

Problema 1

Representa a su estado de energía mas bajo posible; la energía del estado fundamental se conoce también como la energía de punto cero del sistema.

Problema 2

$$E = \frac{hc}{\lambda} = \left(\frac{h^2}{8m_e L^2} \right) n^2 \Rightarrow \frac{hc}{\lambda} = \left(\frac{h^2}{8m_e L^2} \right) [2^2 - 1^2] = \frac{3h^2}{8m_e L^2}$$

$$\Rightarrow \frac{hc}{\lambda} = \frac{3h^2}{8m_e L^2} \Rightarrow 8m_e L^2 hc = 3h^2 \lambda \Rightarrow L^2 = \frac{3h^2 \lambda}{8m_e hc}$$

$$\Rightarrow L = \sqrt{\frac{3h\lambda}{8m_e c}} = \sqrt{\frac{3(6.626 \times 10^{-34}) (794 \times 10^{-9})}{8(9.10 \times 10^{-31} \text{ kg}) (3 \times 10^8 \text{ m/s})}} = 7.93 \times 10^{-10} \text{ m}$$
$$= 0.793 \text{ nm}$$

Problem 3

$$T = e^{-2CL}$$

$$C = \frac{\sqrt{2m_e(U-E)}}{\hbar}$$

$$C = \frac{\sqrt{2(9.10 \times 10^{-31})(8 \times 10^{-20})}}{1.055 \times 10^{-34}} = 3.62 \times 10^9 \text{ m}^{-1}$$

$$2CL = 2(3.62 \times 10^9)(9.5 \times 10^{-10})$$

$$2CL = 6.878$$

$$\Rightarrow T = e^{-6.878} = 1.03 \times 10^{-3}$$

$$(U-E) = (5-4.5)$$

$$U-E = 5 \text{ eV } (1.60 \times 10^{-19})$$

$$U-E = 8 \times 10^{-20} \text{ J}$$

$$m_e = 9.10 \times 10^{-31}$$

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

$$9.5 \text{ \AA} = 9.5 \times 10^{-10} \text{ m}$$

Problema 4

Reorganizando la ec. de Schrödinger para aislar la energía potencial tenemos:

$$U(x) = \frac{\hbar^2}{2m} \frac{1}{\psi} \frac{d^2\psi}{dx^2} \quad \text{como: } \psi(x) = A x e^{-x^2/L^2}$$

$$\Rightarrow \frac{d^2\psi}{dx^2} = (4Ax^2 - 6AxL^2) \frac{e^{-x^2/L^2}}{L^4}$$
$$= \frac{4x^2 - 6L^2}{L^4} \psi(x) = \frac{1}{L^2} \left(\frac{4x^2 - 6L^2}{L^2} \right)$$

$$\Rightarrow U(x) = \frac{\hbar^2}{2mL^2} \left(\frac{4x^2}{L^2} - 6 \right)$$

Problema 5

$$\psi(x) = A e^{ikx}, \quad \frac{d\psi}{dx} = ik\psi, \quad \frac{d^2\psi}{dx^2} = -k^2\psi$$

Sust. en ec. Schrödinger $\rightarrow -\frac{\hbar^2}{2m} \frac{d^2}{dx^2} \psi + U\psi = E\psi$

$$\frac{d^2\psi}{dx^2} = -k^2\psi = -\frac{2m}{\hbar^2}(E-U)\psi$$

Como $k^2 = \frac{(2\pi)^2}{\lambda^2} = \frac{(2\pi p)^2}{\hbar^2} = \frac{p^2}{\hbar^2} \Rightarrow \frac{\hbar^2}{2m} \frac{p^2}{\hbar^2} = (E-U)$

$$\Rightarrow E-U = \frac{p^2}{2m}$$