11th STD.

INSTANT SUPPLEMENTARY EXAM - JULY 2023

Part - III
CHEMISTRY
(With Answers)

Time Allowed : 3.00 Hours] [Maximum Marks : 70

Instructions : (1) Check the question paper for fairness of printing. If there is any lack of fairness, inform the Hall Supervisor immediately.

(2) Use **Blue** or **Black** ink to write and underline and pencil to draw diagrams.

Note : Draw diagrams and write equations wherever necessary.

Part - I

Note : (i) Answer **all** the questions. **(15 × 1 = 15)**

(ii) Choose the most appropriate answer from the given **four** alternatives and write the option code and the corresponding answer.

1. The number of water molecules in a drop of water weighing 0.018 g is :

a) 6.022×10^{26} b) 6.022×10^{23}
c) 6.022×10^{20} d) 9.9×10^{22}

2. Two electrons occupying the same orbital are distinguished by:

a) Azimuthal quantum number
b) Spin quantum number
c) Magnetic quantum number
d) Principal quantum number

3. Which of the following pairs of elements exhibit diagonal relationship?

a) Be and Mg
b) Li and Be
c) Be and B
d) Be and Al

4. The cause of permanent hardness of water is due to:

a) $Ca(HCO_3)_2$ b) $Mg(HCO_3)_2$
c) $CaCl_2$ d) $MgCO_3$

5. Match the flame colours of the alkali and alkaline earth metal salts in the bunsen burner.

1) Sodium	(i) Blue
2) Caesium	(ii) Apple green
3) Calcium	(iii) Yellow
4) Barium	(iv) Brick red

a) (1)-(iii), (2)-(iv), (3)-(i), (4)-(ii)
b) (1)-(i), (2)-(ii), (3)-(iv), (4)-(iii)
c) (1)-(iii), (2)-(i), (3)-(iv), (4)-(ii)
d) (1)-(ii), (2)-(i), (3)-(iv), (4)-(iii)

6. The value of the gas constant R is :

a) 0.082 dm^3 atm b) 0.987 Cal mol^{-1} K^{-1}
c) 8.3 J mol^{-1} K^{-1} d) 8 erg mol^{-1} K^{-1}

7. The temperature of the system decreases in an ________.

a) Isothermal expansion
b) Isothermal compression
c) Adiabatic expansion
d) Adiabatic compression

8. $\frac{K_C}{K_p}$ for the reaction $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$ is:

a) $\frac{1}{RT}$ b) $\sqrt{RT}$
c) RT d) $(RT)^2$

9. Normality of 1.25 M Sulphuric acid is:

a) 1.25 N b) 3.75 N c) 2.5 N d) 2.25 N

10. According to Valence bond theory a bond between two atoms is formed when :

a) fully filled atomic orbitals overlap
b) half filled atomic orbitals overlap
c) non-bonding atomic orbitals overlap
d) empty atomic orbitals overlap

11. In an organic compound, phosphorus is estimated as:
   a) $Mg_2P_2O_7$ b) $Mg_3(PO_4)_2$
   c) H_3PO_4 d) P_2O_5

12. Homolytic fission of covalent bond leads to the formation of :
   a) Electrophile b) Nucleophile
   c) Carbo cation d) Free radical

13. The compounds formed at anode in the electrolysis of an aqueous solution of potassium acetate are:
   a) CH_4 and H_2 b) CH_4 and CO_2
   c) C_2H_6 and CO_2 d) C_2H_4 and Cl_2

14. The name of $C_2F_4Cl_2$ is ___________.
   a) Freon – 112 b) Freon – 113
   c) Freon – 114 d) Freon – 115

15. Bhopal Gas Tragedy is a case of _____________.
   a) Thermal Pollution b) Air Pollution
   c) Nuclear Pollution d) Soil Pollution

Part - II

Note : Answer **any six** questions. Question No. **24** is **Compulsory.** **(6 × 2 = 12)**

16. What do you understand by the term mole?
17. Define Orbital.
18. How is Tritium prepared?
19. Explain intensive properties with two examples.
20. Distinguish between diffusion and effusion.
21. Write K_p and K_c for the reaction

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

22. Give the IUPAC name of the following compounds.
   (i) $CH_2 = CH - CH = CH_2$
   (ii) $CH_3 - C \equiv C - CH - CH_3$ (with Cl attached to the CH carbon)

23. What happens when acetyl chloride is treated with excess of CH_3MgI?
24. Complete the following :

   $$CH_3CH_2OH \xrightarrow[430 - 440K]{Conc.\ H_2SO_4} A \xrightarrow[Benzoyl\ Peroxide]{HBr} B$$

Part - III

Note : Answer **any six** questions. Question No.**33** is **Compulsory.** **(6 × 3 = 18)**

25. Explain the fact that the second ionisation potential is always higher than first ionisation potential?
26. What are the uses of heavy water?
27. Give any three similarities between Beryllium and Aluminium.
28. Mention the three methods used for liquefaction of gases.
29. Define Molality.
30. State Fajan's rule.
31. Which is considered to be earth's protective umbrella? Why?
32. How the aromatic character of a compound can be decided by Huckel's rule?
33. Define:
   (i) Sigma bond (ii) Pi bond

Part - IV

Note : Answer all the questions. **(5 × 5 = 25)**

34. (a) Write short note on :
   (i) Magnetic Quantum Number
   (ii) Azimuthal Quantum Number

   (OR)

   (b) Calculate the effective nuclear charge on 4s electron and 3d electron in Scandium.

35. (a) (i) What is water-gas shift reaction?
   (ii) Write the uses of sodium bicarbonate.

   (OR)

   (b) (i) State Joule-Thomson effect.
   (ii) A sample of gas at 15°C at 1 atm. has a volume of 2.58 dm^3. When the temperature is raised to 38°C at 1 atm, does the volume of the gas increase? If so, calculate the final Volume.

36. (a) Derive the relation between ΔH and ΔU for an ideal gas. Explain each term involved in the equation.

   (OR)

   (b) (i) What is reaction quotient (Q)?
   (ii) Write the four colligative properties.

37. (a) Discuss the formation of N_2 molecule using MO Theory.

(OR)

(b) Describe the classification of organic compounds based on their structure.

38. (a) Complete the reaction.

(i) $Cac_2 \xrightarrow{H_2O}$

(ii) How is DDT prepared?

(OR)

(b) (i) Differentiate BOD and COD.

(ii) What is green chemistry?

ANSWERS

Part - I

1. c) 6.022×10^{20}
2. b) Spin quantum number
3. d) Be and Al
4. c) $CaCl_2$
5. c) (1)-(iii), (2)-(i), (3)-(iv), (4)-(ii)
6. c) 8.3 J mol^{-1} K^{-1}
7. c) Adiabatic expansion
8. d) $(RT)^2$
9. c) 2.5 N
10. b) half filled atomic orbitals overlap
11. a) $Mg_2P_2O_7$
12. d) Free radical
13. c) C_2H_6 and CO_2
14. c) Freon – 114
15. b) Air pollution

Part - II

16. The mole is defined as the amount of a substance which contains 6.022×10^{23} particles such as atoms, molecules or ions. It is denoted by the symbol "*n*".

17. Orbital is a three dimensional space where the probability of finding the electron is maximum.

18. (i) By bombarding lithium with slow neutrons.

(ii) $_3Li^6 + {}_0n^1 \longrightarrow {}_1T^3 + {}_2He^4$

19. (i) The property that is independent of the mass or the size of the system is called an intensive property.

(ii) **Examples:** Refractive index, Surface tension, density, temperature, Boiling point, Freezing point, molar volume, etc.,

20.

Diffusion	Effusion
Diffusion is the spreading of molecules of a substance throughout a space or a second substance.	Effusion is 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 the ability of a gas to travel through a small pin-hole.
Eg. Spreading of something such as brown tea liquid spreading through the water in a tea cup	**Eg.** Pouring out something like the soap studs bubbling out from a bucket of water.

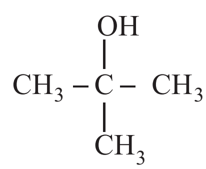
21. $K_c = \dfrac{[CO_2]}{[CO]^2}$ and $K_p = \dfrac{P_{CO_2}}{P^2_{CO}}$

22. (i) buta-1,3-diene

(ii) 4-chloropent-2-yne.

23. When acetyl chloride is treated with excess of CH_3MgI, tertiary alcohols are formed.

$CH_3COCl + CH_3MgI(excess) \longrightarrow$



t-Butyl alcohol

24. A) $CH_2{=}CH_2$ (ethene)

B) $CH_3 - CH_2 - CH_2 - Br$

1-bromipropane

Part - III

25. The minimum amount of energy required to remove a unipositive cation is called second ionization energy. It is represented by the following equation,

$$M^{+}_{(g)} + IE_2 - M^{2+}_{(g)} + 1e,$$

The total number of electrons is less in the cation 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. Thus, the successive ionization energies, always increase in the following order $I.E_1 < I.E_2$. Hence, the second ionization potential is always higher than the first ionization potential.

26. (i) Heavy water is used as moderator in nuclear reactors as it can lower the energies of fast moving neutrons.

(ii) D_2O is commonly used as a tracer to study organic reaction mechanisms and mechanisms of metabolic reactions.

(iii) It is also used as a coolant in nuclear reactors as it absorbs the heart generated.

A	Deuterium	D_2
B	Heavy water	D_2O
C	Propane	C_3H_6
D	Deuteron propane	C_3D_6

27. (i) Beryllium chloride forms a dimeric structure like aluminium chloride with chloride bridges.

(ii) Beryllium hydroxide dissolves in excess of alkali and gives beryllate ion $[Be(OH)_4]^{2-}$ as aluminium hydroxide which gives aluminate ion, $[Al(OH)_4]^-$.

(iii) Beryllium and aluminum ions have strong tendency to form complexes, BeF_4^{2-}, AlF_6^{3-}.

28. (i) **Linde's method :** Joule-Thomson effect is used to get liquid air or any other gas.

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

(iii) **Adiabatic process :** This method of cooling is produced by removing the magnetic property of magnetic material eg. Gadolinium sulphate. By this method, a temperature of 10^{-4} K i.e. as low as Zero Kelvin can be achieved.

29. Molality is defined as the number of moles of the solute per kilogram of the solvent.

$$\text{Molality} = \frac{\text{No. of moles of solute}}{\text{Mass of the solvent (in kg)}}$$

30. **Fajan's rule :**

(i) To show greater covalent character, both the cation and anion should have high charge on them. Higher the positive charge on the cation, greater will be the attraction on the electron cloud of the anion. Similarly higher the magnitude of negative charge on the anion, greater is its polarisability. Hence, the increase in charge on cation or in anion increases the covalent character

Let us consider three ionic compounds aluminum chloride, magnesium chloride and sodium chloride. Since the charge of the cation increase in the order $Na^+ < Mg^{2+} < Al^{3+}$, the covalent character also follows the same order $NaCl < MgCl_2 < AlCl_3$.

(ii) The smaller cation and larger anion show greater covalent character due to the greater extent of polarisation.

Lithium chloride is more covalent than sodium chloride. e size of Li^+ is smaller than Na^+ and hence the polarising power of Li^+ is more. Lithium iodide is more covalent than lithium chloride as the size of I^- is larger than the Cl^-. Hence I^- will be more polarised than Cl^- by the cation, Li^+.

(iii) Cations having $ns^2\ np^6\ nd^{10}$ configuration show greater polarising power than the cations with $ns^2\ np^6$ configuration. Hence, they show greater covalent character.

CuCl is more covalent than NaCl. Compared to Na^+ (1.13 Å). Cu^+ (0.6 Å) is small and have $3s^2\ 3p^6\ 3d^{10}$ conguration.

Electronic conguration of Cu^+ [Ar] $3d^{10}$

Electronic Conguration of Na^+ [He] $2s^2$, p^6

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

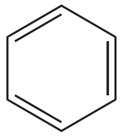
32. A compound may be aromatic, if it obeys Huckel rule

(i) The molecule must be co-planar

(ii) Complete delocalization of π electron in the ring

(iii) Presence of (4n+2) π electrons in the ring where n is an integer (n = 0,1,2….)

Eg :



Benzene

(i) The benzene is a planar molecule

(ii) It has six deloclaised π electrons

(iii) 4n + 2 =6

4n = 6 – 2

4n = 4

n = 1

it obeys Huckel's (4n+2) π electron rule with n = 1 hence, benzene is aromatic.

33. (i) **Sigma bond** : A bond formed due to the overlapping of orbitals along the internuclear axis is called sigma bond. It is stronger than pi bond.

(ii) **Pi bond** : A bond formed by the sidewise overlapping of p orbitals is called pi bond. It is weaker than sigma bond.

Part - IV

34. (a)

(i) **Magnetic Quantum Number (m_l):**

1. It is denoted by the letter 'm_l'. It takes integral values ranging from -*l* to +*l* through 0. i.e. if *l* =1; m = –1, 0 and +1
2. Different values of m for a given l value, represent different orientation of orbitals in space.
3. The Zeeman Effect (the splitting of spectral lines in a magnetic field) provides the experimental justification for this quantum number.
4. The magnitude of the angular momentum is determined by the quantum number *l* while its direction is given by magnetic quantum number.

(ii) **Azimuthal Quantum Number :**

1. It is represented by the letter '*l*', and can take integral values from zero to n-1, where n is the principal quantum number
2. Each *l* value represents a subshell (orbital). *l* = 0, 1, 2, 3 and 4 represents the s, p, d, f and g orbitals respectively.
3. The maximum number of electrons that can be accommodated in a given subshell (orbital) is 2(2*l*+1).
4. It is used to calculate the orbital angular momentum using the expression

$$Angular\ momentum = \sqrt{l(l+1)}\,\frac{h}{2\pi}$$

(OR)

(b)

The electronic configuration of scandium is $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2, 3d^1$. we can rearrange as below.

$\underbrace{(1s)^2}_{(n-3)}\ \underbrace{(2s,2p)^8}_{(n-2)}\ \underbrace{(3s,3p)^8(3d)^1}_{(n-1)}\ \underbrace{(4s)^2}_{n}$

Group	number of electron in the group	contribution of each electron to 'S' value	contribution of a particular group to electrons to 'S' value
(n)	1	0.35	0.35
(n–1)	9	0.85	7.65
(n–2) & others	10	1	10.00
S value			18.00

Z_{eff} = Z – S i.e.= 21– 18 ∴ Z_{eff} = 3

Calculation of effective nuclear charge on 3d electron

$\underbrace{(1s)^2}_{(n-3)}\ \underbrace{(2s,2p)^8}_{(n-2)}\ \underbrace{(3s,3p)^8(3d)^1}_{(n-1)}\ \underbrace{(4s)^2}_{n}$

Group	number of electron in the group	contribution of each electron to 'S' value	contribution of a particular group to electrons to 'S' value
n	0	0.35	0
(n–1) & others	18	1	18
S value			18

∴ Z_{eff} = Z – S i.e. =21 – 18 ∴ Z_{eff} = 3

35. (a)

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

$$CO + H_2O \longrightarrow CO_2 + H_2\uparrow$$

(ii) **Uses of Sodium bicarbonate :**

1. Sodium hydrogen carbonate is used as an ingredient in baking.
2. It is a mild antiseptic for skin infections.
3. It is also used in fire extinguishers.

(OR)

(b)

(i) **Joule Thomson Effect :** The liquefication methods are based on the Joule-Thomson effect. He observed appreciable cooling when the compressed gas is forced through an orifice plug into a low-pressure region. This 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. This effect is observed only below a certain temperature, which is a characteristic one for each gas. This value is given using van der waals constants a and b.

$$T_i = \frac{2a}{Rb}$$

(ii) $T_1 = 15° C + 273$; $T_2 = 38 + 273$

$T_1 = 288$ K $\quad T_2 = 311$ K

$V_1 = 2.58 \text{ dm}^3 \quad V_2 = ? \quad$ (P = 1 atm constant)

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

$$V_2 = \left(\frac{V_1}{T_1}\right) \times T_2 = \frac{2.58 \text{ dm}^3}{288 \text{ K}} \times 311 \text{ K}$$

$V_2 = 2.78 \text{ dm}^3$ i.e. volume increased from 2.58 dm^3 to 2.78 dm^3.

36.

(a) When the system at constant pressure undergoes changes from an initial state with H_1, U_1 and V_1 to a final state with H_2, U_2 and V_2 the change in enthalpy ΔH, can be calculated as follows:

$$H = U + PV$$

In the initial state

$$H_1 = U_1 + PV_1 \quad ......(1)$$

In the final state

$$H_2 = U_2 + PV_2 \quad ......(2)$$

change in enthalpy is (2) – (1)

$$(H_2 - H_1) = (U_2 - U_1) + P(V_2 - V_1)$$

$$\Delta H = \Delta U + P\Delta V \quad ......(3)$$

As per first law of thermodynamics,

$$\Delta U = q + w$$

Equation (3) becomes

$$\Delta H = q + w + P\Delta V$$

$$w = -P\Delta V$$

$$\Delta H = qp - P\Delta V + P\Delta V$$

$$\Delta H = qp \quad ......(4)$$

q_p – is the heat absorbed at constant pressure and is considered as heat content.

Consider a closed system of gases which are chemically reacting to form gaseous products at constant temperature and pressure with V_i and V_f as the total volumes of the reactant and product gases respectively, and n_i and n_f as the number of moles of gaseous reactants and products, then,

For reactants (initial state) :

$$PV_i = n_i RT \quad ......(5)$$

For products (final state) :

$$PV_f = n_f RT \quad ......(6)$$

(6) – (5)

$$P(V_f - V_i) = (n_f - n_i) RT$$

$$P\Delta V = \Delta n_{(g)} RT \quad ......(7)$$

Substituting in (7) in (3)

$$\Delta H = \Delta U + \Delta n_{(g)} RT \quad ......(8)$$

(OR)

(b)

(i) 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.

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

(ii) 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.

37.

(a) **Molecular orbital diagram of nitrogen molecule (N_2) :**

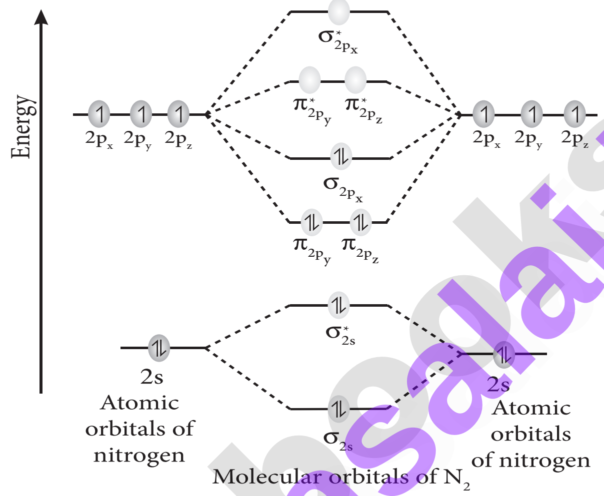
(i) Electronic configuration of N atom $1s^2\ 2s^2\ 2p^3$

(ii) Electronic configuration of N_2 molecule

$\sigma_{1s}^2, \sigma_{1s}^{*2}, \sigma_{2s}^2, \sigma_{2s}^{*2}, \pi_{2p_y}^2, \pi_{2p_z}^2, \sigma_{2p_x}^2$

(iii) Bond order $= \dfrac{N_b - N_a}{2} = \dfrac{10-4}{2} = 3$

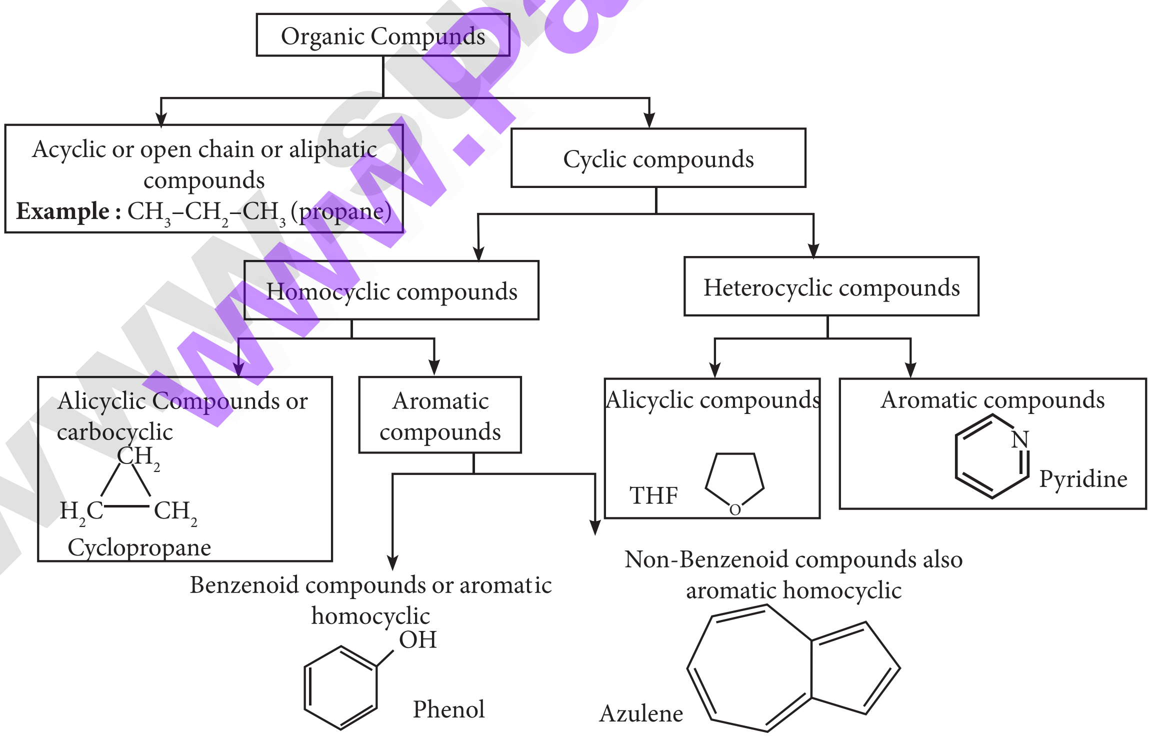
(iv) Molecule has no unpaired electrons hence it is diamagnetic.



MO Diagram for N_2 molecule

(OR)

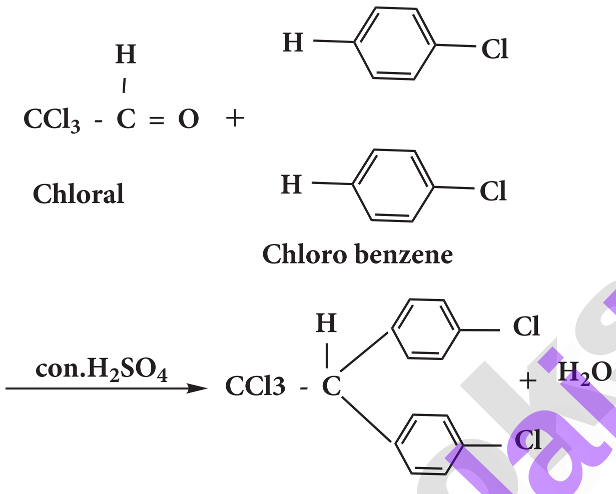
(b)



38. (a) (i) $CaC_2 \xrightarrow{H_2O} CH \equiv CH + Ca(OH)_2$

Calcium Carbride   Ethyne

(ii) **DDT :** DDT can be prepared by heating a mixture of chlorobenzene with chloral (Trichloro acetaldehyde) in the presence of con.H_2SO_4.



DDT

(OR)

(b) (i)

Bio chemical Oxygen Demand (BOD)	**Chemical Oxygen Demand (COD)**
The total amount of oxygen (in milligrams) consumed by microorganisms in decomposing the waste in one litre of water at 20°C for a period of 5 days is called biochemical oxygen demand (BOD).	Chemical oxygen demand (COD) is a 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 hours
Its value is expressed in ppm.	Its value is expressed in mg/litre
BOD is used as a measure of degree of water pollution.	COD is a measure of amount of organic compounds in a water sample.
BOD is only a measurement of consumed oxygen by micro organisms to decompose the organic matter.	COD refers to the requirement of dissolved oxygen for both oxidation of organic and inorganic constituents
Clean water would have BOD value less than 5 ppm	Clean water would have COD value greater than 250 mg/litre.

(ii) Green chemistry means science of environmentally favorable chemical synthesis.

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