

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?

**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  $n = 4$ ?

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

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.

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

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

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