Physics 122

Winter 2012

Final Exam

Equations

$$x' = \frac{x - vt}{\sqrt{1-\beta^2}}$$

$$y' = y$$

$$z' = z$$

$$t' = \frac{t - vx/c^2}{\sqrt{1-\beta^2}}$$

$$T' = \gamma T_o$$

$$L = \frac{L_o}{\gamma}$$

$$\gamma = \frac{1}{\sqrt{1-\frac{v^2}{c^2}}} = \frac{1}{\sqrt{1-\beta^2}}$$

$$u_x' = \frac{u_x - v}{1-(v/c^2)u_x}$$

$$\vec{p} = \gamma m \vec{u}$$

$$E = \gamma mc^2 = K + mc^2$$

$$E^2 = p^2c^2 + m^2c^4$$

$$E_B = \sum_i m_i c^2 - M_{bound}c^2$$

$$f = \frac{\sqrt{1+\beta}}{\sqrt{1-\beta}} f_o$$

$$d\sin\theta = n\lambda$$

$$\frac{1}{\lambda} = R_H\left(\frac{1}{n_\ell^2} - \frac{1}{n_u^2}\right)$$

$$\lambda_{\max} T = 2.898x10^{-3} mK$$

$$R(T) = \varepsilon\sigma T^4$$

$$\mathrm{I}(\lambda, T) = \frac{2\pi c^2 h}{\lambda^5}\frac{1}{e^{hc/\lambda kT} - 1}$$

$E=hf = hc/\lambda$

$$hf = \phi + \frac{1}{2}mv_{\max}^2$$

$$\Delta\lambda = \lambda' - \lambda = \frac{h}{mc}(1-\cos\theta)$$

$$b = \frac{Z_1 Z_2 e^2}{8\pi\varepsilon_o K}\cot\frac{\theta}{2}$$

$$f = \pi nt\left(\frac{Z_1 Z_2 e^2}{8\pi\varepsilon_o K}\right)^2 \cot^2\frac{\theta}{2}$$

$$N(\theta) = \frac{N_i nt}{16}\left(\frac{e^2}{4\pi\varepsilon_o}\right)^2 x$$

$$\frac{Z_1^{\,2} Z_2^{\,2}}{r^2 K^2 \sin^4(\theta/2)}$$

$$\frac{1}{\lambda_K} = R(Z-1)^2\left(1 - \frac{1}{n^2}\right)$$

$$n\lambda = 2d\sin\theta$$

$$\lambda = \frac{h}{p}$$

$$k = \frac{2\pi}{\lambda}$$

$$\omega = 2\pi f = \frac{2\pi}{T}$$

$u_{gr} = d\omega/dk$

$u_{ph} = \omega/k$

$$\Delta p_x \Delta x \geq \frac{\hbar}{2}$$

$$\Delta E \Delta t \geq \frac{\hbar}{2}$$

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

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

$$< g(x) >= \int \Psi^*(x,t) g(x) \Psi(x,t) dx$$

$$\hat{p} = -i\hbar\frac{\partial}{\partial x} \quad and \quad \hat{E} = i\hbar\frac{\partial}{\partial t}$$

$$L = \sqrt{\ell(\ell+1)}\hbar$$

$$L_z = m_\ell \hbar$$

$$\vec{\mu}_\ell = -\frac{e}{2m}\vec{L} = -\frac{\mu_B}{\hbar}\vec{L}$$

$$\vec{\mu}_s = -\frac{g_s \mu_B \vec{S}}{\hbar}$$

$$\Delta\ell = \pm 1$$

$$\Delta m_\ell = 0, \pm 1$$

$$P(r)dr = r^2 \left|R(r)\right|^2 dr$$

$$\vec{J} = \vec{L} + \vec{S}$$

$$J = \sqrt{j(j+1)}\hbar$$

$$j = \ell \pm s$$

$$\Delta j = 0, \pm 1$$

$$R = r_o A^{1/3}$$

$$\mu_N = \frac{e\hbar}{2m_p}$$

$$B = [M(r) + M(S) - M(^A_Z X)]c^2$$

$$R = \lambda N(t) = -\frac{dN}{dt}$$

$$N(t) = N_o e^{-\lambda t} = N_o e^{-t/\tau}$$

$$\tau = \frac{1}{\lambda} = \frac{t_{1/2}}{\ln(2)}$$

Constants

e = 1.6 x 10^{-19} C

c = 3.0 x 10^8 m/s

electron m = 9.1 x 10^{-31} kg = 0.511 MeV/c^2

h = 6.63 x 10^{-34} Js

k = 1.38 x 10^{-23} JK^{-1}

u = 1.66 x 10^{-27} kg

R_H = 1.097 x 10^7 m^{-1}

$$a_o = 5.29x10^{-11}\ m$$

$$\mu_B = 9.27x10^{-24}\ J/T$$