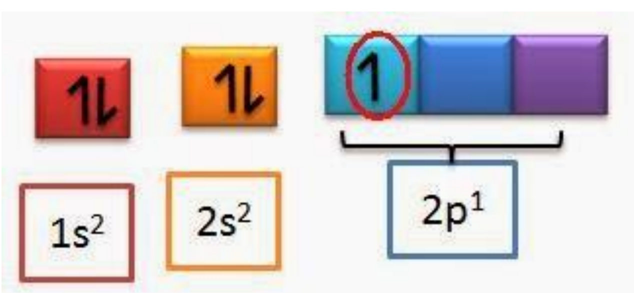
QUANTUM NUMBERS: POSTAL ADDRESS OF AN ELECTRON

As you know, in an atom every electron has a particular place. Just as you have your postal address, every electron also has a particular address. Like a pin code, electrons have a set of Quantum Numbers. These quantum numbers give valuable information about an element. On the basis of quantum numbers of the outer most electron an element gets its particular place in the periodic table. In this post, I am going to explain the quantum numbers and in my next post I will correlate them to the periodic table.



Electronic Configuration of ^{5}B

Write the configuration of ^{5}B: $1s^2$, $2s^2$, $2p^1$. Now arrange its electrons in the orbitals and spot the outer most electron. List down all the specifications you need to write the address of this electron.

1. The orbit number
2. The Sub-shell
3. The orbital
4. The orientation

You are correct; these 4 specifications are listed as quantum numbers and make the complete address of every element. I will explain these specifications one by one.

Orbit Number: Principal Quantum Number (n)

The principal quantum number tells about the orbit number. It is shown by "n". Its value can be 1, 2, 3, 4, 5 …..

In the above example for the outer most electron, the value of "n" will be 2, as it is present in orbit number 2.

The Sub-shell: Azimuthal quantum number (l)

Azimuthal quantum number tells about the sub-shell. The symbol for it is "*l*". Its value can be 0, 1, 2, 3, 4…(n-1). For any electron the value of "*l*" is always less than the value of "n".

The value of "*l*" is assigned for every sub-shell.

For "s" the assigned value of "l" is = 0

For sub-shell "p" the assigned value of "l" is = 1

For sub-shell "d" the assigned value of "l" is = 2

For sub-shell "f" the assigned value of "l" is = 3

In the above example for the outer most electron, the value of "l" will be 1, as it is placed in "p" sub-shell.

The Orbital: Magnetic quantum number (m_l)

Magnetic quantum number (m_l) tells about the particular orbital where electron is placed. As you know every sub-shell has different number of orbitals. These sub-shells have used the advance level of architecture, so that every orbital has a definite orientation in the space. As in "p" sub-shell, one orbital is oriented in "x" axis, other one is in "y" axis and the third one is in the "z" axis. They named as (p_x) , (p_y) and (p_z) according to their orientation in the space.

Magnetic quantum number is the notation for that particular orbital. Like in car we refer different seats as driver seat, window seat, front seat, middle seat and back seat.

The value of Magnetic quantum number depends on the value of Azimuthal quantum number. Value of m_l = +(l) to –(l).

For the "l"= 1that is "p" sub-shell, the value of "m_l" will be= +1, 0, -1.

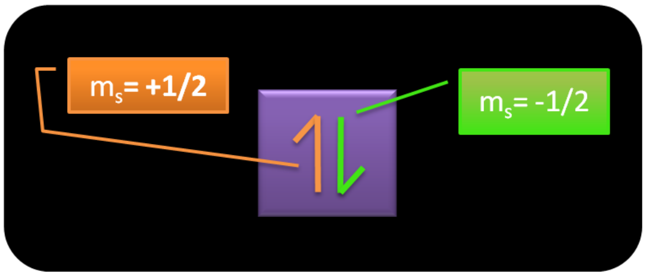
For the "l"= 0that is "s" sub-shell, the value of "m_l" will be= 0.

For the "l"= 2that is "d" sub-shell, the value of "m_l" will be= +2, +1, 0, -1, -2.

For the "l"= 3that is "f" sub-shell, the value of "m_l" will be= +3, +2, +1, 0, -1, -2, -3.

In the above example for the outer most electron, the value of "m_l" will be +1, as it is placed in the (p_x) orbital of the "p" sub-shell.

The orientation: Spin quantum number (m_s)



Spin quantum number

Spin quantum number tells about the orientation of the electron. Either it revolves clockwise or anticlockwise in its axis. Its value can be +1/2 or -1/2.

In the above example for the outer most electron, the value of "m_s" will be +1/2.

If you try yourself a few examples, you will find that none of the two electrons of the same atom have the similar address or in other words have the same value of all the four quantum numbers. It was first discovered by "Wolfgang Pauli". His finding is known today as "Pauli exclusion principle"

Value of "n"=1,2 …	Values of "l"=0 to (n-1)	Values of "m_l"= $+l$ to $-l$	Values of "m_s"= +1/2, -1/2
1	0	0	+1/2, -1/2
2	0	0	+1/2, -1/2
	1	+1 0 -1	+1/2, -1/2
3	0	0	+1/2, -1/2
	1	+1 0 -1	+1/2, -1/2
	2	+2 +1 0 -1 -2	+1/2, -1/2
4	0	0	+1/2, -1/2
	1	+1 0 -1	+1/2, -1/2
	2	+2 +1 0 -1 -2	+1/2, -1/2
	3	+3 +2 +1 0 -1 -2 -3	+1/2, -1/2

Correlation Table of Quantum Numbers

Source : http://chemistrynotmystery.blogspot.in/2014/07/quantum-numbers-postal-address-of.html