

1. [8 points] Consider an electron confined in a three-dimensional cube of length  $L = 5$  nm. If 16 electrons are put into the box, what is the kinetic energy in eV of an electron in the highest state that is occupied?

Highest state is  $(n_x, n_y, n_z) = (3, 1, 1)$   
 $E = h^2 / (8m L^2) \cdot 11 = .166$  eV

**The next three questions refer to the following situation:**

Consider an electron in a hydrogen atom.

2. [4 points] What are all the allowed values of the orbital angular momentum quantum number,  $\ell$ , for this electron if it is in a state with principal quantum  $n = 4$ ?

$\ell = 0, 1, 2, 3$

3. [3 points] How many independent states are there available to the electron at this energy?

$2n^2 = 32$

4. [5 points] Another hydrogen atom has an electron in a state with  $\ell = 7$ . Which of the following combinations of principal, orbital, and orbital magnetic quantum numbers are possible for this electron? Circle all appropriate answers listed.

$(n = 8, \ell = 7, m_\ell = -8), (n = 1, \ell = 7, m_\ell = -7), (n = 2, \ell = 7, m_\ell = -6),$

$(n = 3, \ell = 7, m_\ell = -5), (n = 4, \ell = 7, m_\ell = -4),$  XX  $(n = 8, \ell = 7, m_\ell = -3),$

$(n = 6, \ell = 7, m_\ell = -2), (n = 7, \ell = 7, m_\ell = -1),$  XX  $(n = 8, \ell = 7, m_\ell = 0)$