

HW Pb# 3, 10, 12, 19, 22 and 25

## Problem Chapter 7

Pb# 2.

 $L = 0.2 \text{ nm}$       Cube (0.2 nm, 0.2 nm, 0.2 nm)

$$E_{n_1, n_2, n_3} = \frac{\pi^2 \hbar^2}{2mL^2} (n_1^2 + n_2^2 + n_3^2)$$

$$a) \quad n_1 = n_2 = n_3 = 1 \quad \Rightarrow \quad E_{111} = \frac{3\pi^2 \hbar^2}{2mL^2} = 4.52 \times 10^{-18} \text{ J} \\ = \boxed{28.2 \text{ eV}}$$

$$b) \quad \begin{array}{lll} n_1 = 2 & n_2 = 1 & n_3 = 1 \\ n_1 = 1 & n_2 = 2 & n_3 = 1 \\ n_1 = 1 & n_2 = 1 & n_3 = 2 \end{array} \quad E_{211} = E_{121} = E_{112} = \frac{6\pi^2 \hbar^2}{2mL^2} = 2E_{111} \\ = \boxed{56.4 \text{ eV}}$$

Pb# 4.

$$\Psi(x, y) = \Psi_1(x) \Psi_2(y)$$

$$= A \sin(k_1 x) \sin(k_2 y)$$

$$k_1 = \frac{n_1 \pi}{L} \quad k_2 = \frac{n_2 \pi}{L}$$

$$E = \frac{\hbar^2 \pi^2}{2mL^2} (n_1^2 + n_2^2)$$

$$E_{11} = \frac{\pi^2 \hbar^2}{mL^2}$$

$$\Psi_{11} = A \sin\left(\frac{\pi}{L} x\right) \sin\left(\frac{\pi}{L} y\right)$$

$$E_{12} = \frac{5\pi^2 \hbar^2}{2mL^2} = E_{21}$$

$$\Psi_{12} = A \sin\left(\frac{\pi}{L} x\right) \sin\left(\frac{2\pi}{L} y\right)$$

$$\Psi_{21} = A \sin\left(\frac{2\pi}{L} x\right) \sin\left(\frac{\pi}{L} y\right)$$

$$A = \frac{2}{L}$$