CHEMISTRY
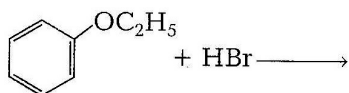## SECTION A
(*Each Question carries 1 Mark*)

1. Predict the product(s) in the following reaction.

2. Name the reagent(s) required to bring about the conversion of but-2-ene to ethanol.
3. What are freons? Give its one use.
4. What happen when dialysis is prolonged? (HOTS)
5. The deficiency of which vitamins causes the disease
   (i) Pernicious anaemia   (ii) Night blindness
6. What type of defect is produced when NaCl is doped with $SrCl_2$?
7. What type of bonding helps in stabilizing the α-helix structure of proteins?
8. Explain, why $MeNH_2$ is stronger base than MeOH?
9. Why does white ZnO(s) becomes yellow on heating?
10. Iodine is more soluble in KI than in water.

SECTION B
(*Each Question carries 2 Marks*)

11. Give reasons for the following :
    (i) At higher altitudes, people suffer from a disease called anoxia. In this disease, they become weak and cannot think clearly.
    (ii) When mercuric iodide is added to an aqueous solution of KI, the freezing point is raised.

12. Describe the following :
    (i) Bacteriostatic and Bactericidal anibiotics
    (ii) Anti-fertility drugs

13. First, second, third and fourth ionization energies of Ni and Pt are given below :

	$(IE)_1 + (IE)_2$	$(IE)_3 + (IE)_4$
Ni	2.49 kJ mol^{-1}	8.80 kJ mol^{-1}
Pt	2.66 kJ mol^{-1}	6.70 kJ mol^{-1}

    Compare the stability of Ni^{2+} and Pt^{2+}, and Ni^{4+} and Pt^{4+} compounds.

14. Calculate the freezing point of a solution containing 50.0 g of ethylene glycol (molecular weight = 62) dissolved in 600 g of water. [K_f for water = 1.86 K kg mol^{-1}]

15. What is a secondary cell? Write the reactions taking place when a lead storage battery is in use.

16. (i) Define colligative properties.
    (ii) Write the conditions for the formation of ideal solutions.

17. The standard potential of a cell using the reaction,

    $$2MnO_4^{-}(aq) + 3Hg(l) + H_2O \rightleftharpoons 2MnO_2(s) + 3HgO(s) + 2OH^{-}(aq) \text{ is } 0.489 \text{ V at } 25°C.$$
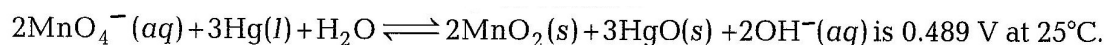
    What is the equilibrium constant of the reaction?

18. (i) Mn(II) shows maximum paramagnetic character amongst the divalent ions of the first transition series.
    (ii) Most of the transition metals do not displace hydrogen from dilute acids, why?

19. While separating a mixture of *ortho* and *para*-nitrophenols by steam distillation, name the isomer which will be steam volatile. Give reasons.

20. Give two requirements for vapour phase refining.
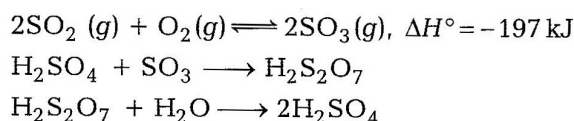
SECTION C
(*Each Question carries 3 Marks*)

21. (i) Differentiate between mineral and ore.
    (ii) Explain the basic principles of the following metallurgical operations.
    (a) Zone refining   (b) Vapour phase refining

22. (i) CHF_3 is less acidic than $CHCl_3$, explain. (HOTS)
    (ii) What happen when
    (a) Bromine reacts with $CH_3 - C \equiv CH$?
    (b) Chloroform kept open with air?

23. (i) Which is a better nucleophile, a bromide ion or an iodide ion? (HOTS)
    (ii) give the major organic product in each of the following reactions.
    (a) $C_6H_5I + Cu \xrightarrow{\ 473\,K\ }$ (HOTS)
    (b) $C_6H_5Br + Mg \xrightarrow{\ Dry\ ether\ }$

24. (i) Draw the structure (structural formula) of pyrophosphate ion.
    (ii) PH_3 forms bubbles when passed slowly in water but NH_3 dissolves. Explain, why?

25. Write the IUPAC names of the given complexes and mention a chemical test to distinguish them.
    $[Co(NH_3)_5Br]SO_4$ and $[Co(NH_3)_5SO_4]Br$

26. A solution containing 0.319 g of $CrCl_3 . 6H_2O$ was passed through a cation exchange resin and acid coming out of the cation exchange resin required 28.5 mL of 0.125 M NaOH. Determine the correct formula of the complex [molecular weight of the complex = 266.5 g mol⁻¹]. (HOTS)

27. (i) What happens when gelatin is mixed with gold sol?
    (ii) How do emulsifying agents stabilize the emulsion?
    (iii) Why does bleeding stop by rubbing moist alum? (HOTS)

SECTION D
(*Each Question carries 4 Marks*)

28. Dr. Saxena, head of metallurgical division always insisted for refining of copper by electrolytic method, instead of other convenient methods, inspite of the fact that it is power consuming and takes longer time.
    Based on the above passage, answer the following questions.
    (i) Is electrolytic refining environmental friendly or economical?
    (ii) How cathode, anode and electrolyte used in this process?
    (iii) Write the values shown by Mr. Saxena.

29. Sulphuric acid is manufactured by,
    (i) contact process (catalyst V_2O_5).
    (ii) lead chamber process (catalyst NO) involving reaction.

$$2SO_2 \, (g) + O_2 \, (g) \rightleftharpoons 2SO_3 \, (g), \; \Delta H° = -197 \, kJ$$

$$H_2SO_4 + SO_3 \longrightarrow H_2S_2O_7$$

$$H_2S_2O_7 + H_2O \longrightarrow 2H_2SO_4$$

By Le-Chatelier's principle, low temperature and high pressure favour forward reaction. Industry A is environment friendly and keeps temperature 700 K and very high pressure. Industry B is not worried about the environment but keeps temperature of about 350 K and high pressure.

Based on the above passage, answer the following questions.

(i) What advantages and disadvantages you can observe of keeping high temperature by Industry *A* and low temperature by Industry *B*?

(ii) Which method is adopted by Industry *A*?

(iii) What is the role of NO (as catalyst)? Can it cause pollution?
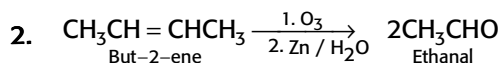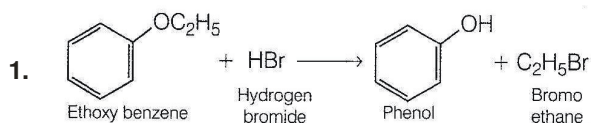
SECTION E
(*Each Question carries 5 Marks*)

30. An organic compound A with molecular formula, C_8H_8O forms orange-red precipitate with 2, 4-DNP reagent and gives yellow precipitate on heating with iodine in the presence of NaOH. It neither reduces Tollen's or Fehling's reagent, nor decolourises bromine water or Baeyer's reagent. On drastic oxidation wit chromic acid, it gives a carboxylic acid B having molecular formula $C_7H_6O_2$. Identify the compound A and B and explain the reactions involved.

31. Assign reasons for the following :

(i) Helium finds wide application in diving system. Why?

(ii) Oxygen forms π bonds whereas sulphur does not form π bonds.

(iii) Nitrogen does not form NCl_5 but phosphorus forms PCl_5.

(iv) Acidic strength decreases in order $HCl > H_2S > PH_3$.

(v) In the noble gases, only xenon forms chemical compounds.

32. The activation energy of a reaction is 75.2 kJ mol^{-1} in the absence of a catalyst and 50.14 kJ mol^{-1} with a catalyst. How many times will the rate of reaction grow in the presence of a catalyst if the reaction proceeds at 25°C? [R = 8.314 JK^{-1} mol^{-1}]

33. An alkene A (molecular formula C_5H_{10}) on ozonolysis gives a mixture of two compounds B and C. Compounds B gives positive Fehling's test and also forms iodoform on treatment with I_2 and NaOH. Compound C does not give Fehling's test but forms iodoform. Identify the compounds A, B and C. Write the reaction for ozonolysis and formation of iodoform from B and C.

34. A violet compound of manganese A decomposes on heating to liberate oxygen and compounds B and C of manganese are formed. Compound C reacts with KOH in the presence of potassium nitrate to give compounds B.

On heating compound C with conc. H_2SO_4 and NaCl, chlorine gas is liberated and a compound D of manganese along with other products is formed. Identify compounds A to D and also explain the reactions involved.

35. Assign reasons for the following.

(i) Describe the favourable conditions for the manufacturing of

(a) Ammonia by Haber's process, and (b) Sulphuric acid by Contact process.

(ii) Draw the structures of the following

(a) $PCl_5 \, (g)$ (b) $S_8 \, (g)$ (c) $ClF_3 \, (g)$

SOLUTIONS

1.

2. $CH_3CH = CHCH_3 \xrightarrow[\text{2. Zn / H}_2\text{O}]{\text{1. O}_3} 2CH_3CHO$
   (But−2−ene) (Ethanal)

3. Chlorofluoro compounds of methane and ethane in which all the H-atoms are replaced by halogen atoms are called freons. E.g. CCl_2F_2, $CFCl_3$. it is used as a refrigerant.

4. Due to excessive dialysis, traces of electrolyte which stabilizes the colloids is removed completely, making the colloid unstable. As a result, coagulation takes place.

5. (i) Pernicious anaemia - Vitamin B_{12} (ii) Night blindness - Vitamin A

6. Vacancy (metal deficiency type) defect is produced when NaCl is doped with $SrCl_2$.

7. Hydrogen bonding helps in stabilizing the α-helix structure of proteins.

8. Nitrogen is less electronegative than oxygen. Therefore, lone pair of electrons on nitrogen is readily available for donation. Hence, $MeNH_2$ is more basic than MeOH.

9. On heating, ZnO loses oxygen according to the following reaction, $ZnO(s) \xrightarrow{\text{Heating}} Zn^{2+} + \frac{1}{2}O_2 + 2e^-$

   Zn^{2+} ions and electrons move to interstitial sites and *F*-centres are created which impart yellow colour to ZnO(s).

10. The I_2 molecules in iodine are not very soluble in water because they are not opposite in terms of polarity. I_2 is non-polar whereas H_2O is polar. But when KI is added to water containing iodine form a polar compound, i.e. KI_3.

11. (i) At higher altitudes, partial pressure of oxygen is less than that at ground level, so that concentration becomes less in blood or tissues. Hence, people suffer from anoxia.

    (ii) Due to the formation of complex $K_2[HgI_4]$, number of particles in the solution decreases and hence, the freezing point is raised.

    $$HgI_2 + 2KI \rightleftharpoons [K_2HgI_4]$$

12. (i) Bactericidal and bacteriostatic are the types of antibiotics. These type of drugs, either kill or inhibit the growth of microorganisms by intervening in their metabolic process e.g..

    Bactericidal : Penicillin, ofloxacin.

    Bacteriostatic : Erythromycin, tetracycline, chloramphenicol.

    (ii) **Anti-fertility Drugs :** Drugs which are used to control unwanted pregnancy are called unti fertility drugs.

    (i) Norethindrone (ii) Novestrol

13. $(IE)_1 + (IE)_2$ values of Ni < Pt. Thus, Ni^{2+} compounds are thermodynamically more stable than Pt^{2+} compounds. Also, $(IE)_3 + (IE)_4$ values of Pt < Ni. Thus, Pt^{4+} compounds are thermodynamically more stable than Ni^{4+} compounds. $K_2[PtCl_6]$ is well known but no such nickel (IV) compound is known.

14. $\Delta T_f = \dfrac{1000 \times K_f \times W_B}{M_B \times W_A} = \dfrac{1000 \times 1.86 \times 50}{62 \times 600} = 2.5\,K$
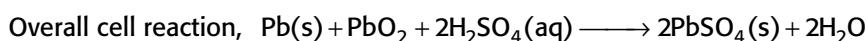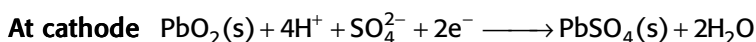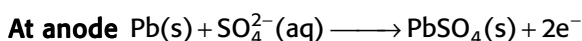
Freezing point of aqueous solution

= Freezing point of water $-\Delta T_f$

= 273.0 − 2.5 = 270.5 K

15. The secondary cells are those in which the cell reaction can be reversed by an external electric energy source. They can be recharged and used again and again. Lead storage battery is a secondary cell.

Following reactions take place when the cell is used.

At anode $Pb(s) + SO_4^{2-}(aq) \longrightarrow PbSO_4(s) + 2e^-$

At cathode $PbO_2(s) + 4H^+ + SO_4^{2-} + 2e^- \longrightarrow PbSO_4(s) + 2H_2O$

Overall cell reaction, $Pb(s) + PbO_2 + 2H_2SO_4(aq) \longrightarrow 2PbSO_4(s) + 2H_2O$

16. (i) The properties of solutions which depend upon the number of solute particles irrespective of their nature relative to the total number of particles present in the solution, are known as colligative properties. E.g. osmotic pressure.

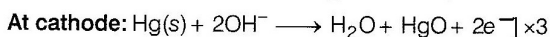(ii) When solute-solvent interactions are almost same as either solute-solute interactions.

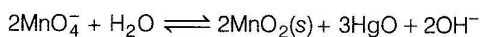(i) $P_{total} = P_1 + P_2$

$P_1 = P_1^0 x_1, P_2 = P_2^0 x_2$

(ii) $\Delta H_{mix} = 0$ (iii) $\Delta V_{mix} = 0$

17. **At anode :**

$MnO_4^- + 2H_2O + 3e^- \longrightarrow MnO_2(s) + 4OH^-] \times 2$

At cathode: $Hg(s) + 2OH^- \longrightarrow H_2O + HgO + 2e^-] \times 3$

Overall reaction

$2MnO_4^- + H_2O \rightleftharpoons 2MnO_2(s) + 3HgO + 2OH^-$

Cell in equilibrium,

$\therefore \qquad E_{cell} = 0$

$E_{cell} = E^\ominus_{cell} - \dfrac{0.059}{6} \log K$

$\therefore \qquad \log K = \dfrac{nE^\ominus_{cell}}{0.059} = \dfrac{6 \times 0.489}{0.059} = 49.56$

$= 3.631 \times 10^{49}.$

18. (i) The configuration of Mn(II) ion :

$3d^5 4s^0$
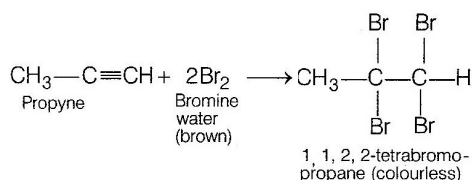|				
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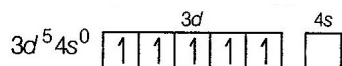
Since, all the 3d orbitals are half-filled in Mn(II), it shows maximum paramagnetic character among the divalent ions of first transition series of elements.

(ii) Most of the transition metals do not displace hydrogen from dilute acids because most of the transition metals have negative oxidation potentials.

19. *o*-nitrophenol is steam volatile due to Chelation (intramolecular H-bonding) and hence, can be separated by steam distillation from *p*-nitrophenol which is not steam volatile because of intermolecular H-bonding.

20. (i) The metal should forms a volatile compound with available reagent.

(ii) The volatile compound should be easily decomposable so that the recovery is easy.

Above two conditions are required for vapour phase refining. Ni is refined by this method.

21. (i) The naturally occurring compounds containing metals present in the Earth's crust are called minerals whereas, ores are those specific minerals from which a metal can be obtained profitably. All ores are minerals but all minerals are not ores.

(ii) (a) **Zone refining :** This process is based upon the principle that impurities are more soluble in the molten state of the metal than in the solid form. Ultra pure metal are obtained by this process.

(b) **Vapour phase refining :** This process is based upon the principle that metal to be refined should form a volatile compound, while impurities do not. Volatile compounds should be easily decomposable so that pure metal can be recovered easily. Ni is refined by Mond's process.

22. (i) CCl_3^- left after the removal of a proton from $CHCl_3$ is stabilized by resonance due to the presence of *d*-orbitals on Cl but : CF_3^- left after the removal of a proton from CHF_3 is not stabilize by resonance due to the absence of *d*-orbitals on F.

(ii) (a) Propyne in the presence of bromine water forms colourless compound 1, 1, 2, 2,-tetraboromopropane.

$$CH_3-C \equiv CH + 2Br_2 \longrightarrow CH_3 - \underset{\underset{Br}{|}}{\overset{\overset{Br}{|}}{C}} - \underset{\underset{Br}{|}}{\overset{\overset{Br}{|}}{C}} - H$$

Propyne   Bromine water (brown)   1, 1, 2, 2-tetrabromo-propane (colourless)

(b) Chloroform is slowly oxidized by air in the presence of light to an extremely poisonous gas carbonyl chloride ($COCl_2$), known as phosgene.
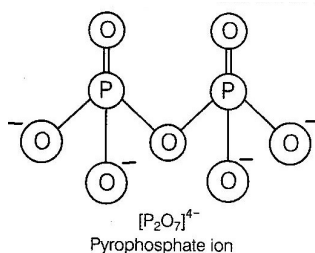
$$CHCl_3 + [O] \longrightarrow \underset{\underset{\text{(poisonous gas)}}{\text{Phosgene}}}{COCl_2} + HCl$$
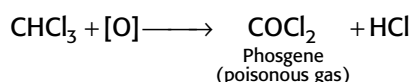
23. (i) Within the group, larger atoms are better nucleophilies because they have more polarisibility. The polarisibility order is
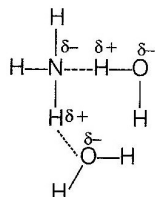
$$I^- > Br^- > Cl^-$$
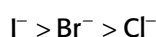
∴ Same will be the order of nucleophile, hence I^- will be a better nucleophile.

(ii) (a) $2C_6H_5I + 2Cu \xrightarrow{473 K}$ $+ 2CuI$

(b) $C_6H_5Br + Mg \xrightarrow{\text{Dry ether}}$ MgBr
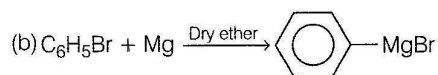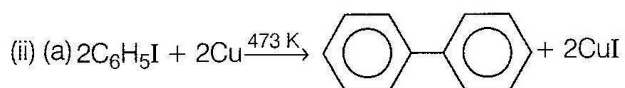
24. (i) The structure of pyrophosphate ion is shown below :

$[P_2O_7]^{4-}$
Pyrophosphate ion

(ii) NH_3 is highly soluble in water due to intermolecular H-bonding.

In PH_3, with less electronegative P does not form H-bonding with H_2O and escapes in the form of bubbles.

25. The IUPAC name of $[Co(NH_3)_5 Br]SO_4$ is pentamminebromido cobalt (III) sulphate and $[Co(NH_3)_5 SO_4]Br$ is pentamminesulphato cobalt (III) bromide.

Treat both the isomers separately with aqueous $BaCl_2$ solution. The isomer which gives a white precipitate is $[Co(NH_3)_5 Br]SO_4]$. While on treatment of both the isomers separately with aqueous $AgNO_3$ solution, $[Co(NH_3)_5 SO_4]Br$ gives a light yellow precipitate.

26. $Cl^- \equiv HCl \equiv NaOH$

From the number of moles of NaOH, number of moles of Cl^- are determined. Hence, complex is known.

Let the number of Cl^- ions outside the coordination sphere or number of chloride ions which can be ionized be n. When the solution of the complex is passed through cation exchanger, nCl^- ions will combine with H^+ (of the cation exchanger) to form HCl.

$$Moles\ of\ NaOH = \frac{MV}{1000}$$

$$nCl^- + nH^+ \longrightarrow nHCl$$
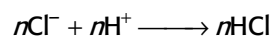
Thus, 1 mole of the complex will form n moles of HCl. 1 mole of complex $\equiv n$ mole of $HCl \equiv n$ mole of NaOH

$$Mole\ of\ the\ complex\ = \frac{0.319\,g}{266.5\,g\,mol^{-1}} = 0.0012\,mol$$

$$Mole\ of\ NaOH\ used\ = \frac{28.5 \times 0.125}{1000} = 0.0036\,mol$$

$$= 0.0012\ mole\ of\ complex$$

$$\equiv 0.0036\ mole\ of\ NaOH$$

$$= 0.0036\ mole\ of\ HCl$$

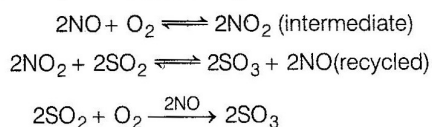$$1\ mole\ of\ complex \equiv \frac{0.0036}{0.0012} = 3\ moles\ of\ HCl$$

$$\therefore \qquad\qquad n = 3$$

Thus, all the Cl^- ions are outside coordination sphere. Hence, complex is $[Cr(H_2O)_6]Cl_3$.

27. (i)   Gold sol is a lyophobic sol. When gelatin is mixed with gold sol, the sol is stabilized.
(ii) The emulsifying agent forms an interfacial layer between suspended particles and the dispersion medium thereby stabilizing the emulsion.
(iii) Moist alum coagulates the blood, and so formed blood clot stops bleeding.

28. (i)   Electrolytic refining of copper is environmental friendly but not economical, because this method is power consuming method.

(ii) **At cathode** Pure copper strips.
    At anode Impure blister copper
    Electrolyte Aqueous $CuSO_4$ solution

(iii) The values shown by Mr. Saxena are concern about environment pollution and human health.

29. (i) The given reaction is exothermic and thus, low temperature may favour forward reaction. But at low temperature, rate of formation of SO_3 (and thus H_2SO_4) is very slow. Thus, temperature is kept about 700 K. At low temperature, forward reaction is favoured but takes longer time and thus, is not economical.

(ii) Contact process is adopted by industry *A*. Since, it is environment friendly. Lead chamber process uses lead and causes pollution.

(iii) Here, NO acts as catalyst.

$$2NO + O_2 \rightleftharpoons 2NO_2 \text{ (intermediate)}$$
$$2NO_2 + 2SO_2 \rightleftharpoons 2SO_3 + 2NO \text{(recycled)}$$
$$2SO_2 + O_2 \xrightarrow{2NO} 2SO_3$$

NO does not go into the atmosphere hence, it does not cause pollution and is recycled.

30. *A* (C_8H_8O) forms orange-red ppt. with 2, 4-DNP thus, it is a carbonyl compound. *A* forms yellow ppt. with I_2/NaOH, thus, $-COCH_3$ group is present.

A does not reduce Tollen's reagent thus, $-CHO$ group is absent. *A* does not decolourise Br_2 water thus ($C = C$) bond absent in side chain. Thus, *A* is
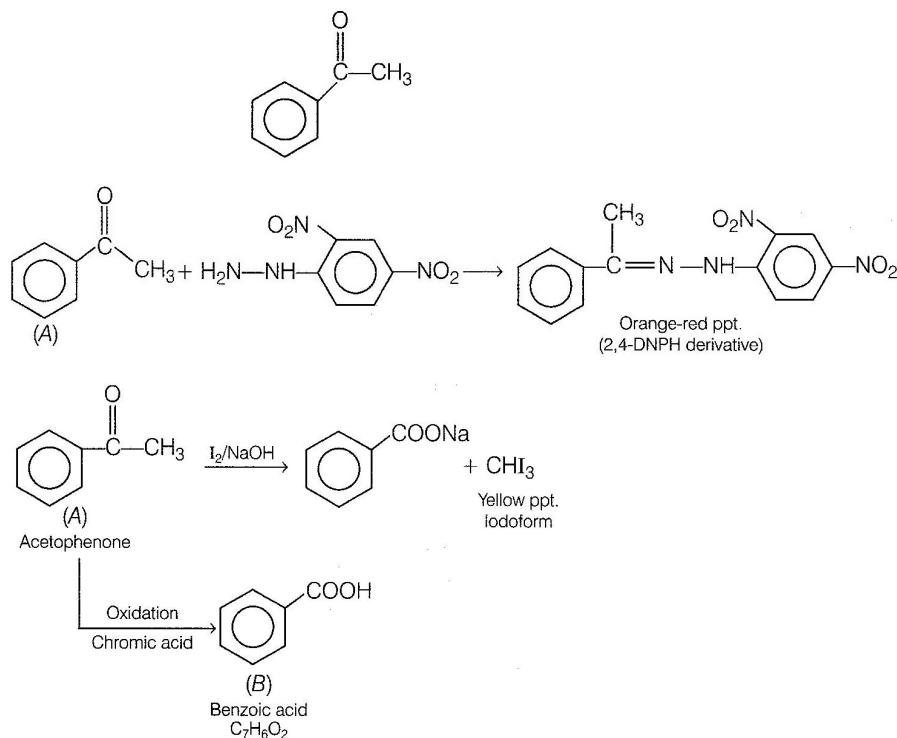
31. (i) Helium is very less stable in blood. Hence, it is used as a diluents for oxygen in modern diving apparatus.

(ii) Oxygen forms π bonds whereas, sulphur does not form π bonds because of its high electronegativity.

(iii) Nitrogen does not form NCl_5 because nitrogen, unlike phosphorus, does not have vacant *d*-orbitals to have 5 unpaired electrons to form NCl_5.

(iv) Since, the electronegativity of atom decreases in order $Cl > S > P$ therefore, the polarity of bond decreases in the order $H – Cl > H – S > H – P$ and hence, acidic strength decreases in same order,

i.e. $HCl > H_2S > PH_3$

(v) In all the noble gases, only xenon forms chemical compounds because its ionisation energy is lowest among noble gases and almost similar to that of oxygen.

32. Let k_1 be the rate constant for the reaction without catalyst when the activation energy is E_1 and k_2 be the rate constant for the reaction in the presence of a catalyst when the energy of activation is E_2.

$\therefore \quad k_1 = Ae^{-E_1/RT}$ .... (i)

$k_2 = Ae^{-E_2/RT}$ ....(ii)

On dividing Eq. (ii) by Eq. (i), we have

$$\frac{k_2}{k_1} = e^{(E_1-E_2)/RT}$$

Or $\quad \ln\frac{k_2}{k_1} = \frac{E_1 - E_2}{RT}$

Or $\quad \log\frac{k_2}{k_1} = \frac{E_1 - E_2}{2.303\,RT} = \frac{(75.2 - 50.14)\times 10^3\,J/mol}{2.303 \times (8.314\,JK^{-1}\,mol^{-1})\,(298\,K)} = 4.3919$

$$\frac{k_2}{k_1} = \text{Antilog } 4.3919 = 2.4654 \times 10^4$$

$\Rightarrow \quad k_2 = 24654\,k_1$

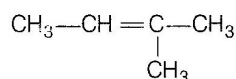i.e. the reaction rate will increase by 24654 times in the presence of a catalyst.

33. $\underset{(A)}{C_5H_{10}} \xrightarrow{\text{Ozonolysis}} B + C$

$\underset{\text{Iodoform test}}{B} \longrightarrow \text{Fehling's test}$

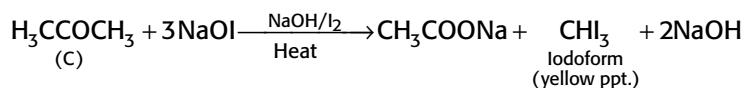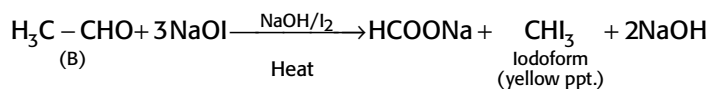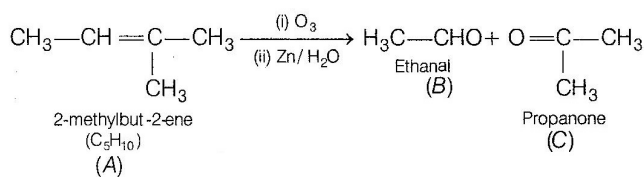$\underset{\text{Iodoform test}}{C} \longrightarrow \text{Note give Fehling's test}$

Since, B and C both give iodoform test, they must contain $COCH_3$ group and C does not give Fehling's test, therefore C is a keto compound.

$\therefore$ Possible structure of *A* is
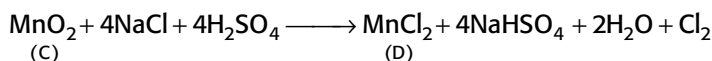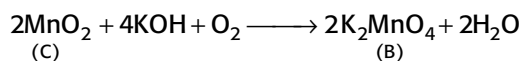
$$CH_3 - CH = \underset{\underset{CH_3}{|}}{C} - CH_3$$

Which on ozonolysis gives an aldehyde and ketone.

$A = CH_3 - CH = \underset{\underset{CH_3}{|}}{C} - CH_3 \quad$ (2-methylbut-2-ene)

$B = H_3C - CHO \quad$ (Ethanal or acetaldehyde)

$C = O = \underset{\underset{CH_3}{|}}{C} - CH_3 \quad$ (Propanone or acetone)

$$CH_3-CH=C-CH_3 \xrightarrow[\text{(ii) Zn/H}_2\text{O}]{\text{(i) O}_3} H_3C-CHO + O=C-CH_3$$

2-methylbut-2-ene
(C_5H_{10})
(A)

Ethanal
(B)

Propanone
(C)

$$H_3C-CHO + 3NaOI \xrightarrow[\text{Heat}]{\text{NaOH/I}_2} HCOONa + CHI_3 + 2NaOH$$
(B)   Iodoform
(yellow ppt.)

$$H_3CCOCH_3 + 3NaOI \xrightarrow[\text{Heat}]{\text{NaOH/I}_2} CH_3COONa + CHI_3 + 2NaOH$$
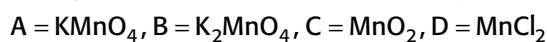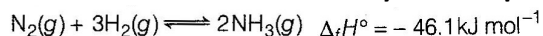(C)   Iodoform
(yellow ppt.)
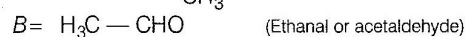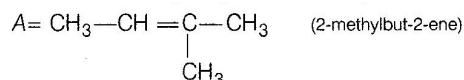
34. Since, compound C on treating with conc. H_2SO_4 and NaCl, gives Cl_2 gas, so it is manganese dioxide (MnO_2). It is obtained along with MnO_4^{2-} when $KMnO_4$ (violet) is heated. Thus,

$A = KMnO_4, B = K_2MnO_4, C = MnO_2, D = MnCl_2$

The reactions involved are $2KMnO_4 \xrightarrow{\Delta} K_2MnO_4 + MnO_2 + O_2$
(A)   (B)   (C)

$$2MnO_2 + 4KOH + O_2 \longrightarrow 2K_2MnO_4 + 2H_2O$$
(C)   (B)

$$MnO_2 + 4NaCl + 4H_2SO_4 \longrightarrow MnCl_2 + 4NaHSO_4 + 2H_2O + Cl_2$$
(C)   (D)
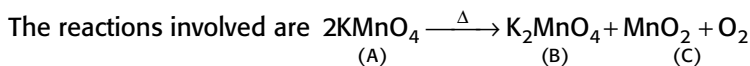
35. (i) (a) **Manufacture of ammonia by Haber's process**

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g) \quad \Delta_f H° = -46.1 \, kJ \, mol^{-1}$$

The reaction is exothermic, reversible and forward reaction leads to decrease in volume.
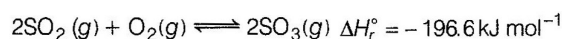
Favourable conditions for maximum yield of NH_3.

High pressure = 200 atm

Optimum temperature (not very high) = 700 K

Catalyst and promoter = Fe_2O_3 with small amount of K_2O and Al_2O_3

(b) **Manufacture of sulphuric acid by contact process**

$$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g) \quad \Delta H_r° = -196.6 \, kJ \, mol^{-1}$$

The reaction is exothermic, reversible and the forward reaction leads to a decrease in volume. Favourable conditions for maximum yield of SO_3.

High pressure = 2 atm

Optimum temperature = 720 K

Catalyst = V_2O_5

(ii) **Structures**

(a) PCl_5 (Trigonal bipyramidal)

(b) S_8 (Crown-shaped or puckered ring structure)

(c) ClF_3 (Distorted T-shape)