XI TH HALF YEARLY EXAMINATION CHEMISTRY ANSWER KEY - 2024 DINDIGUL DISTRICT

****

PART -A

I. CHOOSE THE CORRECT ANSWER. (15 x 1 =15)

1. Which of the following is used as a standard for atomic mass?

a) $_6C^{12}$ b)$_7C^{12}$ c) $_6C^{13}$ d) $_6C^{14}$

2. For d-electron, the orbital angular momentum is

a)$\frac{\sqrt{2}\,h}{2\pi}$ b)$\frac{\sqrt{2h}}{2\pi}$ c) $\frac{\sqrt{2x4h}}{2\pi}$ d) $\frac{\sqrt{6}\,h}{2\pi}$

3. Which of the following elements will have the highest electronegativity?

a) Chlorine b) Nitrogen c) Cesium d) Fluorine

4. Intra molecular Hydrogen bonding is present in

a) Ortho-nitrophenol b) Ice c) Water d) Hydrogen fluoride

5. Sodium is stored in

a) Alcohol b) Water c) Kerosene d) none of these

6. Maximum deviation from ideal gas is expected from

a) CH_4 b) $NH_3(g)$ c) $H_2(g)$ d) $N_2(g)$

7. Change internal energy, when 4 KJ of work is done on the system and 1 KJ of heat is given out by the system is a) +1 KJ b)-5KJ c) +3KJ d) -3KJ

8. In a chemical equilibrium, the rate constant for the forward reaction is 2.5×10^2 and the equilibrium constant is 50. The rate constant for the reverse reaction is 8.

a) 11.5 b) 5 c) $2x10^2$ c) $2x10^3$

9. What is molality of a 10% w/w aqueous soidum hydroxide solution?

a) 2.778 b) 2.5 c) 10 d) 0.4

10. In the molecule $O_A{=}C{=}O_B$, the formal charge on O_A, C and O_B are respectively,

a)-1,0,+1 b) +1,0,-1 c) -2,0,+2 d) 0,0,0

11. The purity of an organic compound is determined by

a) Chromatography b) Crystalisation

c) melting or boiling point d) both (a) and (c)

12. The geometrical shape of carbocation is

a) Linear b) Tetrahedral d) Pyramidal

13. Which of the following compounds will not undergo Friedal-crafts reaction easily

a) Nitro benzene b) Toluene c) Cumene d) Xylene

14. Assertion: Increasing order of boiling points of halo alkanes are $CH_3Cl<CH_2Cl_2<CHCl_3<CCl_4$

Reason: The boiling point of halo alkanes increase with increase in the number of halogen atoms.

a) Assertion is true but reason is false.

b) Both assertion and reason are true and reason is the correct explanation of assertion.

c) Both assertion and reason are false,

d) Both assertion and reason are true and reason is not the correct explanation of assertion.

15. Match the List I with List II and select the correct answer using the code given below the lists.

List I		List II	
A	Depletion of ozonelayer	1	CO_2
B	Acid rain	2	NO
C	Photochemical smog	3	SO_2
D	Green house effect	4	CFC

Code:

	A	B	C	D
a	3	4	1	2
b	2	1	4	3
c	4	3	2	1
d	2	4	1	3

Ans: a)

PART-II

II ANSWER ANY 6 QUESTIONS (Q.NO:24 IS COMPULSORY).

16. Distinguish between Oxidation and Reduction.

Oxidation	Reduction
Addition of Oxygen	Removal of Oxygen
Removal of Hydrogen	Addition of Hydrogen
Removal of Electrons	Addition of Electrons
Oxidation number increase	Oxidation number decrease

17. How many orbitals are possible for n = 4?

n	l	m	Orbitals	Total orbitals
4	0	0	One s orbital	16
	1	-1 0 +1	Three p orbitals	
	2	-2 -1 0 +1 +2	Five d orbitals	
	3	-3 -2 -1 0 +1 +2 +3	Seven f orbitals	

18. Give the uses of heavy water.

- Moderators in Nuclear reactor.
- Coolant in nuclear reactors.
- Tracer element to study the mechanisms of organic reactions

19. Which is known as "desert rose"?

Gypsum crystals are sometimes found to occur in a form that resembles the petals of a flower. This type of formation is called as desert rose.

20. Define Reaction Quotient.

Reaction Quotient is defined as the ratio between the product of the active masses of the products and the reactants raised to a Stoichiometric coefficient under non equilibrium conditions.

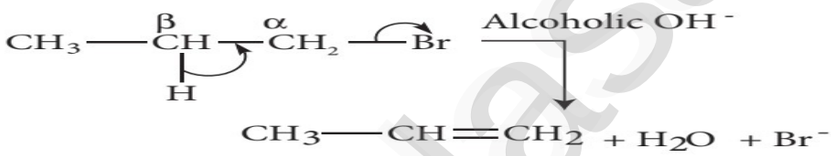
$$Q = \frac{[C]^l\,[D]^m}{[A]^x\,[B]^y}$$

21. What are the conditions when a solution tends to be behaved like an ideal solution?

- ❖ Heat is neither released nor absorbed during the reaction, ΔmixH=0
- ❖ The volume of the solution remains the same ΔmixV=0
- ❖ For an ideal solution, ΔH andΔV for mixing should be zero.
- ❖ PTotal=pA+pB and A-A, B-B and A-B interactions should be nearly the same.

22. Write β-elimination reaction.

- 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.
- Elimination reaction is always accompanied with change in hybridisation.
- Example: n-Propyl bromide on reaction with alcoholic KOH gives propene. In this reaction hydrogen and Br are eliminated

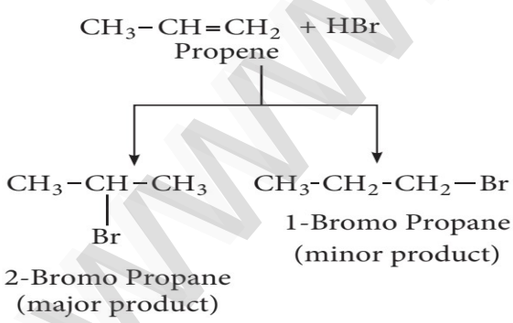


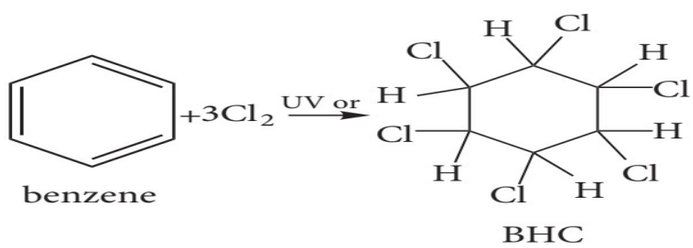
23. Prove cyclo propenyl cation is aromatic.

(i) cyclopropenyl cation has planar structure
(ii) It has 2 delocalised π electron.
(iii) 4n + 2 = 24n = 0n = 0 (an interger) and hence it is aromatic compound.

24. Complete the following reactions.

(i) $CH_3\text{-}CH{=}CH_2 + HBr$ ii) $C_6H_6 + Cl_2 \longrightarrow$





PART - III

III ANSWER ANY 6 QUESTIONS (Q.NO:33 IS COMPULSORY).

25. Write the limitations of Bohr's atom model.

- ❖ The Bohr's atom model is not applicable to multi electron atoms.

- ❖ It was unable to explain the splitting of spectral lines in the presence of magnetic field(Zeeman effect) or an electric field (Stark effect).
- ❖ Bohr's theory was unable to explain the angular momentum of the electron

26. How do you convert para hydrogen into ortho hydrogen?

- ❖ By passing electric discharge.
- ❖ By heating at 800^{0}C
- ❖ By mixing with atomic hydrogen
- ❖ By using catalyst like Fe, Pt
- ❖ By mixing with paramagnetic molecules like oxygen

27. Distinguish between diffusion and effusion.

Diffusion	Effusion
Diffusion is the spreading of molecules of a substance throughout a space or a second substance.	Effusion is the escape of gas molecules through a very small hole in a membrane into an evacuated area.
Diffusion refers to the ability of the gases to mix with each other.	Effusion is an ability of a gas to travel through a small pin-hole.
E.g. Perfume spreads throughout the room	Eg. Leaking of air from car tyre

28. What are State and Path functions? Give two examples.

A state function of a system, which has a specific value for a given state and does not depend on the path by which the particular state is reached.

Ex. Pressure (P), Volume (V), Temperature(T).

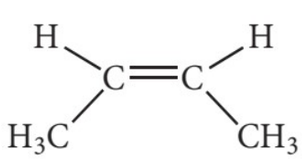
A path function of a system whose value depends on the path by which the system changes from its initial to final states. Ex. Work (w), Heat (q).

29. What is σ bond and π bond? Which is more stable?

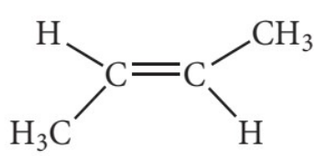
- ❖ When two atomic orbitals overlap along the axis linearly it forms Sigma bond (σ).
- ❖ When two atomic orbitals overlap Sideways it forms Pi - bond (π).
- ❖ σ bond strong. It is formed due to linear overlapping.

30. Explain geometrical isomerism in 2 - butene.

- ❖ The cis isomer is one in which two similar groups are on the same side of the double bond.
- ❖ The trans isomers is that in which the two similar groups are on the opposite side of the double bond.



cis - 2-butene



Trans 2-butene

31. What are Freons? Write their uses.

The chloro, fluro derivatives of methane and ethane are called Freons.

Uses :

- Freons are used as a refrigerants in refrigerators.
- It is used as a propellant for aerosols and foams.
- It is used as propellant for foams to spray out deodorants and insecticides.

32. Differentiate :- BOD and COD.

Biochemical Oxygen Demand (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.

Chemical oxygen demand (COD):

The amount of oxygen required by the organic matter in a sample of water for its oxidation by a strong oxidizing agent like $K_2Cr_2O_7$ in acid medium for a period of 2 hrs.

33. An organic compound (A) of molecular formula C_2H_2O, on heating with conc. H_2SO_4 gives compound (B). (B) on treating with cold dilute alkaline $KMnO_4$, gives compound (C). Identify (A), (B) and (C).

i) $C_2H_5OH \xrightarrow[430\text{-}440K]{\text{Conc. } H_2SO_4} CH_2{=}CH_2$

ethanol — ethene

ii) $CH_2{=}CH_2 + H_2O \xrightarrow[273\ K]{[O]\ \text{Cold dil. } KMnO_4} CH_2(OH)\text{-}CH_2(OH) + MnO_2 \downarrow$

ethane-1,2-diol — dark brown

COMPOUND	IUPAC NAME	FORMULA
A	ETHANOL	C_2H_5OH
B	ETHENE	$CH_2{=}CH_2$
C	ETHAN-1,2 -DIOL	$HO\text{-}CH_2\text{-}CH_2\text{-}OH$

PART-IV

V ANSWER ALL THE QUESTIONS.

34. a) (i) Explain briefly the time independent schrodinger wave equation? (3)

The time independent Schrodinger equation can be expressed as

$\hat{H}\Psi = E\Psi$ .....(1)

Where $\hat{H}$ is called Hamiltonian operator, Ψ is the wave function and E is the energy of the system.

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

Since Ψ is a function of position coordinates of the particle and is denoted by Ψ (x, y, z)

∴ Equation (1) can be written as,

$$\left[\frac{-h^2}{8\pi^2 m}\left(\frac{\partial^2\psi}{\partial x^2}+\frac{\partial^2\psi}{\partial y^2}+\frac{\partial^2\psi}{\partial z^2}\right)+V\psi\right] = E\psi \quad \text{---3}$$

Multiply the equation (3) by $\hat{H}$ and rearranging

$$\frac{\partial^2\psi}{\partial x^2}+\frac{\partial^2\psi}{\partial y^2}+\frac{\partial^2\psi}{\partial z^2}+\frac{8\pi^2 m}{h^2}(E-V)\psi = 0 \quad \text{---4}$$

The above equation (4) Schrodinger wave equation does not contain time as a variable and is referred to as time-independent Schrodinger wave equation.

(ii) Write the electronic configuration of Mn^{2+} and Cr^{3+} (2)

- Mn (z = 25). Electronic configuration of $Mn^{2+} = 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^0\ 3d^5$.
- Cr (z =24) Electronic configuration of $Cr^{3+} = 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^0\ 3d^3$.

(OR)

b) Calculate the empirical and molecular formula of a Compound containing 76.6% carbon, 6.38% hydrogen and rest oxygen. Its vapour density is 47. (5)

Element	Percentage	Atomic mass	Relative number of atoms	Simple ratio	Whole no.
C	76.6	12	$\frac{76.6}{12} = 6.38$	$\frac{6.38}{1.06} = 6$	6
H	6.38	1	$\frac{6.38}{1} = 6.38$	$\frac{6.38}{1.06} = 6$	6
O	17.02	16	$\frac{17.02}{16} = 1.06$	$\frac{1.06}{1.06} = 1$	1

Empirical formula = C_6H_6O

Vapour density 47

∴ Molecular mass = 2 x vapor density = 2 x 47 = 94

Molecular formula Empirical formula x n

Molecular mass x n

n = Molecular mass/Empirical formula mass = 94/94 = 1

∴ Molecular formula = C_6H_6O

35. a) (i) Write down the Born - Haber cycle for the fomation $CaCl_2$.

Born – Haber cycle for the formation of $CaCl_2$

$Ca_{(S)} + Cl_{2(l)} \rightarrow CaC_{2(S)}\ \ \Delta H_f°$

Sublimation : $Ca_{(S)} \rightarrow Ca_{(S)}\ \ \Delta H_1°$

Ionization : $Ca_{(g)} \rightarrow Ca^{2+}_{(g)} + 2e^- = \Delta H_2°$

Vapourisation : $Cl_{2(l)} \rightarrow Cl_{2(g)} = \Delta H_3°$

Dissociation : $Cl_{2(g)} \rightarrow 2Cl_{(g)} = \Delta H_4°$

Electron affinity : $2Cl_{2(g)} + 2e^- \rightarrow 2Cl^{-2(g)}{}_{(g)} = \Delta H_5°$

Lattice enthalpy : $Ca^{2+}_{(g)} + 2Cl^-_{(g)} \rightarrow CaCl_{2(S)} = \Delta H_6°$

$\Delta H_f° = \Delta H_1° + \Delta H_2° + \Delta H_3° + \Delta H_4° + \Delta H_5° + \Delta H_6°$

(ii) State the third law of themodynamics.

It states that the entropy of pure crystalline substance at absolute zero is zero.

(OR)

b) Derive the value of critical constants in terms of Vander Waals Constants?

The van der Waals equation for n moles is

$$\left(P + \frac{a\,n^2}{V^2}\right)(V - nb) = nRT \quad \text{---------- (6.22)}$$

For 1 mole

$$\left(P + \frac{a}{V^2}\right)(V - b) = RT \quad \text{---------- (6.23)}$$

From the equation we can derive the values of critical constants P_c, V_c and T_c in terms of a and b, the van der Waals constants, On expanding the above equation

$$PV + \frac{a}{V} - Pb - \frac{ab}{V^2} - RT = 0 \text{ ------- (6.24)}$$

Multiply equation (6.24) by V^2 / P

$$\frac{V^2}{P}\left(PV + \frac{a}{V} - Pb - \frac{ab}{V^2} - RT\right) = 0$$

$$V^3 + \frac{aV}{P} + -bV^2 - \frac{ab}{P} - \frac{RTV^2}{P} = 0 \text{ --- (6.25)}$$

When the above equation is rearranged in powers of V

$$V^3 - \left[\frac{RT}{P} + b\right]V^2 + \left[\frac{a}{P}\right]V - \left[\frac{ab}{P}\right] = 0 \text{ --- (6.26)}$$

The equation (6.26) is a cubic equation in V. On solving this equation, we will get three solutions. At the critical point all these three solutions of V are equal to the critical volume V_C. The pressure and temperature becomes P_c and T_c respectively

i.e., $V = V_C$

$$V - V_C = 0$$

$$(V - V_C)^3 = 0$$

$$V^3 - 3V_C V^2 + 3V_C{}^2 V - V_C{}^3 = 0 \quad \text{---- (6.27)}$$

As equation (6.26) is identical with equation (6.27), we can equate the coefficients of V^2, V and constant terms in (6.26) and (6.27).

$$-3V_C V^2 = -\left[\frac{RT_C}{P_C} + b\right]V^2$$

$$3V_C = \frac{RT_C}{P_C} + b \quad \text{---- (6.28)}$$

$$3V_C^2 = \frac{a}{P_C} \quad \text{---- (6.29)}$$

$$V_C^3 = \frac{ab}{P_C} \quad \text{---- (6.30)}$$

Divide equation (6.30) by equation (6.29)

$$\frac{V_C^3}{3V_C^2} = \frac{ab / P_C}{a / P_C}$$

$$\frac{V_C}{3} = b$$

i.e. $V_C = 3b$ ------- (6.31)

when equation (6.31) is substituted in (6.29)

$$3V_C^2 = \frac{a}{P_C}$$

$$P_C = \frac{a}{3V_C^2} = \frac{a}{3(3b^2)} = \frac{a}{3 \times 9b^2} = \frac{a}{27\,b^2}$$

$$P_C = \frac{a}{27b^2} \quad \text{------ (6.32)}$$

substituting the values of V_c and P_c in equation (6.28),

$$3V_C = b + \frac{R\,T_C}{P}$$

$$3\,(3\,b) = b + \frac{R\,T_C}{\left(a / 27\,b^2\right)}$$

$$9\,b - b = \left(\frac{R\,T_C}{a}\right) 27\,b^2$$

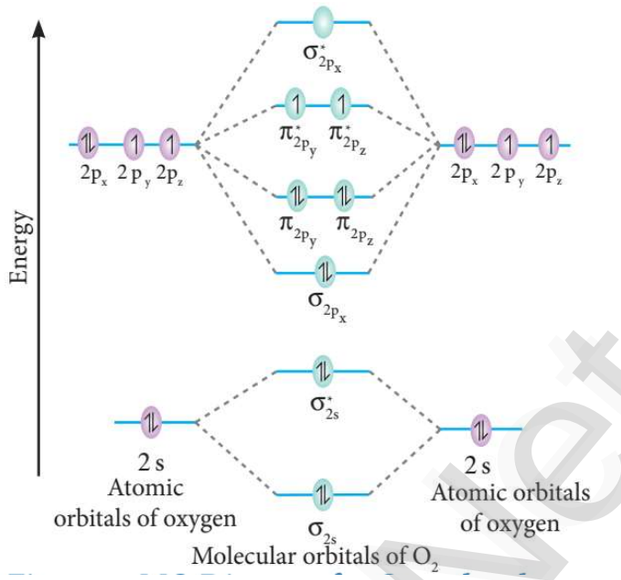
$$8\,b = \frac{T_C\,R\,27b^2}{a}$$

$$\therefore \quad T_C = \frac{8\,a\,b}{27\,R\,b^2} = \frac{8\,a}{27\,R\,b}$$

$$T_C = \frac{8\,a}{27\,R\,b} \quad \text{------ (6.33)}$$

The critical constants can be calculated using the values of van der waals constant of a gas and vice versa.

36. a) Draw the M.O diagram for oxygen molecule. Calculate its bond order and show that O_2, is paramagnetic.



Electronic configuration of O atom:

$1s^2\ 2s^2\ 2p^4$

Electronic configuration of O_2 molecule:

$\sigma_{1s}^2, \sigma_{1s}^{*2}, \sigma_{2s}^2, \sigma_{2s}^{*2}, \sigma_{2px}^2,$

$\pi_{2py}^2\ \pi_{2pz}^2\ \pi_{2py}^{*1}\ \pi_{2pz}^{*1}$

Bond order = Nb−Na/2

= 10−6/2 = 2

Molecule has two unpaired electrons hence it is paramagnetic.

(OR)

b) (i) Derive the relation between Kp and Kc.

Let us consider the general reaction in which all reactants and products are ideal gases.

$xA + yB \rightleftharpoons lC + mD$

The equilibrium constant, Kc is $K_c = \frac{[C]^l[D]^m}{[A]^x[B]^y}$ (1) and K p is, $K_p = \frac{p_C^l \times p_D^m}{p_A^x \times p_B^y}$ (2)

The ideal gas equation is PV = nRT or P= n V/RT

Since Active mass = molar concentration = n/V

P = active mass × (RT)

Based on the above expression the partial pressure of the reactants and products can be expressed as,

$$p_A^x = [A]^x (RT)^x \quad p_B^y = [B]^y (RT)^y \quad p_C^l = [C]^l (RT)^l \quad p_D^m = [D]^m (RT)^m$$

On substitution in Eqn. 2

$$K_p = \frac{[C]^l [RT]^l [D]^m (RT)^m}{[A]^x [RT]^x [B]^y (RT)^y} \quad (3)$$

$$K_p = \frac{[C]^l [D]^m (RT)^{l+m}}{[A]^x [B]^y (RT)^{x+y}}$$

$$K_p = \frac{[C]^l [D]^m}{[A]^x [B]^y} (RT)^{(l+m)-(x+y)} \quad (4)$$

By comparing equation (1) and (4), we get $K_p = K_c (RT)^{\Delta n_g}$ (5)

where, Δn g is the difference between the sum of number of moles of products and the sum of number of moles of reactants in the gas phase.

(ii) State Le-Chatlier principle.

"If a system at equilibrium is distributed, then the system shifts itself in a direction that nullifies the effect of that disturbance".

37. a) Derive the structure of Benzene.

- Elemental Analysis and molecular weight determination have proved that the molecular formula of benzene is C_6H_6 and it is highly unsaturated compound.
- Benzene did not react with water in the presence of acid. so straight chain or ring compound is not possible.

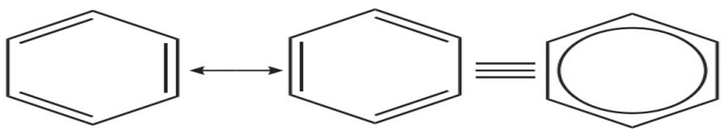
- Benzene reacts with bromine in the presence of $AlCl_3$ to form mono bromo benzene. show that all the six carbon atoms are identical with a cyclic structure.

$$C_6H_6 + 3Br_2 \xrightarrow{AlCl_3} \underset{\text{bromobenzene}}{C_6H_5Br} + HBr$$

- Benzene react three moles of hydrogen in the presence of nickel catalyst to give cyclohexane. This confirms cyclic structure of benzene and the presence of three carbon-carbon double bond

$$C_6H_6 + 3H_2 \xrightarrow{\text{Raney Ni}} \underset{\text{cyclohexane}}{C_6H_{12}}$$

- Resonance description of benzene



- Spectroscopic measurements show that benzene is planar and all of its carbon-carbon bonds are of equal length 1.40A°.
- All the six carbon atoms of benzene are sp2 hybridized.
- All the σ bonds in benzene lie in one plane with bond angle 120°.

(OR)

b) (i) What are electrophiles and nucleophiles? Give suitable examples for each.

Nucleophiles	Electrophiles
Negatively charged ions	Positive charged ions
They are electron rich	They are electron deficient
Donates a pair of electron	Accept a pair of electron
Lewis bases	Lewis acids
NH_3	BF_3

(ii) Define Retention factor (Rf).

$$R_f = \frac{\text{Distance moved by the substance from base line (x)}}{\text{Distance moved by the solvent from base line (y)}}$$

38. a) (i)Give the IUPAC names of the following compounds.

(i) CH_3-CH_2-CH(OH)-CHO Ans: 2-hydroxypropanal.

(ii) CH_3-C≡ C-CH(Cl)-CH_3 Ans: 4 – chloropent – 2 – yne

(ii) Explain the importance of green chemistry in day-to-day life.

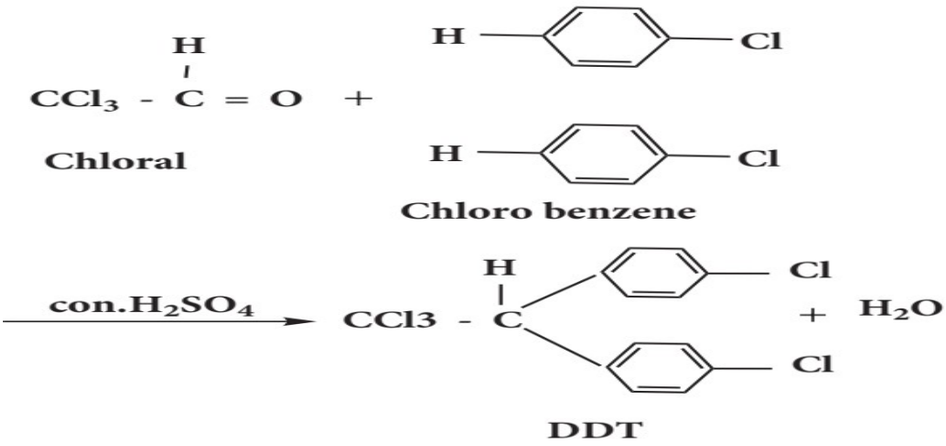
- Bleaching of paper: Conventional method of bleaching was done with chlorine. Now a days H_2O_2can be used for bleaching paper in presence of catalyst.
- Instead of petrol, methanol is used as a fuel in automobiles.

- Neem based pesticides have been synthesised, which are safer than the chlorinated hydrocarbons.

(OR)

b) (i) Explain the preparation of the following compounds.

(i) DDT



(ii) Biphenyl

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

Chlorobenzene — Biphenyl

(iii) Chloropicrin

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

Chloroform — Chloropicrin

(ii) What is Eutrophication?

- Eutrophication is a process by which water bodies receive excess nutrients that stimulates excessive plant growth.
- The growth of algae reduces the oxygen concentration in water and prevent the growth of other living organisms in water body.
- It's results in loss of biodiversity is known as Eutrophication.

PREPARED BY
D.VIGNESH
9042939811