\vec{t}_3)}$$

$$\sigma = \frac{ne^2\tau}{m^*} \qquad R_H = \frac{1}{nq} \qquad \omega_p = \sqrt{\frac{ne^2}{\varepsilon_0 m^*}}$$

$$\Delta V = S\Delta T$$

$$\vec{B} = \mu_0(\vec{H}+\vec{M}) \qquad \vec{D} = \varepsilon_0(\vec{E}+\vec{P}) \qquad \chi = \frac{M}{H} \approx \frac{\mu_0 M}{B}$$

$$C_V = \frac{\pi^2}{3}D_{\updownarrow}(E_F)k_B^2T \qquad \frac{K_{el}}{\sigma T} = L = 2.45\times10^{-8}\,W\Omega/K^2$$

$$n_c = n - i\kappa \qquad \varepsilon = \varepsilon_1 - i\varepsilon_2 \qquad n^2 = \varepsilon$$

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