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Chemistry Note (SSLC first Chapter)

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SSLC CHEMISTRY

CHAPTER WISE NOTE

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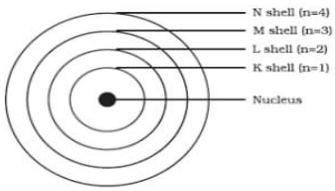
Unit 1

Periodic table and electronic configuration

According to Bohr atom model the electrons are revolved around the nucleus in a fixed circular path is called orbit. As the distance from the nucleus increases, the energy of electron in the shell is increases and the attractive force between the nucleus and the electron decreases.



Each shell contains only a certain number of electrons.

The maximum electron embedded in a shell =$2n^2$
n=shell number

The maximum electron embedded in 1st shell(K) =$2x1^2$ =2
The maximum electron embedded in 2nd shell (L)= $2x2^2$=8
The Maximum electron at 3rd shell = $2x3^2$=18

Electronic configuration of some element:

element	Shell			
	K	L	M	N
$_1$H	1			
$_2$He	2			
$_3$Li	2	1		
$_{10}$Ne	2	8		
$_{11}$Na	2	8	1	
$_{12}$Cl	2	8	7	

Elements and electronic configuration:

- Accordingly electron in each energy level are arranged in its sub energy level
- Each sub energy level in a shell is called a **sub shell**
- They are named as **s p d & f**

Shells and their sub shells:

Shell number	K	L	M	N
Sub shells	s	s p	s p d	s p d f

The sub shell s is common for every shell

each subshell must be accompanied by a shell number in front of the subshell to identify which shell it belong.

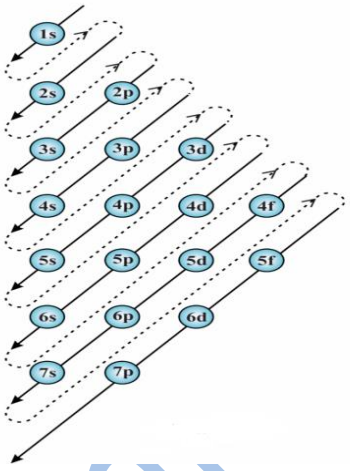
Eg: s sub shell of the 1st shell = 1s
s sub shell of 2nd shell =2s
p sub shell of 2nd shell =2p
d sub shell of 3rd shell =3d

maximum number of electron in sub shell:

Sub shell	s	p	d	f
Maximum number of electron that can be accommodated	2	6	10	14

Filling of electron in sub shell:

- Electron filling in different sub shells takes place in the increasing order of their energies. That is the sub shell which has the lowest energy level is filled first.
- The increasing order of sub shell can be identify from the following diagram.



The increasing order of the sub shell as follows
1s < 2s < 2p < 3s < 3p < 4s < 3d < 4p < 5s < .....

Sub shell electronic configuration: The arrangement of electrons in different sub shell in the increasing order of their sub shell

Eg: $_1H$ the atomic number of hydrogen is 1.ie, hydrogen has only one electron.

There, the shell K contain electron of hydrogen. Corresponding sub shell is s
then we can write electronic configuration of hydrogen($_1H$) as $1s^1$.

$_6C$ atomic number of carbon is 6. So it have 6 electrons.
The hell electronic configuration of carbon = 2,4
so we can write the sub shell electronic configuration of as = $1s^2\ 2s^2\ 2p^2$

When we write the sub shell wise electronic configuration, the number on the left side of the sub shell denotes the shell number and the number on the top right denotes the number of electrons.

Eg: sub shell / Shell number ← $1s^1$ → number of electron

Sub shell electronic configuration of some elements:

SI no	Element	Number of electros.	Shell electronic configuration.				Sub shell electronic configuration
			K	L	M	N	
1	$_{7}N$	7	2				$1s^2\ 2s^2\ 2p^3$
2	$_{9}F$	9	2	7			$1s^2\ 2s^2\ 2p^5$
3	$_{11}Na$	11	2	8	1		$1s^2\ 2s^2\ 2p^6\ 3s^1$
4	$_{13}Al$	13	2	8	3		$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^1$
5	$_{17}Cl$	17	2	8	7		$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^5$
6	$_{18}Ar$	18	2	8	8		$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6$

Different way of representing sub shell electronic configuration of the element:

1) Based on the increasing order of the sub shell.

As we mention above sub shell which has the lowest energy is filled first

Eg: $_{25}Mn \longrightarrow 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^5$

2) Based on the order of the shells.

In this methods different sub shells of the same shell are written in adjacent to each other. Eg: $_{25}Mn \longrightarrow 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^5$ we can write the same electronic configuration as

$_{25}Mn \longrightarrow 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^5\ 4s^2$ (as the subshell of the same shell are adjacent each other)

The shell electronic configuration of scandium($_{21}Sc$) is 2,8,9,2 we know there are 18 electron can embedded in 3rd shell, let se why we write like this way.

Sub shell electronic configuration of $_{21}Sc \longrightarrow 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^1$

based on this type of configuration we can write the electronic configuration of Sc as

$_{21}Sc \longrightarrow$ | $1s^2$ 2 | $2s^2\ 2p^6$ 8 | $3s^2\ 3p^6\ 3d^1$ 9 | $4s^2$ 2 |

3)short form of sub shell electronic:

when we write the electronic configuration of of element we can represent as in short form by using noble gas.

In this method the symbol of the noble gas preceding that element is written with in a square bracket followed by square bracket followed by the electronic configuration of the remaining sub shell.

Eg: atomic number of potassium(K) is 19. ie, it contains 19 electrons.

The electronic configuration of K is $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^1$

Argon(Ar) is the noble gas just before the element K. and the electronic configuration is Ar $= 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6$

then we can write the electronic configuration of K as follows

K = $[1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6]\ [4s^1]$

⇩ ⇩

K = [Ar] $4s^1$ K=[Ar] $4s^1$

Similarly, $_{20}Ca = 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2 \longrightarrow [Ar]\ 4s^2$

$_{12}Mg = 1s^2\ 2s^2\ 2p^6\ 3s^2 \longrightarrow [Ne]\ 3s^2$

$_{3}Li = 1s^2\ 2s^1 \longrightarrow [He]\ 2s^1$

this type representation only by using noble gases.

Peculiarity of the electronic configuration of chromium(Cr) & copper(Cu):

we know the maximum number of electron in the d sub shell is 10. For the sub shell electronic configuration of chromium and copper, the configuration with half filled (d^5) d sub shell and completely filled(d^{10}) sub shell shows greater stability.

Explanation: atomic number of chromium is 24. Electronic configuration written as

$_{24}Cr = 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^4\ 4s^2$.

To attain more stable configuration one electron is shifted from 4s to 3d sub shell. then the new electronic configuration is **$_{24}Cr = 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^5\ 4s^1$.**

As well as, atomic number of copper is 29. Electronic configuration is

$_{29}Cu = 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^9\ 4s^2$.

for the completely filling of d sub shell, one electron is shifted from 4s to 3d the new configuration is like **$_{29}Cu = 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^{10}\ 4s^1$.**

- Like wise, for f sub shell f^7 & f^{14} arrangement are more stable.

Subshell electronic configuration and block:

*Based on the sub shell electronic configuration, elements are classified into four different blocks as s p d & f.

* The block to which the element belongs will be the same as the sub shell to which the last electron is added.

Block	Elements	Number of elements
s Block	Group 1 & 2 elements.	14
p block	Element in group 13 to group 18	36
d block	Element in group 3 to group 12	40
f block	The elements placed at the bottom of the periodic table in two separate rows.	30
➢ s and p block elements are collectively called as representative elements.		

sub shell electronic configuration and period:

the period number is same as the shell number of the outermost shell in the sub shell electronic configuration.

Subshell electronic configuration and atomic number:

We can find the atomic number of an element from its electronic configuration. To find atomic number , add the number given as superscript in the sub shell electronic configuration of an element. which is equal to atomic number.

Element	Atomic number	Sub shell electronic configuration	Sub shell to which last electron filled	block	period
$_{7}N$	7	$1s^2\ 2s^2\ 2p^3$	p	p	2
$_{11}Na$	11	$1s^2\ 2s^2\ 2p^6\ 3s^1$	s	s	3
$_{18}Ar$	18	$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6$	p	p	3
$_{25}Mn$	25	$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^5\ 4s^2$	d	d	4

Sub shell electronic configuration and block:

a) for s block elements:

for s block elements the number of electron in the outer most s sub shell will be the group number.

Eg: $_{3}Li = 1s^2\ 2s^1$ the outer most subshell (2s) contain only one electron,so group number is 1.

$_{12}Mg = 1s^2\ 2s^2\ 2p^6\ 3s^2$ the outer most subshell (3s) contain only two electron, so group number is 2.

Characteristics of s block elements:

- Their oxide and hydroxides are basic in nature.
- S block elements usually form ionic compounds
- More metallic nature
- Low ionization energy
- Low electro negativity
- Elements in 1^{st} & 2^{nd} group are belong to s block elements.(1^{st} group element is alkali metals and 2^{nd} group elements is alkaline earth metals)
- Oxidation state of 1^{st} group element is +1 &oxidation state of 2^{nd} group elements is +2
- High atomic radius.
- Last electrons are filled in s sub shell

b) p block elements

the elements in group 13 to group 18 belongs to p block elements.

Group number is obtained by adding 12 to the number of electron present in the outermost p sub shell

OR

Group number can be obtained by adding 10 to the total number of electron present in the outermost s and p sub shell.

Eg: $_{7}N = 1s^2\ 2s^2\ 2p^3$ the outermost sub shell(2p) contains 3 electrons. Add 12 to the outermost sub shell electron. 12+3=15. Hence group number is 15

$_{10}Ne = 1s^2\ 2s^2\ 2p^6 \longrightarrow$ $6+12=18^{th}$ group.

$_{13}Al = 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^1 \longrightarrow$ $1+12=13^{th}$ group.

Characteristics of p block elements:

- P block contains metals, non metals and metalloids.
- The last electron is filled in p sub shell
- High ionization energy
- High electro negativity
- P block elements shows both +ve and –ve oxidation state.

3) d block elements:

the group number of d block elements will be the same as the sum of electrons in the outermost s sub shell and the number of electron in the preceding d sub shell.

Eg: $_{24}Cr = 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^5\ 4s^1$. Add electron of the subshell 4s and 3d we get 5+1=6

Characteristics of d block elements:

- The last electron is filled in the d sub shell
- Their elements are also known as transition elements.
- All d block elements are metals.
- They form colouerd compounds

  Copper sulphate ⟶ blue

  Cobalt nitrate ⟶ pink

  Ferrous sulphate ⟶ green.

  Colouerd compounds of d block elements is used to manufacture colored glass.
- d block elements shows variable oxidation state.

  Eg: two compounds of iron (Fe) are

  $FeCl_2$ ⟶ ferrous chloride.

  $FeCl_3$ ⟶ ferric chloride.

  In 1st compound ($FeCl_2$) here Fe shows +2 oxidation state a& in 2nd compound ($FeCl_3$) Fe shows +3 oxidation state.

  similarly, two compounds of copper are

  CuCl ⟶ cuprous chloride.

  $CuCl_2$ ⟶ cupric chloride.

  In CuCl Cu shows +1 oxidation state and in $CuCl_2$ Cu shows +2 oxidation state.

  In the case of transition elements the difference in the energy bet when the outer most sub shell and the penultimate d sub shell is very small, hence under suitable condition the electron in d sub shell also take part in chemical reaction. hence transition elements shows variable oxidation state.

  Sub shell electronic configuration of ions:

  Sub shell electronic configuration of positive ion can be written by removing the electron, corresponding to the charge of the ion, in doing so the electron should be removed first from the outermost shell.

  Eg: $_{26}Fe = 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^6\ 4s^2$.

  $Fe^{2+} = 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^6$.

  $Fe^{3+} = 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^5$.

Characteristics of f block elements:

- the element in which last electron enter into the f sub shell
- their elements are also known as inner transition elements.
- Their elements are placed in two separate rows at the bottom of the periodic table. 1^{st} row → lanthanoids 2^{nd} row → actinoiuds
- Most of the elements shows variable oxidation state liked block elements?
- Most of the actinoids are artificial elements.
- Uranium(U), thorium (Th), plutonium (Pu) etc… are used as fuel in nuclear reactor.
- Many of these elements are used as catalyst in the petroleum industry.