

Key

CH301H: Principles of Chemistry I: Honors

Fall 2016, Unique 50015

Quiz 3, 11 October 2016

A particle in a box has the following wavefunction and energy:

$$\Psi(x) = \sqrt{\frac{2}{L}} \sin\left(\frac{n\pi x}{L}\right) \quad E_n = \frac{n^2 h^2}{8mL^2}$$

Explain, using any combination of words, equations, or pictures you wish, how you would find the following quantities.

- The number of nodes when $n = 14$.
- The probability of finding the particle between $0 \leq x \leq L/3$ when $n = 5$.
- The most probable place to find the particle when $n = 1$.
- The lowest energy state when $L = 10 \text{ \AA}$.
- The difference in energy between $n = 3$ and $n = 4$.

a) # nodes = $n - 1$

b) $\Psi(x) = \sqrt{\frac{2}{L}} \sin\left(\frac{5\pi x}{L}\right) : \int_0^{L/3} \Psi^*(x) \Psi(x) dx = \text{probability}$

c) minimize! $\frac{d\Psi}{dx} = 0$

d) $E(n=1) = \frac{(1)^2 h^2}{8m(10 \times 10^{-10} \text{ m})^2}$

e) $\Delta E = E(n=4) - E(n=3)$