



XI CHEMISTRY QUICK NOTES 2023 (FOR DOUBLE PASS)

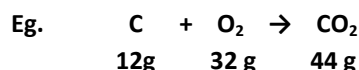
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CHAPTER 1 SOME BASIC CONCEPTS OF CHEMISTRY

1. State and explain Law of conservation of mass

Total mass of reactants = Total mass of products



Total mass of reactants = 12+32=44 g

Total mass of products = 44 g

2. State and explain Law of definite proportion.

A chemical compound always contains the same elements combined together in the same proportion by mass.

Example:- Carbon dioxide can be obtained by many methods.

Its formula $\rightarrow \text{CO}_2$ Mass ratio $\rightarrow 12:32$ Simple ratio $\rightarrow 3:8$

3. State and explain Law of multiple proportion .

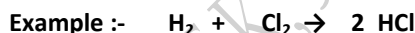
When two elements combine to form two or more compounds, the different masses of one element that combine with a fixed mass of the other element, are in the small whole number ratio.

Example:- Hydrogen and oxygen combine to form two compounds, water (H_2O) and hydrogen peroxide (H_2O_2).

More examples:- (i) CO , CO_2 (ii) NO , NO_2

4. State and explain Gay Lussac's law of gaseous volume

When gaseous reactants combine to form gaseous products, there exist a simple whole number ratio between their volumes.



Volume ratio of reactants and products $\rightarrow 1: 1: 2$

5. Define Mole .

Mole is the amount of a substance which contain 6.022×10^{23} particles (Avogadro's number)

1 Mole = 22.4 L at STP (Molar volume at STP)

6. What are empirical formula and molecular formula?

Molecular formula is the actual formula of a compound.

Empirical formula is the simplest formula of a compound.

Molecular formula = $n \times$ Empirical formula , Where $n = 1,2,3,\dots$

$$n = \frac{\text{Molecular mass}}{\text{Empirical formula mass}}$$

Examples :

EF of glucose ($\text{C}_6\text{H}_{12}\text{O}_6$) is CH_2O

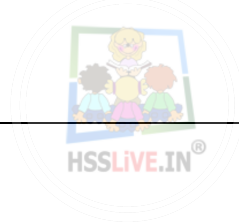
EF of ethane (C_2H_6) is CH_3

EF of benzene (C_6H_6) is CH

EF of Hydrogen peroxide(H_2O_2) is HO

EF of butene (C_4H_8) is CH_2

EF of carbon dioxide (CO_2) is CO_2



EF of acetic acid [CH_3COOH] is CH_2O

EF of $\text{C}_6\text{H}_5\text{Cl}_6$ is CHCl

7. What is Limiting reagent (limiting reactant) ?

The reactant that is consumed completely in a reaction is called Limiting reagent (limiting reactant).

8. What are difference between molality and molarity

Molarity	Molality
$\text{Molarity} = \frac{\text{Number of moles of solute}}{\text{Volume of solution in litre}} = \frac{W_B \times 1000}{M_B \times V_{(\text{in ml})}}$	$\text{Molality} = \frac{\text{Number of moles of solute}}{\text{Mass of solvent in kilogram}} = \frac{W_B \times 1000}{M_B \times W_{A(\text{in gram})}}$
Molarity depends on temperature	Molality does not depend on temperature

9. Define mole fraction.

$$\text{Mole fraction of solute } (X_B) = \frac{\text{Number of moles of solute}}{\text{Total number of moles of solution}} = \frac{n_B}{n_A + n_B}$$

Mole fraction is temperature independent.

CHAPTER 2 STRUCTURE OF ATOM

1. What are the properties of cathode rays and anode rays ?

Cathode rays : They start from cathode, and move towards anode .They travel in straight lines.

They are negatively charged particles

Anode rays : They are produced from the space between cathode and anode and move towards cathode.

They travel in straight lines. They are positively charged particles

2. Explain Rutherford's alpha ray scattering experiment . Give its important observations and conclusions.

	Observations	Conclusions
1	Most of the alpha particles passed through the gold foil without any deflections.	Most of the space in an atom is empty.
2	A few alpha particles were deflected through small angles .	A heavy positive centre is present at the centre of the atom called nucleus.
3	Very few alpha particles are deflected back (180°).	Nucleus is very small in size.

3. What are the postulates of Rutherford atom model?

- (I) Most of the mass and all positive charge is concentrated at the centre of the atom called nucleus.
- (II) Electrons are revolving around the nucleus with very high speeds.
- (III) Most of the space inside the atom is empty.

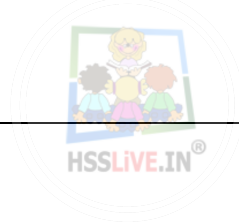
4. What are the draw backs (failure) of Rutherford atom model?

- (I) Failed to explain the stability of the atom.
- (II) Failed to explain hydrogen spectrum.

5. What is Photoelectric effect? What are its characteristics?

When light falls on certain metals, electrons are emitted is called photoelectric effect.

- (I) For the ejection of electrons, the incident light must have a minimum frequency called threshold frequency (ν_0). Corresponding minimum energy is called work function
- (II) The kinetic energy of the ejected electrons depends on the frequency of the incident radiation.
- (III) The number of electrons ejected is proportional to the intensity or brightness of light.



6. Explain line spectrum of hydrogen.

The spectral series of hydrogen spectrum are

Series	Spectral region	n_1	n_2
Lyman series	Ultraviolet	1	2,3,....
Balmer series	Visible	2	3,4,....
Pas4chen series	Infrared	3	4,5,....
Brackett series	Infrared	4	5,6,.....
Pfund series	Infrared	5	6,7,.....

Their wave number and wavelength is determined by the Rydberg equation.

$$\bar{\nu} = \frac{1}{\lambda} = 109677 \left(\frac{1}{n_1^2} - \frac{1}{n_2^2} \right) \text{ cm}^{-1}$$

7. What are the postulates of Bohr atom model?

- (I) The electrons in an atom revolve around the nucleus in circular paths called orbits. These orbits have definite energies called energy shells or energy levels.
- (II) As long as electrons remain in a particular orbit, it does not lose or gain energy.
- (III) Energy is emitted or absorbed by an atom only when an electron in it moves from one orbit to other.

8. What are the merits of Bohr atom model?

- (I) Bohr's model can explain the stability of an atom.
- (II) Bohr's model can explain the atomic spectrum of hydrogen

9. What are the draw backs (Limitations) of Bohr atom model?

- (I) It cannot explain de Broglie concept of dual nature of matter.
- (II) It cannot explain Heisenberg's uncertainty principle.

10. What is Dual nature of matter? Give de Broglie equation.

According to de Broglie, all microscopic particles in motion (e.g., Electron) has particle character and wave character.

de Broglie equation is, $\lambda = \frac{h}{mv} = \frac{h}{p}$

Wavelength (λ) → Wave character.

Momentum (p) → Particle character.

For electron, wave character is significant. It is against Bohr model.

11. State Heisenberg's uncertainty principle. Give its mathematical forms and its significance.

It is not possible to determine simultaneously both the position and velocity (or momentum) of a microscopic moving particle such as electron with absolute accuracy.

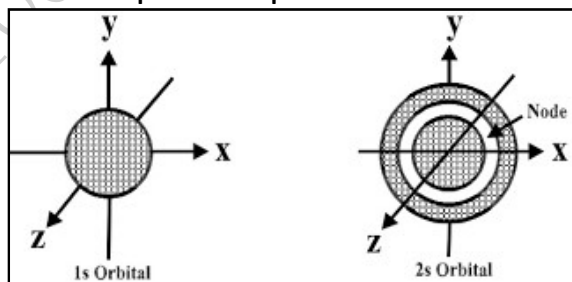
Mathematical form is $\Delta x \cdot \Delta p \geq \frac{h}{4\pi}$

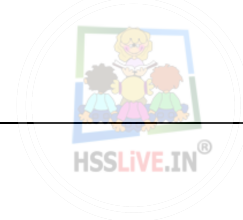
Δx = uncertainty in position. Δp = uncertainty in momentum. h = plank's constant = 6.626×10^{-34} Js

Significance:- This principle rules out the existence of definite paths (orbits) for moving electrons.

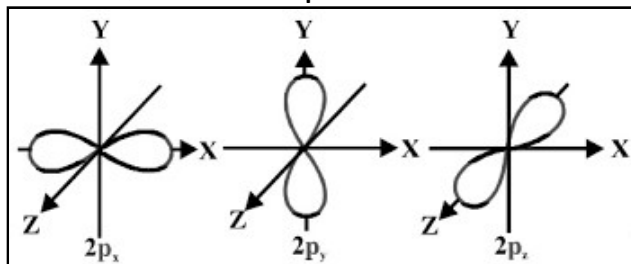
12. Draw the shapes of s- orbitals, p- orbitals, and d- orbitals.

S orbital – Spherical shape

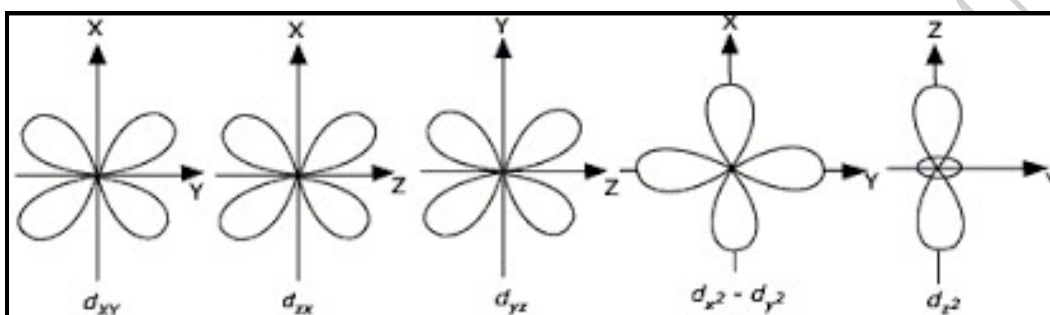




P orbitals → Dumb bell shape



d-orbitals → Double dumb bell shape



13. What are Quantum numbers? Which are four Quantum numbers? Explain each.

Quantum numbers are address of an atom.

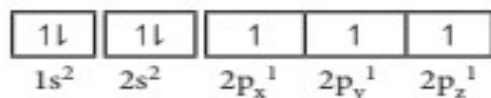
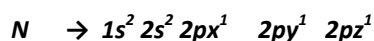
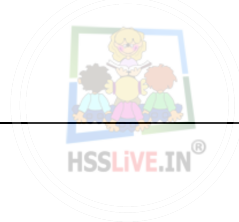
There are four quantum numbers.

- (I) Principal quantum number (n).
- (II) Azimuthal or Angular momentum quantum number (l).
- (III) Magnetic quantum number (m).
- (IV) Spin quantum number (s).

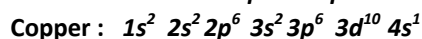
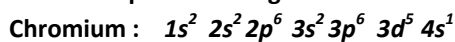
Principal quantum number (n)	The main energy level or shell in which the electron is located. Average distance of the orbital or electron from the nucleus	$n=1$ first energy level, $n=2$ second energy level
Azimuthal or Angular momentum quantum number	The sub shell in which electron is located in a shell Shape of the orbital	For a given value of n , $l = 0$ to $n-1$
Magnetic quantum number (m)	Different orientations (orbitals) in a sub shell	For a given value of l , $m = -l, \dots, 0, \dots, +l$
Spin quantum number (s)	The spin orientation of electrons	$(+1/2)$ or $(-1/2)$

14. Which are rules for writing electronic configuration?

- (I) Aufbau principle :- In the ground state of the atoms, the orbitals are filled in order of their increasing energies. $1s < 2s < 2p < 3s < 3p < 4s < 3d < 4p < 5s < 4d < 5p$
- (II) Pauli's exclusion principle :- It states that no two electrons in the same atom can have the same set of four quantum numbers. An orbital can accommodate maximum two electrons.
- (III) Hund's rule of maximum multiplicity
This rule states that electron pairing in orbitals of same sub shell will not takes place until each available orbital of that sub shell is singly occupied (with parallel spin).



15. Write the exceptional configuration of chromium and copper and give its reason



Half filled and completely filled orbitals have more stability

3 CLASSIFICATION OF ELEMENTS AND PERIODICITY IN PROPERTIES

1. State Mendeleev's periodic law .

The properties of elements are periodic function of their atomic masses (atomic weights).

2. State Modern periodic law

The properties of elements are periodic function of their atomic numbers.

Modern periodic law is proposed by Henry Moseley.

3. Long form of periodic table (Modern periodic table)

It is based on modern periodic law. There are seven periods and 18 groups

Each group constitutes a family of elements with similar properties.

In the modern periodic table, the period indicates the value of principal quantum number (n).

There are 4 blocks in the periodic table -s-block, p-block, d-block, and f-block.

4. Blocks of periodic table

Blocks	Groups	General electronic configuration	Main properties
s-block	1&2	ns^{1-2}	They form mainly ionic compounds
p-block	13 to 18	$ns^2 np^{1-6}$	Includes metals, nonmetal and metalloids.
d-block	3 to 12	$(n-1)d^{1-10} ns^{1-2}$	They form coloured compounds. They shows variable oxidation states.
f-block	Lanthanoids and actinoids	$(n-2)f^{1-14}(n-1)d^{0-1} ns^2$	Within each series properties are similar. Most of the actinoids are radioactive and man made

5. What is Atomic radius? Explain its variation along a period and in a group.

Atomic radius is defined as the distance from the centre of the nucleus of the atom to the outer most shell of electrons.

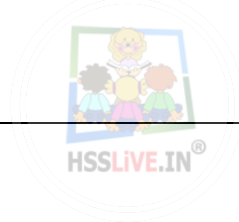
In a period, from left to right, atomic radii decrease due to increase in nuclear charge

In a group, from top to bottom, atomic radii increase due to increase in number of shells.

6. What are isoelectronic species? Give examples. Arrange them in the increasing order of size.

Atoms and ions which contain same number of electrons are called isoelectronic species.

N^{3-} , O^{2-} , F^- , Na^+ , Mg^{2+} , Al^{3+} (These have different nuclear charge, But contain 10 electrons each)



The order of decreasing size is $N^{3-} > O^{2-} > F^- > Na^+ > Mg^{2+} > Al^{3+}$

Among the isoelectronic species, greater the nuclear charge, smaller the size.

7. What is Ionization energy? Explain its variation along a period and in a group.

The amount of energy required to remove the most loosely bound electron from an isolated gaseous atom is called ionization energy (ionization enthalpy).

In a period, from left to right ionization enthalpy increases due to increase in nuclear charge and so valence electrons are more tightly held by the nucleus.

But some irregularities are observed. Beryllium has higher ionization energy than Boron due to stable electronic configuration ($1s^2 2s^2$). Similarly nitrogen has higher ionization energy than oxygen due to half filled stable electronic configuration ($1s^2 2s^2 2p^3$).

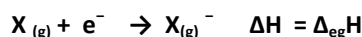
In a group, ionization enthalpy decreases from top to bottom due to increase in atomic size.

8. What are the factors affecting ionization energy?

(i) Atomic size (ii) Nuclear charge (iii) Shielding effect or Screening effect of inner electrons (iv) Electronic configuration.

9. What is electron gain enthalpy (Electron affinity)? Explain its variation along a period and in a group.

The amount of energy released when an electron is added to isolated gaseous atom is called electron gain enthalpy.



In a period, from left to right electron gain enthalpy becomes more and more negative.

It is due to increase in nuclear charge.

In a group, Electron gain enthalpy decreases from top to bottom due to increase in atomic size.

10. Electron gain enthalpy of noble gases are zero or positive. Why?

Due to completely filled electronic configuration ($ns^2 np^6$).

11. Electron gain enthalpy of fluorine is less than that of chlorine. Why?

This is due to the very small size of fluorine atom. As a result, inter electronic repulsion in the 2p sub shell of F is more than that in the relatively larger 3p sub shell in chlorine atom.

12. What is Electro negativity? Explain its variation along a period and in a group.

Electro negativity is the ability of an atom in a molecule to attract the shared pair of electrons towards it.

Halogens have highest electro negativity in their periods.

Fluorine is the most electro negative element.

Electro negativity increases from left to right in a period due to increasing nuclear charge.

Electro negativity decreases from top to bottom in a group due to increase in atomic size.

13. What are Anomalous properties?

The first element of each group in s and p blocks differs from the rest of the elements in many properties are called anomalous properties.

It is due to the following reasons.

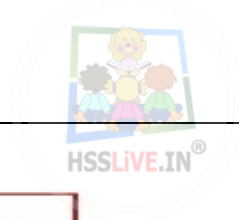
(i) Small size (ii) High charge/radius ratio. (iii) Non availability of d orbitals.

14. What is Diagonal relationship? What are the reasons for Diagonal relationship?

First element in any group shows similarities with second element in next group. This is called diagonal relationship.

For example, Lithium shows resemblance with Magnesium due to diagonal relationship

Beryllium resembles aluminium due to diagonal relationship.



Group ↓ Period →	1	2	13	14
2	Li	Be	B	C
	Na	Mg	Al	Si

Reasons :- (i) similar size, (ii) similar ionization energy, (iii) similar charge/radius ratio

15. Notation for IUPAC nomenclature of elements

digit	name	abbreviation	digit	name	abbreviation
0	nil	n	5	pent	p
1	un	u	6	hex	h
2	bi	b	7	sept	s
3	tri	t	8	oct	o
4	quad	q	9	enn	e

16. Write the IUPAC nomenclature of elements with atomic number from 101, 120, 109

101 → Unnilunium (Unu) , 120 → Unbinilium (Ubn) , 109 → Unnilennium (Une)

17. The atomic number of element with IUPAC name Ununbium is 112

CHAPTER 4 CHEMICAL BONDING AND MOLECULAR STRUCTURE

1. What are the limitations of octet rule?

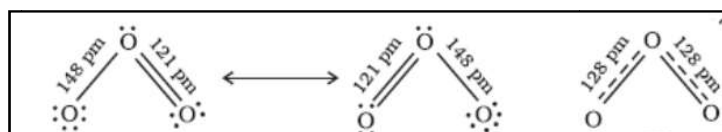
- (I) It cannot explain the formation of molecules with incomplete octet (eg: BeF_2 , BF_3)
- (II) It cannot explain the formation of molecules with expanded (super) octet (eg: PCl_5 , SF_6)

2. What is resonance? Draw the resonance structure of ozone.

The properties of some compounds cannot be explained by single lewis structure. Such compound exist as a combination of two or more structures. This phenomenon is called resonance. Its Characteristics are

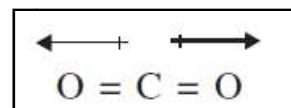
- (I) Resonance stabilizes the molecule.
- (II) Resonance averages the bond characteristics as a whole.

Resonance structure of ozone are

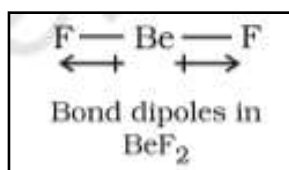


3. The dipole moment of CO_2 is zero. Why?

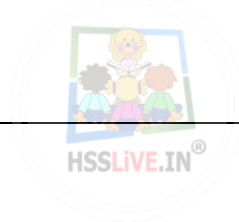
CO_2 is linear molecule and the two equal bond dipoles are in opposite directions and cancel each other. So the dipole moment of CO_2 is zero.



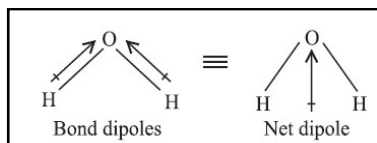
4. The dipole moment of BeF_2 is zero. Why?



BeF_2 is linear molecule and the two equal bond dipoles are in opposite directions and cancel each other. So the dipole moment of BeF_2 is zero.

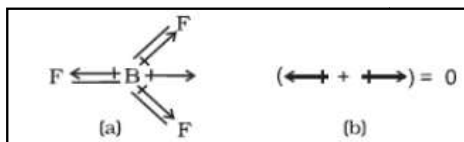


5. The dipole moment of H_2O is not zero. Why?



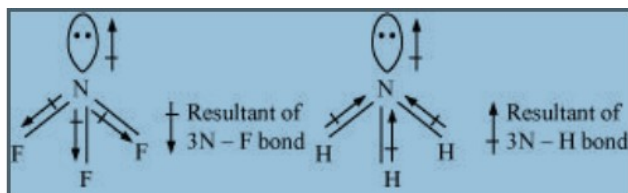
Water molecule has bent structure. Two O-H bonds are oriented at an angle of 104.5° . The bond dipoles of two O-H bonds do not cancel each other. So water molecule has net dipole moment.

6. The dipole moment of BF_3 zero. Why?



BF_3 has trigonal planar structure. Here the resultant of any two bond dipole is equal and opposite to third and the dipole moments of these bonds cancel one another giving net dipole moment equal to zero.

7. Ammonia (NH_3) has higher dipole moment than NF_3 , even though F is more electronegative than hydrogen. Why?



Both have pyramidal structure. The individual dipole moments do not cancel each other. So they have net dipole moment.

But ammonia has higher dipole moment. It is due to the orbital dipole due to the lone pair is in the same direction of three N-H bonds.

But in nitrogen tri fluoride, the resultant dipole of three N-F bonds is in opposite direction to the orbital dipole of lone pair. So partially cancelled and dipole moment is low.

8. State Fajan's rule regarding the partial covalent character of an ionic bond.

Covalent character of ionic bond increases with (i) Small size of cation and large size of anion

(ii) Large charge on both the cation and anion.

Covalent character increases in the order :

(1) $\text{LiCl} > \text{NaCl} > \text{KCl}$ (Here Lithium is small size cation)

(2) $\text{NaCl} < \text{MgCl}_2 < \text{AlCl}_3$ (Here Aluminium is small size cation)

(3) $\text{NaF} < \text{NaCl} < \text{NaBr} < \text{NaI}$ (Here iodine is large size anion)

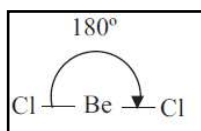
9. What are the main postulates of valence shell electron pair repulsion theory(VSEPR)

- (I) The shape of the molecule depends on the number of valence electron pairs of the central atom.
- (II) The electron pairs repel each other. As a result, the electron pairs try to stay as far apart to acquire a state of minimum energy or maximum stability.
- (III) The repulsive interaction decreases in the order.

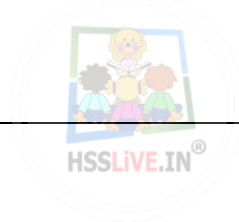
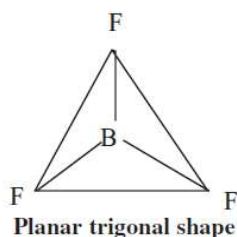
Lone pair-Lone pair > Lone pair-Bond pair > Bond pair-Bond pair

10. Explain the shape of following molecules on the basis of VSEPR theory.

BeCl_2



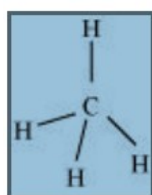
Two bond pairs around Beryllium. Linear geometry. Bond angle 180°

**BF₃**

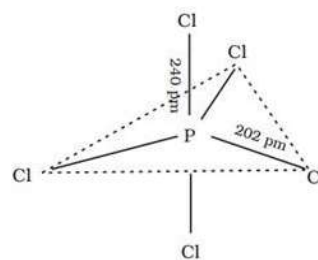
Three bond pairs around Boron. Trigonal planar geometry. Bond angle 120°

CH₄

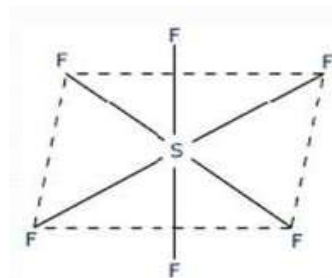
Four bond pairs around Carbon. Tetrahedral geometry. Bond angle 109.5°

**PCl₅**

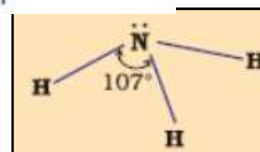
Five bond pairs around Phosphorus. Trigonal bipyramid geometry.
Bond angle 120° and 90°

**SF₆**

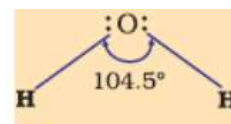
Six bond pairs around Sulphur. Octahedral geometry.
Bond angle 90°

**NH₃**

Nitrogen has three bond pairs and one lone pair.
Bond pair-lone pair repulsion is greater and bond angle is slightly reduced from tetrahedral angle to 107° .
Geometry is trigonal pyramidal.

**H₂O**

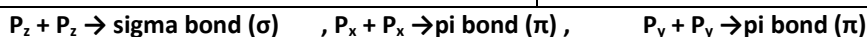
Oxygen has two bond pairs and two lone pairs around it.
There are three type repulsions.
Bond pair-bond pair repulsion < bond pair- lone pair repulsion < lone pair – lone pair repulsion.
Due to these repulsions bond angle is reduced from tetrahedral angle to 104.5° .
Geometry is bent shape or inverted V shape.





11. What are the difference between sigma bond and pi bond?

Sigma bond (σ bond)	Pi bond (π bond)
Sigma bond is formed by the end to end (or axial) overlap of atomic orbitals	Pi bond is formed by the side wise (or lateral) overlap of atomic orbitals
This can be formed by overlap of s-s, s-p, p-p orbitals	This can be formed mainly by overlap of p-p orbitals
Sigma bond is strong bond	Pi bond is weak bond
Free rotation of atoms around sigma bond is possible	Free rotation of atoms around pi bond is not possible



12. What is Hybridization? Give their Characteristics

Inter mixing of atomic orbitals of same element with slightly different energies and different shape to get orbitals of same energy and shape is called hybridisation.

13. Explain sp^3 hybridisation

One s orbital + Three p orbitals \rightarrow Four sp^3 hybridized orbitals

Example: CH_4 , Tetrahedral geometry. Bond angle is 109.5° .

14. Explain sp^2 hybridisation

One s orbital + Two p orbitals \rightarrow Three sp^2 hybridized orbitals

Example: BF_3 . Trigonal planar geometry. Bond angle is 120°

15. Explain sp hybridisation

One s orbital + One p orbital \rightarrow Two sp hybridized orbitals

Example: $BeCl_2$, Linear geometry, Bond angle is 180°

16. Explain sp^3d hybridisation using PCl_5 as example.

One s orbital + Three p orbitals + One d orbital \rightarrow Five sp^3d hybridized orbitals

Trigonal bipyramid geometry. Bond angle is 120° and 90°

17. Explain the geometry of PCl_5 molecule and account for its high reactivity.

Hybridisation is sp^3d . Trigonal bipyramid geometry.

There are three equatorial bonds and two axial bonds.

The axial bonds are slightly longer than equatorial bonds due to greater repulsion from equatorial bonds.

Due to different bond lengths, it is unsymmetric and highly reactive.

18. Explain sp^3d^2 hybridisation using SF_6 as example.

One s orbital + Three p orbitals + Two d orbitals \rightarrow Six sp^3d^2 hybridized orbitals

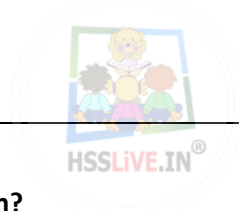
Octahedral geometry. Bond angle is 90° .

19. What are the postulates of Molecular orbital theory(MOT)?

- (I) Molecular orbitals are formed by the combination of atomic orbitals of same energy and proper geometry.
- (II) The number of molecular orbitals formed is equal to the number of combining atomic orbitals.

20. What are the differences between bonding molecular orbital and anti bonding molecular orbital?

BMO	ABMO
BMO is formed by the addition (attraction) of atomic orbitals	ABMO is formed by the subtraction (repulsion) of atomic orbitals
Its energy is less than the energy of atomic orbitals	Its energy is more than the energy of atomic orbitals

**21. Define bond order . How is bond order related to bond length and bond strength?**

Bond order is defined as half of the difference between the number of electrons in the bonding molecular orbitals and the number of electrons in the anti bonding molecular orbitals .

$$\text{Bond order} = \frac{1}{2} [N_b - N_a]$$

If the bond order is positive , molecule is stable.

If the bond order is zero, molecule is unstable. Such molecule will not exist.

22. Explain the stability and magnetic property of H₂ molecule (2 electrons)

Molecular orbital electronic configuration :- $\sigma 1s^2$

$$\text{Bond order} = \frac{1}{2} [N_b - N_a] = \frac{1}{2} [2 - 0] = 1$$

Here the bond order is positive , molecule is stable. Bond order = 1 , single bond,

No unpaired electrons, diamagnetic.

23. Why He₂ molecule will not exist? (4 electrons)

Molecular orbital electronic configuration :- $\sigma 1s^2 \sigma^* 1s^2$

$$\text{Bond order} = \frac{1}{2} [N_b - N_a] = \frac{1}{2} [2 - 2] = 0$$

Here the bond order is zero , molecule is unstable. So it will not exist.

24. Electronic configuration of some diatomic molecules and their bond order

Molecule	Electronic configuration	Bond order	Stable/unstable	No. of bonds	Diamagnetic/paramagnetic
Li ₂	$\sigma 1s^2 \sigma^* 1s^2 \sigma 2s^2$	1	Stable	1	diamagnetic
Be ₂	$\sigma 1s^2 \sigma^* 1s^2 \sigma 2s^2 \sigma^* 2s^2$	0	Unstable		
B ₂	$\sigma 1s^2 \sigma^* 1s^2 \sigma 2s^2 \sigma^* 2s^2 \pi 2p_x^1 = \pi 2p_y^1$	1	Stable	1	paramagnetic
C ₂	$\sigma 1s^2 \sigma^* 1s^2 \sigma 2s^2 \sigma^* 2s^2 \pi 2p_x^2 = \pi 2p_y^2$	2	Stable	2	diamagnetic
F ₂	$\sigma 1s^2 \sigma^* 1s^2 \sigma 2s^2 \sigma^* 2s^2 \sigma 2p_z^2 \pi 2p_x^2 = \pi 2p_y^2$ $\pi^* 2p_x^2 = \pi^* 2p_y^2$	1	Stable	1	diamagnetic
Ne ₂	$\sigma 1s^2 \sigma^* 1s^2 \sigma 2s^2 \sigma^* 2s^2 \sigma 2p_z^2 \pi 2p_x^2 = \pi 2p_y^2$ $\pi^* 2p_x^2 = \pi^* 2p_y^2 \sigma^* 2p_z^2$	0	Unstable		

25. With the help of molecular orbitals , find bond order of N₂ and explain its stability(14 electrons)

$\sigma 1s^2 \sigma^* 1s^2 \sigma 2s^2 \sigma^* 2s^2 \pi 2p_x^2 = \pi 2p_y^2 \sigma 2p_z^2$

$$\text{Bond order} = \frac{1}{2} [N_b - N_a] = \frac{1}{2} [10 - 4] = 3$$

Here the bond order is positive , molecule is stable.

Bond order = 3 , triple bond.

Here all electrons are paired , the molecule is diamagnetic.

26. Calculate the bond order and predict the magnetic property of O₂ molecule (16 electrons)

Molecular orbital electronic configuration :-

$\sigma 1s^2 \sigma^* 1s^2 \sigma 2s^2 \sigma^* 2s^2 \sigma 2p_z^2 \pi 2p_x^2 = \pi 2p_y^2 \pi^* 2p_x^1 = \pi^* 2p_y^1$

$$\text{Bond order} = \frac{1}{2} [N_b - N_a] = \frac{1}{2} [10 - 6] = 2$$

Here the bond order is positive , molecule is stable.

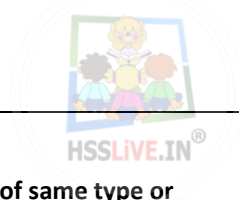
Bond order = 2 , double bond.

Here unpaired electrons are present in $\pi^* 2p_x$ and $\pi^* 2p_y$, so oxygen molecule is paramagnetic.

27. What is hydrogen bond? Which are different type hydrogen bonds? Explain each

Hydrogen bond is defined as the attractive force between hydrogen atom bonded to fluorine, oxygen or nitrogen and an electronegative atom of the same or adjacent molecule.

There are two types of hydrogen bonds



(I) Inter molecular hydrogen bond :- Hydrogen bond between different molecules of same type or different type. It increases the boiling point.

e.g., H bonding in HF,H-F.....H-F.....H-F.....H-F.....

(II) Intra molecular hydrogen bond:- Hydrogen bond within the same molecule.

It decreases the boiling point.

e.g., Hydrogen bonding in Ortho nitro phenol

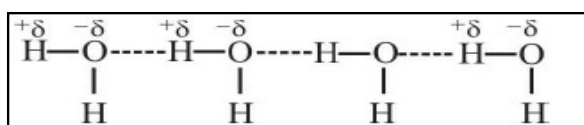
28. Ortho nitro phenol and para nitro phenol can be separated by steam distillation. Explain

Ortho nitro phenol → Intra molecular hydrogen bond → Boiling point is low and steam volatile.

Para nitro phenol → Inter molecular hydrogen bonding → Boiling point is high and so it is not steam volatile.

So these can be separated by steam distillation.

29. H_2O is liquid, H_2S is gas at room temperature. Give reason



In water, molecules are associated by inter molecular hydrogen bonds. So it exists as liquid at room temperature.

But in hydrogen sulphide, no hydrogen bond is possible. So it exists as alone and so gas.

30. HF is liquid while HCl is gas at room temperature. Give reason

In between HF molecules, inter molecular hydrogen bonds are possible and so liquid. But not in HCl

.....H-F.....H-F.....H-F.....H-F.....

CHAPTER 6 THERMODYNAMICS

1. What are state functions and path functions? Give examples for each.

A function or property that depends only on the initial state and final state of the system and not on the path followed is called state function.

Examples :- Temperature (T), Pressure (P)

A function or property that depends on the initial state and final state of the system and on the path followed also is called path function.

Examples:- Heat (q), work (w)

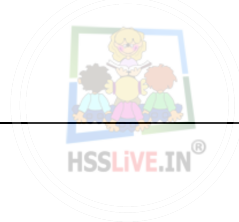
2. What are extensive and intensive properties? Give examples for each.

(I) Extensive properties :- These are properties which depend on the amount of matter present in the system. Examples: - Mass (m), Volume (V), Length (l), Internal energy (U), Enthalpy (H), Entropy (S), Gibbs free energy (G), heat capacity etc

(II) Intensive properties:- These are properties which are independent on the amount of matter present in the system. Examples: - Temperature, pressure, density, refractive index, viscosity, surface tension, specific heat, molar heat capacity

3. Explain (a) isothermal process (b) isobaric process (c) isochoric process (d) adiabatic process.

Types of process	Explanation	Condition
Isothermal process	A process which takes place at constant temperature	$\Delta T = 0$
Isobaric process	A process which takes place at constant pressure	$\Delta P = 0$
Isochoric process	A process which takes place at constant volume	$\Delta V = 0$
Adiabatic process	A process which takes place at constant heat	$dq = 0$



4. What is Internal energy (U)?

Internal energy is the total energy present within a substance.

It is a state function and extensive property.

5. State First law of thermo dynamics and give its mathematical form.

It states that energy can neither be created nor destroyed.

Mathematical form is $\Delta U = q + w$

ΔU = change in internal energy, q = heat, w = work

6. Define Enthalpy (H)

Enthalpy is the heat content of the system.

Enthalpy is the sum of the internal energy and pressure volume energy.

$$H = U + PV$$

It is a state function and extensive property.

7. Give the relation connecting ΔH and ΔU .

$$\Delta H = \Delta U + P \Delta V \quad \text{OR}$$

$$\Delta H = \Delta U + \Delta n RT \quad \text{Where} \quad \Delta n = n_p - n_R$$

8. The relation connecting q_p and q_v is $q_p = q_v + \Delta n RT$

9. What are exothermic and endothermic reactions? Give its sign of ΔH .

Exothermic reactions	Endothermic reactions
The reactions which takes by the liberation of heat is called exothermic reactions	The reactions which takes by the absorption of heat is called endothermic reactions
For exothermic reactions, $\Delta H = -ve$.	For endothermic reactions, $\Delta H = +ve$.

10. Give the relation between C_p and C_v for an ideal gas.

$$C_p - C_v = R$$

$C_p \rightarrow$ Molar heat capacity at constant pressure. $C_v \rightarrow$ Molar heat capacity at constant volume.

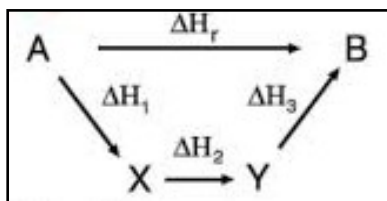
11. Enthalpy of reaction:

$\Delta_r H =$ Sum of enthalpies of products – Sum of enthalpies of reactants

12. **Standard enthalpy change of a reaction =**

Standard enthalpies of formation of products - Standard enthalpies of formation of reactants.

13. State and illustrate Hess's Law of Constant Heat of Summation.



It states that the enthalpy change in a chemical reaction is the same whether the reaction takes place in one step or several steps.

$$\Delta H_r = \Delta H_1 + \Delta H_2 + \Delta H_3$$

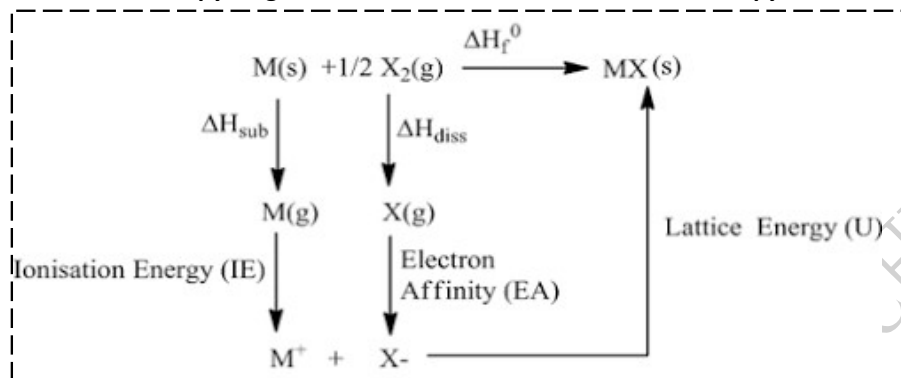
**14. What is Lattice enthalpy ?**

The lattice enthalpy of an ionic compound is the enthalpy change when one mole of the ionic compound dissociates in to its gaseous ions.

Born Haber cycle is used to calculate Lattice enthalpy.

15. Draw Born Haber cycle for the determination of lattice enthalpy.

(Construct an enthalpy diagram for the determination of lattice enthalpy of sodium chloride)



$$\Delta H_f^0 = \Delta H_{sub} + IE + \Delta H_{diss} + EA + U$$

$$U = \Delta H_f^0 - (\Delta H_{sub} + IE + \Delta H_{diss} + EA)$$

16. What is spontaneous process and non spontaneous process?

Spontaneous process is a process that takes place without the help of any external agency.

E.g. Flow of water from high level to low level, flow of heat from hot body to cold body

Non spontaneous process is a process that takes place with the help of an external agency.

E.g. flow of water from low level to high level.

17. Define Entropy (S) ?

Entropy (S) is a measure of degree of disorder or randomness of the system.

18. Predict in which of the following entropy increases ($\Delta S = +ve$) entropy decreases ($\Delta S = -ve$)

(a) Melting of ice \rightarrow entropy increases ($\Delta S = +ve$)

(b) $2 \text{N}_2\text{O}_{5(g)} \rightarrow 4 \text{NO}_{2(g)} + \text{O}_{2(g)} \rightarrow$ entropy increases ($\Delta S = +ve$)

(c) Condensation of steam in to water \rightarrow entropy decreases ($\Delta S = -ve$)

(d) Freezing of water in to ice \rightarrow entropy decreases ($\Delta S = -ve$)

(e) $2 \text{NaHCO}_3(s) \rightarrow \text{Na}_2\text{CO}_3(s) + \text{CO}_2(g) + \text{H}_2\text{O}(g) \rightarrow$ entropy increases ($\Delta S = +ve$)

(f) $4 \text{Fe} + \text{O}_2(g) \rightarrow 2 \text{Fe}_2\text{O}_3(s) \rightarrow$ entropy decreases ($\Delta S = -ve$)

19. State Second law of thermo dynamics and gives equation

It states that the entropy of the universe increases in the course of every spontaneous (natural) change.

$$\Delta S_{\text{universe}} > 0$$

20. Define Gibb's free energy (G)

Gibbs energy is defined as the maximum amount of available energy that can be converted to useful work.

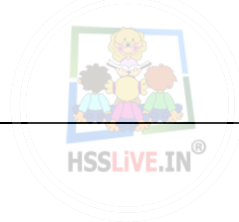
$$G = H - TS$$

21. The relation connecting ΔG , ΔH , and ΔS is $\Delta G = \Delta H - T \Delta S$.**22. Explain Gibb's energy and spontaneity.**

(i) If ΔG is negative, the process will be spontaneous.

(ii) If ΔG is zero, the process is in equilibrium.

(iii) If ΔG is positive, the process will be non spontaneous.



CHAPTER 7 EQUILIBRIUM

1. State Henry's law and give its one application.

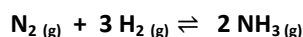
Henry's law states that the mass of a gas dissolved in a given mass of solvent at a particular temperature is directly proportional to the pressure of the gas above the solvent.

$$\text{i.e., } m \propto p \quad \text{or} \quad m = k p$$

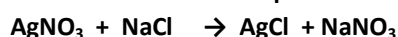
Example: Soda water.

2. What are reversible and irreversible reactions .

A reaction which takes place both in forward and backward directions under the same conditions is called reversible reactions.



A reaction in which the products do not react to give back the reactant is called irreversible reactions.



3. Explain the concept of chemical equilibrium.

At equilibrium, rate of forward reaction = rate of backward reaction

4. What are the characteristics of chemical equilibrium?

- (I) Chemical equilibrium is dynamic in nature.
- (II) Chemical equilibrium can be attained from either direction.
- (III) Chemical equilibrium can be attained only in closed systems.

5. What is equilibrium constant?

Consider a general reversible reaction, $aA + bB \rightleftharpoons cC + dD$

$$K_c = \frac{[C]^c [D]^d}{[A]^a [B]^b}$$

$$K_p = \frac{p_C^c p_D^d}{p_A^a p_B^b}$$

6. The relation between K_p and K_c is $K_p = K_c (RT)^{\Delta n}$

K_p = Equilibrium constant in terms of pressure. K_c = Equilibrium constant in terms of concentration.

Δn = No. of mole of gaseous products - No. of mole of gaseous reactants.

If $\Delta n = 0$, $K_p = K_c$

7. What are the characteristics of equilibrium constant?

- (I) The value of equilibrium constant is independent of initial concentration of reactants.
- (II) For a reversible reaction, the equilibrium constant for the reverse reaction will be the reciprocal of the equilibrium constant for the forward reaction.

8. What are the applications of equilibrium constant?

- (I) Prediction of extent of reaction:- Larger the value of equilibrium constant, greater is the extent to which the reactants are converted into the products.
 - If $K_c > 10^3$, products predominate over the reactants.
 - If $K_c < 10^{-3}$, reactants predominate over the products.
 - If K_c is between 10^{-3} and 10^3 , appreciable concentration of reactants and products.
- (II) Prediction of direction of reaction.
 - If $Q_c > K_c$, the reaction will proceed in the backward direction. (in the direction of reactants)



If $Q_c < K_c$, the reaction will proceed in the forward direction. (in the direction of products)

If $Q_c = K_c$, the reaction will be in equilibrium.

9. State Le-chatelier principle.

If a system in equilibrium is subjected to change in concentration, temperature or pressure, the equilibrium shifts in the direction that tends to reduce the effect of the change.

10. How do the effect of concentration, temperature and pressure affect of the rate of a chemical reaction?

(I) Effect of change of concentration:-

Concentration of reactants is increased \rightarrow Forward direction \rightarrow More products

Concentration of the products is increased \rightarrow Backward direction \rightarrow More of the reactants

(II) Effect of change of temperature:-

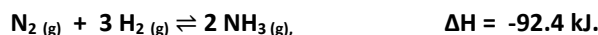
Increase of temperature \rightarrow Endothermic reaction (in the direction of absorption of heat).

Decrease of temperature \rightarrow Exothermic reaction (in the direction of heat is produced).

(III) Effect of change of pressure:-

Increase of pressure will shift the equilibrium in the direction in which the pressure is reduced.
(decrease in the number of molecules).

11. Explain the effect of concentration, temperature and pressure in the following reaction.

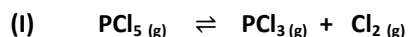


(I) Effect of concentration:- increase the concentration of N_2 or $\text{H}_2 \rightarrow$ forward direction \rightarrow more NH_3

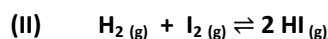
(II) Effect of pressure:- Here forward reaction is accompanied by the decrease in the number of moles, so high pressure will favour forward reaction and more NH_3 is formed.

(III) Effect of temperature:- Here forward reaction is exothermic and so low temperature will favour forward reaction. But at very low temperature, N_2 and H_2 will be less reactive and so optimum temperature is used (500°C).

12. Explain the effect of pressure in the following reactions.



Here forward reaction is accompanied by the increase in the number of moles, so low pressure will favour forward reaction. High pressure will favour backward reaction.



Here no change in number of molecules of reactants and products. So pressure has no effect.

13. Explain the effect of temperature in the following reactions.



Here forward reaction is endothermic, and hence increase in temperature will favour forward reaction.

14. Explain Arrhenius concept of acids and bases with examples

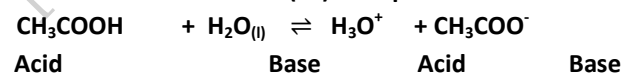
Arrhenius acid \rightarrow Give hydrogen ion(H^+) in aqueous solution. e.g., HCl , CH_3COOH etc.

Arrhenius base \rightarrow Give hydroxyl ion(OH^-) in aqueous solution. e.g., NaOH , NH_4OH etc.

15. Explain Bronsted Lowry concept of acids and bases with examples.

Bronsted acid \rightarrow Proton(H^+) donor.

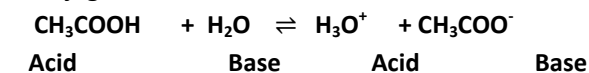
Bronsted base \rightarrow Proton(H^+) acceptor.

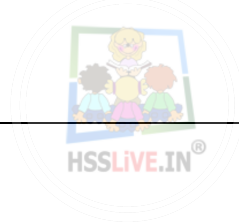


16. What are conjugated acid base pairs with examples

Conjugated acid = Base + H^+

Conjugated base = Acid - H^+





Here CH_3COO^- is a conjugate base of acid CH_3COOH .

H_3O^+ is a conjugate acid of base H_2O

Species	Conjugate acid	Conjugate base
H_2O	H_3O^+	OH^-
HCO_3^-	H_2CO_3	CO_3^{2-}
HSO_4^-	H_2SO_4	SO_4^{2-}
NH_3	NH_4^+	NH_2^-

17. Explain Lewis concept of acids and bases with examples.

Lewis acids \rightarrow Electron pair acceptors. e.g., BF_3 , AlCl_3 , Mg^{2+} , Co^{3+} , H^+

Lewis bases \rightarrow Electron pair donors. e.g., NH_3 , H_2O , OH^- , Cl^-

18. What are Amphoteric substances?

Substances which can act as both acid and base. E.g., H_2O , HCO_3^- , HSO_4^-

19. Define P^{H} and calculate the P^{H} of neutral solution.

P^{H} is defined as negative logarithm of hydronium concentration.

$$\text{P}^{\text{H}} = -\log[\text{H}_3\text{O}^+]$$

For acidic solution P^{H} is less than 7.

For basic solution P^{H} is greater than 7

For neutral solution P^{H} is 7

20. What is Buffer solution? Which are two types? Explain each

Buffer solution is a solution which resists the change in pH value by the addition of small amount of acid or base.

Blood is an example of natural buffer.

These are two types

(I) Acidic buffer:- Its pH is less than 7. It is mixture of weak acid and its salt with strong base.

eg., solution of acetic acid and sodium acetate.

(II) Basic buffer:- Its pH is more than 7. It is mixture of weak base and its salt with strong acid.

eg., solution of ammonium hydroxide and ammonium chloride.

21. Define Common ion effect and give examples.

Common ion effect is defined as the suppression of dissociation of weak electrolyte by the addition of strong electrolyte containing common ion.

e.g. The ionisation of ammonium hydroxide is suppressed by adding ammonium chloride.

22. Define Solubility product.

Solubility product is the product of concentration of ions in saturated solution.

For AgCl salt, $K_{\text{sp}} = [\text{Ag}^+][\text{Cl}^-]$

For BaSO_4 salt, $K_{\text{sp}} = [\text{Ba}^{2+}][\text{SO}_4^{2-}]$

For PbCl_2 salt, $K_{\text{sp}} = [\text{Pb}^{2+}][\text{Cl}^-]^2$

For $\text{Al}(\text{OH})_3$ salt, $K_{\text{sp}} = [\text{Al}^{3+}][\text{OH}^-]^3$

For $\text{Ca}_3(\text{PO}_4)_2$ salt, $K_{\text{sp}} = [\text{Ca}^{2+}]^3[\text{PO}_4^{3-}]^2$

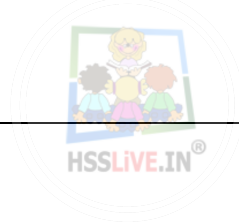
23. Give the relations connecting solubility product and solubility.

Solubility product is used to calculate solubility of sparingly soluble salts.

For AB type salt, $K_{\text{sp}} = S^2$

For AB_2 type salt, $K_{\text{sp}} = 4 S^3$

For AB_3 type salt, $K_{\text{sp}} = 27 S^4$

**24. What is Salt hydrolysis ? Explain.**

Salt on hydrolysis with water give acidic or basic solution is called salt hydrolysis.

- (i) Salt of a strong acid and weak base gives acidic solution. Examples : NH_4Cl , FeCl_3 , CuSO_4
- (ii) Salt of a weak acid and strong base gives basic solution. Examples : CH_3COONa , Na_2CO_3 , KCN
- (iii) Salt of a strong acid and strong base gives neutral solution. Examples : NaCl , NaNO_3 , KCl

UNIT 8 REDOX REACTIONS

1. Define oxidation and reduction on the basis of electronic concept

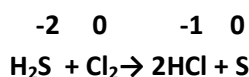
Oxidation: Removal of electrons. $\text{Zn} \rightarrow \text{Zn}^{2+} + 2\text{e}^-$

Reduction: Addition of electrons. $\text{Cu}^{2+} + 2\text{e}^- \rightarrow \text{Cu}$

2. Define oxidation and reduction on the basis of oxidation number concept

Oxidation: Increase in oxidation number.

Reduction: Decrease in oxidation number.

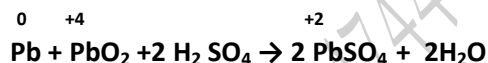


Here the oxidation number of sulphur in H_2S is -2, it is increased to zero (oxidation).

Here the oxidation number of chlorine in Cl_2 is 0, it is decreased to -1 (Reduction).

H_2S is reducing agent (reductant), Cl_2 is oxidizing agent (oxidant).

3. Which is the substance undergoing oxidation, reduction, oxidant and reductant in the reactions.



Pb undergo oxidation , PbO_2 undergo reduction, PbO_2 is oxidizing agent, Pb is reducing agent.

4. Explain the different types of redox reactions with examples.

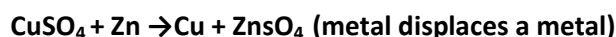
- (i) **Combination reactions:-** A reaction in which one element combines with another element or compound to form product is called combination reactions.



- (II) **Decomposition reactions:-** A reaction in which a compound breaks down to form two or more components in which one of the product should be in the elemental state.

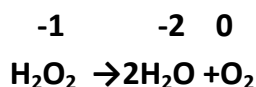


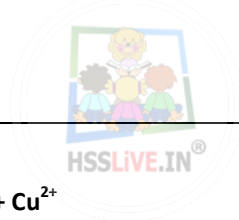
- (III) **Displacement reactions:-** A reaction in which an atom or ion in a compound is replaced by another atom or ion.



- (IV) **Disproportionation reactions:-** A reaction in which the same species undergo simultaneous oxidation and reduction is called disproportionation reaction.

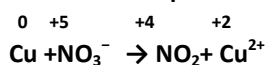
The element should be in the intermediate oxidation state.





5. Balance the following equation using oxidation number method. $\text{Cu} + \text{NO}_3^- \rightarrow \text{NO}_2 + \text{Cu}^{2+}$

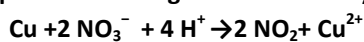
(I) Write skeleton equation and assign oxidation number.



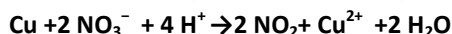
(II) Find out increase and decrease of Oxidation Number and equalize $\text{Cu} + 2\text{NO}_3^- \rightarrow \text{NO}_2 + \text{Cu}^{2+}$

(III) Balance atoms other than hydrogen and oxygen. $\text{Cu} + 2\text{NO}_3^- \rightarrow 2\text{NO}_2 + \text{Cu}^{2+}$

(IV) Equalize the charge on both side by adding H^+ (since it is in acidic medium)



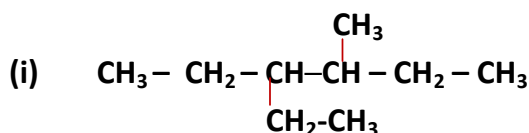
(V) Balancing hydrogen atom by adding H_2O and check the number of oxygen atoms.



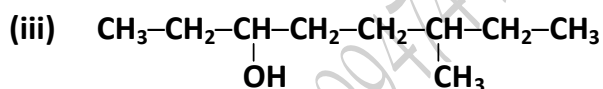
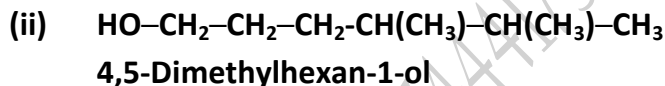
6. Stock notations :- (a) Mn(IV)O_2 (b) HAu(III)Cl_4 (c) Fe(II)O

CHAPTER12. ORGANIC CHEMISTRY- SOME BASIC PRINCIPLES AND TECHNIQUES

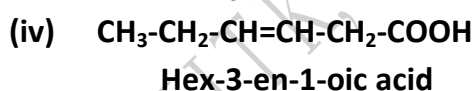
1. Write the IUPAC names of the following compounds :



3-Ethyl-4-methylhexane



6-Methyloctan-3-ol



2. Give the structural formula of the following compounds:

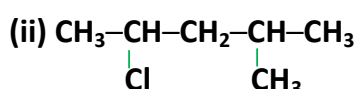
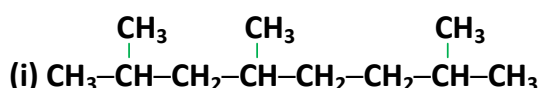
i) 2,4,7 – Trimethyloctane

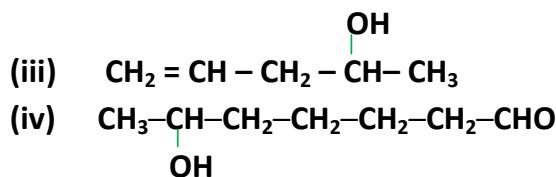
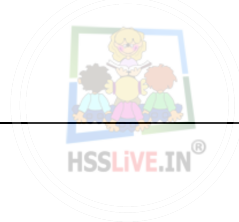
ii) 2-Chloro-4-methylpentane

iii) Pent-4-en-2-ol

iv) 6-Hydroxyheptanal

Ans:

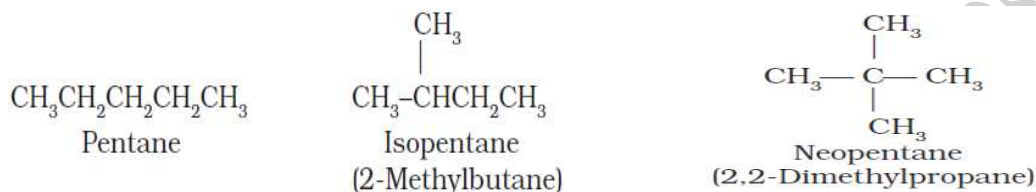




3. What is Structural isomerism? Which are four types of structural isomerism ?

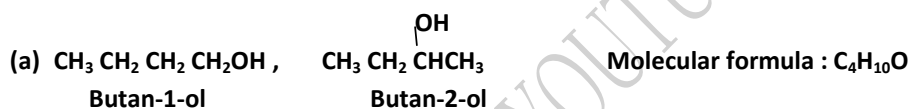
Structural isomers have same molecular formula but different structural formula.

(i) Chain isomerism : They have same molecular formula but different carbon chains.



They have molecular formula C_5H_{12}

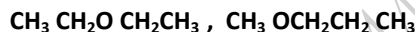
(ii) Position isomerism : They have same molecular formula but differ in the position of functional group.



(iii) Functional group isomerism : They have same molecular formula but different functional groups.



(iv) Metamerism : It arises due to different alkyl groups on either side of the same functional group.



Molecular formula : $\text{C}_4\text{H}_{10}\text{O}$

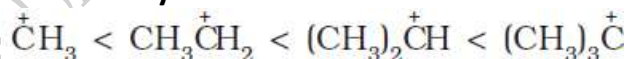
4. Fission of a covalent bond

Homolysis or homolytic cleavage	Heterolysis or heterolytic cleavage
Covalent bond breaks in such a way that, each of the bonded atom gives one electron each.	Covalent bond breaks in such a way that the shared pair of electrons remains with one of the parts.
Free radicals are produced by homolysis	Carbo cations (carbonium ions) and carbanions are produced by heterolysis

5. Which are reaction intermediates? Explain each

(i) Carbo cations (carbonium ion): The groups containing positively charged carbon is called carbocation. Carbocation is trigonal planar and sp^2 hybridised.

The stability order is $1^\circ < 2^\circ < 3^\circ$

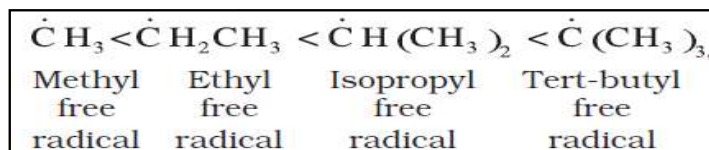


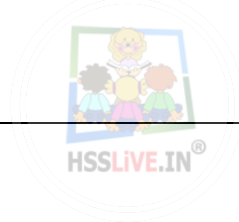
(ii) Carbanions: The groups containing negatively charged carbon is called carbanion. It is sp^3 hybridised.

The stability order is $3^\circ < 2^\circ < 1^\circ$



(iii) Free radicals: The groups containing unpaired electron. The stability order is $1^\circ < 2^\circ < 3^\circ$





6. What are nucleophiles and electrophiles ? Give examples for each.

Nucleophiles:- Nucleus loving species. A reagent that brings an electron pair is called nucleophile.

Eg: OH^- , Cl^- , CN^- , RCOO^- , carbanions (negative ions), NH_3 , H_2O (molecules having lone pair)

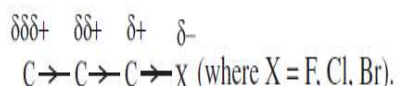
Electrophiles:- Electron loving species. A reagent that takes away an electron pair is called an electrophile. Eg:- H^+ , Cl^+ , carbocations (positive ions), BF_3 , AlCl_3 (electron deficient molecules)

7. Explain the different types of electron displacement effects in covalent bonds.

(I) **Inductive effect:-**

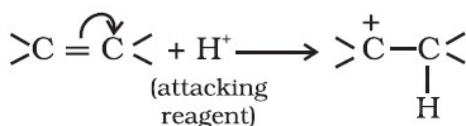
It is the permanent polarization of a sigma bond due to the presence of polar group.

It is a permanent effect.

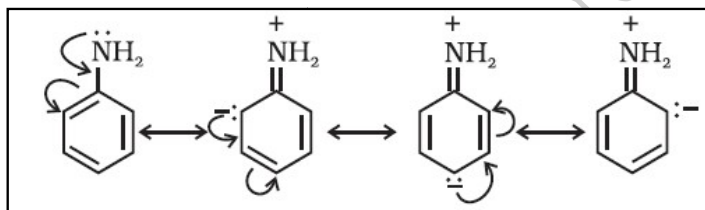


(II) **Electromeric effect:-**

It is a temporary effect. It is complete transfer of pi electrons of multiple bond in the presence of attacking reagent. When attacking reagent is removed, shift back to its original condition.



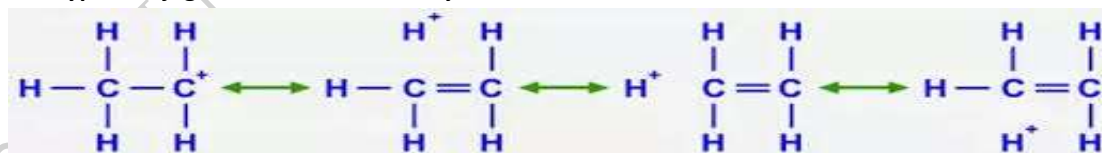
(III) **Resonance effect (Mesomeric effect):** It is the charge produced in the molecule by the interaction of two π -bonds or between a π -bond and lone pair of electrons present on an adjacent atom.



(IV) **Hyper conjugation:** It is a permanent effect.

Here the sigma electrons of C-H bond of alkyl group enter in to partial conjugation with the unsaturated system or with the unshared p orbital.

The hyper conjugative structures of ethyl carbocations are



8. **Purification techniques:**

Purification techniques	When it is used	Examples
Sublimation	It is used to separate sublimable compounds from non sublimable impurities	Naphthalene, iodine, camphor
Crystallisation	It is based on the difference in the solubilities of the compound and the impurities in a suitable solvent.	A mixture of benzoic acid and naphthalene can be separated from hot water in which benzoic acid dissolves but naphthalene does not



Distillation	To separate (1) volatile liquids from non volatile impurities (2) the liquids having sufficient difference in their boiling points	Chloroform (bp. 334K) and Aniline (bp. 457 K)
Fractional distillation	To separate liquids having close boiling points	Crude oil, toluene and cyclohexane, ethanol and water
Distillation under reduced pressure	To purify liquids which decompose at or below its boiling points	Glycerol can be separated from spent lye.
Steam distillation	To separate substances which are steam volatile and are immiscible with water	Aniline water mixture
Differential extraction	When an organic compound is present in aqueous solution, it is separated by shaking it with an organic solvent in which it is more soluble than in water	Benzoic acid from water is extracted by using benzene

9. Which are different types of chromatography?

(I) Adsorption chromatography (II) Partition chromatography (Paper chromatography).

10. Name two types of chromatographic techniques based on adsorption.

(I) Column chromatography

(II) Thin layer chromatography

11. How will you detect the presence of carbon and hydrogen in an organic compound?

Organic compound is heated with cupric oxide. Carbon is converted to carbon dioxide which turns lime water milky. Hydrogen is converted to water which turns anhydrous copper sulphate to blue.

12. Detection of nitrogen, sulphur and halogen: Lassaigne's test

It is done using sodium fusion extract (Lassaigne's extract) .

It is prepared by heating organic compound with sodium in a fusion tube. When red hot, it is plunged in to water taken in a china dish. The solution is boiled and filtered. Filtrate is called sodium fusion extract (Lassaigne's extract) .

No.	Experiment	Observation	Inference
1	Extract is treated with ferrous sulphate and concentrated sulphuric acid	Prussian blue colour	Presence of nitrogen
2	To extract sodium nitro prusside is added	Violet colour	Presence of sulphur
3.	To extract nitric acid and silver nitrate is added	White precipitate (AgCl)	Presence of chlorine
		Pale yellow (AgBr) precipitate	Presence of bromine
		Yellow precipitate (AgI)	Presence of iodine

13. Ferriferrocyanide, $\text{Fe}_4[\text{Fe}(\text{CN})_6]_3$:- The blue coloured compound in the Lassaigne's test for nitrogen.

14. In the Lassaigne's test for halogen, they are precipitated as silver halide (AgX)

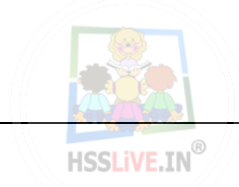
15. Explain Leibig's method for the estimation of carbon and hydrogen.

Organic compound is heated with copper (II) oxide, carbon is converted to carbon dioxide and hydrogen to water. From the weight of carbon dioxide, percentage of carbon is calculated. .

From the weight of water, the percentage of hydrogen can be calculated.

16. Explain different methods for the estimation nitrogen in an organic compound.

(I) Dumas method : Nitrogen containing organic compound is converted to molecular nitrogen (N_2) .
From the volume of nitrogen gas collected, we can determine the percentage of nitrogen.



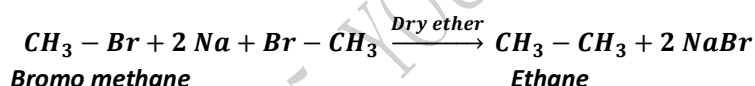
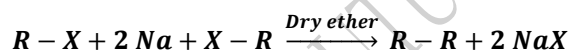
- (II) Kjeldahl's method : Organic compound containing nitrogen is converted to ammonia gas. From the volume of ammonia gas collected, we can determine the percentage of nitrogen.
17. Estimation of halogen : Carius method:- Halogen containing organic compound is heated with nitric acid and silver nitrate. Halogen is precipitated as silver halide (AgX).
From the weight of silver halide, we can determine the percentage of halogen.
18. Estimation of sulphur :Carius method:
Sulphur is precipitated as barium sulphate (BaSO₄) by adding barium chloride.
From the weight of BaSO₄, we can determine the percentage of sulphur .

CHAPTER 13

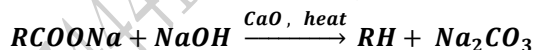
HYDROCARBONS

1. How will you prepare alkanes?

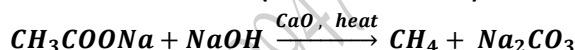
- (I) By Wurtz reaction : Alkyl halides react with metallic sodium in dry ether to form alkanes with even number of carbon atoms. This reaction is known as wurtz reaction



- (II) By decarboxylation of sodium salt of carboxylic acid with soda lime, one carbon less alkane is formed. Soda lime is a mixture of caustic soda (NaOH) and quick lime (CaO).

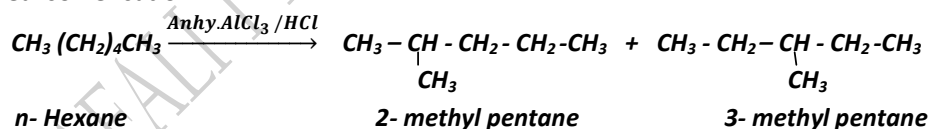


When sodium acetate (sodium ethanoate) is heated with soda lime, methane is formed.

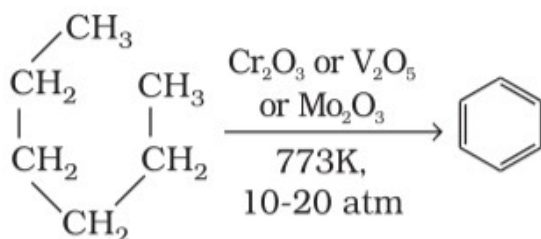


2. What is isomerisation ? Give example

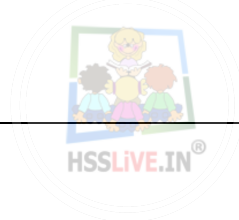
Normal alkanes on heating with anhydrous aluminium chloride and HCl, branched chain alkanes are formed is called isomerisation.



3. Explain aromatization or reforming with example.

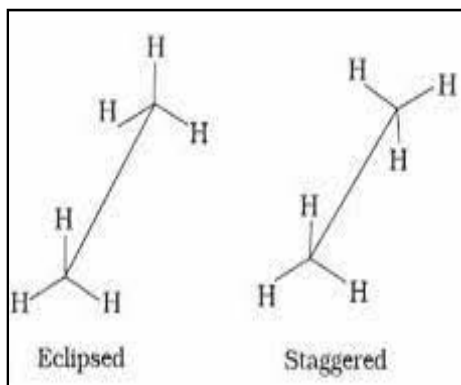


Normal alkanes having six or more carbon atoms on heating at high temperature and pressure in the presence of catalyst like chromium oxide, benzene and its homologues are formed.

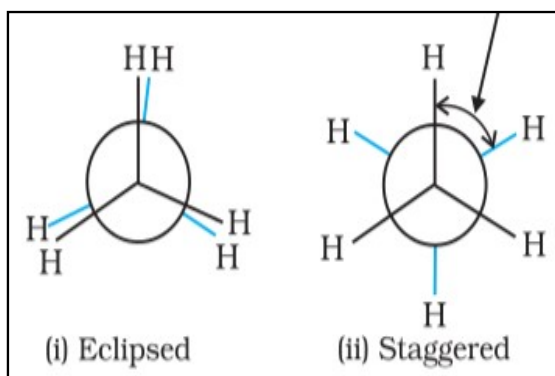


4. What are different types of conformations of ethane? Compare their stability.

Sawhorse projections of ethane



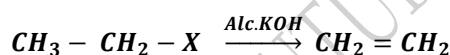
Newman projections of ethane



Ethane has staggered, eclipsed and skew conformations.

Staggered conformation is more stable. This is because hydrogen atoms of two carbon atoms are at maximum distance and repulsion is minimum and stability is maximum.

5. How will you prepare alkenes?



6. What is meant by geometrical isomerism?

The isomerism arises due to restricted rotation about carbon-carbon double bond is called geometrical isomerism.

For geometrical isomerism, the groups attached to each carbon must be different.

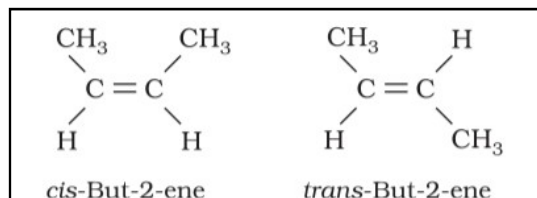
If the same group same side is called cis isomer.

If the same group opposite side is called trans isomer.

Cis isomer is more polar.

Trans isomer is more stable

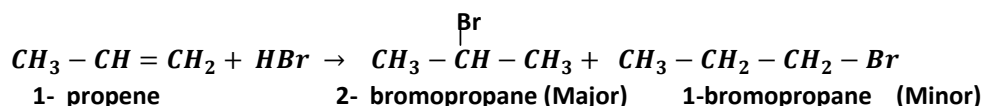
7. Draw the geometrical isomers of 2-butene



8. State and explain Markownikoff's rule

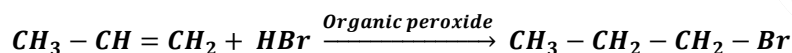
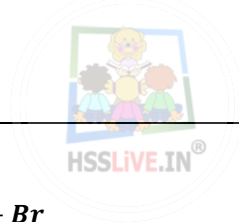
Markownikoff's rule :- It states that "when unsymmetrical reagent is added to unsymmetric alkene, the negative part of the addendum (adding molecule) gets attached to the carbon containing lesser number of hydrogen atoms.

When HBr is added to 1-propene, the major product is 2-bromopropane



9. What is peroxide effect or kharasch effect or anti markownikoff's rule? Give an example.

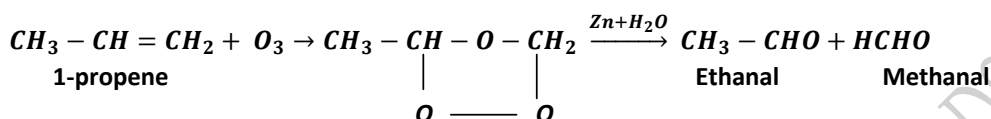
In the presence of organic peroxides, addition of HBr to unsymmetric alkene takes place against Markownikoff's rule. Only HBr shows peroxide effect.



1-Bromo propane (Major product)

10. What is Ozonolysis ?

Alkenes react with ozone molecule give ozonide which on reduction with zinc dust and water give aldehydes and ketones .

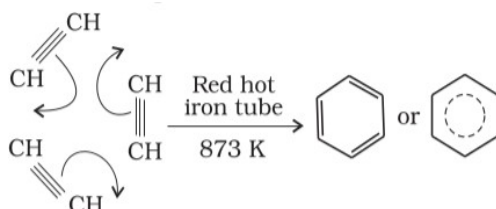


11. Give the preparation of acetylene (ethyne)

From calcium carbide.:- Calcium carbide on treatment with water gives acetylene(ethyne)



12. How will you convert s acetylene to benzene?



When acetylene (ethyne) is passed through red hot iron tube, benzene is formed.

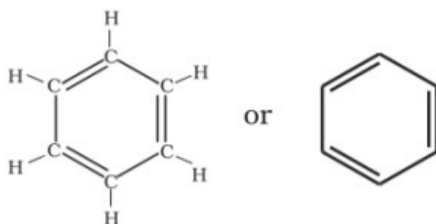
13. 1-alkynes are acidic. Give reason. Give example

In 1-alkynes, triple bonded carbon is 'sp' hybridized state. It is more electronegative due to 50 % s character. Hence carbon can attract the shared electron pair of C-H bond. So hydrogen can release as proton. So 1-alkynes are acidic.

Examples: 1-alkynes react with active metals gives hydrogen gas.

14. Explain the structure of benzene.

- (i) The molecular formula of benzene is C_6H_6 .
- (ii) Kekule structure of benzene is



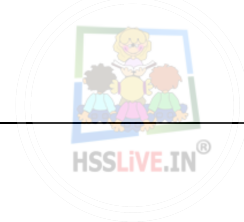
- (iii) Even though benzene contain three double bonds, benzene is stable.

In benzene, each carbon is in sp^2 hybridised state. Each carbon has one unhybridised p orbital. So continuous overlap is possible. So pi electrons are delocalized. These delocalized pi electrons are responsible for the stability of benzene.

15. State huckel's rule aromaticity.

A cyclic , conjugated , planar system is aromatic if it contains $(4n + 2)$ pi electrons in the ring.

Where $n = 1, 2, 3$ etc



Benzene Cyclopentadienyl anion Cyclohepta trienyl cation

These are planar molecules, complete delocalization of pi electrons in the ring is possible, Huckel rule obeys. So these are aromatic. $4n + 2 = 6$ (here $n=1$)

16. With the help of huckel's explain 1,4- hexadiene and 1,3-butadiene are not aromatic.



Hex-1,4-diene

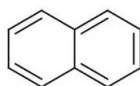


1,3-butadiene

No. of pi electrons = 4 (2π bonds $\times 2 e^{-}$)

$4n + 2 = 4$ ($n = 0.5$) Hence the value of n is 0.5. So it does not obey Huckel rule and is not aromatic.

17. Naphthalene is aromatic. Explain using Huckel rule.



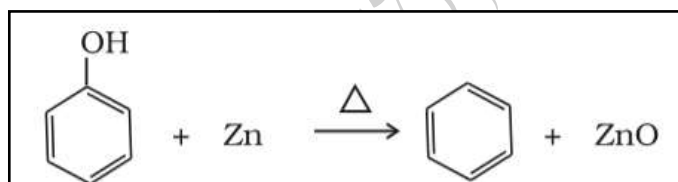
Naphthalene is planar, complete delocalization of pi electrons are possible.

No. of pi electrons = 10 (5π bonds $\times 2 e^{-}$) $4n + 2 = 10$ ($n = 2$)

Hence the value of n is 2. So it obeys Huckel rule and is aromatic.

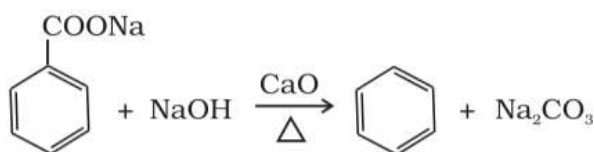
18. How will you prepare benzene ?

(I) From Phenol :- When phenol is heated with zinc dust benzene is formed



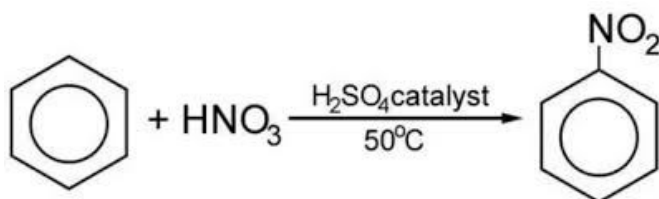
(II) From sodium benzoate :-

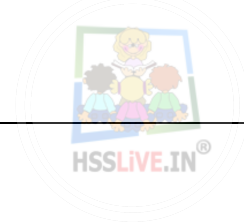
Benzene is formed by the decarboxylation of sodium benzoate with soda lime.



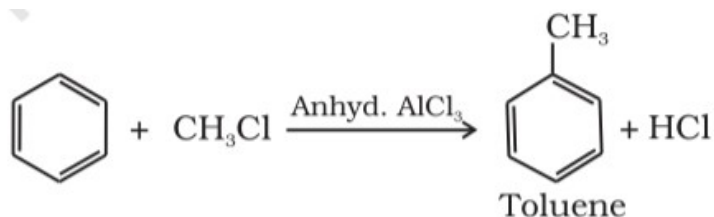
19. Electrophilic substitution reaction :-

(i) Nitration: Benzene is converted to nitrobenzene in the presence of nitrating mixture (Mixture of concentrated nitric acid and concentrated sulphuric acid)

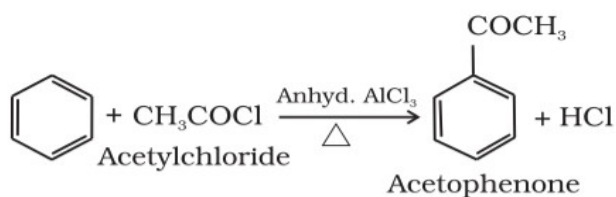




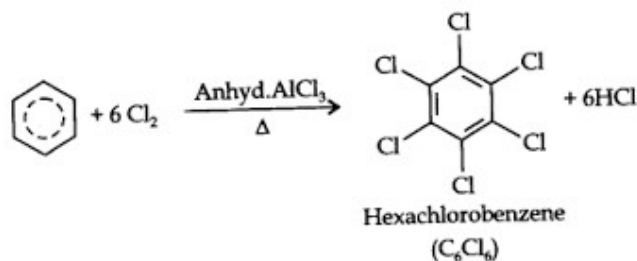
(ii) Friedel –Craft alkylation (Benzene to Toluene) :-



(iii) Friedel-Craft acylation (Benzene to Aceto phenone)

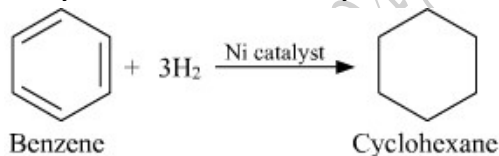


20. What happens when excess chlorine is added to benzene in the presence of anhydrous aluminium chloride?



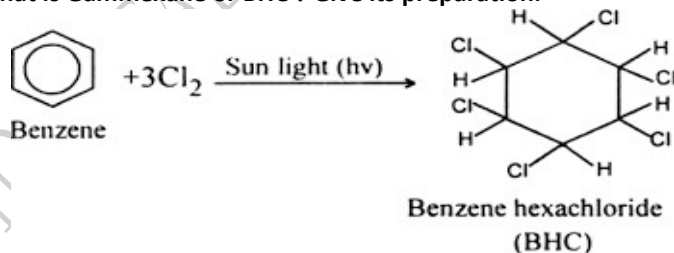
Hexachlorobenzene (C₆Cl₆) is formed.

21. How will you convert benzene to cyclohexane?



Benzene add three molecule of hydrogen give cyclohexane.

22. What is Gammexane or BHC ? Give its preparation.



Under ultra violet light, three chlorine molecule is added to benzene to produce benzene hexa chloride (C₆H₆Cl₆) . It is known as gammexane (BHC) . It is used as an insecticide.