

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

$$v_p = \frac{\omega}{k}$$

$$v_g = \frac{d\omega}{dk}$$

$$E^2 = p^2 c^2 + m_0^2 c^4$$

$$E = K + m_0 c^2$$

$$\Delta K = e \Delta V$$

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

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

$$\int_{-\infty}^{+\infty} |\psi|^2 dx = 1$$

$$\langle Q \rangle = \int_{-\infty}^{+\infty} \psi^* [Q] \psi dx$$

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

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

$$\psi_0(x) = \left(\frac{m\omega}{\pi\hbar}\right)^{1/4} e^{-m\omega x^2 / 2\hbar}$$

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

$$\Delta Q = \sqrt{\langle Q^2 \rangle - \langle Q \rangle^2}$$

$$[p_x] = \frac{\hbar}{i} \frac{\partial}{\partial x}$$

$$[E] = i\hbar \frac{\partial}{\partial t}$$

$$[K] = -\frac{\hbar^2}{2m} \frac{\partial^2}{\partial x^2}$$

$$[H] = -\frac{\hbar^2}{2m} \frac{\partial^2}{\partial x^2} + U(x)$$

$$E = \frac{\pi^2 \hbar^2}{2mL^2} (n_1^2 + n_2^2 + n_3^2)$$

$$|\bar{L}| = \sqrt{l(l+1)} \hbar \quad L_z = m_l \hbar$$

$$\psi_{nlm}(r, \theta, \phi) = R_{nl}(r) Y_l^{ml}(\theta, \phi)$$

$$E_n = (-13.6 \text{ eV}) \frac{Z^2}{n^2}$$

$$P(r) = r^2 |R_{nl}(r)|^2$$

$$\int_0^\infty P(r) dr = 1$$

$$\langle f \rangle = \int_0^\infty f(r) P(r) dr$$

$$\int_0^\pi \alpha^2 \cos 2\alpha d\alpha = \frac{\pi}{2}$$

$$\int_0^\infty x^n e^{-x} dx = n!$$

Constant :

$$e = 1.6 \times 10^{-19} \text{ C} \quad m_e = 9.1 \times 10^{-31} \text{ kg} \quad \hbar = 1.05 \times 10^{-34} \text{ J} \cdot \text{s}$$

$$m_p = 1.67 \times 10^{-27} \text{ kg} \quad 1 \frac{\text{MeV}}{c} = 5.45 \times 10^{-22} \text{ kg} \cdot \frac{m}{s}$$

$$k_B = 1.38 \times 10^{-23} \text{ J / K} \quad a_0 = 0.529 \text{ \AA}$$

$$h = 6.63 \times 10^{-34} \text{ J} \cdot \text{s}$$

$$m_e c^2 = 0.511 \text{ MeV}$$

$$m_p c^2 = 938 \text{ MeV}$$