CHEM 3620 – Exam 1 Equations

Q: How would a chemist determine the correct amount of quacamole to put on her burrito?

$$\hat{H}\psi = -\frac{\hbar^2}{2m}\nabla^2\psi + V\psi = E\psi$$

Spherical Polar Coordinates

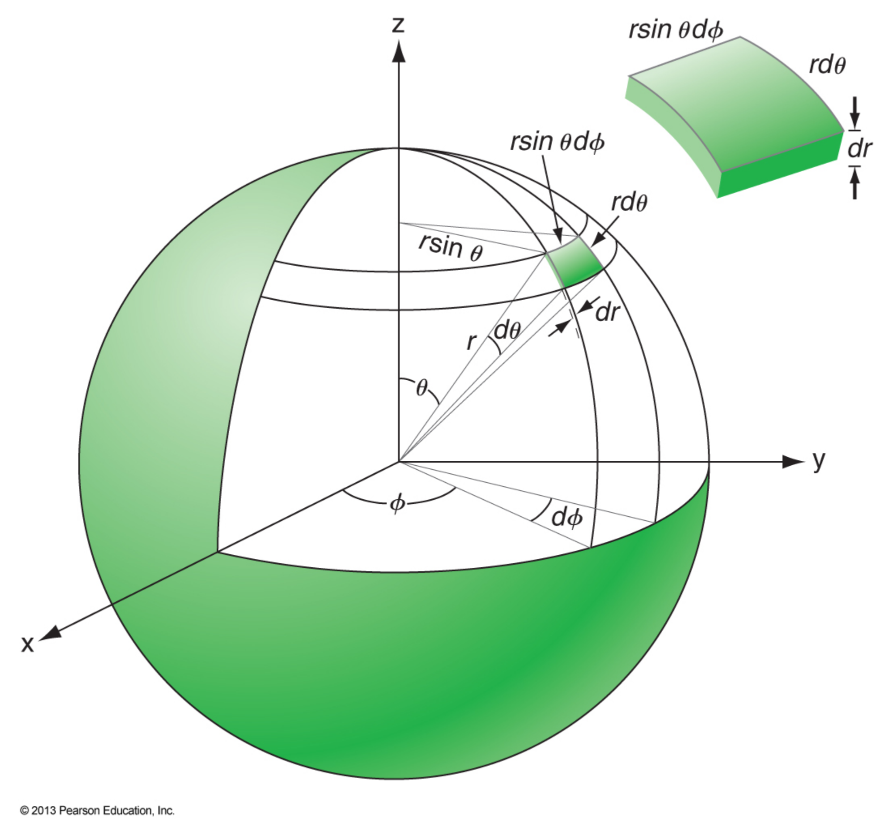

Table of Particle Properties

Name	Symbol	Value	Units
Elementary Charge	e	1.602177×10^{-19}	C
Electron Rest-Mass	m_e	9.109382×10^{-31}	kg
Proton Rest-Mass	m_p	1.672622×10^{-27}	kg
Neutron Rest-Mass	m_n	1.674927×10^{-27}	kg

A: She would use Avocado's number! – Good luck!

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

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

$$\int_0^\infty \int_0^\pi \int_0^{2\pi} \psi^* \psi r^2 \sin\theta \mathrm{d}\phi \mathrm{d}\theta \mathrm{d}r = 1$$

$$N^2 \int \phi^*(\tau)\phi(\tau) d\tau = 1$$

$$\Delta p_x \Delta x \geq \frac{1}{2}\hbar$$

$$\int \phi_n^*(\tau)\phi_m(\tau) d\tau = 0 \quad \text{for } n \neq m$$

$$\kappa = \frac{\sqrt{2m(V-E)}}{\hbar}$$

$$\int \phi_n^*(\tau)\phi_m(\tau) d\tau = 1 \quad \text{for } n = m$$

$$\epsilon = \frac{E}{V}$$

$$\left\langle \hat{A} \right\rangle = \int \psi^* \hat{A} \psi \mathrm{d}\tau$$

$$T = \left[1 + \frac{\left(e^{\kappa L} - e^{-\kappa L}\right)^2}{16\epsilon(1-\epsilon)}\right]^{-1}$$

$$\Delta p_x = \left[\left\langle p_x^2 \right\rangle - \left\langle p_x \right\rangle^2\right]^{1/2}$$

$$\Psi_k(x) = Ae^{ikx} + Be^{-ikx}$$

$$E_n = \frac{n^2 h^2}{8mL^2}$$

$$E_k = \frac{k^2 \hbar^2}{2m}$$

$$E_{n_x,n_y} = \frac{h^2}{8m}\left(\frac{n_x^2}{L_x^2} + \frac{n_y^2}{L_y^2}\right)$$

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

$$E_{n_x,n_y,n_z} = \frac{h^2}{8m}\left(\frac{n_x^2}{L_x^2} + \frac{n_y^2}{L_y^2} + \frac{n_z^2}{L_z^2}\right)$$

$$\psi_{n_x,n_y}(x,y) = \frac{2}{\sqrt{L_x L_y}} \sin\left(\frac{n_x \pi x}{L_x}\right) \sin\left(\frac{n_y \pi y}{L_y}\right)$$

$$\psi_{n_x,n_y,n_z}(x,y,z) = \sqrt{\frac{8}{L_x L_y L_z}} \sin\left(\frac{n_x \pi x}{L_x}\right) \sin\left(\frac{n_y \pi y}{L_y}\right) \sin\left(\frac{n_z \pi z}{L_z}\right)$$

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

$$\omega = \sqrt{\frac{k_f}{\mu}}$$

$$\mu = \frac{m_A m_B}{m_A + m_B}$$

$$\psi_v(x) = N_v H_v\left(\frac{x}{\alpha}\right) e^{-\frac{x^2}{2\alpha^2}}$$

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

$$\Psi_{m_l}(\phi) = \frac{e^{i m_l \phi}}{\sqrt{2\pi}}$$

$$\alpha = \left(\frac{\hbar^2}{\mu k_f}\right)^{1/4}$$

$$E_{m_l} = \frac{m_l^2\hbar^2}{2I}$$

$$\Psi_{l,m_l}(\theta,\phi) = Y_l^{m_l}$$

$$I = mr^2$$

$$m_l = 0, \pm 1, \pm 2, \ldots \pm l$$

$$E_{l,m_l} = l(l+1)\frac{\hbar^2}{2I}$$

$$\hat{l}_z\psi = m_l\psi$$

$$\hat{l}^2\psi = l(l+1)\hbar^2$$

$$6.022 \times 10^{23} AMU = 1g$$

$$h = 6.626 \times 10^{-34} J\,s$$

$$\hbar = 1.055 \times 10^{-34} J\,s$$