King Fahd University of Petroleum & Minerals
Physics Department
Phys212- Quiz#6

Name: Key ID#:

1. Calculate the first excited state momentum and energy of an electron confined to an infinite well of width 0.4 nm. ($\hbar$ = 197.3 eV nm/c, m_e = 0.511 MeV/c^2)

$p = \hbar k = \hbar \frac{n\pi}{L}$ First excited state $n = 2 \Rightarrow p = \frac{2\pi\hbar}{L}$

$p = \frac{2\pi \times 197.3}{0.4} = 3099$ eV/c

$E = K = \frac{p^2}{2m} = \frac{(3099)^2}{2 \times 0.511 \times 10^6} = \boxed{9.4 \text{ eV}}$

2. Estimate the first excited state energy for an electron confined to a potential well of width 0.4 nm and height 200 eV.

We expect $E \ll U \Rightarrow \delta = \frac{\hbar}{\sqrt{2mU}} = \frac{197.3}{\sqrt{2 \times 0.511 \times 10^6 \times 200}}$

$= 0.0138$ nm

$n = 2$

$\Rightarrow E = \frac{4\pi^2\hbar^2}{2m(L+2\delta)^2} = \boxed{8.224 \text{ eV}}$

$\delta = \frac{\hbar}{\sqrt{2m(U-E)}} = 0.0141$ nm

$E = \frac{4\pi^2\hbar^2}{2m(L+2\delta)^2} = \boxed{8.20 \text{ eV}}$

$\delta = \frac{\hbar}{\sqrt{2m(U-E)}} = 0.0141$ nm

$\boxed{E \simeq 8.20 \text{ eV}}$ ← this is the estimated value.