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Class : 11

Register Number | | | | | | |

COMMON HALF YEARLY EXAMINATION 2024 - 25

Time Allowed : 3.00 Hours] **CHEMISTRY** **[Max. Marks : 70**

PART – I

I. Choose the correct answer. **15x1=15**

1. Carbon forms two oxides namely carbon monoxide and carbon dioxide. The equivalent mass of which element remains constant?
   a) Carbon b) Oxygen
   c) Both Carbon and Oxygen d) Neither Carbon and Oxygen
2. Two electrons occupying the same orbital are distinguished by
   a) Azimuthal quantum number b) Spin quantum number
   c) Magnetic quantum number d) Orbital quantum number
3. **Assertion** : Helium has the highest value of ionisation Energy among all the elements known
   Reason : Helium has the highest value of electron affinity among all the elements known
   a) both assertion and reason are true, reason is the correct explanation of Assertion
   b) both assertion and reason are true but the reason is not the correct explanation of Assertion.
   c) assertion is true but the reason is False d) both assertion and reason are False
4. Water is a ----------
   a) basic oxide b) acidic oxide c) amphoteric oxide d) none of these
5. Which alkali metal is used in devising photo electric cell?
   a) Sodium b) Cesium c) Potassium d) Francium
6. Use of hot air balloon in sports and meteorological observation in an application of
   a) Boyle's law b) Newton's law c) Kelvin law d) Brownin's law
7. Heat of Combustion is always
   a) positive b) negative c) zero d) either positive or negative
8. An Equilibrium constant of $3.2X10^{-6}$ for a reaction means the Equilibrium is
   a) largely towards forward direction b) largely towards reverse direction
   c) never established d) none of these
9. Which one of the following binary liquid mixtures exhibit positive deviation from Raoult's law?
   a) Acetone +Chloroform b) water + nitric acid
   c) HCl + water d) ethanol + water
10. Bond order in nitrogen molecule is
    a) 2 b) 1 c) 3 d) 0
11. A liquid which decomposes at its boiling point can be purified by
    a) Distillation at atmospheric pressure b) Distillation under reduced pressure
    c) Fractional distillation d) Steam distillation
12. The geometrical shape of a carbocation is
    a) Linear b) tetrahedral c) planar d) pyramidal
13. Some meta - directing substituents in Aromatic substitution are given. Which one is most deactivating?
    a) -COOH b) $-NO_2$ c) $-C \equiv N$ d) $-SO_3H$
14. ------ of the following compounds, which has the highest boiling point?
    a) n - Butyl Chloride b) Isobutyl Chloride c) t - butyl Chloride d) n - Propyl chloride
15. Bhopal Tragedy is due to the release of a toxic gas is ----------
    a) Methyl Isocyanate b) Methyl cyanide c) Methyl isocyanide d) Ethyl iso cyanate

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PART - II

II. Answer any six questions. Question No. 24 is compulsory. **6x2=12**

16. What do you understand by the term mole?
17. Define Orbital? What are the n and l values for $3p_x$ and $4d_{x^2-y^2}$ electron?
18. What is water gas shift reaction?
19. Distinguish between diffusion and effusion?
20. Write the K_p and K_c for the following reaction?
    $2\,CO_{(g)} \rightleftharpoons CO_{2(g)} + C_{(s)}$
21. Which ~~bond~~ is stronger σ or π? why?
22. What is functional Isomerism? Give an example?
23. What are degradable and non-degradable Pollutants.
24. Complete the following reaction:

    (i) $CH_2 = CH_2 \xrightarrow{I_2}$ (ii) $CH_3CH = CH_2 + HBr \xrightarrow{\text{Peroxide}}$

PART - III

III. Answer any six questions. Question No. 33 is compulsory. **6x3=18**

25. State and Explain Pauli's Exclusion Principle.
26. Define Electronegativity?
27. Give the uses of Gypsum?
28. What is the effect of adding inert gas on the reaction at Equilibrium.
29. Give the limitations of Henry's law?
30. Explain inductive effect with example?
31. How does Huckel rule help to decide the aromatic character of a compound?
32. How is DDT Prepared? Give its uses.
33. If an automobile engine burns petrol at a temperature of 816°C and if the surrounding temperature is 21°C. Calculate its maximum possible efficiency?

PART - IV

IV. Answer all the questions. **5x5=25**

34. a) i) Define oxidation Number. **(2)** **(OR)**
    ii) Balance the following equation by oxidation number method. **(3)**
    $KMnO_4 + FeSO_4 + H_2SO_4 \longrightarrow MnSO_4 + Fe_2(SO_4)_3 + K_2SO_4 + H_2O$ **(OR)**
    b) i) What is screening effect? **(2)**
    ii) State the trends in the variation of Electronegativity in groups and Periods?
35. a) i) Give the uses of heavy water? **(2)**
    ii) How is temporary hardness of water removed by clark's method? **(3)** **(OR)**
    b) Explain Castner-Kellner method of preparation of sodium hydroxide? **(5)**
36. a) i) Define Joule - Thomson effect? **(2)**
    ii) Give the application of the Bomb calorimeter? **(3)** **(OR)**
    b) Explain VSEPR theory. Applying this theory to Predict the shapes of IF_7 and SF_6 **(5)**
37. a) Derive K_p and K_c for the dissociation of PCl_5? **(5)** **(OR)**
    b) i) Why Chlorination of methane is not Possible in dark **(2)**
    ii) What happens when ethene reacts with Ozone? **(3)**
38. a) i) Give the general formula for the following. Classes of organic Compounds. **(2)**
    (a) Aliphatic monohydric alcohol
    (b) Aliphatic amines.
    ii) Give the IUPAC names of the following **(3)**
    Compounds. (i) $CH_3 - \underset{\displaystyle CH_3}{\underset{|}{CH}} - \underset{\displaystyle Br}{\underset{|}{CH}} - CH_3$ (ii) $CH_3 - O - CH_3$
    (iii) $CH_2 = CH - CH = CH_2$ **(OR)**
    b) What are the various methods you suggest to Protect our environment from Pollution? **(5)**

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SACRED HEART MATRICULATION HIGHER SECONDARY SCHOOL

SHOLINGANALLUR, CHENNAI – 600119.

COMMON HALF YEARLY EXAM – DECEMBER 2024

STD: **11** **CHEMISTRY ANSWERKEY**

TIME: **180 MINUTES** MAXIMUM MARKS: **70**

PART – A

I. ***Answer all the questions. Choose the correct answer from the given four alternatives and write the option code and the corresponding answer.*** **(15x1=15)**

1. b) Oxygen
2. b) Spin Quantum Number
3. c) Assertion is True but Reason is False
4. c) Amphoteric Oxide
5. b) Cesium
6. a) Boyle's law
7. b) Negative
8. b) Largely towards reverse Direction
9. d) Ethanol + Water
10. c) 3
11. b) Distillation under reduced pressure
12. c) Planer
13. b) – NO_2
14. a) n-Butyl Chloride
15. a) Methyl isocyanate

PART – B

II. ***Answer any six questions. Question No.24 is compulsory.*** **(6x2=12)**

16. **What do you understand by the term mole?**

The mole is defined as the amount of a substance which contains 6.023×10^{23} particles such as atoms, molecules or ions. It is denoted by the symbol "*n*".

17. **Define Orbital? What are the *n* and *l* values for $3p_x$ and $4d_{x^2-y^2}$ electron?**

- Orbital is a three dimensional space where the probability of finding the electron is maximum. For $3p_x$ electron *n* value = 3, *l* value = 1
- For $4d_{x^2-y^2}$ electron *n* value = 4, *l* value = 2

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

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.

$$\mathbf{CO + H_2O \rightarrow CO_2 + H_2\uparrow}$$

19. **Distinguish between diffusion and effusion?**

	Diffusion	Effusion
1	During diffusion one gas mixes with another usually by thermal random motion resulting in the collision between each other while releasing molecular energy.	Effusion is said to occur when gas molecules escape through a pinhole into a vacuum.

2	Diffusion is the ability of gases to mix with each other usually in the absence of a barrier.	Effusion in simple terms is the ability of gas to travel through a small opening.
3	Diffusion happens when there are no holes or if holes in the barrier are larger than the mean free path.	Effusion occurs when the size or aperture of the hole is smaller than the mean free path of the molecules.
4	Diffusion occurs due to difference in concentrations.	Effusion occurs or is facilitated by a difference of pressures.

20. Write the K_P and K_C for the following reaction? $2CO_{(g)} \rightleftharpoons CO_{2(g)} + C_{(s)}$

$K_C = \frac{[CO_2]}{[CO]^2}$; $K_P = \frac{P_{CO_2}}{P_{CO}{}^2}$

21. Which bond is stronger σ or π? Why?

- Sigma bonds (σ) are stronger than pi (π) bonds. Because Sigma bonds are formed from bonding orbitals directly between the nuclei of the bonding atoms resulting in greater overlap and a strong sigma bond (axial overlapping).
- Pi (π) bonds results from overlap of atomic orbitals that are in contact through overlap (lateral overlapping). Pi bonds are more diffused bonds than sigma bonds.

22. What is functional isomerism? Give an example?

Different compounds having same molecular formula but different functional groups are said to exhibit functional isomerism.

CH_3-CH_2-OH ethanol (alcohol group) **CH_3-O-CH_3** methoxymethane (ether group)

23. What are degradable and non-degradable Pollutants?

- The pollutants which cannot be decomposed by the natural biological process are called Bio-degradable pollutants. ***Example:*** plant wastes, animal wastes etc.
- The pollutants which cannot be decomposed by the natural biological process are called Non bio-degradable pollutants. ***Example:*** metal wastes (mainly Hg and Pb), DDT, plastics, nuclear wastes etc.

24. Complete the following reaction.

(i) $CH_2{=}CH_2 \xrightarrow{I_2} [I - CH_2 - CH_2 - I] \xrightarrow{-I_2} CH_2{=}CH_2$

(ii) $CH_3{-}CH{=}CH_2 + HBr \xrightarrow{Peroxide} CH_3{-}CH_2{-}CH_2{-}Br$

PART – C

III. *Answer any six questions. Question No.33 is compulsory.* **(6x3=18)**

25. State and Explain Pauli's Exclusion Principle.

- Pauli's exclusion principle states that "No two electrons in an atom can have the same set of values of all four quantum numbers." $H_{(Z=1)}$ $1s^1$
- For the lone electron present in hydrogen atom, the four quantum numbers are: $n = 1$; $l = 0$; $m = 0$ and $s = +½$.
- For the two electrons present in helium, one electron has the quantum numbers same as the electron of hydrogen atom, $n = 1$, $l = 0$, $m = 0$ and $s = +½$. For other electron, the fourth quantum number is different i.e., $n = 1$, $l = 0$, m = 0 and $s = –½$

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. Give the uses of Gypsum?

- Gypsum is used in making drywalls or plaster boards.
- It is used in the production of Plaster of Paris.
- It is used in making surgical and orthopaedic casts.
- It plays an important role in agriculture as a soil additive, conditioner, and fertilizer.
- It is used in toothpastes, shampoos and hair products.

28. What is the effect of adding inert gas on the reaction at Equilibrium.

When an inert gas (i.e., a gas which does not react with any other species involved in equilibrium) 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 products or the molar concentration of the substance involved in the reaction remains unchanged. Hence at constant volume, addition of inert gas has no effect on equilibrium.

29. Give the limitations of Henry's law?

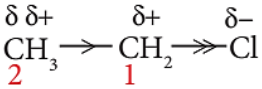
- Henry's law is applicable at moderate temperature and pressure only.
- Only the less soluble gases obeys Henry's law.
- The gases reacting with the solvent do not obey Henry's law. ***For example***, ammonia or HCl reacts with water and hence does not obey this law.

$$NH_3 + H_2O \rightleftharpoons NH_4^+ + OH^-$$

- The gases obeying Henry's law should not associate or dissociate while dissolving in the solvent.

30. Explain inductive effect with example?

- 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. It is denoted as I effect.
- Atoms or groups which lose electrons towards a carbon atom are said to have a +I effect.
  Example: **$-C(CH_3)_3$, $-CH(CH_3)_2$, $-CH_2CH_3$, $-CH_3$**
- For example consider ethane and ethylchloride. The C-C bond in ethane is non polar while the C-C bond in ethyl chloride is polar. We know that chlorine is more electronegative than carbon, and hence it attracts the shared pair of electron between C-Cl in ethyl chloride towards itself.



31. How does Huckel rule help to decide the aromatic character of a compound?

Huckel proposed that aromaticity is a function of electronic structure. A compound may be aromatic, if it obeys the following rules

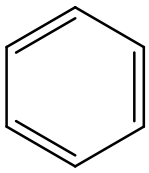
(i) The molecule must be co-planar

(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….)

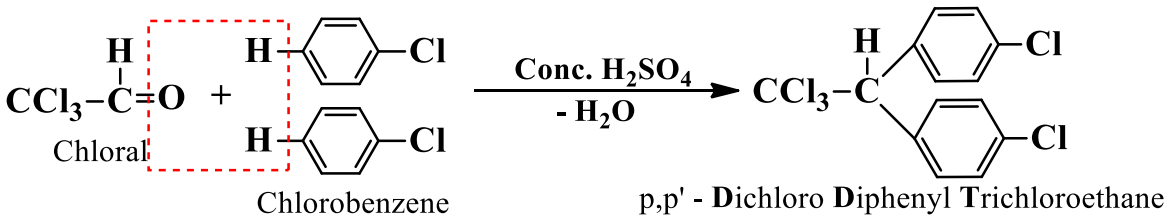
Example,

- The benzene is a planar molecule
- It has six delocalised π electrons
- 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.



Benzene

32.How is DDT Prepared? Give its uses.



Uses:

- 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
- It is used in building construction as pest control
- It is used to kill various insects like housefly and mosquitoes due to its high and specific toxicity.

33.If an automobile engine burns petrol at a temperature of 816°C and if the surrounding temperature is 21°C. Calculate its maximum possible efficiency?

T_h = ***816***+273 = 1089K; T_c = ***21***+273 = 294K; % Efficiency = $\left(\frac{1089-294}{1089}\right) \times 100$ = **73%**

PART – D

IV. *Answer all the questions.* **(5x5=25)**

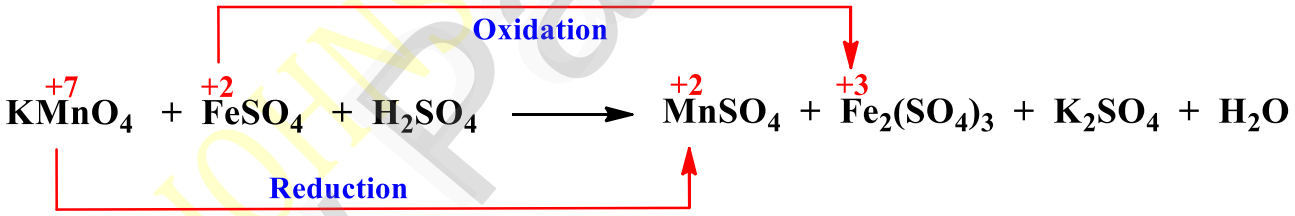
34.(a) (i) Define Oxidation Number. (2 MARKS)

Oxidation number refers to the number of charges an atom (imaginary charge) would have in a molecule or an ionic compound, if electrons were transferred completely the oxidation numbers reflect the number of electron transferred.

(ii) Balance the following equation by oxidation number method. (3 MARKS)

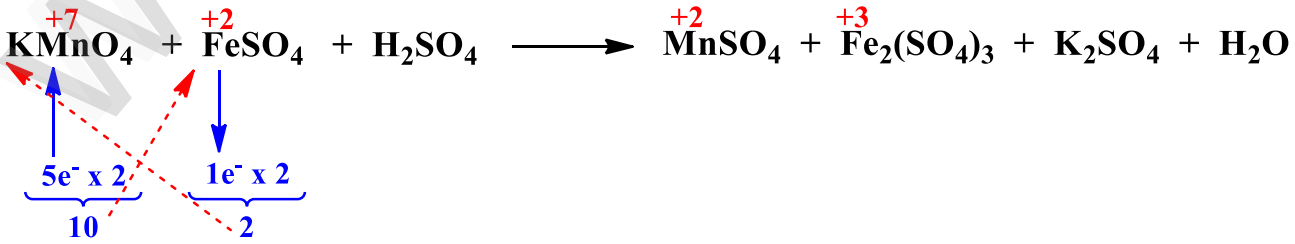
$$KMnO_4 + FeSO_4 + H_2SO_4 \rightarrow MnSO_4 + Fe_2(SO_4)_3 + K_2SO_4 + H_2O$$

Step 1: Using oxidation number concept, identify the reactants (atom) which undergo oxidation and reduction.



- The oxidation number of Mn in $KMnO_4$ changes from +7 to +2 by gaining five electrons.
- The oxidation number of Fe in $FeSO_4$ changes from +2 to +3 by loosing one electron.

Step 2: Since, the total number of electrons lost is equal to the total number of electrons gained, equate, the number of electrons, by cross multiplication of the respective formula with suitable integers on reactant side as below. Here, the product $Fe_2(SO_4)_3$ contains 2 moles of iron, So, the Coefficients $1e^-$ & $5e^-$ are multiplied by the number '2'.



$$2KMnO_4 + 10FeSO_4 + H_2SO_4 \rightarrow MnSO_4 + Fe_2(SO_4)_3 + K_2SO_4 + H_2O$$

Step 3 Balance the reactant / Product - Oxidised / reduced: Now, based on the reactant side, balance the products (ie oxidised and reduced).The above equation becomes

$$2KMnO_4 + 10FeSO_4 + H_2SO_4 \longrightarrow 2MnSO_4 + 5Fe_2(SO_4)_3 + K_2SO_4 + H_2O$$

Step 4: Balance the other elements except H and O atoms. In this case, we have to balance K and S atoms but K is balanced automatically.

Reactant Side: 10 'S' atoms (**10** $FeSO_4$), but, ***Product Side:*** 18 'S' atoms

$$2KMnO_4 + 10FeSO_4 + H_2SO_4 \longrightarrow \underset{2S}{2MnSO_4} + \underset{15S}{5Fe_2(SO_4)_3} + \underset{1S = 18S}{K_2SO_4} + H_2O$$

Therefore the difference 8-S atoms in reactant side, has to be balanced by multiplying H_2SO_4 by '8' The equation now becomes,

$$2KMnO_4 + 10FeSO_4 + 8H_2SO_4 \longrightarrow 2MnSO_4 + 5Fe_2(SO_4)_3 + K_2SO_4 + H_2O$$

Step 5: Balancing 'H' and 'O' atoms

Reactant side '16'-H atoms ($8H_2SO_4$ i.e. 8 x 2H = 16 'H') and ***Product side*** '2' - H atoms (H_2O i.e. 1 x 2H = 2 'H'). Therefore, multiply H_2O molecules in the product side by '8'

$$2KMnO_4 + 10FeSO_4 + 8H_2SO_4 \longrightarrow 2MnSO_4 + 5Fe_2(SO_4)_3 + K_2SO_4 + 8H_2O$$

(OR)

(b) (i) What is Screening Effect? (2 MARKS)

- In addition to the electrostatic forces of attraction between the nucleus and the electrons, there exists repulsive forces among the electrons.
- The repulsive force between the inner shell electrons and the valence electrons leads to a decrease in the electrostatic attractive forces acting on the valence electrons by the nucleus.
- Thus, the inner shell electrons act as a shield between the nucleus and the valence electrons. This effect is called shielding effect.

(ii) State the trends in the variation of Electronegativity in Groups and Periods? (3 MARKS)

Variation of Electronegativity in a group: The electronegativity generally decreases down a group. As we move down a group the atomic radius increases and the nuclear attractive force on the valence electron decreases. Hence, the electronegativity decreases.

Variation of Electronegativity in a period: The electronegativity generally increases across a period from left to right. As discussed earlier, 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 also increases in a period.

35.(a) (i) Give the Uses of Heavy Water? (2 MARKS)

- Heavy water is widely used as moderator in nuclear reactors as it can lower the energies of fast neutrons.
- 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.

(ii) How is temporary Hardness of water removed by Clark's method?(3 MARKS)

Clark's method use to calculated amount of lime is added to hard water containing the magnesium and calcium, and the resulting carbonates and hydroxides can be filtered off.

$$Ca(HCO_3)_2 + Ca(OH)_2 \rightarrow 2CaCO_3 + 2H_2O$$

$$Mg(HCO_3)_2 + 2Ca(OH)_2 \rightarrow 2CaCO_3 + Mg(OH)_2 + 2H_2O$$

(OR)

(b) Explain Castner-Kellner method of preparation of Sodium Hydroxide?

Sodium hydroxide is prepared commercially by the electrolysis of brine solution in **Castner-Kellner** cell using a mercury cathode and a carbon anode. Sodium metal is discharged at the cathode and combines with mercury to form sodium amalgam. Chlorine gas is evolved at the anode. The sodium amalgam thus obtained is treated with water to give sodium hydroxide.

At cathode: $Na^+ + e^- \longrightarrow Na\ (amalgan)$

At anode: $Cl^- \longrightarrow \frac{1}{2}Cl_2 \uparrow + e^-$

Overall reaction: $2Na(amalgam) + 2H_2O \longrightarrow 2NaOH + 2Hg + H_2 \uparrow$

Sodium hydroxide is a white, translucent and deliquescent solid, that dissolves in water to give a strong alkaline solution. It melts at 591 K.

36.(a) (i).Define Joule-Thomson Effect? (2 MARKS)

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***.

(ii) Give the application of the Bomb Calorimeter? (3 MARKS)

- Bomb calorimeter is used to determine the amount of heat released in combustion reaction.
- It is used to determine the calorific value of food.
- Bomb calorimeter is used in many industries such as metabolic study, food processing, explosive testing etc.

(OR)

(b) Explain VSEPR theory. Applying this theory to Predict the shapes of IF_7 and SF_6.

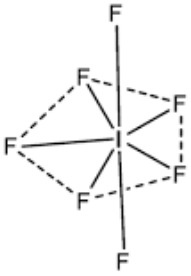
Important principles of VSEPR Theory are as follows:

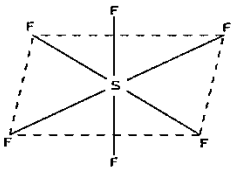
- The shape of the molecules depends on the number of valence shell electron pair around the central atom.
- There are two types of electron pairs namely bond pairs and lone pairs. The bond pair of electrons are those shared between two atoms, while the lone pairs are the valence electron pairs that are not involved in bonding.
- Each pair of valence electrons around the central atom repels each other and hence, they are located as far away as possible in three dimensional space to minimize the repulsion between them.
- The repulsive interaction between the different types of electron pairs is in the following order.

lp – lp > lp – bp > bp – bp

lp- lone pair ; bp- bond pair

- **IF_7 :** The hybridisation of IF_7 is sp^3d^3 and its shape is pentagonal bi pyramidal.
- **SF_6 :** The hybridisation of SF_6 is sp^3d^2 and its shape is octahedral.





37. (a) Derive K_P and K_C for the dissociation of PCl_5?

Consider that ‘a’ moles of PCl_5 is taken in a container of volume V. Let ‘x’ moles of PCl_5 be dissociated into x moles of PCl_3 and x moles of Cl_2.

	PCl_5	PCl_3	Cl_2
Initial number of moles	a	-	-
Number of moles dissociated	x	-	-
Number of moles at equilibrium	a – x	x	x
Active mass or molar concentration at equilibrium	$\frac{a-x}{V}$	$\frac{x}{V}$	$\frac{x}{V}$

Applying law of mass action,

$K_C = \frac{[PCl_3][Cl_2]}{[PCl_5]} = \frac{\left(\frac{x}{V}\right)\left(\frac{x}{V}\right)}{\left(\frac{a-x}{V}\right)} = \frac{x^2}{(a-x)V}$

The equilibrium constant K_p can also be calculated as follows:

We know the relationship between the K_c and K_p

$K_P = K_C(RT)^{\Delta n_g}$

Here the, $\Delta n_g = n_p - n_r = 2 - 1 = 1$

Hence $K_P = K_C(RT)$

We know that $PV = nRT$ $\quad\quad\quad\quad$ $\therefore RT = \frac{PV}{n}$

Where n is the total number of moles at equilibrium. n = (a-x) + x + x = (a+x)

$K_P = \frac{x^2}{(a-x)V}\ \frac{PV}{n} = \frac{x^2}{(a-x)V}\ \frac{PV}{(a+x)} = \frac{x^2P}{(a-x)(a+x)}$

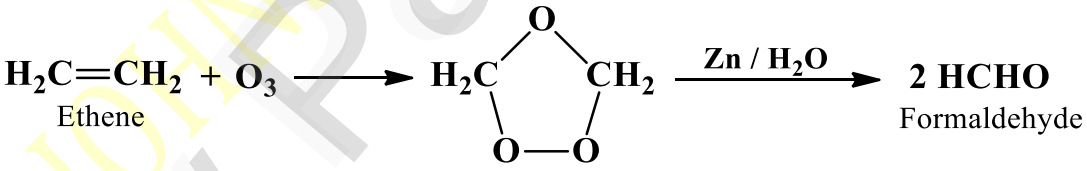
(OR)

(b) (i) Why Chlorination of methane is not Possible in Dark? (2 MARKS)

Methane does not react with chlorine in dark. Reaction of methane with Cl_2 proceeds by free radical mechanism. The initiation step in the free radical chain reaction is $Cl_2 \rightarrow 2Cl\cdot$ This step requires more energy. The excess energy is provided by heat or light.

(ii) What happens when ethane reacts with Ozone? (3 MARKS)

Ozonolysis is a method of oxidative cleavage of alkenes or alkynes using ozone and forms two carbonyl compounds. Alkenes react with ozone to form Ozonide and it is cleaved by Zn/H_2O to form smaller molecules.

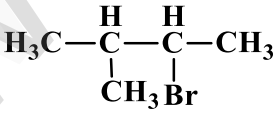


38. (a) (i) Give the general formula for the following Classes of Organic Compounds. (2 MARKS)

(a) Aliphatic monohydric alcohol $C_nH_{2n+1}OH$

(b) Aliphatic amines $C_nH_{2n+1}NH_2$

(ii) Give the IUPAC names of the following. (3 MARKS)

(i)  **2-bromo-3-methylbutane**

(ii) **CH_3-O-CH_3** **Methoxymethane**

(iii) **CH_2=CH-CH=CH_2** **Buta-1,3-diene**

(OR)

(b) What are the various methods you suggest to Protect our environment from 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.
- Substitution of less toxic solvents for highly toxic ones used in certain industrial processes.
- Use of fuels with lower sulphur content (e.g., washed coal)
- Growing more trees.
- Control measures in vehicle emissions are adequate.

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Merry Christmas

&

Happy New Year -2025

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