Equations Chapters 1-5

$$d\rho(\nu,T) = \rho_\nu(T)\,d\nu = \left(\frac{8\pi k_B T}{c^3}\right)\nu^2 d\nu$$

$$d\rho(\nu,T) = \rho_\nu(T)\,d\nu = \left(\frac{8\pi h}{c^3}\right)\frac{\nu^3 d\nu}{e^{h\nu/k_B T} - 1}$$

$$\lambda_{\max} T = 2.90\times10^{-3}\,mK = \frac{hc}{4.965 k_B}$$

$$\frac{\partial^2 u(x,t)}{\partial x^2} = \frac{1}{\upsilon^2}\frac{\partial^2 u(x,t)}{\partial t^2}$$

$$u(x,t) = \sum_{n=1}^{\infty} A_n \cos(\omega_n t + \phi_n)\sin\frac{n\pi x}{l} = \sum_{n=1}^{\infty} u_n(x,t)$$

$$\nu_n = \frac{\omega_n}{2\pi}$$

$$\tilde{\nu} = R_H\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$$

$$\Delta E = \frac{m_e e^4}{8\varepsilon_o^2 h^2}\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$$

$$E_n = \frac{h^2 n^2}{8ma^2} = \frac{\hbar^2}{2m}\left(\frac{n\pi}{a}\right)^2$$

$$\psi_n(x) = \left(\frac{2}{a}\right)^{1/2}\sin\left(\frac{n\pi x}{a}\right)$$

$$\hat{H}\Psi(x,t) = i\hbar\frac{\partial\Psi(x,t)}{\partial t}$$

$$\frac{1}{2}mV^2 + \phi = h\nu$$

$$\hat{H} = \frac{\hat{P}^2}{2m} + V(x) = -\frac{\hbar^2}{2m}\frac{d^2}{dx^2} + V(x)$$

$$\hat{P} = -i\hbar\frac{d}{dx}$$

$$E = h\nu$$

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

$$c = \lambda \nu$$

$$\tilde{\nu} = \frac{1}{\lambda}$$

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

$$\sin^2\theta + \cos^2\theta = 1$$

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

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

$$\int f^* \hat{A} g dV = \int g\left(\hat{A} f\right)^* dV$$

$$\left[\hat{A}, \hat{B}\right] = \hat{A}\hat{B} - \hat{B}\hat{A}$$

$$\sigma_a^2 = \left\langle a^2 \right\rangle - \left\langle a \right\rangle^2$$

$$\left\langle a \right\rangle = \int \psi^*(x) \hat{A} \psi(x) dx$$

$$\left\langle a^2 \right\rangle = \int \psi^*(x) \hat{A}^2 \psi(x) dx$$

$$\hat{A}\varphi_n = a_n \varphi_n$$

$$\Psi(x,t) = \sum_{n=1}^{\infty} c_n \psi_n(x) e^{-i\omega_n t}$$

$$\hat{A}\left(c_1 f_1(x) + c_2 f_2(x)\right) = c_1 \hat{A} f_1(x) + c_2 \hat{A} f_2(x)$$

$$E(eV) = \frac{12399}{\lambda(angstoms)}$$

$$E_N(eV) = -\frac{13.6057}{N^2}$$

$$a_0 = \frac{4\pi\varepsilon_0 \hbar^2}{M_e e^2}; r = a_0 N^2; M_e V^2 = \frac{e^2}{4\pi\varepsilon_0 a_0 N^2}$$

$$rp = N\hbar$$

$$E_{N_x N_y} = \frac{\hbar^2}{2M}\left(\left(\frac{N_x \pi}{a}\right)^2 + \left(\frac{N_y \pi}{b}\right)^2\right)$$

$$\Psi_{N_x N_y}(x,y) = \sqrt{\frac{4}{ab}} \sin\left(\frac{N_x \pi x}{a}\right) \sin\left(\frac{N_y \pi y}{b}\right)$$

$$E_{N_x N_y N_z} = \frac{\hbar^2}{2M}\left(\left(\frac{N_x \pi}{a}\right)^2 + \left(\frac{N_y \pi}{b}\right)^2 + \left(\frac{N_z \pi}{c}\right)^2\right)$$

$$\Psi_{N_x N_y N_z}(x,y) = \sqrt{\frac{8}{abc}} \sin\left(\frac{N_x \pi x}{a}\right) \sin\left(\frac{N_y \pi y}{b}\right) \sin\left(\frac{N_z \pi z}{c}\right)$$

$$\nabla^2 = \frac{1}{r^2}\frac{\partial}{\partial r}\left(r^2\frac{\partial}{\partial r}\right)_{\theta,\phi} + \frac{1}{r^2\sin\theta}\frac{\partial}{\partial\theta}\left(\sin\theta\frac{\partial}{\partial\theta}\right)_{r,\phi} + \frac{1}{r^2\sin^2\theta}\left(\frac{\partial^2}{\partial\phi^2}\right)_{r,\theta}$$

$$x = r\sin\theta\cos\phi,\ \ y = r\sin\theta\sin\phi,\ z = r\cos\theta$$

$$dV = r^2\sin\theta dr d\theta d\phi$$

$$\omega = \left(\frac{k}{m}\right)^{1/2} = \left(\frac{k}{\mu}\right)^{1/2}$$

$$V(l) = D\left(1 - e^{-\beta(l-l_0)}\right)^2$$

$$E_\upsilon = \hbar\omega\left(\upsilon + \frac{1}{2}\right) = h\nu\left(\upsilon + \frac{1}{2}\right)$$

$$\hat{L}_x = y\hat{P}_z - z\hat{P}_y = -i\hbar\left(-\sin\phi\frac{\partial}{\partial\theta} - \cot\theta\cos\phi\frac{\partial}{\partial\phi}\right)$$

$$\hat{L}_y = z\hat{P}_x - x\hat{P}_z = -i\hbar\left(\cos\phi\frac{\partial}{\partial\theta} - \cot\theta\sin\phi\frac{\partial}{\partial\phi}\right)$$

$$\hat{L}_z = x\hat{P}_y - y\hat{P}_x = -i\hbar\frac{\partial}{\partial\phi}$$

$$X = \frac{m_1x_1 + m_2x_2}{m_1 + m_2}$$

$$\hat{L}^2 = -\hbar^2\left(\frac{1}{\sin\theta}\frac{\partial}{\partial\theta}\left(\sin\theta\frac{\partial}{\partial\theta}\right)_{r,\phi} + \frac{1}{\sin^2\theta}\left(\frac{\partial^2}{\partial\phi^2}\right)_{r,\theta}\right)$$

$$E_J = \frac{\hbar^2}{2I}J(J+1)$$

$$E_n = -\frac{m_e e^4}{8\varepsilon_0^2h^2n^2} = -\frac{e^2}{8\pi\varepsilon_0 a_0 n^2}$$

$$\nu = 2B(J+1),\ B = \frac{h}{8\pi^2 I},\ \nu = \frac{1}{2\pi}\sqrt{\frac{k}{\mu}},\ \mu = \frac{m_1m_2}{m_1+m_2}$$

$$\psi_\upsilon(x) = N_\upsilon H_\upsilon\left(\alpha^{1/2}x\right)e^{-\alpha x^2/2},\ \ \alpha = \left(\frac{k\mu}{\hbar^2}\right)^{1/2}$$

$$N_\upsilon = \frac{1}{\left(2^\upsilon\upsilon!\right)^{1/2}}\left(\frac{\alpha}{\pi}\right)^{1/4}$$

$$V = \frac{kx^2}{2},\ V(r) = -\frac{e^2}{4\pi\varepsilon_0 r}$$