South Pasadena • AP Chemistry

Name KEY
Period ___ Date ___/___/___

7 • Atomic Structure

QUANTUM NUMBER PRACTICE

1. Summarize:
   The principal quantum number, ***n***, can have the values of: 1, 2, 3, 4, 5, etc. up to "n"
   The angular momentum quantum number, ℓ, can have integer values from 0 to n-1.
   The magnetic quantum number, m_ℓ, can have integer values from $-\ell$ to $+\ell$.

2. When n = 3, ℓ can have values of 0, 1, 2.
   For the 3d orbital, ℓ has a value of 2.

   When n = 4, ℓ can have values of 0, 1, 2, 3.
   For the 4p orbital, ℓ has a value of 1.

   When n = 2, ℓ can have values of 0, 1.
   For the 2s orbital, ℓ has a value of 0

3. Summarize:

orbital	s	p	d	f
value of ℓ	0	1	2	3

} Memorize this!

4. There are five 4d orbitals. List the quantum numbers for each orbital.

n	ℓ	m_ℓ
4	2	-2
4	2	-1
4	2	0
4	2	1
4	2	2

Questions from the textbook (answers in the book)

5. Rank the following orbitals in the H atom in order of increasing energy: 3s, 2s, 2p, 4s, 3p, 1s, and 3d.
   [Check answer in book #76] 1s < 2s = 2p < 3s = 3p = 3d < 4s
   [NOTE: ANY MULTI-ELECTRON ATOM = 1s < 2s < 2p < 3s < 3p < 4s < 3d]

6. How many orbitals in an atom can have the following quantum number or designation?

   a) 3p 3
   b) 4p 3
   c) $4p_x$ 1
   d) 6d 5
   e) 5d 5
   f) 5f 7
   g) ***n*** = 5 25 (n^2)
   h) 7s 1

7. Answer the following questions as a summary quiz on the chapter. [Check answer in book #78]

a) The quantum number ***n*** describes the energy of an atomic orbital.

b) The shape of an atomic orbital is given by the quantum number ℓ.

c) A photon of orange light has less (less or more) energy than a photon of yellow light.

d) The maximum number of orbitals that may be associated with the set of quantum numbers n=4 and ℓ =3 is ~~7~~. (4 f orbitals) oops! ℓ = 0, 1, 2, 3 = s p d f

e) The maximum number of orbitals that may be associated with the quantum number set n=3, ℓ =2, and m_ℓ = -2 is 1. 3d orbital m_ℓ = a specific orbital

f) Label each of the orbital pictures found in question 78 (page 329)with the appropriate letter: I need my book

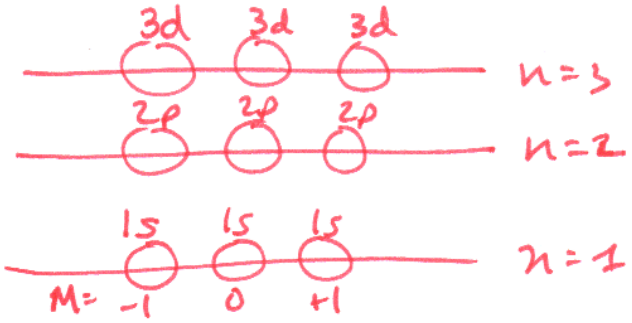
g) When n=5, the possible values of ℓ are 0, 1, 2, 3, 4 P d

h) The maximum number of orbitals that can be assigned to the n=4 shell is 16.

8. Suppose you live in a different universe where a different set of quantum numbers is required to describe the atoms of that universe. These quantum numbers have the following rules:

N, principal	1, 2, 3, … ∞
L, orbital	= N
M, magnetic	-1, 0, +1

How many orbitals are there altogether in the first three electron shells? [Check answer in book #80]



9. Assume an electron is assigned to the 1s orbital in the H atom. Is the electron density zero at a distance of 0.40 nm from the nucleus? NO (See *A Closer Look: Atomic Orbitals*)

The e- density does not become zero until ∞ ~~infinity~~ INFINITY.