CATALYST

STD 11

CHEMISTRY

SMART LEARN MATERIAL

Department of Chemistry,

HOLY CROSS SCHOOL,

SALEM – 14

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How to use this booklet?

- Minimum learning material for your successful chemistry exam day
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- More you write and practice…..

More easy to recall in the exam hall…..

How to score more?

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"Strengthen your Basics in Chemistry"

INORGANIC CHEMISTRY

UNIT 2 QUANTUM MECHANICAL MODEL OF ATOM

VERY SHORT AND SHORT ANSWER QUESTION AND ANSWER

1. What do you mean by the dual property of matter?

- Albert Einstein proposed that light has dual nature. i.e. light photons behave both like a particle and as a wave. Louis de Broglie extended this concept and proposed that all forms of matter showed dual character.

2. State Pauli's exclusion principle.

- "No two electrons in an atom can have the same set of values of all four quantum numbers."

3. Define orbital. What are the 'n' and 'l' values for 3px and $4dx^2\text{-}y^2$ electron?

- Orbital is a three dimensional space in which the probability of finding the electron is maximum.

For 3px : n = 3; l = 1

For $4dx^2\text{-}y^2$: n = 4; l = 2

4. Define Bohr's quantum condition.

- The circumference of the orbit should be an integral multiple of the wavelength of the electron wave. Otherwise, the electron wave is out of phase.

$$2\pi r = n\lambda$$

5. State Heisenberg's uncertainty principle.

- 'It is impossible to **accurately** determine both the position as well as the momentum of a microscopic particle **simultaneously**'.

$$\Delta x.\Delta p \geq h/4\pi$$

- where, Δx and Δp are uncertainties in determining the position and momentum, respectively.

6. Explain briefly the time independent Schrodinger wave equation.

- The time independent Schrodinger equation can be expressed as,

$$\hat{H}\psi = E\psi - - - - - -1$$

- Where H is called Hamiltonian operator

$$\hat{H} = \left[\frac{-h^2}{8\pi^2 m}\left(\frac{\delta^2}{\delta x^2} + \frac{\delta^2}{\delta y^2} + \frac{\delta^2}{\delta z^2}\right) + V\right]$$

- Eqn 1 can be written as,

$$E\psi = \left[\frac{-h^2}{8\pi^2 m}\left(\frac{\delta^2\psi}{\delta x^2} + \frac{\delta^2\psi}{\delta y^2} + \frac{\delta^2\psi}{\delta z^2}\right) + V\psi\right]$$

- Multiply by $-\frac{8\pi^2 m}{h^2}$ and rearranging

$$\frac{\delta^2\psi}{\delta x^2} + \frac{\delta^2\psi}{\delta y^2} + \frac{\delta^2\psi}{\delta z^2} + \frac{8\pi^2 m}{h^2}(E - V)\psi = 0$$

7. State (n+l) rule.

- The lower the value of (n + l) for an orbital, the lower is its energy. If two orbitals have the same value of (n + l),the orbital with lower value of n will have the lower energy.

8. Describe the Aufbau's principle.

The word Aufbau in German means 'building up'. In the ground state of the atoms, the orbitals are filled in the order of their increasing energies. That is the electrons first occupy the lowest energy orbital available to them.

9. How many orbitals are possible for n=4? Calculate.

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

four sub-shells ⇒ s, p, d, f

$l = 0$ $m_l = 0$; one 4s orbital.

$l = 1$ $m_l = -1, 0, +1$; three 4p orbitals.

$l = 2$ $m_l = -2, -1, 0, +1, +2$; five 4d orbitals.

$l = 3$ $m_l = -3, -2, -1, 0, +1, +2, +3$; seven 4f orbitals

Over all Sixteen orbitals.

10. Define quantum numbers and mention its types.

- The electron in an atom can be characterized by a set of four quantum numbers, namely principal quantum number (n), azimuthal quantum number(l), magnetic quantum number (m) and spin quantum number (s).

11. State Zeeman effect & Stark effect.

- Splitting of spectral lines in magnetic field is called Zeeman effect and splitting of spectral lines in electric field, is called Stark effect.

12. State Hund's rule.

- It states that electron pairing in the degenerate orbitals does not take place until all the available orbitals contain one electron each.

13. Give the electronic configuration of Mn^{2+} and Cr^{3+}.

Mn^{2+} : $_{18}[Ar]\ 3d^5\ 4s^0$ **Cr^{3+}** : $_{18}[Ar]\ 3d^3\ 4s^0$

14. Give the expected and actual electronic configuration of Cr and Cu.

For chromium - 24	For copper - 29
Expected configuration :	Expected configuration :
$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^4\ 4s^2$	$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^9\ 4s^2$
Actual configuration :	**Actual configuration :**
$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^5\ 4s^1$	$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^{10}\ 4s^1$

15. What is meant by exchange energy?

- If two or more electrons with the same spin are present in degenerate orbitals, there is a possibility for exchanging their positions. During exchange process the energy is released and the released energy is called exchange energy.

16. Give the Relationship between radial wave function and angular wave functions.

$\Psi(r, \theta, \varphi) = R(r).f(\theta).g(\varphi)$

- where R(r) is called radial wave function, other two functions are called angular wave functions.

Other important questions: (5 marks)

1. List out the Postulates of Bohr's atom model. (39)
2. Mention the Limitations of Bohr's atom model. (40)
3. Derive de-Broglie relationship. (40)
4. Explain Davison and Germer experiment. (42)
5. Write notes on various quantum numbers. (44)

UNIT 3 PERIODIC CLASSIFICATION OF ELEMENTS

VERY SHORT AND SHORT ANSWER QUESTION AND ANSWER

1. What is Dobereiner's triads? Give an example.

- In Dobereiner's triads, the atomic weight of the middle element nearly equal to the arithmetic mean of the atomic weights of the remaining two elements.
- E.g: Li (7), Na(23), K(39): 7 + 39 = 46/2 = 23

2. What is Newland's law of octaves?

- On arranging the elements in the increasing order of atomic weights, he observed that the properties of every eighth element are similar to the properties of the first element. This law holds good for lighter elements up to calcium.

3. Define Mendeleev's periodic Law.

- "The properties of the elements are the periodic functions of their atomic weights" and this is called periodic law.

4. List out the anomalies of Mendeleev's periodic table.

- Some elements with similar properties were placed in different groups and those with dissimilar properties were placed in same group.
- Example: Tellurium (127.6) was placed in VI group but Iodine (127.0) was placed in VII group.
- Similarly elements with higher atomic weights were placed before lower atomic weights based on their properties in contradiction to his periodic law. Example $_{27}Co^{59}$ was placed before $_{28}Ni^{58.7}$

5. Define modern periodic law.

- "The physical and chemical properties of the elements are periodic functions of their atomic numbers."

6. Give the IUPAC name of the following elements with atomic number 108, 110 and 114.

- 108 : Unniloctium
- 110 : Ununnilium
- 114 : Ununquadium

7. What are isoelectronic ions? Give example.

- Ions with similar number of electrons and posses same inert gas configuration are called as isoelectronic ions. e.g: F^-, Na^+ (2,8 = Ne)

8. What are 's' block elements? Give its general electronic configuration.

- The elements of group 1 and group 2 are called s-block elements, since the last valence electron enters the ns orbital. The group 1 elements are called alkali metals while the group 2 elements are called alkaline earth metals. General valence shell electronic configuration is ns^{1-2}

9. What are 'p' block elements? Give its general electronic configuration.

- The elements of groups 13 to 18 are called p-block elements or representative elements and have a general electronic configuration ns^2, np^{1-6}. The elements of the group 16 and 17 are called chalcogens and halogens respectively. The elements of 18^{th} group contain completely filled valence shell electronic configuration (ns^2, np^6) and are called inert gases or noble gases.

10. What is effective nuclear charge? (Zeff)

- The net nuclear charge experienced by valence electrons in the outermost shell is called the effective nuclear charge. It is approximated by the below mentioned equation.
- Zeff = Z – S Where Z is nuclear charge S is screening constant

11. What are transition elements? Give its general valence shell electronic configuration.

- The elements of the groups 3 to 12 are called d-block elements or transition elements with general valence shell electronic configuration ns^{1-2}, $(n-1)d^{1-10}$. These elements also show more than one oxidation state and form ionic, covalent and co-ordination compounds.

12. What are 'f' block elements? Give its general valence shell electronic configuration.

- The lanthanides ($4f^{1-14}$, $5d^{0-1}$, $6s^2$) and the actinides ($5f^{0-14}$, $6d^{0-2}$, $7s^2$) are called f-block elements. These elements are metallic in nature and have high melting points. Their compounds are mostly coloured. These elements also show variable oxidation states.

13. Define atomic radius of an atom.

- Atomic radius of an atom is defined as the distance between the centre of its nucleus and the outermost shell containing the valence electron.

14. Define covalent radius.

- It is one-half of the inter nuclear distance between two identical atoms linked together by a single covalent bond. Inter nuclear distance can be determined using x-ray diffraction studies.

15. Define metallic radius.

- It is defined as one-half of the distance between two adjacent metal atoms in the closely packed metallic crystal lattice.

16. Define ionic radius.

- It is defined as the distance from the centre of the nucleus of the ion up to which it exerts its influence on the electron cloud of the ion.

17. Explain the periodic trend of atomic radius.

- Atomic radius tends to decrease in a period. As we move from left to right along a period, the valence electrons are added to the same

shell. The simultaneous addition of protons to the nucleus, increases the nuclear charge, as well as the electrostatic attractive force between the valence electrons and the nucleus.

- In the periodic table, the atomic radius of elements increases down the group. As we move down a group, new shells are opened to accommodate the newly added valence electrons. As a result, the distance between the Centre of the nucleus and the outermost shell containing the valence electron increases.

18. Explain the periodic trend of ionic radius.

- Ionic radius tends to decrease in a period. As we move from left to right along a period, the valence electrons are added to the same shell. The simultaneous addition of protons to the nucleus, increases the nuclear charge, as well as the electrostatic attractive force between the valence electrons and the nucleus.
- In the periodic table, the ionic radius of elements increases down the group. As we move down a group, new shells are opened to accommodate the newly added valence electrons. As a result, the distance between the Centre of the nucleus and the outermost shell containing the valence electron increases.

19. Define ionization potential. Give its unit.

- It is defined as the minimum amount of energy required to remove the most loosely bound electron from the valence shell of the isolated neutral gaseous atom in its ground state. It is expressed in kJ mol^{-1} or in electron volts (eV).

20. Explain the periodic trend of ionization potential.

- When we move from left to right along a period, the valence electrons are added to the same shell, at the same time protons are

added to the nucleus. This successive increase of nuclear charge increases the electrostatic attractive force on the valence electron and more energy is required to remove the valence electron resulting in increase in ionization energy.

- As we move down a group, the valence electron occupies new shells, the distance between the nucleus and the valence electron increases. So, the nuclear force of attraction on valence electron decreases. Hence ionization energy decreases down a group.

21. How would you explain the fact that the second ionization potential is always higher than first ionization potential.

- The minimum amount of energy required to remove an electron from a unipositive cation is called second ionization energy.

- The total number of electrons are less in the cation(M^+) than the neutral atom while the nuclear charge remains the same. Therefore the effective nuclear charge of the cation is higher than the corresponding neutral atom.

22. In what period and group will an element with Z=118 will be present?

- Period no:7, Group no: 18

23. Define electron affinity.

- It is defined as the amount of energy released when an electron is added to the valence shell of an isolated neutral gaseous atom in its ground state to form its anion. It is expressed in kJ mol^{-1}.

24. What is screening(shielding) effect?

- The inner shell electrons act as a shield between the nucleus and the valence electrons. This effect is called shielding effect.

25. Explain the periodic trend of electron affinity.

- As we move from left to right in a period, generally electron affinity increases, i.e. the amount of energy released will be more. This is

due to an increase in the nuclear charge and decrease in size of the atoms.

- As we move down a group, generally the electron affinity decreases. It is due to increase in atomic size and the shielding effect of inner shell electrons.

26. Define electronegativity.

- It is defined as the relative tendency of an element present in a covalently bonded molecule, to attract the shared pair of electrons towards itself.

27. Explain the periodic trend of electronegativity.

- The atomic radius decreases in a period, as the attraction between the valence electron and the nucleus increases. Hence the tendency to attract shared pair of electrons increases. Therefore, electronegativity increases in a period.
- As we move down a group the atomic radius increases and the nuclear attractive force on the valence electron decreases. Hence, the electronegativity decreases.

28. Why halogens act as oxidizing agent?

- Halogens having the general electronic configuration of ns^2, np^5 readily accept an electron to get the stable noble gas electronic configuration (ns^2, np^6), and therefore in each period the halogen has high electron affinity (high negative values) . So halogens acts as oxidizing agent

29. Differentiate electron affinity and electronegativity.

Electron affinity	Electronegativity

It is the tendency of an isolated gaseous atom to attract an electron	It is the tendency of an atom in a molecule to attract the shared pair of electrons
Unit eV/atom or kcal/mole or kJ/mole	No units
It is a property of an isolated atom	It is a property of a bonded atom
It does not change regularly in a period or group	It changes regularly in a period or group

30. Mention any two anomalous properties of second period elements.

- The first element of each group differs from other members of the group in certain properties. For example, lithium and beryllium form more covalent compounds, unlike the alkali and alkali earth metals which predominantly form ionic compounds.
- The elements of the second period have only four orbitals (2s & 2p) in the valence shell and have a maximum co-valence of 4, whereas the other members of the subsequent periods have more orbitals in their valence shell and shows higher valences. For e.g, boron forms BF_4^- and aluminum forms AlF_6^{3-}

Other important questions: (5 marks)

1. Explain the Pauling's method for the determination of ionic radius. (83)
2. Briefly give the basis for Pauling's scale of electronegativity.(87)

UNIT 4 HYDROGEN

VERY SHORT AND SHORT ANSWER QUESTION AND ANSWER

1. **Explain why hydrogen is not placed with the halogens in the periodic table?**
   - The electron affinity of hydrogen is much less than that of halogen atoms. Hence, the tendency of hydrogen to form hydride ion is low compared to that of halogens to form the halide ions as evident from the following reactions:

     $H_2 + e^- \rightarrow H^-$ $\Delta H = +36$ kcal mol^{-1}

     $Br_2 + e^- \rightarrow Br^-$ $\Delta H = -55$ kcal mol^{-1}

2. **Justify the position of hydrogen in the periodic table.**
   - Hydrogen has similarities with alkali metals as well as the halogens, it is difficult to find the right position in the periodic table. However, in most of its compounds hydrogen exists in +1 oxidation state. Therefore, it is reasonable to place the hydrogen in group 1 along with alkali metals.

3. **What are isotopes? Write names of isotopes of hydrogen.**
   - Isotopes are the atoms of the same element having same atomic number but different mass number.
   - Hydrogen has three naturally occurring isotopes, viz., Protium ($_1H^1$ or H), Deuterium ($_1H^2$ or D) and Tritium ($_1H^3$ or T).

4. **How will you convert ortho hydrogen into para hydrogen?**
   - The para-form can be catalytically transformed into ortho-form using platinum or iron.
   - It can also be converted by passing an electric discharge,
   - By heating above 800°C
   - By mixing with paramagnetic molecules such as O_2, NO, NO_2 or with nascent/atomic hydrogen.

5. **Explain the preparation of hydrogen using electrolysis.**
   - Hydrogen is obtained by the electrolysis of water containing traces of acid or alkali or the electrolysis of aqueous solution of sodium

hydroxide or potassium hydroxide using a nickel anode and iron cathode.

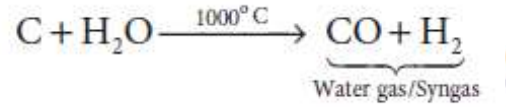
At anode : $2\ OH^- \rightarrow H_2O + O_2 + 2e^-$

At cathode : $2\ H_2O + 2\ e^- \rightarrow 2\ OH^- + H_2$

overall reaction : $H_2O \rightarrow H_2 + ½O_2$

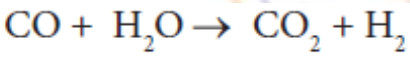
6. What is water gas? How is it prepared?

- The mixture of $CO+H_2$ is known as *water gas*. *It is prepared by passing* steam over a red-hot coke .



7. **What is water gas shift reaction?**

- The carbon monoxide of the water gas can be converted to carbon dioxide by mixing the gas mixture with more steam at 400°C and passed over a shift converter containing iron/copper catalyst. This reaction is called as *water-gas shift reaction.*



8. What is heavy water? Mention the uses of it.

- Heavy water (D_2O) is the oxide of heavy hydrogen.

Uses:

- Heavy water is widely used as moderator in nuclear reactors.
- It is commonly used as a tracer to study organic reaction mechanisms and mechanism of metabolic reactions
- It is also used as a coolant in nuclear reactors as it absorbs the heat generated.

9. How will you prepare ammonia by Haber's process?

- Ammonia is prepared by Haber's process using 1:3 ratio of nitrogen and hydrogen gas at 380-450^{0}C and at 200 atm in

presence of iron catalyst.

$$N_2 + 3H_2 \underset{200\ atm/Fe}{\overset{380\text{-}450^\circ C}{\rightleftharpoons}} 2\ NH_3$$

10. Mention any three uses of hydrogen.

- Atomic hydrogen and oxy-hydrogen torches are used for cutting and welding.
- Liquid hydrogen is used as a rocket fuel.
- Hydrogen is also used in fuel cells for generating electrical energy.

11. Distinguish between hard water and soft water.

- Presence of Ca, Mg, Fe and Mn metal salts in the form of bicarbonate, chloride and sulphate in water makes water 'hard'.
- On the other hand, water free from soluble salts of calcium and magnesium is called soft water.

12. How do you expect the metallic hydrides to be used for hydrogen storage?

- It is absorbed and released like a water sponge. Such a reversible uptake of hydrogen in metals and alloys is also attractive for hydrogen storage and for rechargeable metal hydride battery applications.

13. Why interstitial hydrides have lower density than the parent metal?

- Metallic hydrides are usually obtained by hydrogenation of metals and alloys in which hydrogen occupies the interstitial sites (voids) and this leads to slight expansion of lattice site which is responsible for low density

14. Define ionic hydrides.

- Ionic hydrides composed of an electropositive metal, an alkali or alkaline-earth metal, formed by transfer of electrons from metal to hydrogen atoms.

15. What is hydrogen bonding? Mention its types with atleast one example.

- When a hydrogen atom (H) is covalently bonded to a highly electronegative atom such as fluorine (F) or oxygen (O) or nitrogen (N), the bond is polarized. Due to this effect, the polarized hydrogen atom is able to form a weak electrostatic interaction with another electronegative atom present in the vicinity. This interaction is called as a hydrogen bond and is denoted by dotted lines (...).
  - **Intramolecular Hydrogen Bond**
  - e.g.: Ortho-Nitrophenol, Salicilaldehyde
  - **Intermolecular hydrogen bond**
  - e.g.: ammonia and water.

16. How tritium is prepared?

- Tritium can be artificially prepared by bombarding lithium with slow neutrons in a nuclear fission reactor.

$${}^{6}_{3}\mathrm{Li} + {}^{1}_{0}\mathrm{n} \rightarrow {}^{4}_{2}\mathrm{He} + {}^{3}_{1}\mathrm{T}$$

17. Discuss the three types of covalent hydrides?

- Covalent hydrides are divided into three categories, electron precise (CH_4, C_2H_6, SiH_4, GeH_4), electron deficient (B_2H_6) and electron-rich hydrides (NH_3, H_2O).

18. An ice cube at 0°C is placed in some liquid water at 0°C, the ice cube sinks. why?

- In ice, presence of two hydrogen atoms and two lone pairs of electron on oxygen atoms in each water molecule allows formation of a three dimensional structure. This arrangement creates an open structure, which accounts for the lower density of ice compared with water at 0°C

19. Do you think that heavy water can be used for drinking purposes?

- In general heavy water of high viscosity and high density, retards the growth of living organisms like plants and animals. The rates of enzyme catalyzed bio chemical reactions involving D_2O are slower than those involving H_2O. Further the enzymes may then lose their ability in such bio chemical reactions, hence it is not suitable for drinking purposes.

20. Explain the exchange reactions of deuterium.

- Deuterium can replace reversibly hydrogen in compounds either partially or completely depending upon the reaction conditions. These reactions occur in the presence of deuterium or heavy water.

$$CH_4 + 2\,D_2 \rightarrow CD_4 + 2\,H_2$$

$$2\,NH_3 + 3\,D_2 \rightarrow 2\,ND_3 + 3\,H_2$$

Other important questions: (5 marks)

1. Compare the Structures of H_2O and H_2O_2(112, 115).
2. Explain with suitable example a) Inter molecular and b) intra molecular hydrogen bonding (114).
3. What are ortho and para hydrogen? Differentiate ortho hydrogen from para hydrogen(102).

PHYSICAL CHEMISTRY

UNIT 6 GASEOUS STATE

VERY SHORT AND SHORT ANSWER QUESTION AND ANSWER

1. State Boyle's law.

- At a given temperature the volume occupied by a fixed mass of a gas is inversely proportional to its pressure.
- It can be written as

$V \alpha \frac{1}{P}$ ------ $V = k \times \frac{1}{P}$ ------

PV = k (at constant temperature and mass)

2. State Charle's law.

- For a fixed mass of a gas at constant pressure, the volume is directly proportional to its temperature (K). Mathematically it can be represented as

V = kT (at constant P and n)

3. Define Kelvin's scale.

- The temperature scale with absolute zero as starting point which is called Kelvin scale.

4. State Gay Lussac's law.

- Joseph Gay-Lussac stated that, at constant volume the pressure of a fixed mass of a gas is directly proportional to temperature.

$P \alpha T$ (at constant volume)

5. State Dalton's law of Partial pressure.

- John Dalton stated that "the total pressure of a mixture of non-reacting gases is the sum of partial pressures of the gases present in the mixture" where the partial pressure of a component gas is the pressure that it would exert if it were present alone in the same volume and temperature.

6. Explain the applications of Dalton's law.

- In a reaction involving the collection of gas by downward displacement of water, the pressure of dry vapor collected can be calculated using Dalton's law.
- $\mathbf{P_{dry\ gas\ collected} = p_{total} - p_{water\ vapour}}$
- $P_{water\ vapour}$ is generally referred as aqueous tension and its values are available for air at various temperatures.

7. State Graham's law of diffusion.

- The rate of diffusion or effusion is inversely proportional to the square root of molar mass. This statement is called Graham's law of diffusion/effusion.
- Mathematically, rate of diffusion $\alpha \frac{1}{\sqrt{M}}$

8. Distinguish between diffusion and effusion.

Diffusion: When two non -reactive gases are allowed to mix, the gas molecules migrate from region of higher concentration to a region of lower concentration. This property of gas which involves the movement of the gas molecules through another gases is called diffusion.

Effusion is another process in which a gas escapes from a container through a very small hole.

9. Aerosols cans carry clear warning of heating of the can. Why?

- Aerosols are colloids of gas in liquid. On heating the can temp rises and pressure will also increase and at ambient temp about 120^0F may lead to explosions. Hence they carry clear warning of heating.

10. Would it be easier to drink water with a straw on the top of mount Everst?

- It is difficult to drink water with a straw on the top of mount Everst. This is because at higher altitudes the pressure decreases and hence temp also decreases

11. What is compressibility factor 'Z'?

- The deviation of real gases from ideal behaviour is measured in terms of a ratio of PV to nRT. This is termed as compressibility factor. Mathematically, Z =PV/ nRT

12. What are ideal gases? Distinguish between real and ideal gases.

- Gases which obeys gas equation (PV=nRT), and the individual gas molecules occupy negligible volume when compared to the total volume of the gas and there is no attractive force between the gas molecules, under all conditions are called ideal gases.
- Gases can be liquefied shows that the attractive force exists among molecules. Hence, there is no gas which behaves ideally under all conditions. The non-ideal gases are called real gases.

13. Why the individual volume of the gas molecules can be neglected?

- When the pressure is low, the volume of the container is very large compared to the volume of the gas molecules so that individual volume of the gas molecules can be neglected.

14. Define critical temperature of CO_2?

- CO_2 gas is liquefied completely at 31.1°C. This temperature is known as the liquefaction temperature or critical temperature of CO_2, at the pressure of 73 atm.

15. Define Tc, Pc and Vc.

- **Critical temperature (Tc)** of a gas is defined as the temperature above which it cannot be liquefied even at high pressure.
- **Critical pressure (Pc)** of a gas is defined as the minimum pressure required to liquefy 1 mole of a gas at its critical temperature.
- **Critical volume (Vc)** is defined as the volume occupied by 1 mole of a gas at its critical temperature and critical pressure.

16. What is Joule Thomson effect?

- The phenomenon of lowering of temperature when a gas is made to expand adiabatically from a region of high pressure into a region of low pressure is known as Joule- Thomson effect.

17. How critical constants are related to Van der Waal's constants?

- The critical constants are related to Van der Waals constants as follows

$$T_C = \frac{8a}{27Rb}, \quad P_C = \frac{a}{27b^2} \text{ and } V_C = 3b$$

18. What do you mean by adiabatic demagnetization?

- In **Adiabatic process,** cooling is produced by removing the magnetic property of magnetic material such as gadolinium sulphate. By this method, a temperature of 10^{-4} K i.e. as low as 0 K can be achieved.

19. Why do astronauts have to wear protecting suits when they are on the surface of moon? Why does the moon have no atmosphere?

- In space there is no air to breath and no air pressure, if we do not Wear, Our body will continue to push out and blow up like a balloon. It would look cool, but we will be dead, so astronauts have to wear protecting suits.
- Because the value of acceleration due to gravity on the surface of the moon is less. Molecules of atmospheric gases on the surface of the moon have thermal velocities greater than escape velocity.

20. Why there is no hydrogen in our atmosphere?

- Under ordinary conditions on earth, hydrogen exist as diatomic gas. Because of its light weight, which enable it to escape from earth gravity more easily than heavier gases.

21. **Write the Van der Waal's equation for a real gas.**

$$\left(P+\frac{a\,n^2}{V^2}\right)(V-nb)=nRT$$

- p-pressure,v-volume,n-no of moles,a&b –vanderwaal's constants

22. **Write notes on a. Linde's method and b. Claude's method.**

a) In **Linde's method,** Joule-Thomson effect is used to get liquid air or any other gas.

b) In **Claude's process,** the gas is allowed to perform mechanical work in addition to Joule-Thomson effect so that more cooling is produced.

23. **When ammonia combines with HCl, NH_4Cl is formed as dense as white dense fumes. Why do more fumes appear near HCl?**

$$NH_3 + HCl \rightarrow NH_4Cl$$

- The rate of diffusion is inversely proportional to the molecular weight of the gas. Lower the molecular weight, faster is the diffusion. Molecular mass of HCl is 36.5gmol^{-1} while the molecular mass of NH_3 is 17g mol^{-1}. Hence ammonia diffuses faster than HCl and thus appear as dense whiter fumes near HCl.

Other important questions: (5 marks)

1. Write the Van der Waal's equation for a real gas. Explain the correction term for pressure and volume.(171, 172)
2. Derive the values of critical constants in terms of Van der Waal's constants(174, 175).

UNIT 8 PHYSICAL AND CHEMICAL EQUILIBRIUM

VERY SHORT AND SHORT ANSWER QUESTION AND ANSWER

1. What is physical equilibrium?

- The system in which the amount of matter constituting different phase does not change with time is said to be in physical equilibrium.

2. Define melting point of a substance

- The temperature at which the solid and liquid phases of a substance are at equilibrium is called the melting point or freezing point of that substance.

3. What is condensation point of a liquid.

- The temperature at which the liquid and vapour phases are at equilibrium is called the boiling point and condensation point of the liquid.

4. Explain each of the following equilibrium.

a. Solid - liquid equilibrium

- At 273 K, the system will reach a state of physical equilibrium in which the amount of water in the solid phase and liquid phase does not change with time.

b. Liquid – vapour equilibrium

- At 373 K, the system will reach a state of physical equilibrium in which the amount of water in the liquid phase and vapour phase does not change with time.

c. Solid – vapour equilibrium

- Consider a system in which the solid sublimes to vapour. In this process also, equilibrium can be established between these two phases.

5. Chemical equilibrium is in a state of dynamic equilibrium. Explain why?

- At equilibrium the forward and the backward reactions are proceeding at the same rate and no macroscopic change is observed. So chemical equilibrium is in a state of dynamic equilibrium.
- At equilibrium $R_f = R_r$

6. What is homogeneous and heterogeneous equilibria? Give an example for each.

Homogeneous equilibrium

- In a homogeneous equilibrium, all the reactants and products are in the same phase.
- For example: $H_{2(g)} + I_{2(g)} \rightleftharpoons 2HI_{(g)}$

Heterogeneous equilibrium

- If the reactants and products of a reaction in equilibrium, are in different phases, then it is called as heterogeneous equilibrium.
- Example: $H_2O_{(l)} \rightleftharpoons H_2O_{(g)}$

7. State law of mass action.

- "At any instant, the rate of a chemical reaction at a given temperature is directly proportional to the product of the active masses of the reactants at that instant".

8. Define equilibrium constant.

- At a given temperature, the ratio of the product of active masses of reaction products raised to the respective stoichiometric coefficients in the balanced chemical equation to that of the reactants is a constant, known as equilibrium constant.

$$K_C = \frac{[C]^l[D]^m}{[A]^x[B]^y}$$

9. What do you mean by active mass?

$$\text{Active mass} = \left(\frac{n}{V}\right) \text{ mol dm}^{-3}\text{(or) mol L}^{-1}$$

where n is the number of moles and V is the volume of the container (dm^3 or L)

10. What is Δng? Calculate Δng for the following.

$2NH_{3(g)} \rightleftharpoons N_{2(g)} + 3H_{2(g)}$ Δng = np – nr; 4 – 2 = 2

$N_{2(g)} + O_{2(g)} \rightleftharpoons 2NO_{(g)}$ Δng = np – nr; 2 – 2 = 0

$2SO_{2(g)} + O_{2(g)} \rightleftharpoons 2SO_{3(g)}$ Δng = np – nr; 2 – 3 = -1

11. Write Kp & Kc for the following equilibrium.

$2SO_{2(g)} + O_{2(g)} \rightleftharpoons 2SO_{3(g)}$

$2CO_{(g)} \rightleftharpoons CO_{2(g)} + C_{(s)}$

$Ag_2O_{(s)} + 2NH_{3(aq)} \rightleftharpoons 2AgNO_{3(aq)} + H_2O_{(l)}$

1) $K_C = \frac{[SO_3]^2}{[SO_2]^2[O_2]}$ $\quad K_p = \frac{P_{SO_3}^2}{P_{SO_2}^2 \times PO_2}$

2) $\therefore K_C = \frac{[CO_2]}{[CO]^2}$ and $K_p = \frac{P_{CO_2}}{P_{CO}^2}$

3) $K_C = \frac{[AgNO_3]^2}{[NH_3]^2}$

12. Define reaction quotient of a chemical reaction.

- Under non-equilibrium conditions, reaction quotient 'Q' is defined as the ratio of the product of active masses of reaction products raised to the respective stoichiometric coefficients in the balanced chemical equation to that of the reactants.

$$Q = \frac{[C]^l\,[D]^m}{[A]^x\,[B]^y}$$

13. How 'Q' value is used to predict the direction of the reaction?

- If Q = Kc, the reaction is in equilibrium state.
- If Q > Kc, the reaction will proceed in the reverse direction i.e., formation of reactants.
- If Q < Kc, the reaction will proceed in the forward direction i.e., formation of products.

14. Give the Kp & Kc relationship for the following equilibrium reactions.

$N_{2(g)} + 3H_{2(g)} \rightleftharpoons 2NH_{3(g)}$ Since $\Delta ng = -2$; $Kp = Kc\,(RT)^{-2}$

$PCl_{3(g)} + Cl_{2(g)} \rightleftharpoons PCl_{5(g)}$ Since $\Delta ng = -1$; $Kp = Kc\,(RT)^{-1}$

$H_{2(g)} + I_{2(g)} \rightleftharpoons 2HI_{(g)}$ Since $\Delta ng = 0$; $Kp = Kc$

15. State Le-Chatelier's principle.

- Le-Chatelier's Principle "If a system at equilibrium is disturbed, then the system shifts itself in a direction that nullifies the effect of that disturbance."

16. Is the catalyst affect the state of equilibrium? Explain.

- A catalyst does not affect the state of the equilibrium. The catalyst increases the rate of both the forward and the reverse reactions to the same extent.

17. How does the increase or decrease of temperature influence the following equilibrium reaction $N_{2(g)} + 3H_{2(g)} \rightleftharpoons 2NH_{3(g)}$ $\Delta H = -92.2$ kJ

- In this equilibrium, the forward reaction is exothermic i.e. the heat is liberated while the reverse reaction is endothermic i.e. the heat is absorbed.

18. What is the effect of added inert gas on the reaction at equilibrium?

- When an inert gas is added to an equilibrium system at constant volume, the total number of moles of gases present in the container increases, that is, the total pressure of gases increases. the partial pressure of the reactants and the products are unchanged. Hence at constant volume, addition of inert gas has no effect on equilibrium.

19. If there is no change in concentration, why is the equilibrium state considered dynamic?

- Chemical reaction which are reversible do not cease, when equilibrium is attained.
- At equilibrium the forward and the backward reactions are proceeding at the same rate and no macroscopic change is observed. So chemical equilibrium is in a state of dynamic equilibrium.

Other important questions: (5 marks)

1. Derive a general expression for the equilibrium constant K_P and K_C for the reaction (14)

   $3H_2(g) + N_2(g) \rightleftharpoons 2NH_3(g)$

2. Derive the relation between K_P and K_C.(7)
3. Deduce the Vant Hoff equation.(20)
4. Derive a general expression for the equilibrium constant K_P and K_C for the reaction $H_{2\,(g)} + I_{2(g)} \leftrightarrows 2HI_{(g)}$ (12)
5. Derive a general expression for the equilibrium constant K_P and K_C for the reaction $PCl_{5(g)} \leftrightarrows PCl_{3(g)} + Cl_{2(g)}$ (13)

6. Derive Kc for the general equilibrium reaction xA + yB ⇌ lC + mD

Let us consider a reversible reaction,

$$xA + yB \rightleftharpoons lC + mD$$

where, A and B are the reactants, C and D are the products and x,y, l and m are the stoichiometric coefficients of A, B, C and D, respectively.

Applying the law of mass action, the rate of the forward reaction,

$$r_f \alpha [A]^x [B]^y \text{ (or) } r_f = k_f [A]^x [B]^y$$

Similarly, the rate of the backward reaction,

$$r_b \alpha [C]^l [D]^m$$

(or)

$$r_b = k_b [C]^l [D]^m$$

where k_f and k_b are proportionality constants

At equilibrium,

Rate of forward reaction (r_f)

= Rate of backward reaction (r_b)

$$k_f [A]^x [B]^y = k_b [C]^l [D]^m$$

$$\text{or} \quad \frac{k_f}{k_b} = \frac{[C]^l [D]^m}{[A]^x [B]^y} = K_c$$

where, K_c is the equilibrium constant in terms of concentration (active mass).

UNIT 9 SOLUTIONS

VERY SHORT AND SHORT ANSWER QUESTION AND ANSWER

1. Define solutions

- A solution is a homogeneous mixture of two or more substances, consisting of atoms, ions or molecules.
- The compound that is present in largest amount in a homogeneous mixture is called the solvent, and the others are solutes.

2. What is meant by mole fraction?

- It is the ratio of number of moles of the component to the total number of moles of all the components present in solution

$$X = \frac{\textbf{Number of moles of the component}}{\textbf{total number of moles of all the components present in solution}}$$

3. Define Molarity, molality and normality.

Molarity (M):

- It is the number of moles of solute present in 1 L of the solution.

$$\textbf{Molarity} = \frac{\textbf{Number of moles of solute}}{\textbf{Volume of Solution (in L)}}$$

Molality (m):

- It is the number of moles of solute present in 1 kg of the solvent.

$$\textbf{Molality} = \frac{\textbf{Number of moles of solute}}{\textbf{Mass of the solvent (in Kg)}}$$

Normality (N):

- It is the number of gram equivalents of solute present in one litre of the solution.

$$\textbf{Normality} = \frac{\textbf{Number of gram equivalent of solute}}{\textbf{Volume of Solution (in L)}}$$

4. Define ebullioscopic constant.

- The ebullioscopic constant Kb is equal to the elevation in boiling point for 1 molal solution.

$$\text{Since } m = 1,\ \Delta T_b = K_b$$

5. What is vapour pressure of liquid? What is relative lowering of vapour pressure?

- The pressure of the vapour in equilibrium with its liquid is called vapour pressure of the liquid at the given temperature.
- Relative lowering of vapour pressure is the ratio of the lowering of vapour pressure of the solution to the vapour pressure of the pure solvent.

6. State Henry's law.

- It states that the solubility of a gas in a liquid at a given temperature is directly proportional to the partial pressure of the gas.

7. Mention the limitations of Henry's law.

- Henry's law is applicable at moderate temperature and pressure only.
- Only the less soluble gases obeys Henry's law
- The gases reacting with the solvent do not obey Henry's law.

8. State Raoult's law.

- The vapour pressure of a solution containing a non-volatile solute is directly proportional to the mole fraction of the solvent (X_A). The proportionality constant being the vapour pressure of the pure solvent.

9. What is osmosis?

- The spontaneous flow of solvent molecules from a dilute solution into a concentrated solution when the two are separated by a perfect semipermeable membrane is called osmosis.

10. What is osmotic pressure?

- Osmotic pressure (π) is the pressure which must be applied to the solution side (more concentrated solution) to just prevent the passage of pure solvent into it through a semipermeable membrane.

11. What is molal depression constant? Does it depends on nature of the solute?

- The molal depression constant K_f is equal to the deperession in freezing point for 1 molal solution. This is also known as Cryoscopic Constant.
- Depression constant does not depend on the nature of the solute, but depends on the number of solute particles in the solution.

12. Define the term isotonic solution.

- Two solution having same osmotic pressure at a given temperature are called isotonic solutions.

13. Define ppm.

- Parts per million
- If the solute quantity is very minimum then ppm unit is used to express its concentration.

$$ppm = \frac{Number\ of\ parts\ of\ the\ component}{Total\ number\ of\ parts\ of\ all\ components} \times 10^6$$

14. What is working standard?

- At the time of experiment, the solution with required concentration is prepared by diluting the stock solution. This diluted solution is usually called working standard.

15. List out the factors that influence the solubility.

- The solubility of a solute generally depends on the nature of the solute and solvent in which it is dissolved. It also depends on the temperature and pressure of the solution.

16. Define evaporation.

- If the kinetic energy of molecules in the liquid state overcomes the intermolecular force of attraction between them, then the molecules will escape from the liquid state. This process is called 'evaporation' and it happens on the surface of the liquid.

17. What is condensation?

- If evaporation is carried out in a closed container then the vapour remains in contact with the surface of the liquid. These vapour molecules are in continuous random motion during which they collide with each other and also with the walls of the container. As the collision is inelastic, they lose their energy and as result the vapour returns back to liquid state. This process is called as 'condensation'.

18. Write a short note on freezing point and depression in freezing point

Freezing point

- Freezing point is defined as "the temperature at which the solid and the liquid states of the substance have the same vapour pressure".

Depression in freezing point

- Lowering of freezing point of the solvent when the solute is added is called depression in freezing point.

$\Delta T_f = T^0 - T$

19. KCl in water deviates from ideal behavior. Why?

- KCl in water deviates from ideal behavior because the solute dissociates to give K^+ and Cl^{--} ion which form strong ion-dipole interaction with water molecules.

$$KCl\,(s) + H_2O\,(l) \rightarrow K^+(aq) + Cl^-(aq)$$

20. Write a short notes on Van't Hoff equation.

- For dilute solutions, the osmotic pressure is directly proportional to the molar concentration of the solute and the temperature of the solution.

$$\Pi = cRT.$$

- c = Concentration of the solution in molarity T = Temperature R = Gas constant

21. Define abnormal molar mass.

- The dissociation or association of solute molecules would alter the total number of particles present in the solution and hence affect the results of measured colligative properties. In such solutions, the value of the molar mass of the solute determined using colligative properties would be different from the actual molar mass, and it is called abnormal molar mass.

22. Define colligative properties.

- For an ideal dilute solution, the properties, namely, relative lowering of vapour pressure, elevation of boiling point, depression in freezing point and osmotic pressure do not depend on the chemical nature of the solute but depends only on the number of solute particles (ions/molecules) present in the solution. These four properties are known as colligative properties.

23. What are aqueous and non aqueous solutions? Give example.

- If the water is used as the solvent, the resultant solution is called as an aqueous solution. (NaCl in water) If solvents (Benzene, CCl_4, ether etc.,) other than water is used, then the resultant solution is called as a non-aqueous solution.

24. **When does a solution behaves ideally?**

- An ideal solution is a solution in which each component i.e. the solute as well as the solvent obeys the Raoult's law over the entire range of concentration.

25. How will you calculate mass percentage, volume percentage and mass by volume percentage?

$$\textbf{mass percentage} = \frac{mass\ of\ the\ solute(in\ g)}{mass\ of\ \ solution(in\ g)} \text{ x } 100$$

$$\textbf{volume percentage} = \frac{mass\ of\ the\ solute(in\ g)}{volume\ of\ \ solution(in\ ml)} \text{ x } 100$$

$$\textbf{mass by volume percentage} = \frac{volume\ of\ the\ solute(in\ ml)}{volume\ of\ \ solution(in\ ml)} \text{ x } 100$$

26. What is reverse osmosis? What are its applications?

- **Reverse osmosis** can be defined as a process in which a solvent passes through a semipermeable membrane in the opposite direction of osmosis, when subjected to a hydrostatic pressure greater than the osmotic pressure

Application of Reverse osmosis

- Reverse osmosis is used in the desalination of sea water and also in the purification of drinking water.

27. Mention the differences between ideal and non ideal solution

Ideal solution	Non ideal solution
An ideal solution is a solution in which each component i.e. the solute as well as the solvent obeys the Raoult's law over the entire range of concentration.	The solutions which do not obey Raoult's law over the entire range of concentration, are called non-ideal solutions.
For an ideal solution, $\Delta v_{mixing} = 0$ $\Delta H_{mixing} = 0$	For a non - ideal solution, $\Delta v_{mixing} \neq 0$ $\Delta H_{mixing} \neq 0$
Does not shows any deviation from Raoult's law	Shows positive and negative deviation from Raoult's law
Example :Benzene and toluene	Example :Benzene and acetone(+)

Other important questions: (5 marks)

1. State Raoult's law and obtain expression for lowering of vapour pressure when nonvolatile solute is dissolved in solvent.(49, 50)
2. Prove that relative lowering of vapour pressure is a colligative property.(50, 51)
3. Prove that elevation of boiling point is directly proportional to molality.(52)
4. Prove that depression of freezing point is a colligative property.(54)
5. How would you determine molecular mass from osmotic pressure.(56)

ORGANIC CHEMISTRY

UNIT 12 BASIC CONCEPTS OF ORGANIC REACTIONS

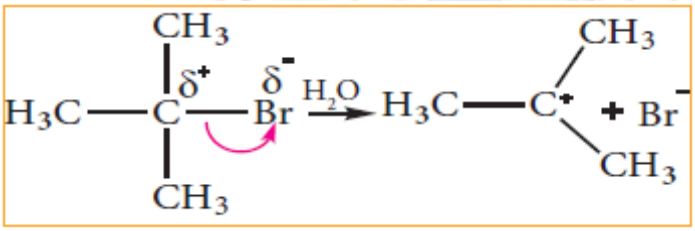
VERY SHORT AND SHORT ANSWER QUESTION AND ANSWER

1. What do you mean by mechanism of the reaction?

- The series of simple steps which collectively represent the chemical change, from substrate to product is called as the mechanism of the reaction.

2. What is heterolytic cleavage? Explain with example.

- Heterolytic cleavage is the process in which a covalent bond breaks unsymmetrically such that one of the bonded atoms retains the bond pair of electrons. It results in the formation of a cation and an anion. The cleavage is denoted by a curved arrow pointing towards the more electronegative atom.



3. What is homolytic cleavage? Explain with example.

- Homolytic cleavage is the process in which a covalent bond breaks symmetrically in such way that each of the bonded atoms retains one electron and forms free radicals. It is denoted by a half headed arrow (fish hook arrow).

Cl—Cl → Cl .+ Cl.

4. Differentiate carbocation and carbanion.

Carbocation	Carbanion
It Is an ion in which carbon bears a positive charge	It Is an ion in which carbon bears a negative charge
It is formed through heterolytic cleavage where carbon is more electro negative than its bonded atom.	It is formed through heterolytic cleavage where carbon is less electro negative than its bonded atom
In a carbocation, the carbon bearing positive charge is sp^2 hybridized and hence it has a planar structure.	The carbanion are generally pyramidal in shape and the lone pair occupies one of the sp^3 hybridized orbitals.

5. Differentiate electrophiles and nucleophiles? Give suitable examples for each.

S.No.	Electrophiles	Nucleophiles
1.	are electron deficient	are electron rich
2.	are cations	are often anions
3.	are Lewis acids	are Lewis bases
4.	accepts an electro pair	donate an electron pair
5.	attack on electron rich sites	attack on electron deficient sites
6.	H^+, Cl^+, etc.,	Br^-, NH_3, etc.,

6. What is inductive effect? Mention its types.

- Inductive effect is defined as the change in the polarisation of a covalent bond due to the presence of adjacent bonds, atoms or groups in the molecule.
- Based on the ability the substituents are classified as **+I** groups and **-I** groups. Their ability to **release or withdraw** the electron through sigma covalent bond is called **+I effect and -I effect** respectively.

7. What is electromeric effect? Give its types.

- Electromeric is a temporary effect which operates in unsaturated compounds (containing >C=C<, >C=O, etc...) in the presence of an attacking reagent.
- When the **π** electron is transferred towards the attacking reagent, it is called + E (positive electromeric) effect.
- When the **π** electron is transfered away from the attacking reagent, it is called, -E (negative electromeric) effect.

8. What do you mean by mesomerism?

- Certain organic compounds can be represented by more than one structure and they differ only in the position of bonding and lone pair of electrons. Such structures are called resonance structures (canonical structures) and this phenomenon is called resonance. This phenomenon is also called mesomerism or mesomeric effect.

9. Write short notes on hyper conjugation.

- The delocalisation of electrons of **σ** bond is called as hyper conjugation. It is a special stabilising effect that results due to the interaction of electrons of a **σ**-bond (usually **C-H** or **C-C**) with the adjacent, empty non-bonding p-orbital or an anti-bonding **σ*** or **π*-** orbitals resulting in an extended molecular orbital. It is a permanent effect.

10. What is resonance hybrid?

- The resonating structures are called canonical forms and the actual structure lies between these resonating structures, and is called a resonance hybrid.

11. What are substitution reactions? Mention its types with examples.

- Reactions in which, an atom or a group of atoms attached to a carbon atom is replaced by a new atom or a group of atoms. Classified as

i) Nucleophilic substitution Example: Hydrolysis of alkyl halides
ii) Electophilic substitution Example: Nitration of Benzene
iii) Free radical substitution Example: Chlorination of methane

12. What are addition reactions? Mention its types with example.

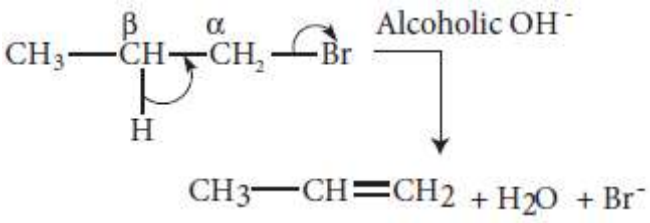
- It is a characteristic reaction of an unsaturated compound (compounds containing C-C localised double or triple bond). In this reaction two molecules combine to give a single product. They are classified as

i) Nucleophilic addition Example: addition of HCN to acetaldehyde
ii) Electophilic addition Example: Bromination of alkene
iii) Free radical addition Example: Hydrohalogenation of alkene in the presence of peroxide

13. What are elimination reactions? Explain with an example.

- In this reaction two substituents are eliminated from the molecule, and a new C-C double bond is formed between the carbon atoms to which the eliminated atoms/groups are previously attached.

Example: Dehydrohalogenation of n-Propyl bromide with alc. KOH.



14. Identify the electrophile and nucleophile from the following

H^+, CN^-, RNH_3^+, BF_3, NH_3, ROH, $:CCl_2$, H_2O

S.No.	Electrophiles	Nucleophiles
1.	H^+	CN^-
2.	RNH_3^+	NH_3,
3.	BF_3	ROH
4.	$:CCl_2$	H_2O

Other important questions: (5 marks)

1. Write short notes on
   a. Resonance (168)
   b. Hyper conjucation (170)
2. Explain Inductive effect with suitable example. (166)
3. Explain Electromeric effect with example. (167,168)
4. Give examples for the following types of organic reactions

   (i) β - elimination (173)

   (ii) electrophilic substitution.(171)

UNIT 15 ENVIRONMENTAL CHEMISTRY

VERY SHORT AND SHORT ANSWER QUESTION AND ANSWER

1. What is biodegradable pollutants?

- The pollutants which can be easily decomposed by the natural biological processes are called bio-degradable pollutants. Examples:plant wastes, animal wastes etc.

2. What is non biodegradable pollutants?

- The pollutants which cannot be decomposed by the natural biological processes are called Non bio-degradable pollutants. Examples: metal wastes (mainly Hg and Pb), D.D.T, plastics, nuclear wastes etc.,

3. What is Troposphere? How is it classified?

- The lowest layer of the atmosphere is called the troposphere and it extends from 0 – 10 km from the earth surface.
- It is classified into **Hydrosphere, Lithosphere, Biosphere**

4. Mention the effects of CO.

- Carbon monoxide is a poisonous gas which when inhaled, binds with haemoglobin and form carboxy haemoglobin which impairs normal oxygen transport by blood and hence the oxygen carrying capacity of blood is reduced. This oxygen deficiency results in headache, dizziness, tension, Loss of consciousness, blurring of eye sight and cardiac arrest.

5. Define green chemistry.

- Green chemistry is a chemical philosophy encouraging the design of products and processes that reduce or eliminate the use and generation of hazardous substances.

6. What do you mean by depletion of ozone layer?

- Ozone layer present in stratosphere protect the living species against harmful UV rays from space but due to the air pollution and degrading human activity, the ozone layer gets damaged or becomes thinner.
- The loss of ozone molecules in the upper atmosphere is termed as depletion of stratospheric ozone.

7. Define green house effect & global warming.

- Greenhouse effect may be defined as the heating up of the earth surface due to trapping of infrared radiations reflected by earth's surface by CO_2 layer in the atmosphere". The heating up of earth through the greenhouse effect is called global warming.

8. What is the tolerable limits of fluoride ions in drinking water? What happens if it exceeds 10 ppm?

- Fluoride ion concentration above 2 ppm causes brown mottling of teeth. Excess fluoride causes damage to bone and teeth.

9. What are (Freons) CFCs? How does they impact the depletion of ozone layer?

- The chloro fluoro derivatives of methane and ethane are referred by trade name Freons. These Chloro Fluoro Carbon compounds are stable, non-toxic, noncorrosive and non-inflammable, easily liquefiable and are used in refrigerators, air- conditioners and in the production of plastic foams.

$$CF_2Cl_2 \xrightarrow{h\upsilon} CF_2Cl + Cl^{\cdot}$$

$$CFCl_3 \xrightarrow{h\upsilon} CFCl_2 + Cl^{\cdot}$$

$$Cl^{\cdot} + O_3 \rightarrow ClO + O_2$$

$$ClO^{\cdot} + O \rightarrow Cl + O_2$$

- Chlorine radical is regenerated in the course of reaction. Due to this continuous attack of Cl° thinning of ozone layer takes place which leads to formation of ozone hole.

10. What is acid rain?

- Rain water normally has a pH of 5.6 due to dissolution of atmospheric CO_2 into it. Oxides of sulphur and nitrogen in the atmosphere may be absorbed by droplets of water that make up clouds and get chemically converted into sulphuric acid and nitric acid respectively as a results of pH of rain water drops to the level 5.6, hence it is called acid rain.

11. List out the effects of acid rain.

- Acid rain affects plants and animal life in aquatic ecosystem. It is harmful for agriculture, trees and plants as it dissolves and removes the nutrients needed for their growth. It causes respiratory ailment in humans and animals.

12. What is meant by particulates? Mention its types.

- Particulate pollutants are small solid particles and liquid droplets suspended in air. Many of particulate pollutants are hazardous. Examples: dust, pollen, smoke, soot and liquid droplets (aerosols) etc,.
- **Viable particulates, Non-viable particulates**

13. Mention any three strategies to control environmental pollution.

- **Waste management**: Environmental pollution can be controlled by proper disposal of wastes.
- **Recycling**: A large amount of disposed waste material can be reused by recycling the waste, thus it reduces the land fill and converts waste into useful forms. Growing more trees.

14. Define stone leprosy and give its equation.

- Acid rain causes extensive damage to buildings and structural materials of marbles. This attack on marble is termed as Stone leprosy.

$$CaCO_3 + H_2SO_4 \rightarrow CaSO_4 + H_2O + CO_2\uparrow$$

15. Among CO and CO_2, which is more dangerous? Why?

CO is more dangerous than CO_2.

- Carbon monoxide is a poisonous gas produced as a result of incomplete combustion of coal or firewood. It is released into the air mainly by automobile exhaust. It binds with haemoglobin and form carboxy haemoglobin which impairs normal oxygen transport by blood and hence the oxygen carrying capacity of blood is reduced.

16. What is smog?

- Smog is a combination of smoke and fog which forms droplets that remain suspended in the air.

17. Distinguish between classical smog and photochemical smog.

S.No.	Classical smog	Photo chemical smog
1.	Classical smog was first observed in London in December 1952 and hence it is also known as London smog.	Photo Chemical smog was first observed in Los Angels in 1950. It occurs in warm, dry and sunny climate.
2.	It consists of coal smoke and fog.	This type of smog is formed by the combination of smoke, dust and fog with air pollutants like oxides of nitrogen and hydrocarbons in the presence of sunlight.
3.	It causes bronchial irritation	Photochemical smog causes irritation to eyes, skin and lungs, increase in chances of asthma.

18. What is BOD?

- The total amount of oxygen in milligrams consumed by microorganisms in decomposing the waste in one liter of water at 20°C for a period of 5 days is called biochemical oxygen demand (BOD) and its value is expressed in ppm.

19. What is COD?

- Chemical oxygen demand (COD) is defined as the amount of oxygen required by the organic matter in a sample of water for its oxidation by a strong oxidising agent like $K_2Cr_2O_7$ in acid medium for a period of 2 hrs.

20. List out the harmful effects of chemical water pollutants.

- Cadmium and mercury can cause kidney damage.
- Lead poisoning can leads to the severe damage of kidneys, liver, brain etc. it also affects central nervous system
- Polychlorinated biphenyls (PCBs) causes skin diseases and are carcinogenic in nature.

21. What is Total dissolved solid (TDS)?

- Dissolved solids "refer to any minerals, salts, metals, cations or anions dissolved in **water"**. **Total dissolved solids** (**TDS**) comprise inorganic salts (principally calcium, magnesium, potassium, sodium, bicarbonates, chlorides, and sulfates) and some small amounts of organic matter that are dissolved in **water**.

22. How does paper is bleached?

- Conventional method of bleaching of paper was done with chlorine. Now a days H_2O_2 can be used for bleaching paper in presence of catalyst.

23. What would happen if the greenhouse gases were totally missing in the earth's atmosphere?

- In the absence of Green house gases, average temperature of the earth will decrease drastically. This decrease in temperature restricts the life in earth.

24. Which is considered to be earth's protective umbrella? Why?

- Ozone layer in the upper atmosphere is considered as the earth's protective umbrella. This acts as a filter for the shorter wavelength and highly hazardous ultraviolet radiation from the sun, protecting life on earth.

25. What is eutrophication? What are its effects?

- Eutrophication is a process by which water bodies receive excess nutrients that stimulates excessive plant growth (algae, other plant weeds). This enhanced plant growth in water bodies is called as algae bloom.
- The growth of algae in extreme abundance covers the water surface and reduces the oxygen concentration in water.

Other important questions: (5 marks)

1. What are particulate pollutants? Explain any three.(265)

2. Ethane burns completely in air to give CO_2, while in a limited supply of air gives CO. The same gases are found in automobile exhaust. Both CO and CO_2 are atmospheric pollutants

i) What is the danger associated with these gases (262)

ii) How do the pollutants affect the human body? (263)

3. How is acid rain formed? Explain its effect (264)
4. Differentiate the following

(i) BOD and COD (271)

(ii) Viable and non-viable particulate pollutants (265)

5. What are the various methods you suggest to protect our environment from pollution?(274)

OTHER IMPORTANT QUESTIONS FROM ORGANIC CHEMISTRY

VERY SHORT AND SHORT ANSWER QUESTION AND ANSWER

UNIT 13 HYDROCARBONS

1. Explain Kolbe's electrolytic method of preparation of a. Alkane b. Alkene and c. Alkyne

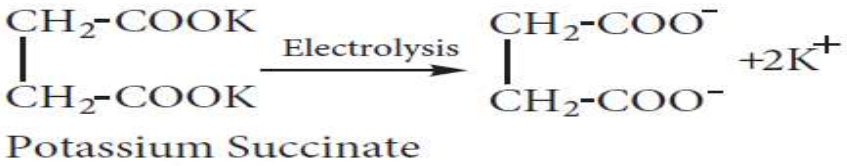
a. Alkane

- When sodium or potassium salt of carboxylic acid is electrolyzed, a higher alkane is formed.

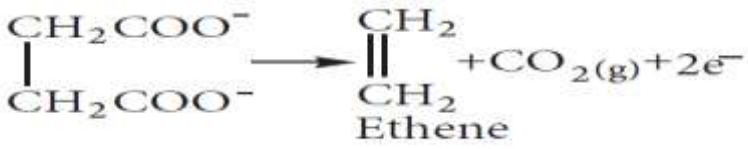
$$2CH_3COONa + 2H_2O \rightarrow \underbrace{CH_3\text{-}CH_3}_{\text{At Anode}} + \underbrace{2CO_2 + H_2}_{\text{at Cathode}} + 2NaOH$$

b. Alkene

- When an aqueous solution of potassium succinate is electrolyzed between two platinum electrodes, ethene is produced at the anode.



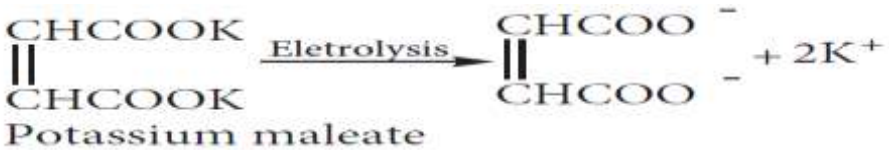
Potassium Succinate



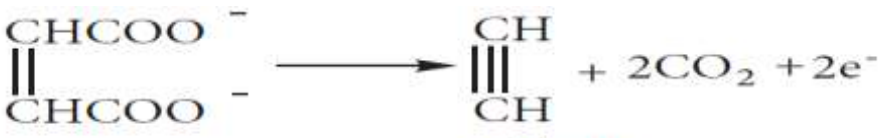
Ethene

c. Alkyne

- Electrolysis of sodium or potassium salt of maleic or fumaric acid yields alkynes.



Potassium maleate



acetylene

2. Write notes on Wurtz reaction.

- When a solution of halo alkanes in dry ether is treated with sodium metal, higher alkanes are produced. This reaction is used to prepare higher alkanes with even number of carbon atoms. For example:

CH_3-Br + 2Na + CH_3-Br → CH_3-CH_3 + 2NaBr

3. Write Corey House mechanism.

- An alkyl halide and lithium di alkyl cuprate are reacted to give higher alkane. For example:

CH_3-CH_2-Br + $(CH_3)_2$LiCu → $CH_3CH_2CH_3$ + CH_3Cu + LiBr

4. What is Kharasch addition?

- The addition of HBr to an alkene in the presence of organic peroxide, gives the anti Markovnikoff's product. This effect is called peroxide effect.

$$CH_3 - CH = CH_2 + HBr \xrightarrow[(C_6H_5CO)_2O_2/Peroxide]{} CH_3 - CH_2 - CH_2 - Br$$

5. Mention the uses of Alkane.

- The exothermic nature of alkane combustion reaction explains the extensive use of alkanes as fuels.
- Methane present in natural gas is used in home heating.
- Mixture of propane and butane are known as LPG gas which is used for domestic cooking purpose.
- GASOLINE is a complex mixture of many hydrocarbons used as a fuel for internal-combustion engines.

6. What is Baeyer's reagent? How is it used to prepare glycol?

- Cold dilute alkaline $KMnO_4$ solution is known as Baeyer's Reagent
- Alkenes react with Baeyer's reagent to form vicinal diols. The purple solution (Mn^{2+}) becomes dark green (Mn^{6+}), and then produces a dark brown precipitate (Mn^{4+}).

$$CH_2 = CH_2 + H_2O \xrightarrow[[o]\ Cold\ dil.KMnO_4/273K]{} HO - CH_2 - CH_2 - OH + MnO_2$$

7. **Mention the uses of alkenes**.

- Alkenes find many diverse applications in industry.
- They are used as starting materials in the synthesis of alcohols, plastics, liquors, detergents and fuels
- Ethene is the most important organic feed stock in the polymer industry. E.g. PVC, Sarans and polyethylene.
- These polymer are used in the manufacture of floor tiles, shoe soles, synthetic fibres, raincoats, pipes etc.,

8. What is polymerization? Give an example.

- A polymer is a large molecule formed by the combination of larger number of small molecules. The process in known as polymerisation. Alkenes undergo polymerisation at high temperature and pressure, in the presence of a catalyst.

$$n\ CH_2{=}CH_2 \xrightarrow[873\ K]{\text{red hot Iron tube}} \left(\sim CH_2\text{-}CH_2 \sim\right)_n$$

ethene — poly ethylene or polythene

9. **Mention the uses of Alkynes.**

- Acetylene is used in oxy acetylene torch used for welding and cutting metals.
- It is used for manufacture of PVC, polyvinyl acetate, polyvinyl ether, orlon and neoprene rubbers.

10. **Define aromaticity.**
    - Huckel proposed that aromaticity is a function of electronic structure. A compound may be aromatic, if it obeys the following rules
    - The molecule must be co-planar
    - Complete delocalization of π electron in the ring
    - Presence of (4n+2) π electrons in the ring where n is an integer (n=0,1,2….)
    - This is known as Huckel's rule.

11. **Explain Wurts fittig reaction.**
    - When a solution of bromo benzene and iodo methane in dry ether is treated with metallic sodium, toluene is formed.

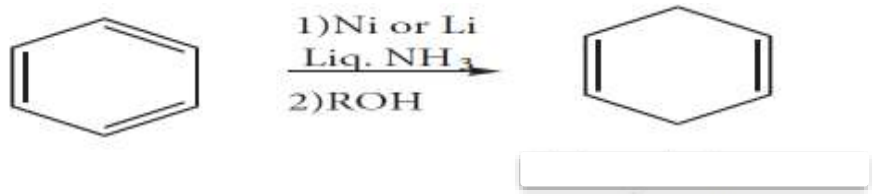
$$C_6H_5\text{-}Br + 2Na + CH_3\text{-}I \rightarrow C_6H_5\text{-}CH_3 + NaBr + NaI$$

12. **Explain Friedel Craft's reaction.**
    - When benzene is treated with methyl chloride in the presence of anhydrous aluminium chloride, toluene is formed.

$$C_6H_6 + CH_3Cl \xrightarrow[anhydrous\ AlCl_3]{} C_6H_5 - CH_3 + HCl$$

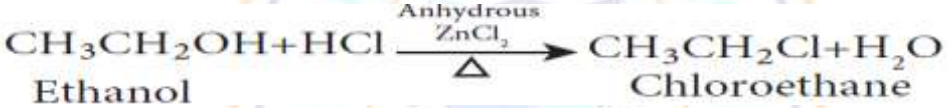
13. **What is Birch reduction?**

- Benzene can be reduced to 1, 4-cyclohexadiene by treatment with Na or Li in a mixture of liquid ammonia and alcohol. It is the convenient method to prepare cyclic dienes.



UNIT 14 HALOALKANES AND HALOARENES

14. **What is Lucas reagent? How do you convert alcohol into alkyl chloride?**
    - Mixture of con.HCl and anhydrous ZnCl2 is called **Lucas reagent.**
    - Alcohols can be converted into halo alkanes by reacting it with hydrogen halide



15. **What is Walden inversion?**
    - In S_N2 reaction, The attack of nucleophile occurs from the back side. The carbon at which substitution occurs has inverted configuration during the course of reaction just as an umbrella has tendency to invert in a wind storm. This inversion of configuration is called Walden inversion.

16. **State Saytzeff's rule.**
    - 'In a dehydrohalogenation reaction, the preferred product is that alkene which has more number of alkyl groups attached to the doubly bonded carbon.

17. **What is TEL? How is it prepared?**
    - Tetra ethyl lead is otherwise known as TEL.

- Haloalkane reacts with active metals like sodium, lead etc in the presence of dry ether to form organo metallic compounds.

$$4CH_3CH_2Br + 4Na/Pb \rightarrow (CH_3CH_2)_4Pb + 4NaBr + 3Pb$$

18. **Write notes on Williamson's ether synthesis.**

- Haloalkane, when boiled with sodium alkoxide gives corresponding ethers.

$$CH_3CH_2Br + NaOCH_2CH_3 \xrightarrow[\Delta]{} CH_3CH_2OCH_2CH_3 + NaBr$$

19. **What is Darzen's halogenation?**

- Alcohols can be converted into halo alkenes by reacting it with Thionyl chloride in the presence of pyridine.

$$CH_3CH_2OH + SOCl_2 \xrightarrow[Pyridine]{} CH_3CH_2Cl + SO_2 + HCl$$

20. **What is Fittig reaction?**

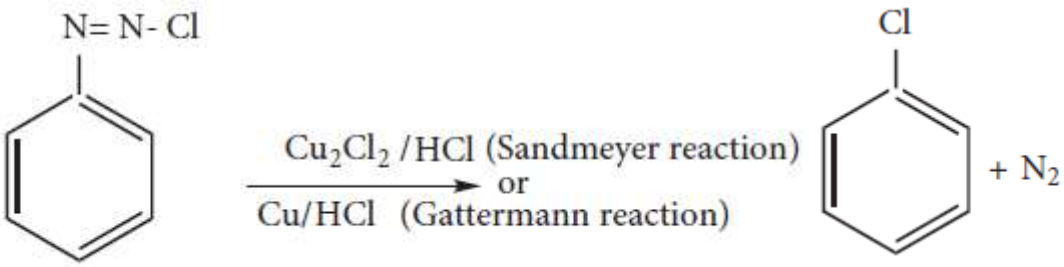
- Haloarenes react with sodium metal in dry ether, two aryl groups combine to give biaryl products. This reaction is called Fittig reaction

$$C_6H_5Cl + 2Na + ClC_6H_5 \xrightarrow[Ether]{\Delta} C_6H_5 - C_6H_5 + 2NaCl$$

Biphenyl

21. **What is Sandmeyer's reaction?**

- When aqueous solution of benzene diazonium chloride is warmed with Cu_2Cl_2 in HCl gives chloro benzene



22. **Explain Finkelstein's reaction.**

- Chloro or bromoalkane on heating with a concentrated solution of sodium iodide in dry acetone gives iodo alkanes. This reaction is called Finkelstein reaction, (S_N2 reaction).

$$CH_3CH_2Br + NaI \xrightarrow[\Delta/Acetone]{} CH_3CH_2I + NaBr$$

23. Write notes on Swarts reaction.

- Chloro or bromo alkanes on heating with metallic fluorides like AgF, SbF_3 or Hg_2F_2 gives fluoro alkanes. This reactions is called Swarts reaction.

$$CH_3CH_2Br + AgF \xrightarrow[\Delta]{} CH_3CH_2F + AgBr$$

24. **Explain Hunsdiecker reaction.**

- Silver salts of fatty acids when refluxed with bromine in CCl4 gives bromo alkane

$$CH_3CH_2COOAg + Br_2 \xrightarrow[reflux/CCl_4]{} CH_3CH_2Br + CO_2 + AgBr$$

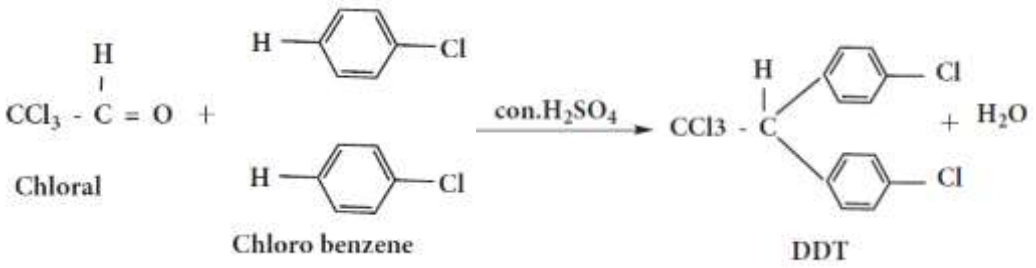
25. **What is Chloropicrin? How is it prepared? Mention its use.**

- Chloroform reacts with nitric acid to form chloropicrin.(Trichloro nitro methane)
- It used as an insecticide and soil sterilising agent.

$$CHCl_3 + HNO_3 \xrightarrow[\Delta]{} CCl_3NO_2 + H_2O$$

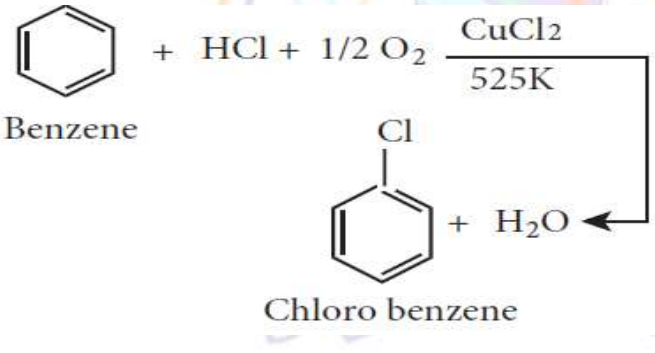
26. **What is DDT? How is it prepared? Mention its use.**

- p,p'-dichloro diphenyl trichloro ethane is otherwise known as DDT.
- DDT can be prepared by heating a mixture of chlorobenzene with chloral (Trichloro acetaldehyde) in the presence of con.H2SO4.
- DDT is used to control certain insects which carries diseases like malaria and yellow fever. It is used in farms to control some agricultural pests



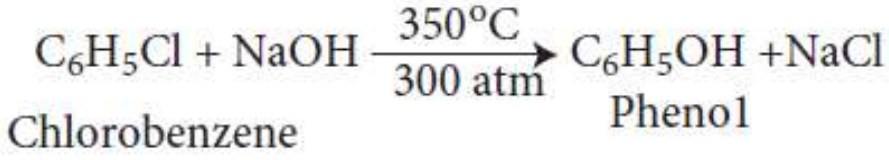
27. **Write short notes on Raschig process.**

- Chloro benzene is commercially prepared by passing a mixture of benzene vapour, air and HCl over heated cupric chloride .This reaction is called Raschig process.



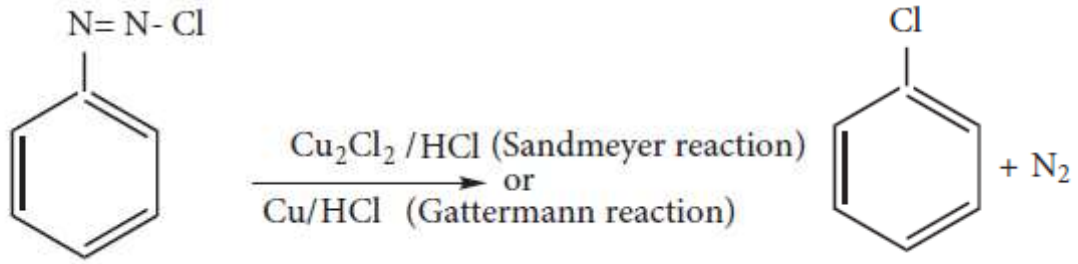
28. **Write notes on Dow's process.**

- The halogen of haloarenes can be substituted by OH– with appropriate nucleophilic reagents at high temperature and pressure.



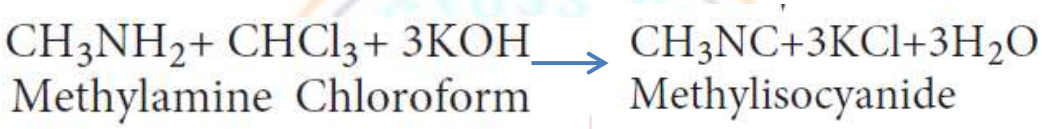
29. **Explain Gatterman reaction.**

- When aqueous solution of benzene diazonium chloride is warmed with Cu metal and HCl gives chloro benzene



30. **Explain Carbylamine reaction.**

- Chloroform reacts with aliphatic or aromatic primary amine and alcoholic caustic potash, to give foul smelling alkyl isocyanide (carbylamines)



31. **Explain Balz-Schiemann reaction.**

- Fluoro benzene is prepared by treating benzenediazonium chloride with fluoro boric acid. This reaction produces diazonium fluoroborate which on heating produces fluorobenzene. This reaction is called Balz – schiemann reaction.