MIDTERM I EXAM – APRIL 25, 2011

This is an in-class test; 50 minutes. No calculators should be needed. There are xx questions for a total of 50 points.

The following equations and constants may be helpful to you. You are not required to prove any formulae that are provided on this sheet, unless specifically requested to do so. The Y_{lm} functions and the s, p, d functions will be provided if you need them. **You may also fill the rest of this 8.5 x 11 page (both sides) with your own notes. Please turn in your equation sheet with your exam.**

$$E\left(\vec{k}\right) = \sum_{R} e^{i\vec{k}\cdot\vec{R}}\left\langle\vec{0}\left|\hat{H}\right|\vec{R}\right\rangle \qquad\qquad \Psi_{\vec{k}}\left(\vec{r}+\vec{T}\right) = e^{i\vec{k}\cdot\vec{T}}\Psi_{\vec{k}}\left(\vec{r}\right)$$

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

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

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

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

$$m_e = 9.1\times10^{-31}\text{ kg} = 9.1\times10^{-28}\text{ g} = 0.511\text{ MeV/c}^2$$

$$N_A = 6.02\times10^{23}\text{ atom/mol}$$

$$\varepsilon_0 = 8.85\times10^{-12}\text{ F/m} \qquad\qquad \mu_B = \frac{e\hbar}{2m_e} = 8.9.27\times10^{-24}\text{ J/T}$$

$$v\left(\vec{k}\right) = \frac{1}{\hbar}\nabla_k E\left(\vec{k}\right) \qquad\qquad m*\left(\vec{k}\right) = \frac{\hbar^2}{\nabla_k^2 E\left(\vec{k}\right)}$$

$$f_{FD} = \frac{1}{e^{(E-E_F)/k_B T}+1}$$