

1. [8 points] Consider an electron confined in a three-dimensional cube of length $L = 5$ nm. If 20 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, ℓ , for this electron if it is in a state with principal quantum $n = 5$?

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 $\ell = 6$. Which of the following combinations of principal, orbital, and orbital magnetic quantum numbers are possible for this electron? Circle all appropriate answers listed.

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

$$(n = 4, \ell = 6, m_\ell = -4), \quad (n = 5, \ell = 6, m_\ell = -3), \quad (n = 6, \ell = 6, m_\ell = -2),$$

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