

Equations Chapters 5-7

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

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

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

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

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

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

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

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

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

$$X = \frac{m_1 x_1 + m_2 x_2}{m_1 + m_2}$$

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

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

$$E_n = -\frac{m_e e^4}{8 \epsilon_0^2 \hbar^2 n^2} = -\frac{e^2}{8 \pi \epsilon_0 a_0 n^2}$$

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

$$\psi_v(x) = N_v H_v \left(\alpha^{1/2} x \right) e^{-\alpha x^2/2}, \quad \alpha = \left(\frac{k\mu}{\hbar^2} \right)^{1/2}$$

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

$$V = \frac{kx^2}{2}, \quad V(r) = -\frac{e^2}{4\pi\epsilon_0 r}$$