

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?

Highest state is $(n_x, n_y, n_z) = (3, 1, 1)$
 $E = \frac{h^2}{8m L^2} (3^2 + 1^2 + 1^2) = 1.166$ 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, ℓ , for this electron if it is in a state with principal quantum $n = 5$?

$\ell = 0, 1, 2, 3, 4$

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

$2n^2 = 50$

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.

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

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

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