# General Chemistry With Doc M

## Monday 10/12/15

Today: 5.5-5.8

Tuesday: Lab 7
Quiz: Molar pipette

Wednesday: Chapter 5

Thursday: No Review!

Friday: No Class!

---

Tiny World $\xleftrightarrow[\div N_A]{* N_A}$ Big World

$E = h\nu = \frac{hc}{\lambda}$

kJ/mol

$$\frac{1}{\lambda} = 1.097 \times 10^{-2}\ nm^{-1}\left(\frac{1}{m^2} - \frac{1}{n^2}\right)$$

$$\Delta E = E_f - E_i = -2.178 \times 10^{-18}\ J\left(\frac{1}{n_f^2} - \frac{1}{n_i^2}\right)$$

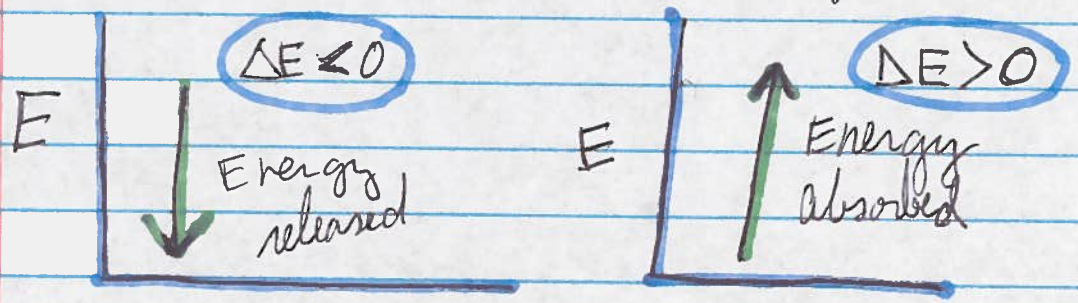
$n = ? \rightarrow n = 2$ visible

$n = ? \rightarrow n = 1$ UV light

$n = ? \rightarrow n = 3$ infared

★ $n = 1$ is the ground state

★ $n > 1$ is an excited state for hydrogen



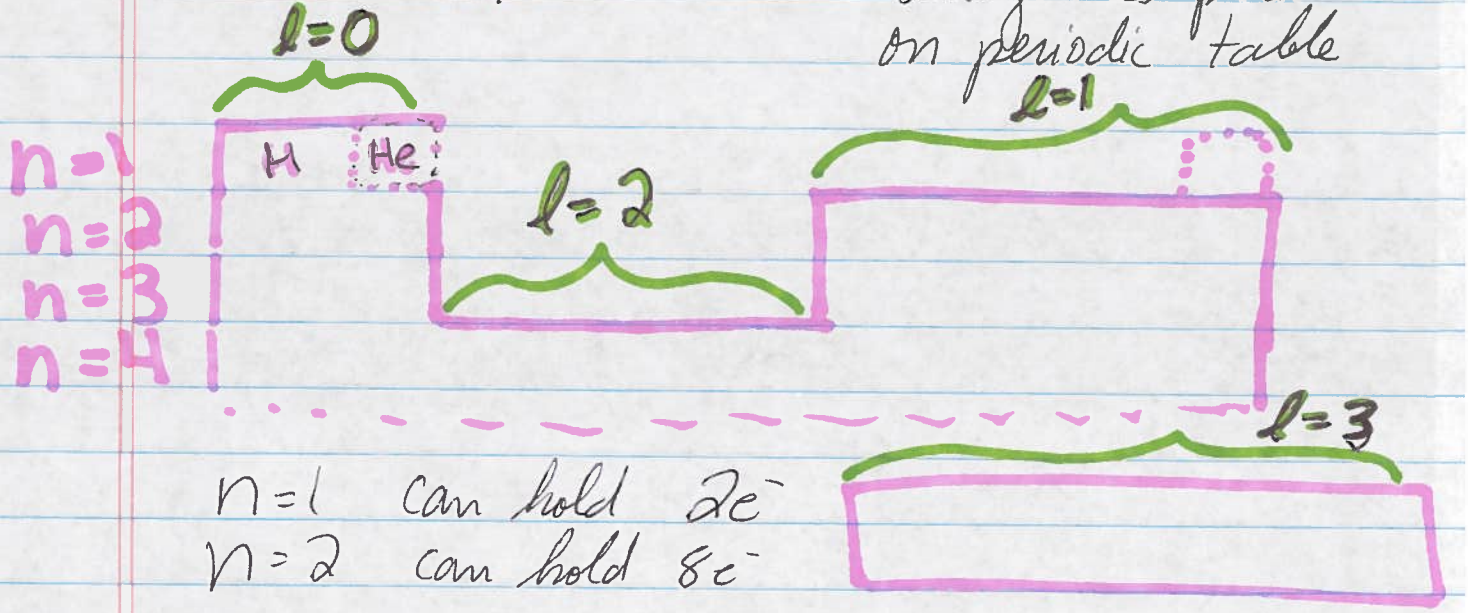

## Quantum Mechanics

1. Electrons behave as waves (de Broglie)
2. Cannot predict exact location or path for $e^-$, only the probability of finding it
3. Physical space for finding $e^-$ is "orbital"
4. $E_{orbital} \propto -1/n^2$
5. Each orbital is defined by 3 quantum #'s
6. Each orbital can contain 0, 1 or 2 $e^-$

# First Quantum #

## n

$n = 1, 2, 3 \ldots \infty$ → designates period on periodic table

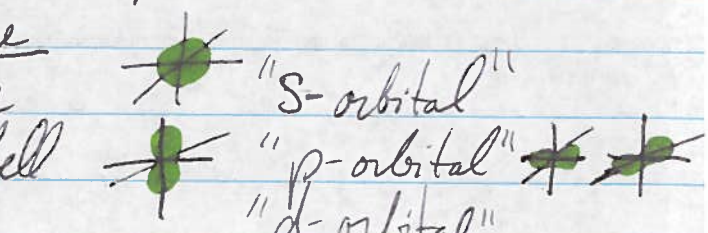


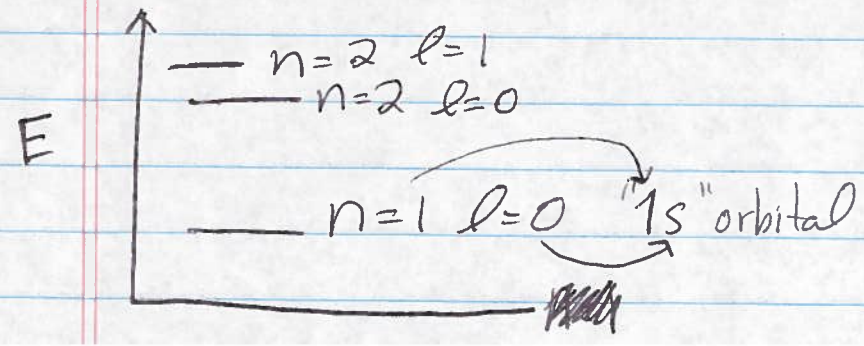

n=1 can hold 2e⁻
n=2 can hold 8e⁻

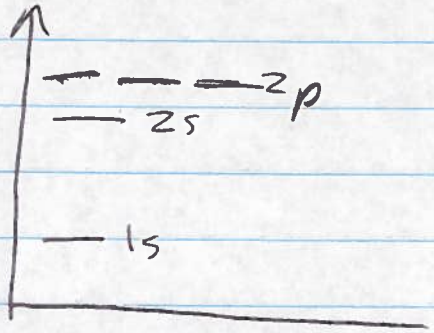
# 2nd Quantum # (angular momentum)

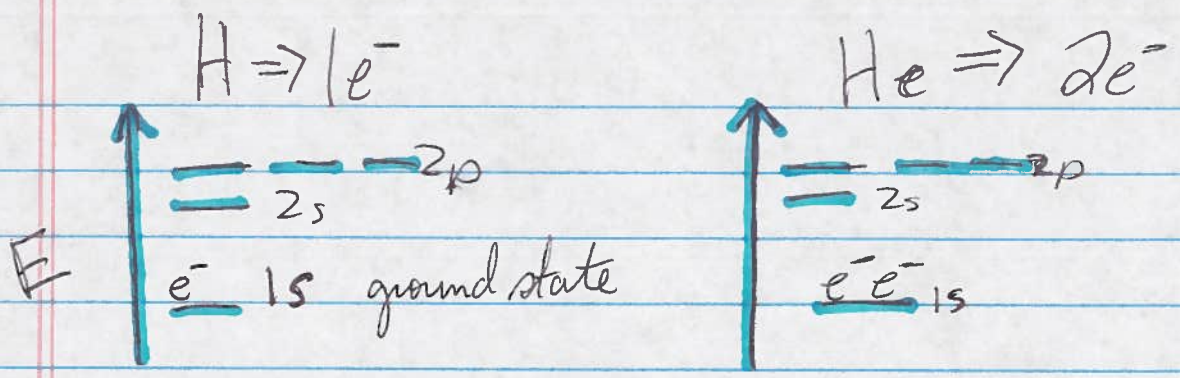
"Shape" Qn → l

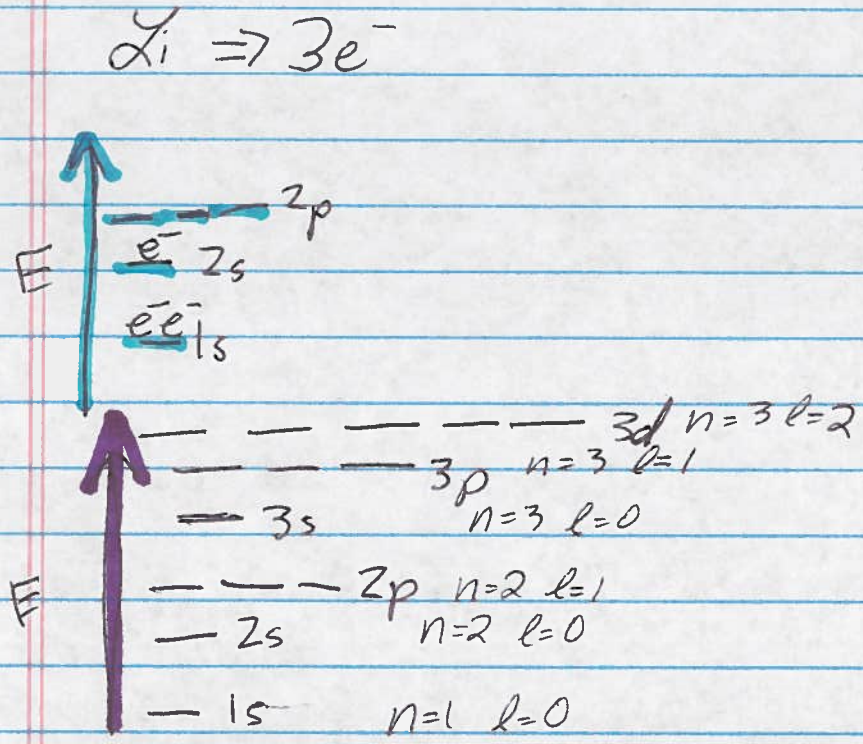
| n | l | Shape |
|---|---|---|
| 1 | 0 | sphere |
| 2 | 0, 1 | dumbbell |
| 3 | 0, 1, 2 | |
| ... | | |
| 62 | 0, 1, 2 ... 61 | |
| k | 0, 1, 2 ... (k-1) | |

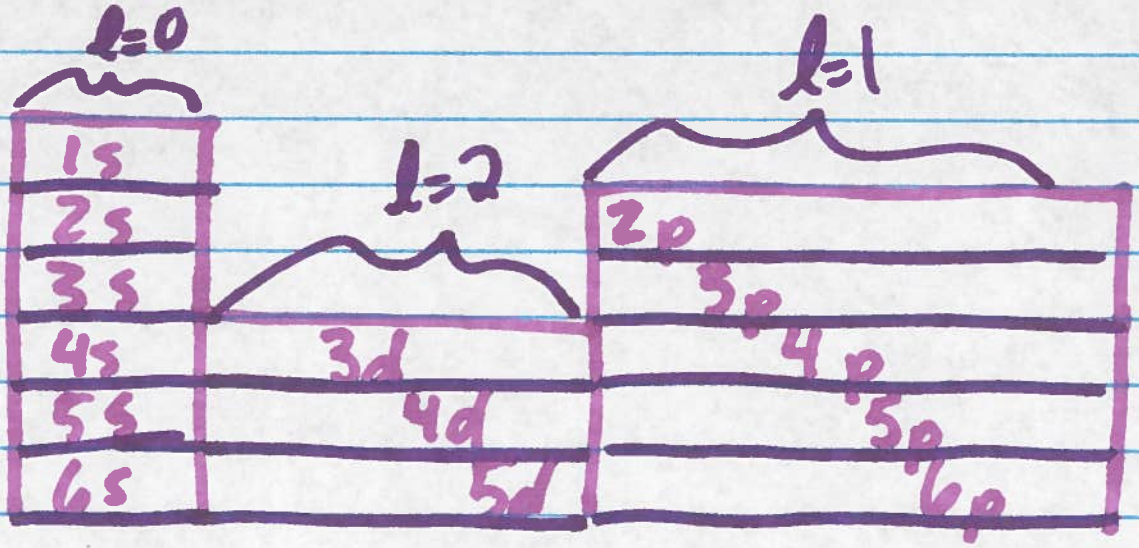


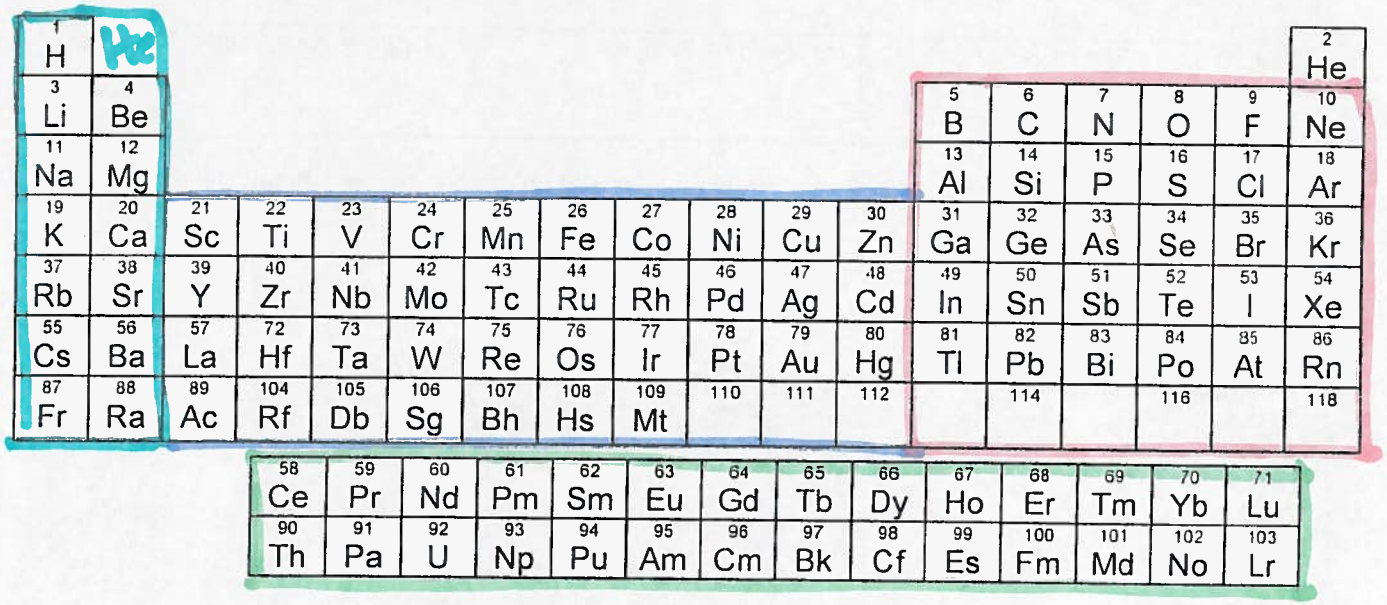

H ⇒ 1e⁻
2p
2s
E
e⁻ 1s ground state
He ⇒ 2e⁻
2p
2s
e⁻ e⁻ 1s


Li ⇒ 3e⁻
2p
E
e⁻ 2s
e⁻ e⁻ 1s
3d n=3 ℓ=2
3p n=3 ℓ=1
3s n=3 ℓ=0
E
2p n=2 ℓ=1
2s n=2 ℓ=0
1s n=1 ℓ=0


ℓ=0
ℓ=2
ℓ=1
1s
2s
3s
4s
5s
6s
3d
4d
5d
2p
3p
4p
5p
6p

**Folder Activity Chapter 5 Day 2** **12 October 2015**

Printed Name: Monika Sothanaskes Chm 203 Student number: TA




1. Which of the following sets of quantum numbers is not allowed? Explain what is wrong.

| | | |
|---|---|---|
| (a) n = 4; $l$ = 2; $m_l$ = 2<br>good | (b) n = 1; $l$ = 1; $m_l$ = 0<br>$l$ must be less than n | (c) n = 3; $l$ = 3; $m_l$ = -2<br>$l$ must be less than n |
| (d) n = 4; $l$ = 0; $m_l$ = 1<br>$\|m_l\|$ cannot be greater than $l$ | (e) n = 5; $l$ = 2; $m_l$ = -2<br>good | (f) n = 4; $l$ = 3; $m_l$ = -3<br>good |

2. Write the following sets of quantum numbers using the s, p, d, and f designations. The first one is done for you.

| | | |
|---|---|---|
| (a) n = 4; $l$ = 2; $m_l$ = 2<br>4d | (b) n = 5; $l$ = 3; $m_l$ = -3<br>5f | (c) n = 3; $l$ = 0; $m_l$ = 0<br>3s |
| (d) n = 2; $l$ = 1; $m_l$ = -1<br>2p | (e) n = 1; $l$ = 0; $m_l$ = 0<br>1s | (f) n = 3; $l$ = 2; $m_l$ = -2<br>3d |

3. What values for $l$ are allowed for each of these values of n? The first one is done for you.

| | | |
|---|---|---|
| (a) n = 4; $l$ = ?<br>$l$ = 0...3 | (b) n = 5; $l$ = ?<br>$l$ = 0, 1, 2, 3, 4 | (c) n = 3; $l$ = ?<br>$l$ = 0, 1, 2 |
| (d) n = 2; $l$ = ?<br>$l$ = 0, 1 | (e) n = 1; $l$ = ?<br>$l$ = 0 | (f) n = 74, $l$ = ?<br>$l$ = 0...73 |

4. What values for n are allowed for each of these values of $l$? The first one is done for you.

| | | |
|---|---|---|
| (a) n = ?; $l$ = 3<br>n > 3 | (b) n = ?; $l$ = 1<br>n > 1 | (c) n = ?; $l$ = 0<br>n > 0 |
| (d) n = ?; $l$ = 4<br>n > 4 | (e) n = ?; $l$ = 2<br>n > 2 | (f) n = ?; $l$ = 37<br>n > 37 |

5. What values for n and *l* are allowed for each of these values of $m_l$ =? The first one is done for you.

| | | |
|---|---|---|
| (a) n = ?; *l* = ?; $m_l$ = -2<br>n > *l* and *l* ≥ 2 | (b) n = ?; *l* = ?; $m_l$ = 3<br>$n > l$, $l \geq 3$ | (c) n = ?; *l* = ?; $m_l$ = 0<br>$n > l$, $l \geq 0$ |
| (d) n = ?; *l* = ?; $m_l$ = -1<br>$n > l$, $l \geq 1$ | (e) n = ?; *l* = ?; $m_l$ = 4<br>$n > l$, $l \geq 4$ | (f) n = ?; *l* = ?; $m_l$ = 15<br>$l \geq 15$ |

6. List the orbitals in order of increasing energy (aufbau principle) up through barium, atomic number 56. The series has been started for you:

1s, 2s, 2p, 3s, 3p, 4s, 3d, 4p, 5s, 4d, 5p, 6s

7. Use your list to create an energy diagram for all orbitals from 1s up through 6s.