PHYSICS 160: Principles of Modern Physics
Spring 2007
Midterm Exam #2 Equation Sheet

$$i\hbar\frac{\partial\Psi(x,t)}{\partial t}=\frac{-\hbar^2}{2m}\frac{\partial^2\Psi(x,t)}{\partial x^2}+V(x,t)\Psi(x,t)$$

$$\frac{-\hbar^2}{2m}\frac{d^2\psi(x)}{dx^2}+V(x)\psi(x)=E\psi(x)$$

$$\langle A\rangle=\int_{-\infty}^{\infty}\Psi^*\hat{A}\Psi dx$$

$$\hat{p}_x=\frac{\hbar}{i}\frac{\partial}{\partial x}$$

$$\hat{p}_x^2=-\hbar^2\frac{\partial^2}{\partial x^2}$$

$$P(x)dx=\psi^*\psi dx$$

$$\Psi(x,t)=Ae^{i(kx-\omega t)}$$

$$T=\left[1+\frac{V_o{}^2\sin^2(k_{II}L)}{4E(E-V_o)}\right]^{-1},$$

where $k_{II}=\sqrt{\frac{2m}{\hbar^2}(E-V_o)}$

$$T=\left[1+\frac{V_o{}^2\sinh^2(\kappa_{II}L)}{4E(V_o-E)}\right]^{-1},$$

$$\approx 16\frac{E}{V_o}\left(1-\frac{E}{V_o}\right)e^{-2\kappa_{II}L}\ \text{for}\ \kappa_{II}L>>1,$$

where $\kappa_{II}=\sqrt{\frac{2m}{\hbar^2}(V_o-E)}$

$$V(x)=\frac{1}{2}m\omega^2x^2$$

$$V(r)=\frac{-e^2}{4\pi\varepsilon_o r}$$

$$E_n=\frac{\pi^2\hbar^2}{2mL^2}n^2$$

$$E_n=\left(n+\frac{1}{2}\right)\hbar\omega$$

$$\psi_n(x)=\sqrt{\frac{2}{L}}\sin\left(\frac{n\pi x}{L}\right)$$

$$\psi_n(x)=C_ne^{-m\omega x^2/2\hbar}H_n(x)$$

$$\psi_{nlm}(r,\theta,\phi)=C_{nlm}e^{-r/na_o}(r/a_o)^l\mathcal{L}_{nl}(r/a_o)Y_{lm}(\theta,\phi)$$

$$\left|\vec{L}\right|=\sqrt{l(l+1)}\hbar$$

$$L_z=m_l\hbar$$

$$\left|\vec{S}\right|=\sqrt{s(s+1)}\hbar$$

$$S_z=m_s\hbar$$

$$\left|\vec{J}\right|=\sqrt{j(j+1)}\hbar$$

$$J_z=m_j\hbar$$

$$j=l+s,|l-s|$$

$$\mu_z=-m_jg_j\mu_B$$

$$\Delta E=-\mu_zB$$

$$\mu_B=\frac{e\hbar}{2m_e}=9.27\times10^{-24}\ \text{J/T}$$

$$=5.79\times10^{-5}\ \text{eV/T}$$

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

$$A=Z+N$$

$$R=r_oA^{1/3}$$

$$B_{nuc}=Zm_Hc^2+Nm_nc^2-M_Ac^2$$

$$m_ec^2=511\ \text{keV}$$

$$m_pc^2=938\ \text{MeV}$$

$$m_nc^2=940\ \text{MeV}$$

$$1\,\text{u}=1.66054\times10^{-27}\ \text{kg}=931\,\text{MeV/c}^2$$