(Modern Physics) **Quiz 5 - PHY244**

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Giving or receiving aid is cause for dismissal from the university.

$m_e c^2 = 511000$ eV , $c = 3 \times 10^8$ m/s , $hc = 1240$ nm·eV , $e = 1.6 \times 10^{-19}$ C .

$\psi_n(x) = (\sqrt{2/a}) \sin(n\pi x/a)$

♠ An electron is in the ground state of a one-dimensional box of a size a =2.5 nm. Determine its quantum ground state energy (relative to the flat bottom of the potential well).

$$p_e = \frac{hc}{2a} = \frac{1240\ \text{nm}\cdot\text{eV}}{5\ \text{nm}} = 248\ \text{eV}$$

$$E = \frac{p^2}{2m} = \frac{(248)^2}{2 \cdot 511000} = 0.0602\ \text{eV}$$

♠ Use reasonable approximation to determine the probability of the electron in the narrow interval $[\frac{1.01}{6}a, \frac{0.99}{6}a]$.

$$\psi(\text{strip}) \approx \sqrt{\frac{2}{a}} \sin\left(\frac{\pi \frac{a}{6}}{a}\right) = \sqrt{\frac{2}{a}} \sin 30^\circ = \frac{1}{\sqrt{2a}}$$

$$\psi^2 = \frac{1}{2a}$$

$$\int_{\text{strip}} \psi^2 dx = \psi^2 \Delta x = \frac{1}{2a} \times \frac{0.02}{6} a = \frac{0.01}{6} = 0.0017$$

♠ Determine the probability of the electron in the interval $[0.5a, a]$.

$\frac{1}{2}$ by symmetry