

## ChemQuest 11

# An Electron's Address

Name: \_\_\_\_\_

Date: \_\_\_\_\_

Hour: \_\_\_\_\_

## **Information:** Energy Levels and Sublevels

As you know, in his solar system model Bohr proposed that electrons are located in energy levels. The current model of the atom isn't as simple as that, however.

**Sublevels** are located inside energy levels just like subdivisions are located inside cities. Each sublevel is given a name. Note the following table:

TABLE 1

<u>Energy Level</u>	<u>Names of sublevels that exist in the energy level</u>
1 <sup>st</sup> energy level	s
2 <sup>nd</sup> energy level	s and p
3 <sup>rd</sup> energy level	s, p, and d
4 <sup>th</sup> energy level	s, p, d, and f

Note that there is no such thing as a “d sublevel” inside of the 2<sup>nd</sup> energy level because there are only s and p sublevels inside of the 2<sup>nd</sup> energy level.

## **Critical Thinking Questions**

1. How many sublevels exist in the 1<sup>st</sup> energy level?
2. How many sublevels exist in the 2<sup>nd</sup> energy level?
3. How many sublevels exist in the 3<sup>rd</sup> energy level?
4. How many sublevels would you expect to exist in the 5<sup>th</sup> energy level?
5. Does the 3f sublevel exist? (Note: the “3” stands for the 3<sup>rd</sup> energy level.)

## **Information: Orbitals**

So far we have learned that inside energy levels there are different sublevels. Now we will look at orbitals. **Orbitals** are located inside sublevels just like streets are located inside subdivisions. Different sublevels have different numbers of orbitals.

TABLE 2

Sublevel	# of Orbitals Possible
s	1
p	3
d	5
f	7

Here's an important fact: only two electrons can fit in each orbital. So, in an s orbital you can have a maximum of 2 electrons; in a d orbital you can have a maximum of 2 electrons; in any orbital there can only be two electrons.

Since a d sublevel has 5 orbitals (and each orbital can contain up to two electrons) then a d sublevel can contain 10 electrons (= 5 x 2). Pay attention to the difference between "sublevel" and "orbital".

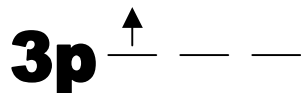
## **Critical Thinking Questions**

6. How many orbitals are there in a p sublevel?
7. How many orbitals are there in a d sublevel?
8. a) How many total sublevels would be found in the entire 2<sup>nd</sup> energy level?  
b) How many orbitals would be found in the entire 2<sup>nd</sup> energy level?
9. a) How many electrons can fit in an f sublevel?  
b) How many electrons can fit in an f orbital?
10. How many electrons can fit in a d orbital? in a p orbital? in any kind of orbital?
11. In your own words, what is the difference between a sublevel and an orbital?
12. How many electrons can fit in each of the following energy levels:  
1<sup>st</sup> energy level =  
2<sup>nd</sup> energy level =  
3<sup>rd</sup> energy level =  
4<sup>th</sup> energy level =

## **Information:** Representing the Most Probable Location of an Electron

The following is an “address” for an electron—a sort of shorthand notation. The diagram below represents an electron located in an orbital inside of the p sublevel in the 3<sup>rd</sup> energy level.

EXAMPLE #1:

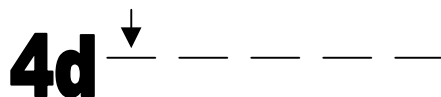


Some important facts about the above diagram:

- The arrow represents an electron.
- The upward direction means that the electron is spinning clockwise.
- “3p” means that the electron is in the p sublevel of the 3<sup>rd</sup> energy level.
- Each blank represents an orbital. Since there are three orbitals in a p sublevel, there are also three blanks written beside the p.
- In the diagram, the electron is in the first of the three p orbitals.

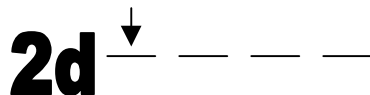
Here’s another example:

EXAMPLE #2:



## **Critical Thinking Questions**

- In example #2, why are there 5 lines drawn next to the d?
- In example #2, what does it mean to have the arrow pointing down?
- Write the notation for an electron in a 2s orbital spinning clockwise.
- Write the notation for an electron in the first energy level spinning clockwise.
- What is wrong with the following notation? You should find two things wrong.



- Write the notation for an electron in the 4<sup>th</sup> energy level in an f sublevel spinning clockwise.