UNIT 1: Atomic structure, catalysis and Nano-chemistry

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ATOMIC STRUCTURE -

Chemistry is a branch of science that deals with the study of the nature of matter, its composition, occurrence, methods of preparation, properties and uses.

ATOM : An Atom is the smallest invisible particle of element, having all the characteristics of the parent element, which can neither be created nor destroyed by any chemical change. It cannot exist freely. The atoms of certain elements such as hydrogen, oxygen, nitrogen, etc.do not have independent existence where as atoms of helium, neon, argon, etc. do have independent existence. All elements are composed of atoms.

Fundamental particles of an atom :-

1. PROTON -

1.The proton is a positively charged particle.

2.It has unit positive charge. The mass of proton is approximately equal to the mass of one hydrogen atom. It is equal to 1.00732 amu.

3.The proton is present in atoms of all the elements.

4. Protons are present inside the nucleus of an atom

Fundamental particles of an atom :

2.ELECTRON -

1. **The electron is a negatively charged particle.**
2. **It has unit negative charge and negligible mass.**
3. **The mass of and electron is about 1/1837 of mass of a hydrogen atom.**
4. **Electrons are present in all the atoms.**
5. **Electrons are revolving around the nucleus in various circular orbits (shell).**

Fundamental particles of an atom :

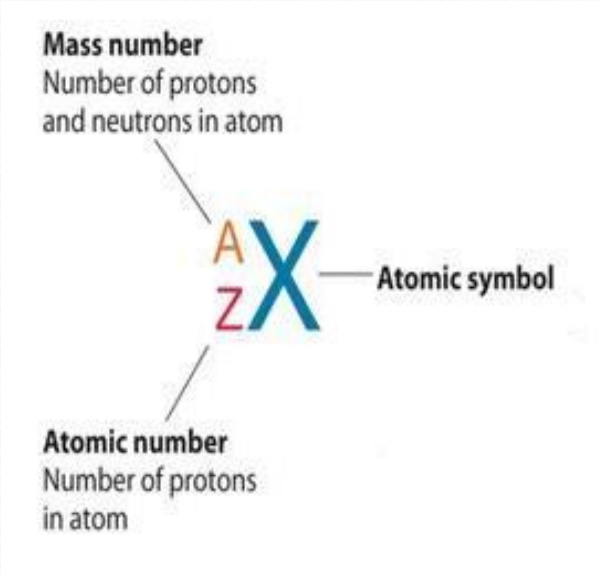
3:NEUTRON -

1. The neutron is a neutral particle. Hence, it has no charge.

2. It has unit mass. The neutron is present in atoms of all elements except hydrogen. The mass of a neutron is slightly greater than the mass of a proton. It is equal to 1.00871 amu.

3. Neutron is present inside the nucleus of an atom.

ATOMIC NUMBER AND ATOMIC MASS NUMBER



1. ATOMIC NUMBER (Z)

The atomic number is the number protons present in the nucleus of an atom or number of electrons revolving around the nucleus in an atom.

Atomic number= No of protons=No of electrons

2. MASS NUMBER (A) -

The mass number of an element is given by the total number of protons and neutrons present in the nucleus of an atom.

A= (P+N)

Therefore the number of neutrons is = A-Z.

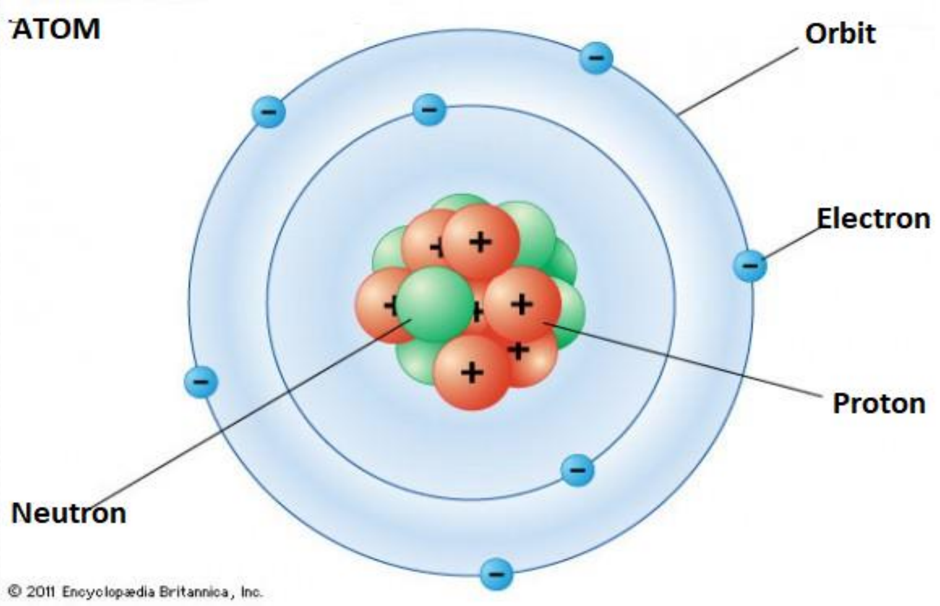
STRUCTURE OF ATOM :

The atom consists of two parts.

They are

1.The central nucleus

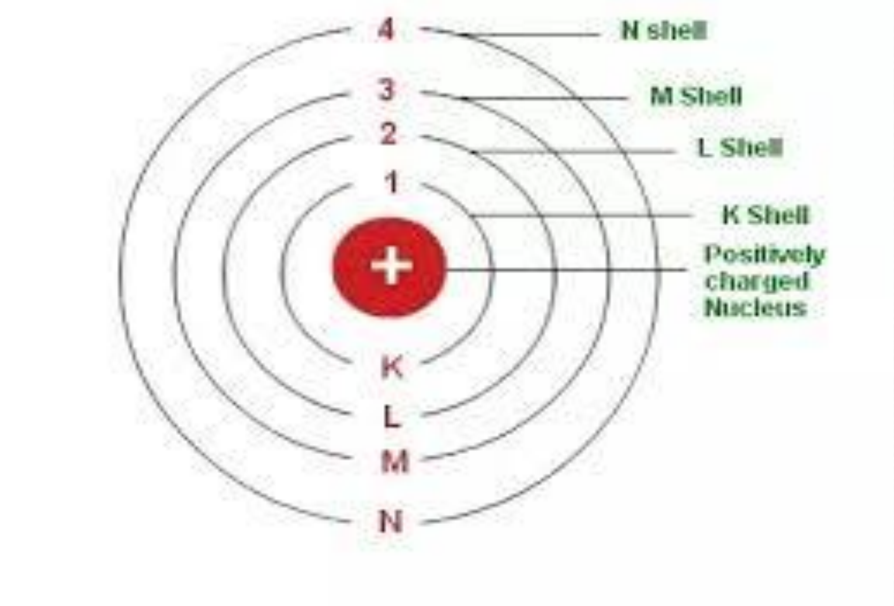
2.The outer extra nuclear part.



1. The central Nucleus:

The nucleus is the central part of an atom consists of protons and neutrons. Since the protons are positively charged particle and neutrons are neutral, the nucleus is always positive part of an atom. The entire weight of an atom is present only in the nucleus.

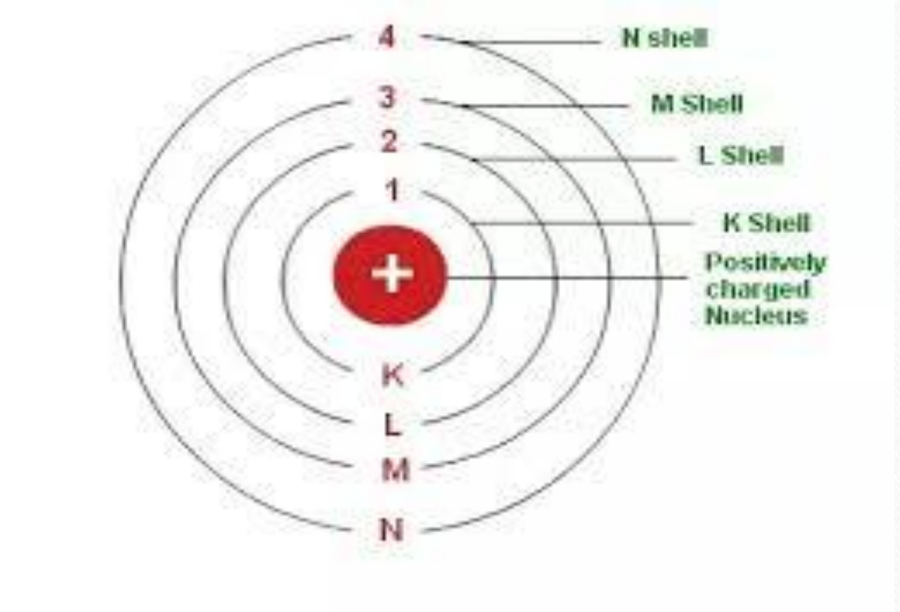
2. The outer extra nuclear part :



1. It is the part around the nucleus. It contains all electrons of an atom. It is negative part of the atom. The electrons are revolving around the nucleus in a regular path called shell or orbit or energy levels.

2. The shells or orbits are numbered, as 1,2,3,4 etc from the nucleus. They are also known as K, L, M, N Shell or orbit.

2. The outer extra nuclear part :

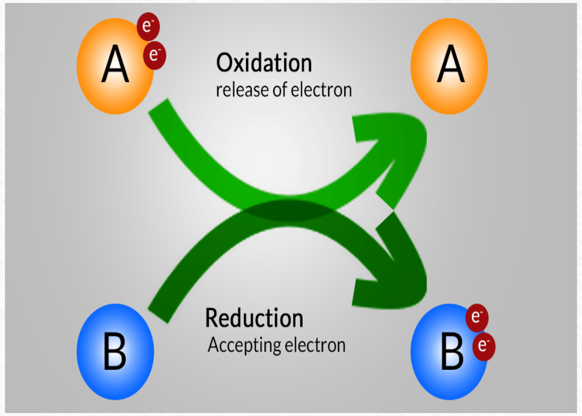


3. Each shell can accommodate only certain number of electron, which is given by the formula $2n^2$ where the 'n' is the number of the shell. Therefore, the numbers of electrons that are accommodated in the 1st, 2nd, 3rd shell respectively are 2,8,18.

4. The electrons present in the outer most orbit is called as valence electron.

5. The atom as whole is a neutral one. Since the number of protons (positively charges) is equal to the number of electrons (negative charges).

OXIDATION



Oxidation is a process that involves removal (loss) of electrons.

Example:

$$Na - 1e^{-} \longrightarrow Na^{+}$$

REDUCTION

Reduction is a process that involves addition (gain) of electrons.

Example:

$$Cl + 1e^{-} \longrightarrow Cl^{-}$$

CHEMICAL BOND :-

"A chemical bond may be defined as an attraction between the two atoms in a molecule"

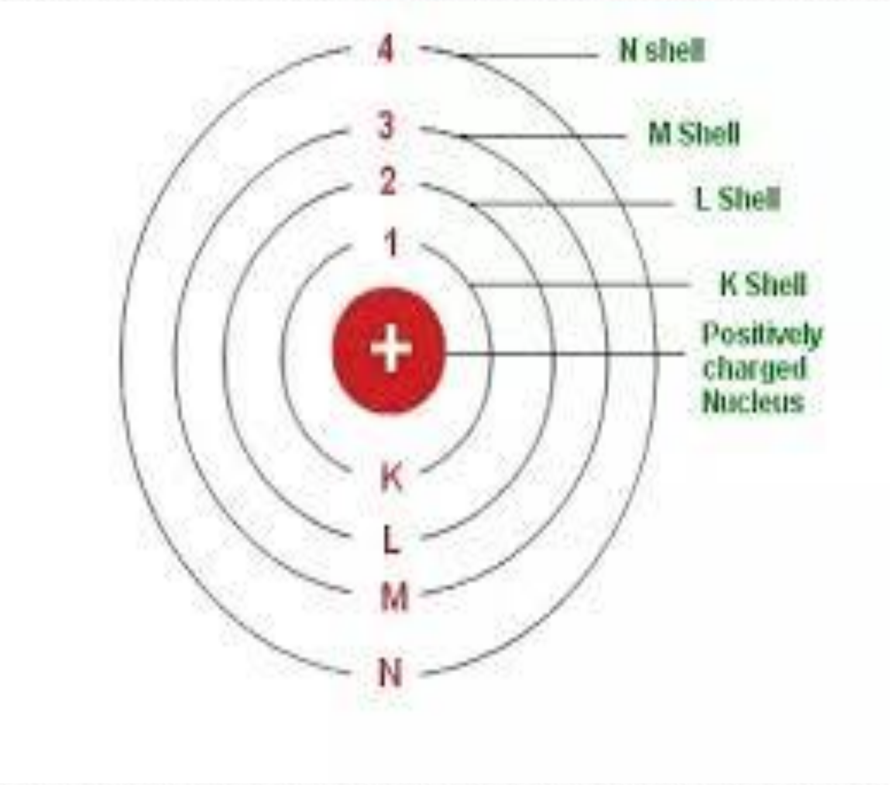
OCTET RULE :-

According to Lewis "octet theory, all the elements with an unstable or incomplete electronic configuration have a tendency to attain the stable electronic configuration of the nearest inert gas configuration either by complete transfer of valence electron from one atom to another or by mutual sharing of valence electron between the atoms". This tendency to attain the stable electron configuration is responsible for the formation of chemical bonding.

DUPLET RULE :-

duplet rule, states that element like helium can be stable with two electrons in its shell. It is called as duplet rule.

BOHRS ATOMIC MODEL



1. An atom consist of a dense positively charged central part called as nucleus.
2. The electrons revolve around the nucleus in fixed circular path called as orbit or shell. The electrostatic force of attraction between nucleus and electron balanced by the centrifugal force. Hence the electrons do not fall into the nucleus and therefore atom remains stable.

BOHRS ATOMIC MODEL

3. Electron can rotate in only certain permitted orbits known as stationary states

4. Each stationary states is having definite amount of energy called as energy level or orbit or shell.

5. Energy levels are named as K,L,M and N for n = 1,2,3,4----

6. Electrons in the energy level nearest to the nucleus have lower energy while those are at greater distance from the nucleus have higher energy.

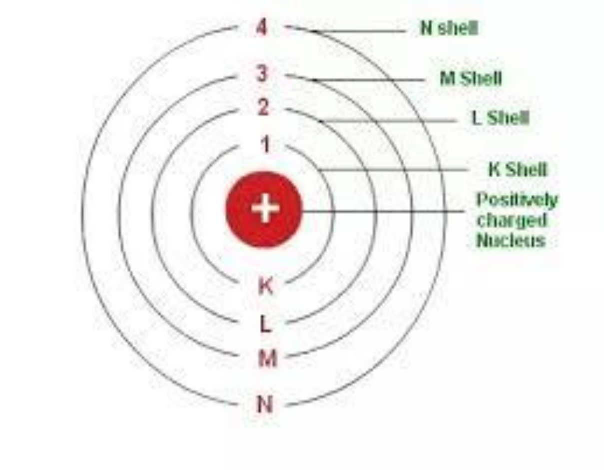
7. Electrons in the same energy level has same energy and remains constant.The energy of an electron can change only when it moves from one level to another. When the excited electron jumps from lower to higher energy level, it absorbs energy while when the excited electron jumps from higher energy level lower , it emits energy.

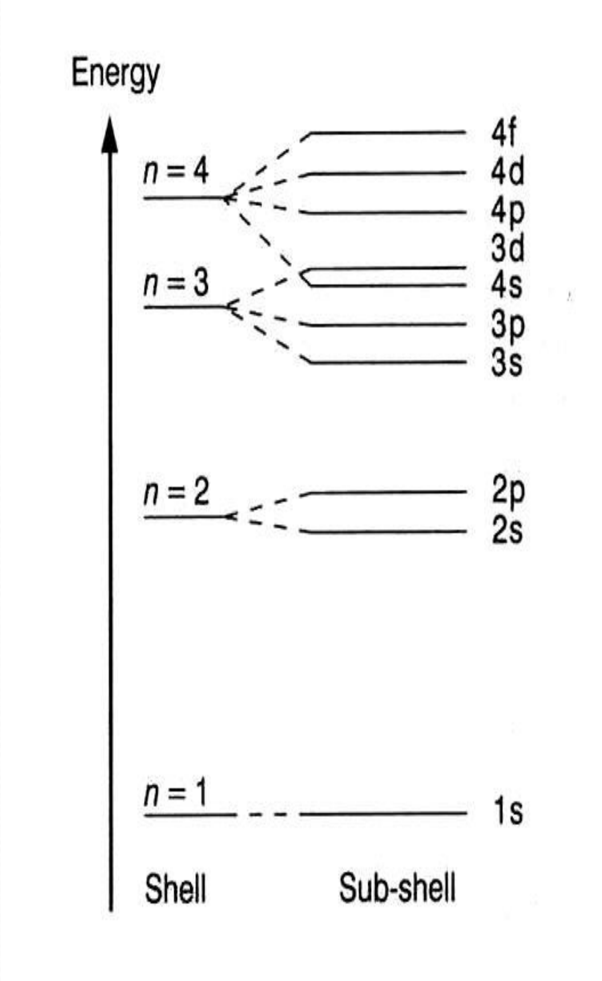
8. The angular momentum of an electron(mvr)must be an integral multiple of h/2¶

Hence mvr = nh/2¶

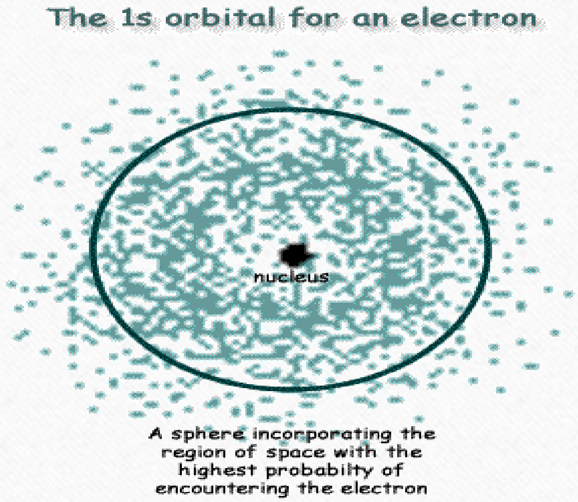
DIFFERENCE BETWEEN ORBIT AND ORBITAL

ORBIT (Energy Level/Shell))





ORBITAL (Sub energy level/Sub shell)



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DIFFERENCE BETWEEN ORBIT AND ORBITAL

SR. NO.	ORBIT	ORBITAL
1	It is circular path around the nucleus in which electrons are revolving.	It is three dimensional space around the nucleus within which the probability of finding an electron is maximum.
2	It is circular in shape.	S,p and d orbital are spherical ,dumb-bell and double dumb-bell shape in shape respectively
3	The maximum no of electrons in an orbit is 2n2 where n is the number of the orbit	The maximum number of electrons in an orbital is two.
4	These are non-dimensional	These are dimensional
5	K,L,M,N---- are orbits	S, p_x p_y, p_z are orbital.

❑ FORMATION OF CATION (Hydrogen atom)

Number of proton = 1 (number of positive charge is +1)
Number of electron = 1 (number of negative charge is -1)
Number of neutron = 0
When hydrogen atom losses its outer most electron, it has only one proton. The H becomes H+ ion due to the loss of one electron. Hence, the H+ ion is called as proton

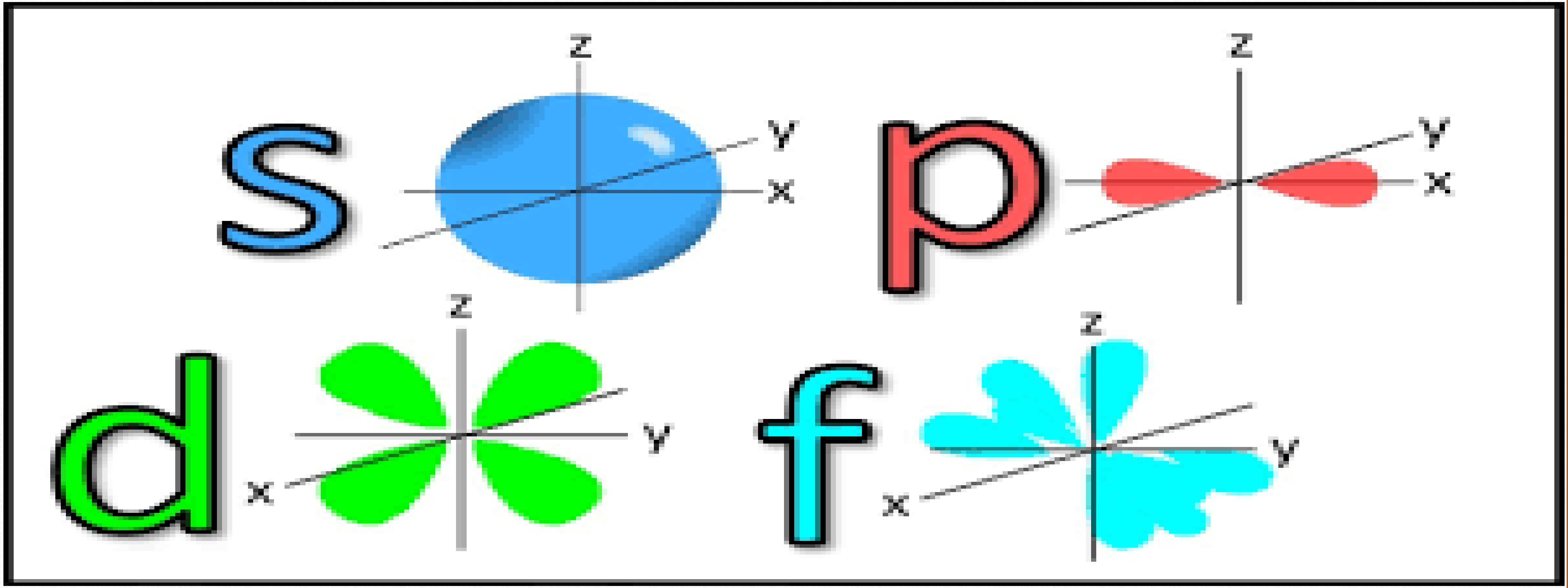
$$H\ (Atom) - 1e^{-} \longrightarrow H^{+}(Cation)$$

❑ FORMATION OF ANION (Chloride ion)

When an atom gains an electron, it becomes anion. From the above example, chlorine atom gains an electron from sodium it becomes an anion.

$$Cl\ (Atom) + 1e^{-} \longrightarrow Cl^{-}\ (Anion)$$

SHAPES OF ORBITALS



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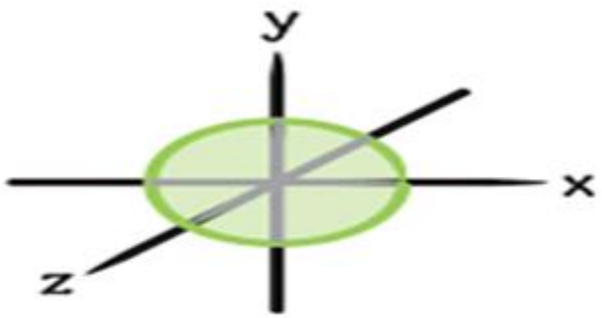
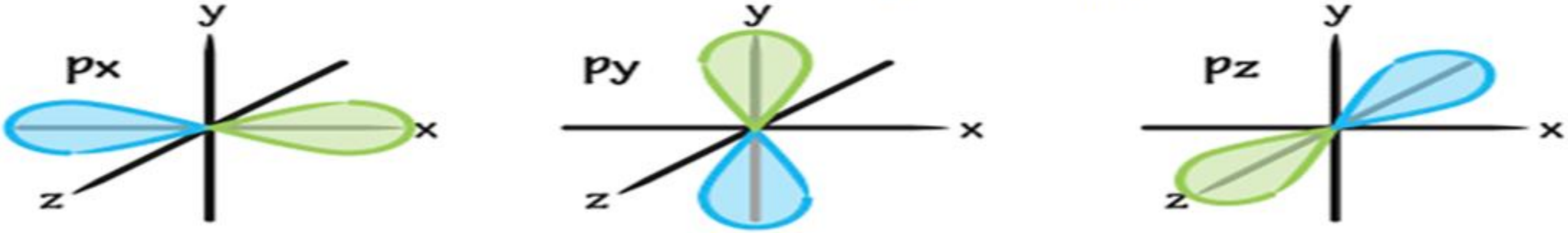
SHAPES OF ORBITALS

s orbital (Spherical shaped)



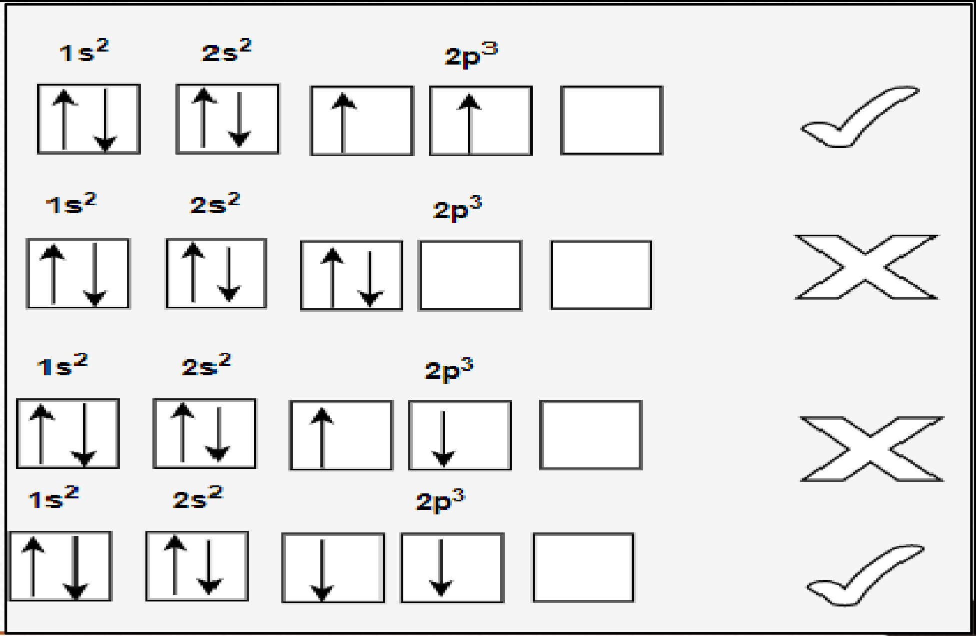
p orbitals (Dumbell shaped)

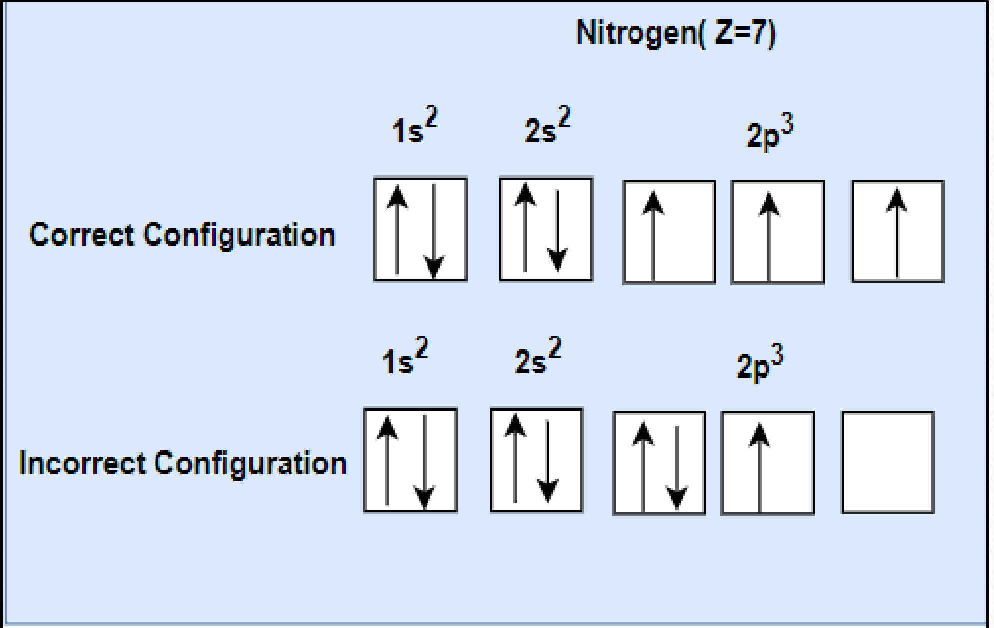


HUND'S RULE :

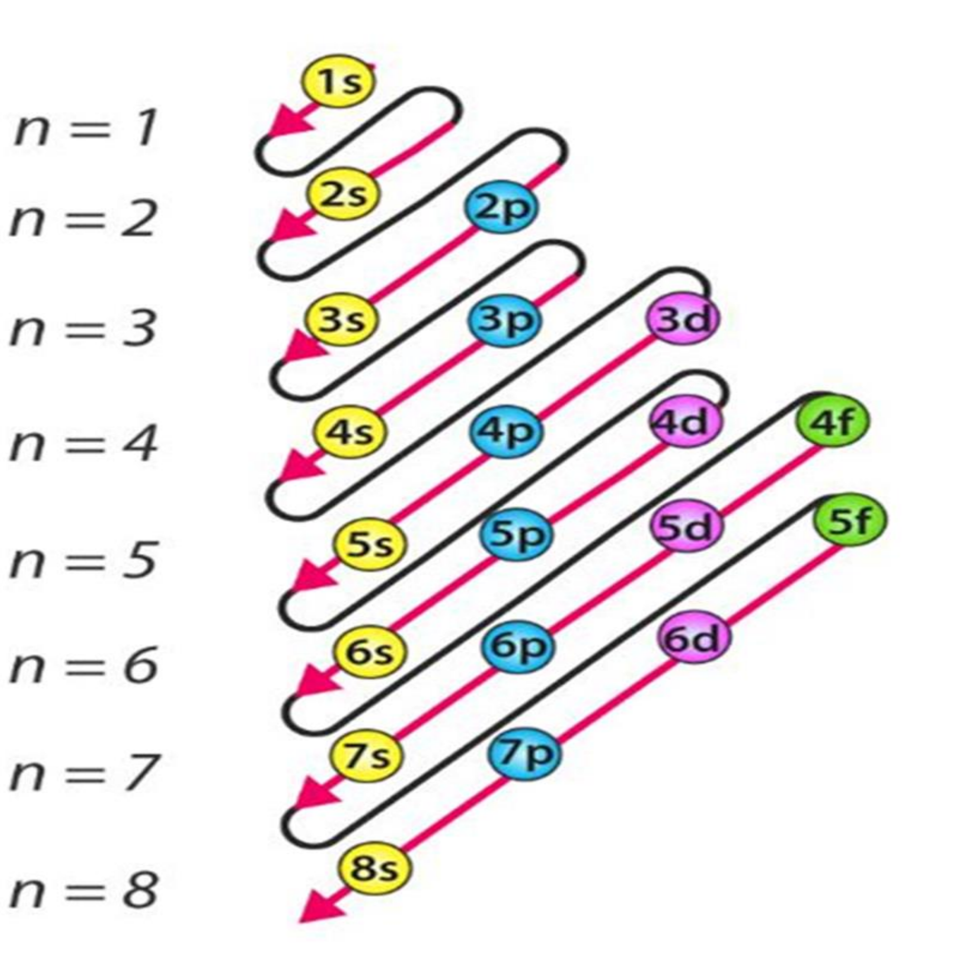
"When several orbitals of the same energy are available, then the electrons first fill all the orbitals with parallel spin before pairing starts"

Carbon (6) - $1S^2,2S^2,2P^2$	Nitrogen (7)- $1S^2,2S^2,2P^3$





AUFBAU'S PRINCIPLE -



<u>The aufbau's principle</u> states that in the ground state of an atom or ion, electrons fill atomic orbitals of the lowest available energy levels before occupying higher levels.

<u>Quantum numbers</u> -Quantum numbers may be defined as a set of 4 numbers with the help of which we can get complete information about all the electrons in an atom, i.e. location, energy, the type of Orbital occupied, space and orientation of that orbital.

Quantum numbers and their significance -

1) PRINCIPLE QUANTUM NUMBER(n):This quantum number shows the average distance of an electron cloud from the nucleus and indicates the size of electron cloud. It indicated as,

n = 1,2,3,4……… OR n = K , L , M , N …….etc

2) AZIMUTHAL QUANTUM NUMBER (l): It is used to describe the subshells within main shell.

It describe the shape of the electron cloud and can take value as 0,1,2,3,…… to (n-1)

n = 1	l = 0
n = 2	l = 0,1
n = 3	l = 0,1,2
n = 4	l = 0,1,2,3

3) MAGNETIC QUANTUM NUMBER (m):It describes orbitals within subshells.(Orbitals – The 3 Dimensional region around the nucleus. It takes value from –l through 0 to +l

Azimuthal Quantum No.	Magnetic Quantum No.	
l = 0 (s-sub level)	m = 0	
l = 1(p-sub level)	m =-1, 0 ,+1	
l = 2(d-sub level)	m =-2, -1, 0 ,+1,+2	
l = 3(f-sub level)	m =-3,-2, -1, 0 ,+1,+2,+3	

4) <u>SPIN QUANTUM NUMBER </u>(s) – It describes the direction of electron around its own axis .(clockwise or anti-clockwise)Thus electron have only two values

s = +1/2 for clockwise (↑) and s = -1/2 for anticlockwise (↓)

Pauli's exclusion Principle : According to it: “no two electrons can have the same set of all four quantum numbers.” Or it states that an orbital can have maximum of two electrons and that must be of opposite spin. Due to this, it was concluded that an orbital can have maximum of two electrons which can have all 3-quantum number same but the spin will be definitely different.

Quantum no concept -

https://youtu.be/oOVLkiBnq6o

https://youtu.be/hDPCAhOTSqc

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Permitted values of Quantum nos and orbitals -

n	l	m_l	m_s	Number of orbitals	Orbital Name	Number of electrons	Total Electrons
1 (K shell)	0	0	½ - ½	1	1*s*	2	2
2 (L Shell)	0	0	½ - ½	1	2*s*	2	8
	1	-1, 0, +1	½ - ½	3	2*p*	6	
3 (M-shell)	0	0	½ - ½	1	3*s*	2	18
	1	-1, 0, +1	½ - ½	3	3*p*	6	
	2	-2, -1, 0, +1, +2	½ - ½	5	3*d*	10	
4 (L-shell)	0	0	½ - ½	1	4*s*	2	32
	1	-1, 0, +1	½ - ½	3	4*p*	6	
	2	-2, -1, 0, +1, +2	½ - ½	5	4*d*	10	
	3	-3, -2, -1, 0, +1, +2, +3	½ - ½	7	4*f*	14	

RULES FOR DISTRIBUTIONOF ELECTRONS

<u>Rule 1</u>: The maximum number of electrons present in a particular shell is calculated by the formula 2n2, where "n" represents the shell number. For instance, K shell is the first shell and it can hold up to 2(1)2 = 2 electrons. Similarly, L shell is the second shell and it can hold up to 2(2)2 = 8 electrons. This formula helps to calculate the maximum number of electrons that an orbit can accommodate.

<u>Rule 2</u>:

The maximum capacity to hold electrons in the outermost shell is 8.

RULES FOR DISTRIBUTIONOF ELECTRONS

Rule 3:

The electrons will fill the inner shells before the outer shells. First electrons will fill the K-shell and then L shell and so on.

Thus, electronic configuration of elements follows an ascending order.

Rule 4:

Hund's Rule

Rule 5:

Aufbau's Principle

ELECTRONIC CONFIGURATION

Definition : It is the distribution of electrons of an atom or molecule (or other physical structure) in atomic or molecular orbitals

USES OF THE ELECTRONIC CONFIGURATION:

1) Electronic Configuration helps to understand the structure of periodic table with respect to each element.
2) It also helps in understanding and explanation of the chemical bonds between the atoms.
3) It explains the different properties and peculiar properties of certain elements. For example, electronic configuration explains the reason for the unique properties of lasers and semiconductors.

ELECTRONIC CONFIGURATION

Atomic No.	Element	ELECTRONIC CONFIGURATION
1	Hydrogen (H)	$1s^1$
2	Helium (He)	$1s^2$
3	Lithium (Li)	[He] $2s^1$
4	Beryllium (Be)	[He][$2s^2$
5	Boron (B)	[He] $2s^2\ 2p^1$
6	Carbon (C)	[He]$2s^2\ 2p^2$
7	Nitrogen (N)	[He] $2s^2\ 2p^3$
8	Oxygen (O)	[He]$2s^2\ 2p^4$
9	Fluorine (F)	[He] $2s^2\ 2p^5$
10	Neon (Ne)	$1s^2\ 2s^2\ 2p^6$

ELECTRONIC CONFIGURATION

Atomic No.	Element	ELECTRONIC CONFIGURATION
11	Sodium (Na)	[Ne] $3s^1$
12	Magnesium (Mg)	[Ne] [Ne] $3s^2$
13	Aluminium (Al)	[Ne] [Ne] $3s^2$ $3p^1$
14	Silicon (Si)	[Ne] [Ne] $3s^2$ $3p^2$
15	Phosphorus (P)	[Ne] [Ne] $3s^2$ $3p^3$
16	Sulfur (S)	[Ne] [Ne] $3s^2$ $3p^4$
17	Chlorine (Cl)	[Ne] [Ne] $3s^2$ $3p^5$
18	Argon (Ar)	$1s^2$ $2s^2$ $2p^6 3s^2$ $3p^6$
19	Potassium (K)	[Ar] $4s^1$
20	Calcium (Ca)	[Ar] $4s^2$

ELECTRONIC CONFIGURATION

Atomic No.	Element	ELECTRONIC CONFIGURATION
21	Scandium (Sc)	[Ar] $3d^1 4s^2$
22	Titanium (Ti)	[Ar] $3d^2 4s^2$
23	Vanadium (V)	[Ar] $3d^3 4s^2$
24	Chromium (Cr)	[Ar] $3d^5 4s^1$
25	Manganese (Mn)	[Ar] $3d^5 4s^2$
26	Iron (Fe)	[Ar] $3d^6 4s^2$
27	Cobalt (Co)	[Ar] $3d^7 4s^2$
28	Nickel (Ni)	[Ar] $3d^8 4s^2$
29	Copper (Cu)	[Ar] $3d^{10} 4s^1$
30	Zinc (Zn)	[Ar] $3d^{10} 4s^2$

Catalyst – The substance which alter the rate of reaction without themselves undergoing any chemical change are called catalyst and the phenomenon is called as catalysis.

1.4.1 Types of Catalysts

Catalysts are of three types on the basis of their influence towards chemical reactions.

1. **Positive catalysts :** Positive catalysts increase the rate of chemical reaction.

   Examples : (1) Combination of hydrogen and oxygen in the presence of spongy platinum. (2) Conversion of starch into sugar in the presence of acids.

2. **Negative catalysts :** Negative catalysts decrease the rate of chemical reaction.

   Examples : (1) Decomposition of H_2O_2 is suppressed by adding small amount of glycerine or urea. (2) Decomposition of chloroform is suppressed by adding small amount of ethanol.

3. **Auto-catalysis :** In certain reactions, one of the products alter the rate of reaction, which is known as auto-catalyst and such reactions are known as auto catalytic reactions.

   For ordinary catalysis, the product yield increases with time, whereas for auto catalysis, the reaction first proceeds slowly, then accelerates with accumulation of the product-catalyst and finally again slows down as an equilibrium yield is approached.

   Examples : (1) Decomposition of explosives.

   (2) Combustion reactions.

   (3) Polymerization reactions.

Promoters and Inhibitors :

Promoters :

- It is a substance, added to the catalyst during its preparation, which gives improved activity, selectivity or stability for the desired reaction.
- Promoter is added in small amounts.
- Promoter by itself has no catalytic property. Thus, molybdenum promotes the catalytic activity of iron in the Haber's process for the manufacture of ammonia.
- Promoters are also known as accelerators.

Inhibitors :

- An inhibitor is the opposite of a promoter.
- It is a substance, added to the catalyst during its manufacturing to impart poor activity, stability or selectivity.
- Inhibitors may be useful for reducing the activity of a catalyst for an undesirable side reaction.
- **Example :** The decomposition of H_2O_2 slows down by adding a small amount of glycerine or urea (inhibitor) in alkaline solution (catalyst).

Characteristics of catalysts -

The following characteristic features are common to most catalytic reactions :

1. The catalyst remains unchanged in amount and chemical composition at the end of the reaction. However, it may undergo some physical change.
2. A small quantity of catalyst is needed.
3. The catalyst does not alter the position of equilibrium in a reversible reaction. It is well evident that the ratio of reaction velocity constant for the forward and reverse reactions must be the same. Therefore, the catalyst for promoting the forward reaction must also be a catalyst for the reverse reaction.
4. Catalyst does not increase the yield of the product. e.g. The use of platinised asbestos as a catalyst in the combination of SO_2 and O_2, causes an appreciable increase in the rate of the reaction, but it does not increase the yield of SO_3.

5. The catalyst does not start the reaction. In the absence of the catalyst, the reaction is occurring extremely slowly, but the catalyst speeds up the reaction.
6. The catalyst is specific in its action i.e. a particular catalyst can bring about a particular change only. A substance which acts as catalyst for one reaction may fail to catalyse the other reaction. e.g. MnO_2 can catalyse the decomposition of $KClO_3$, while it has no effect on the rate of combination of SO_2 and O_2.
7. The catalyst cannot alter the nature of the products of the reaction. e.g. $KClO_3$ on decomposition gives KCl and O_2, whether MnO_2 is added or not.
8. A catalyst is poisoned by certain substances. It has been found that the impurities of any type, even if present in small amounts, inhibit or retard the rate of catalysed reactions. These impurities are called catalytic poison. e.g. The rate of combination of SO_2 and O_2 is considerably less, if some arsenic compounds are present.

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TYPES OF CATALYSIS -

There are two main types of catalysis :

(i) Homogeneous catalysis.

(ii) Heterogeneous catalysis.

1. Homogeneous catalysis :

When the reactants and the catalyst are in the same phase (i.e. liquid or gas), the process is said to be homogeneous catalysis.

Examples :

(1) Hydrolysis of sugar is catalysed by H^+ ions furnished by sulphuric acid.

$$\underset{\text{Sugar}}{C_{12}H_{22}O_{11}(aq.)} + H_2O\ (l) \xrightarrow{H_2SO_4(l)} \underbrace{\underset{\text{Glucose}}{C_6H_{12}O_6(aq.)} + \underset{\text{Fructose}}{C_6H_{12}O_6(aq.)}}_{\text{Sugar}}$$

(2) Destruction of atmospheric ozone, where everything is present as a gas.

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2. Heterogeneous catalysis :

The catalytic process in which the reactants and the catalyst are in different phases is known as heterogeneous catalysis.

For example,

(1) Oxidation of sulphur dioxide into sulphur trioxide in the presence of platinised asbestos.

$$2SO_2(g) \xrightarrow{Pt(s)} 2SO_3\ (g)$$

The reactant is in gaseous state while the catalyst is in the solid state.

(2) The decomposition of H_2O_2 in aqueous solution is catalysed by colloidal platinum as

$$\underset{\text{liquid}}{H_2O_2} \xrightarrow{Pt(s)} \underset{\text{liquid}}{2H_2O} + \underset{\text{gas}}{O_2}$$

ENGINEERING APPLICATIONS OF CATALYSIST -

1. Catalytic converters are used in automobiles to convert harmful pollutants in exhausts into less harmful substances through oxidation-reduction reactions.
2. Catalysts are used in industrial production of many basic chemicals like ammonia, nitric acid, sulphuric acid, methanol etc.
3. Catalysts are used in industrial manufacturing processes for plastic and other essential items making the whole reaction more environmentally friendly.
4. Catalysts are used for production of bio-fuels from corn, switchgrass, trees.
5. catalysts are used in batteries and fuel cells to improve their durability and efficiency.
6. Catalysts are used in water softening and treatment plants.
7. Petroleum refining makes intensive use of a catalyst.
8. Catalytic heaters generate flameless heat from a supply of combustible fuel.
9. It is also used in food processing like hydrogenation (reaction with H_2 gas) of a fats using catalyst to produce margarine.

Introduction to nano chemistry : **From clothes, sunglasses you wear to computer hard drives and even cleaning products, nanotechnology plays a big role in the manufacture of many materials. We have been using Lasers in DVD, CD players for a long time which contain nano size components.**

Definition of Nano chemistry : It is the combination of chemistry and nanoscience. It deals with designing and synthesis of materials of nanoscale with different size, shape, structure and composition and their organization into functional architectures. Nano chemistry is used in chemical, physical, materials science as well as engineering, biological and medical applications.

Look at Fig.1 which shows comparative scales from macro-materials to atoms

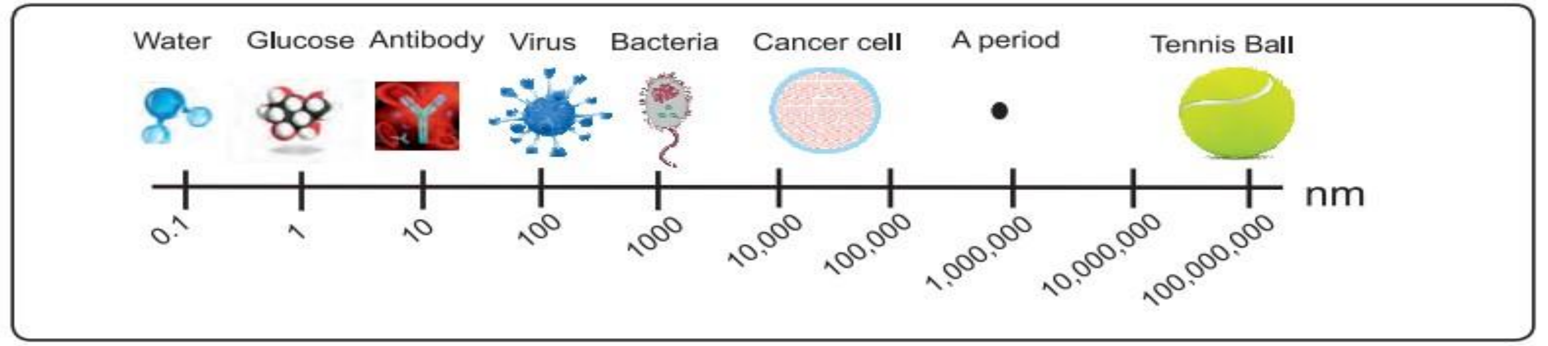

Figure 1

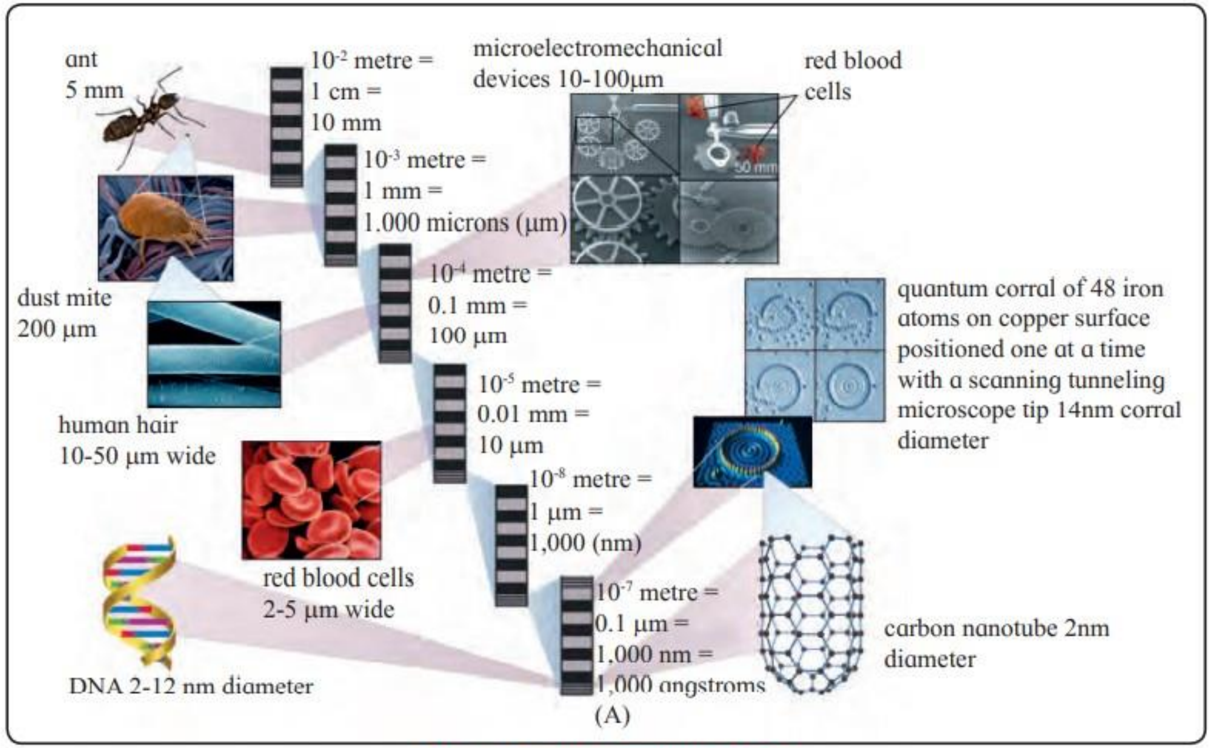

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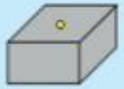
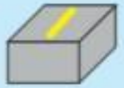
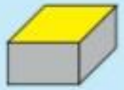
Figure 2

Observe Fig.2 which depicts the materials in nature, as well as devices that are manmade. In both figures some objects like tennis ball (Fig.1), ant, human hair (Fig. 2) we can see with our own eyes whereas bacteria, virus, red blood cell, we cannot observe with naked eye. These are known as nanomaterials.

Nanomaterial Dimension	Nanomaterial Type	Example
All three dimensions < 100 nm	Nanoparticles, Quantum dots, nanoshells, nanorings, microcapsules	
One dimensions < 100 nm	Nanotubes, fibres, nanowires	
Two dimension < 100 nm	Thin films, layers and coatings	

The nanomaterial is a material having structural components with at least one dimension in the nanometer scale that is 1-100nm. Nanomaterials are larger than single atoms but smaller than bacteria and cells. These may be nanoparticles, nanowires and nanotubes according to dimensions. Nanostructured materials may be large organic molecules, inorganic cluster compounds and metallic or semiconductor particles.

What are zero-, one- and two-dimensional nanoscale system?

i. Zero-Dimensional Nanostructures: For example, Nanoparticles.

A zero-dimensional structure is one in which all three dimensions are in the nanoscale.

ii. One-Dimensional Nanostructure is one in which two dimensions are in the nanoscale.

For example, Nanowires and Nano rods.

iii. Two-Dimensional Nanostructure is one in which one dimension is in the nanoscale.

For example, Thin films.

Nanotechnology is the design, characterization, production and application of structures, device and system by controlling shape and size at nanometre scale.

The nanometer scale : ‘Nano’ in Greek means dwarf but in actual case ‘nano’ is even smaller than dwarf. Conventionally, the nanometer scale is defined as 1-100 nm. One nanometer is one billionth of a meter. (that is 1nm = 10-9m). The materials we see around us are bulk materials that possess macroscopic physical properties. Grain of sand that is micron-sized material also possesses same bulk properties. But material synthesized at nanoscale (1nm - 100nm) possesses unique optical, structural, thermal, catalytic, magnetic and electrical properties. These properties change as a function of size and are very different from their bulk materials.

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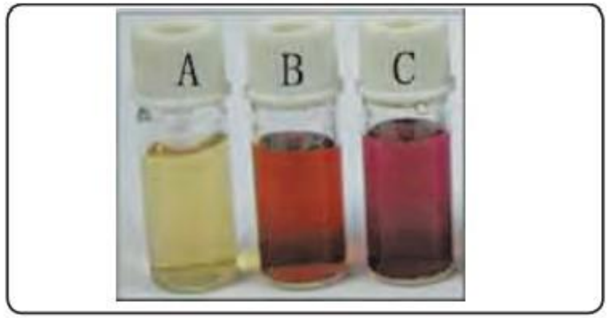
Characteristic features of Nanoparticles -

1 Colour: It is an optical property that is different at nanoscale. Elemental gold as we know, has nice shining yellow colour. However, if you had only 100 gold atoms arranged in cube, its colour would be red.



2 Surface area : High surface-to-volume ratio is a very important characteristic of nanoparticles. If a bulk material is sub divided into a group of individual nanoparticles, the total volume remains the same, Surface area of nanoparticles Area = 6 × 1m2 = 6 m2 Area = 6×(1/2m)2 ×8 = 12 m2 collective surface area is largely increased. With large surface area for the same volume, these small particles react much faster because more surface area provides more number of reaction sites, leading to more chemical reactivity. Explanation of increase in surface area with decrease in particle size.

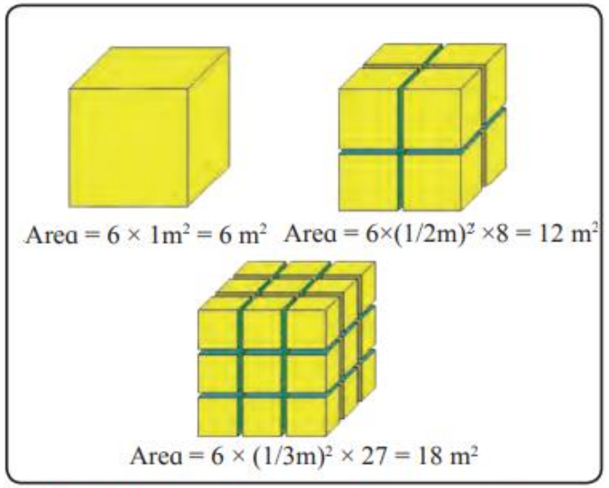


Fig. 16.5 : Surface area of nanoparticles

3. **Catalytic activity:** Due to increase in surface area with decrease in particle size, nanomaterial-based catalysts show increased catalytic activity. Usually they are heterogeneous catalysts that means catalysts are in solid form and the reactions occur on the surface of the catalyst. Nanoparticle catalysts can be easily separated and can be recycled. Example, Pd, Pt metal nanoparticles used in hydrogenation reactions. TiO2 , ZnO are used in photocatalysis. Gold in bulk form is unreactive, but gold nanoparticles are found to be very good catalyst for various organic reactions.

4 Thermal properties :

The melting point of nanomaterial changes drastically and depends on size.

Eg sodium clusters (Na) of 1000 atoms appeared to melt at 288 K while cluster of 10,000 atoms melted at 303 K and bulk sodium melts at 371K.

5 Mechanical properties (Mechanical strength) :

Nanosized copper and palladium clusters with diameter in the size range of 5-7 nm can have hardness up to 500% greater than bulk metal.

6 Electrical conductivity :

Electrical conductivity is observed to change at nanoscale. For example, carbon nanotube can act as a conductor or semiconductor in behaviour.

Advantages :

1. Revolution in electronics and computing.

2. Energy sector - nanotechnology will make solar power more economical. Energy storage devices will become more efficient.

3. Medical field : Manufacturing of smart drugs, helps cure faster and without side effects. Curing of life threatening diseases like cancer and diabetes

Disadvantages :

Nanotechnology has raised the standard of living but at the same time, it has increased the pollution which includes air pollution. The pollution caused by nanotechnology is known as nano pollution. This kind of pollution is very dangerous for living organisms. Nanoparticles can cause lung damage. Inhaled particulate matter can be deposited throughout the human respiratory tract and then deposit in lungs. The characteristics of nanoparticles that are relevant for health effects are size, chemical composition and shape.

Applications of nanomaterials :

a. Nanoparticles can contribute to stronger, lighter, cleaner and smarter surfaces and systems. They are used in the manufacturing of scratchproof eyeglasses, transport, sunscreen, crack resistant paints and so on.

b. Used in electronic devices. For example, Magneto resistive Random Access memory (MRAM)

c. Nanotechnology plays an important role in water purification techniques. Water contains waterborne pathogens like viruses, bacteria . Recently cost effective filter materials coated with silver nanoparticles (AgNps) is an alternative technology. (For example : water purifier) Silver nanoparticles act as highly effective bacterial disinfectant.

d. Self cleaning materials : Lotus is an example of self cleaning. The lotus plant (Nelumbo nucifera) although grows in muddy water, its leaves always appear clean. The plants' leaves are superhydrophobic. Nanostructures on lotus leaves repel water which carries dirt as it rolls off. Lotus effect is the basis of self cleaning windows


Nano Devices
Optical Engineering
Defence& Security
Nanobio-technology
Bio Engineering
Medicine & Drugs
Innovative Application
Cosmetics
Energy
Nano Fabrics
Nanotechnology

Thank you!