

KING FAHD UNIVERSITY OF PETROLEUM & MINERALS
DEPARTMENT OF PHYSICS

PHYSICS 212 Modern Physics
TERM 022
EXAM #3

Date: Saturday 17 May 2003

Grade = 50

Instructor: Dr. A. Mekki

Name: Key Id#: _____

SHOW THE DETAILS OF YOUR WORK

1. An electron in a one-dimensional infinite square well is in the ground state with an energy of 1.26 eV.
- What is the width of the well?
 - What are the energy and the wave function of the first excited state?
 - Is the state degenerate?

(a) The energies are given by $E_n = \frac{n^2 \pi^2 \hbar^2}{2mL^2}$ $n = 1, 2, 3, \dots$

For the ground state $n=1$

$$\Rightarrow E_1 = \frac{\pi^2 \hbar^2}{2mL^2} \Rightarrow L = \sqrt{\frac{\pi^2 \hbar^2}{2mE_1}}$$

$$E_1 = 1.26 \text{ eV} = 1.26 \times 1.6 \times 10^{-19} = 2.1 \times 10^{-19} \text{ J}$$

$$\Rightarrow L = 5.33 \times 10^{-10} \text{ m} = \boxed{5.33 \text{ \AA}}$$

(b) $E_n = n^2 E_1$ $n=2 \Rightarrow E_2 = 4 E_1 = \boxed{5.04 \text{ eV}}$

$$\psi_2 = \sqrt{\frac{2}{L}} \sin\left(\frac{2\pi x}{L}\right) = \boxed{6.08 \times 10^4 \sin(1.16 \times 10^{10} x)}$$