Series 1333

Code No. SS/41Chem.

Roll No. | | | | | | | |

Candidates must write the Code on the title page of the answer-book

CHEMISTRY (Theory) & SOLUTION

Time allowed : 3¼ hours **Maximum Marks : 56**

General Instructions to the Examinees :

(1) Candidate must write first his/her Roll No. on the question paper compulsorily.

(2) All the questions are compulsory.

(3) Write the answer to each question in the given answer-book only.

(4) For questions having more than one part the answers to those parts are to be written together in continuity.

(v) If there is any error / difference / contradiction in Hindi & English versions of the question paper, the question of Hindi version should be treated valid.

(vi)

Q. Nos.	Mark per question
1 – 13	1
14 – 24	2
25 – 27	3
28 – 30	4

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SECTION A

1. Write any one example of network solid. **[1 Mark]**

Ans. Example of network solid is diamond . It is the network solid of carbon atoms.

2. Write definition of azeotropic mixture. **[1 Mark]**

Ans. Azeotropes are binary mixtures having the same composition in liquid and vapour phase and boil at a constant temperature. In such cases, it is not possible to separate the components by fractional distillation.

3. Rate constant of a chemical reaction is $1.72 \times 10^{4}\ s^{-1}$. Calculate the order of reaction. **[1 Mark]**

Ans. $k = \dfrac{\text{Rate}}{[\text{Rectant}]^n}$ .....(1)

Unit of k is s^{-1} according to question

Unit of Rate = concentration / time (sec.)

Unit of reactants concentration = $[\text{conc.}]^n$

Putting all the values in equation [1]

$$s^{-1} = \frac{[\text{conc.}]}{\text{sec.} \times [\text{conc.}]^n}$$

$$[\text{conc.}]^{1-n} = s^{-1} \times s$$

$$[\text{conc.}]^{1-n} = 1 \qquad \text{If } [\text{conc.}]^0 = 1$$

$$[\text{conc.}]^{1-n} = [\text{conc.}]^0$$

$1 - n = 0$, $\quad n = 1$

Order of reaction is (n) = 1

4. Define threshold energy. **[1 Mark]**

Ans. Threshold energy – The minimum amount of energy which must be associated with the molecules, so that their mutual collisions result in product formation.

5. Give any one example of bidentate ligand. **[1 Mark]**

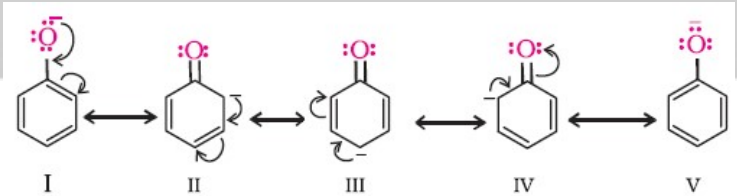
Ans. Example of bidentate ligand is Ethylene diamine $[H_2N - CH_2 - CH_2 - NH_2]$.

6. Write IUPAC name of Diethyl ether. **[1 Mark]**

Ans. IUPAC name of Diethyl ether is ethoxy ethane.

7. Draw the resonating structures of phenoxide ion.

Ans. Resonating structures of phenoxide ion are



8. Write chemical equation of carbylamine reaction.

Ans. Carbylamine reaction

$$R{-}NH_2 + CHCl_3 + 3KOH \xrightarrow{\text{Heat}} R{-}NC + 3KCl + 3H_2O$$

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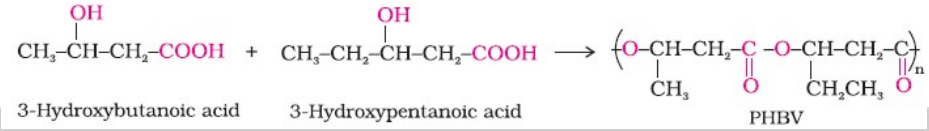
9. Write name of the hormone secreted by thyroid gland.

Ans. Hormone secreted by thyroid gland is thyroxine.

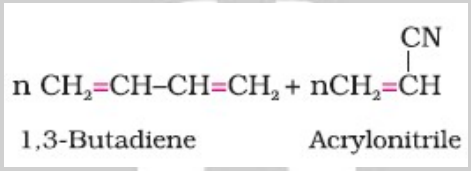
10. Write any one example of biodegradable polymer.

Ans. Example of biodegradable polymer is Poly β – hydroxybutyrate – co-β-hydroxy valerate (PHBV)



11. Write monomer units of polymer Buna-N.

Ans. Monomer units of polymer Buna-N are



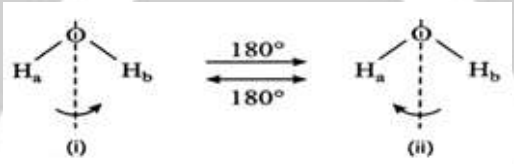
12. What is polydispersity index for a polymer ?

Ans. Polydispersity – The ratio of weight average molecular weight and number average molecular weight of a polymer.

$$PDI = \frac{\overline{M_w}}{\overline{M_n}}$$

13. Write the value of axis of symmetry (C_n) present in H_2O molecule.

Ans. Water has C_2 axis of symmetry because water on rotating by 180° returns back to its original position.



$$C_n = \frac{360°}{n} = \frac{360°}{180°} = 2$$

SECTION B

14. **(A)** Write any two difference between Schottky and Frenkel defects. **[1 + 1 = 2 Marks]**

Ans. Difference between Schottky and Frenkel defects.

Schottky defect	Frenkel defect
1. Equal number of cationic and anionic vacancies are present in this defect	Some cations are displace from normal lattice sites to the interstitial sites.
2. Density is lowered in this defect	Density is unaffected

(B) Calculate the packing efficiency in simple cubic lattice.

Ans. **Packing efficiency**

% Vol. of cube occupied by atoms, ions, Molecules in one unit cell is P.E.

$$P.E. = \frac{\text{Vol. of atoms}}{\text{Vol. of unit cell}} \times 100$$

$$= \frac{z \times \frac{4}{3}\pi r^3}{a^3} \times 100$$

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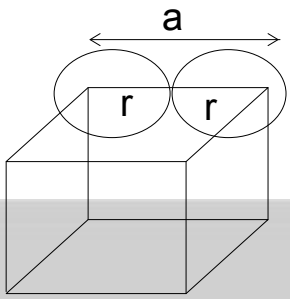
(1) Simple Cubic unit cell (S.C.C.)

z = 1

a = 2r



$$P.E. = \frac{1\times\frac{4}{3}\pi r^3}{(2r)^3}\times 100$$

$$= \frac{\pi}{6}\times 100$$

$$\approx 52.4\%$$

15. 0.05M solution of $K_4[Fe(CN)_6]$ at 300K is 92% dissociated. Calculate the osmotic pressure of the solution. ($R = 0.0821$ atm. LK^{-1} mol^{-1})

Ans. $K_4\left[Fe(CN)_6\right]$ dissociates as

$$K_4\left[Fe(CN)_6\right] \rightleftharpoons 4K^+ + \left[Fe(CN)_6\right]^{4-}$$

Number of ions (n) after dissociation is 5

$\alpha = \frac{i-1}{n-1}$ α = 92 % or .92

n = 5

Then $i = \alpha(n-1)+1$

$i = .92(5-1)+1$

$i = .92(4)+1$

$i = 3.68+1$

$i = 4.68$

Osmotic pressure (π)

π = iCRT

C = 0.05 mol L^{-1}

R = 0.0821 atm. $L\,K^{-1}$ mol^{-1}

T = 300 K

π = 4.68 × 0.05 × 0.0821 × 300

= 5.76342 atm.

16. **(A)** Write any two factors which affects the conductance of electrolysis. **[1 + 1 = 2 Marks]**

Ans. Factors which affects the conductance of electrolysis are

(i) the nature of the electrolyte added

(ii) size of the ions produced and their sovation

(B) Corrosion is an electrochemical phenomenon. Explain.

Ans. Corrosion is a redox process by which metals are oxidized by oxygen in presence of moisture. For example rusting of iron is an electrochemical phenomenon.

Oxidation : $Fe(s) \longrightarrow Fe^{2+}_{(aq)} + 2e^-$

Reduction: $O_2 + 4H^+_{(aq)} + 4e^- \longrightarrow 2H_2O_{(\ell)}$

In atmosphere $4Fe^{2+} + O_2 + 4H_2O_{(\ell)} \longrightarrow 2Fe_2O_{3(s)} + 8H^+_{(aq)}$

Oxidation $Fe_2O_3 + xH_2O \longrightarrow \underset{\text{Rust}}{Fe_2O_3.xH_2O}$

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17. The conductivity of 0.10M solution of KCl at 298K is 0.0129 s cm^{-1}. Calculate its molar conductivity.

Ans. $\Lambda_m = \frac{k \times 1000}{C}$ K = 0.0129 scm^{-1}

$= \frac{0.0129 \times 1000}{0.10}$ C = 0.10 mol L^{-1}

= 129 scm^2 mol^{-1}

18. A first order reaction takes 40 minute for 20% decomposition. Calculate half life. ($\log_{10}10 = 1$, $\log_{10}2 = 0.3010$)

Ans. For first order $t = \frac{2.303}{K}\log\frac{a}{a-x}$ x = 20 %

$$t = \frac{2.303}{K}\log\frac{100}{100-20}$$

$$40 = \frac{2.303}{K}\log\frac{100}{80} \quad \text{.....(1)}$$

$$40 = \frac{2.303}{K}\log\frac{10}{8}$$

$$K = \frac{2.303}{40}\left[\log 10 - \log 2^3\right]$$

$$K = \frac{2.303}{40}\left[1 - 3 \times .301\right]$$

$$K = \frac{2.303}{40}.097$$

= 0.00558 min^{-1}

Half life for first order

$$t_{1/2} = \frac{.693}{K}$$

$$t_{1/2} = \frac{.693}{.00558} = 124.19 \text{ min.}$$

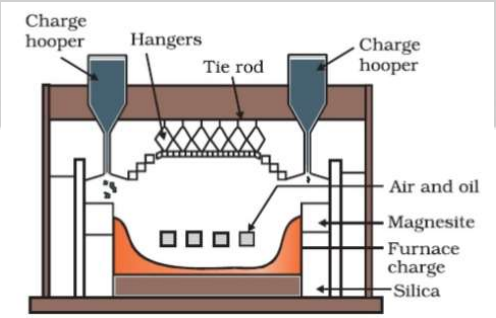
19. **(A)** What is the role of graphite rod in the electrometallurgy of aluminium ?

Ans. Graphite rod behaves as anode and is useful for reduction to the metal

$2Al_2O_3 + 3C \longrightarrow 4Al + 3CO_2$

(B) Draw a labelled diagram of reverberatory furnace.

Ans. Reverberatory furnace



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20. Give the oxidation state and coordination number of the central metal ion in the following complexes.
(A) $[Co(en)_3]^{3+}$ **(B)** $K_4[Fe(CN)_6]$

Ans. Calculation of oxidation state of metal in complex ion

(A) $[Co(en)_3]^{3+}$
$x + 3\,(0) = 3$
$x = 3$

Coordination number = 6
(en) is bidentate ligand

(B) $K_4[Fe(CN)_6]$
$4\,(+1) + x + 6(-1) = 0$
$4 + x - 6 = 0$
$x = 2$

Coordination number = 6
(CN) is monodentate ligand

21. **(A)** Why phenol are more acidic than alcohol ? Explain.

Ans. Phenols are stronger acids ($K_a = 10^{-8} - 10^{-10}$) than alcohols ($Ka = 10^{-16} - 10^{-18}$) because phenoxide ion is stabilized by resonance but alkoxide ion is not.

(B) Arrange the following alcohols in increasing order of their reactivity towards esterification reaction.
CH_3-CH_2-OH, $(CH_3)_2CH-OH$, $(CH_3)_3C-OH$

Ans. Increasing order of alcohols reactivity towards esterification reaction.
$(CH_3)_3C-OH < (CH_3)_2CH-OH < CH_3-CH_2-OH$

OR

(A) Why the boiling points of alcohols are higher than hydrocarbons and ether of comparable molecular mass ? Explain.

Ans. The high boiling point of alcohols are mainly due to the presence of intermolecular hydrogen bonding in them which is lacking in ethers and hydrocarbons.

(B) Arrange the following alcohols in increasing order of their reactivity towards dehydration reaction,.
CH_3-CH_2-OH, $(CH_3)_2CH-OH$, $(CH_3)_3C-OH$

Ans. Increasing order of alcohols reactivity towards dehydration reaction
$CH_3-CH_2-OH < (CH_3)_2CH-OH < (CH_3)_3C-OH$

22. Identify [A] and [B] in the following chemical reactions.

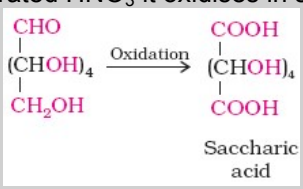
$$C_6H_5N_2^+Cl^- \xrightarrow[NaNO_2(Aqueous)]{Cu(Powder)} [A] \xrightarrow[6[H]]{Sn|HCl} [B]$$

Ans.

$$C_6H_5N_2^+Cl^- \xrightarrow[NaNO_2(Aqueous)]{Cu(Powder)} \underset{\text{Nitrobenzene}}{C_6H_5NO_2\ (A)} \xrightarrow[6[H]]{Sn|HCl} \underset{\text{Aniline}}{C_6H_5NH_2\ (B)}$$

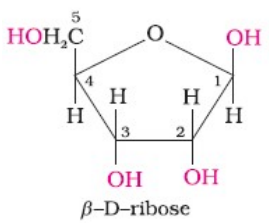
23. **(A)** What happen's when glucose reacts with concentrated HNO_3? Give chemical equation.

Ans. When Glucose reacts with concentrated HNO_3 it oxidises in saccharic acid



(B) Draw the structure of β-D-ribose sugar.

Ans.



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24. **(A)** Differentiate between configurational and conformational isomers.

Ans.

Configurational	Conformational
1. It is due to the presence of one or more chiral carbon atom (optical isomers) or restricted rotation of C = C(Geometrical isomers).	It is due to free rotation of C – C single bond
2. Position of atoms or groups in space is fixed.	Position of atoms or groups in space changes.
3. One form of configuration is not converted into another form.	At room temperature one form of conformation is converted into another

(B) The chair conformer of cyclohexane is more stable than boat conformer. Explain.

Ans. Boat conformer is free of angle strain. However, the boat conformer is not as the chair conformer because some of the bonds in the boat conformer are eclipsed, giving it torsional strain. The boat conformer is further destabilized by the close proximity of the flagpole hydrogens (the hydrogens at the "bow" and "stern" of the boat), which causes steric strain. Torsional strain and flagpole interactions cause boat conformation to have considerably higher energy than chair conformation. The chair form is more stable than the boat form by 44 kJ mol^{-1}.

SECTION C

25. Read the given paragraph and given answer of the following questions.

The rare earth elements of the modern periodic table are known as lanthanoids. They have separate block in periodic table. The lanthanoid series consist of fourteen elements starting from Cerium (atomic number – 58) to Lutetium (atomic number - 71). All lanthanoids generally exhibit +3 oxidation state. In addition some lanthanoids show +2 and +4 oxidation state also. As we move from left to right in lanthanoid series there is regular decrease in the size of an atom. This is known as lanthanoid contraction. There are many industrial application as – formation of mischmetal, production of parts of Jet engine.

(A) The basic nature of hydroxides of lanthanoid elements decreases moving from left to right. Explain.

Ans. With an increase in the atomic number ,the basic strength of the oxides and hydroxides decreases. This contraction causes as decrease in the size of lanthanoide cations and, therefore, the polarizing power of the cations increases. This further decreases the ionic character of the oxides and hydroxides. Thus, $Ce(OH)_4$ is maximum and $Lu(OH)_4$ is least basic .

(B) Write name of two lanthanoid elements used in the formation of mischmetal.

Ans. Ce (Cerium) and La (Lanthanum)

(C) Write the name of one lanthanoid element exhibiting +4 oxidation state.

Ans. Ce (Cerium) Form Ce^{+4}

26. Read the given paragraph and write answer of the following questions.

Chemicals have special importance in various field of daily life as - in foods, in soap and detergents. Chemicals are used in food materials for preservation, to enhance appeal and to increase its nutritive quality in them. Chemical substance which are added to the food materials to prevent their spoilage and retain nutritive value for long times are called food preservatives. Artificial sweeteners are those chemical compounds which are used to give sweetening effect to the food materials. Diabetic patients are advised to used saccharin in place of sugar.

(A) Why chemicals are added in food materials ?

Ans. Chemicals are added to food for (i) their preservation (ii) enhancing their appeal, and (iii) adding nutritive value in them.

(B) Write name of any two food preservatives.

Ans. Sodium benzoate, C_6H_5COONa

Salts of sorbic acid and propanoic acid

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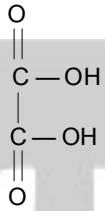
(C) Why diabetic patients are advised to used saccharin.

Ans. It is about 550 times sweeter than sugar on mass to mass basis. It is not biodegradable (or is not metabolized in the body) and does not have any calorific value of food. It is excreted as such in urine. It is primarily used as sweetening agent by diabetic patients.

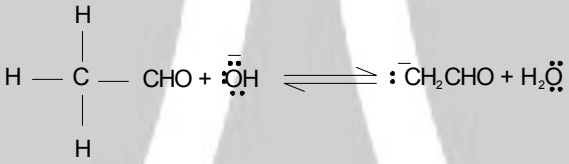
27. **(A)** Write structural formula of oxalic acid.

Ans.

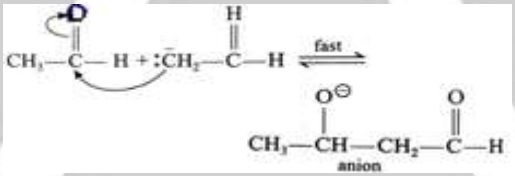


(B) Explain mechanism of Aldol condensation.

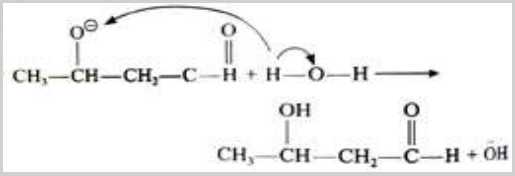
Ans. **1.** In reverse order, the hydroxide ion deprotonates the aldehyde.



2. Here Enolate ion 1 attack the unreacted aldehyde.



3. Anion accepts one proton from water and to form aldol and hydroxyl ion.

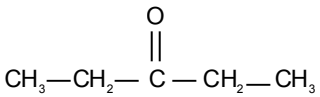


The products obtained by aldol condensation, when heated give α, β unsaturated aldehyde and ketone by dehydration.

OR

(A) Write structural formula of Diethyl ketone.

Ans.



(B) Explain mechanism of Kolbe electrolysis.

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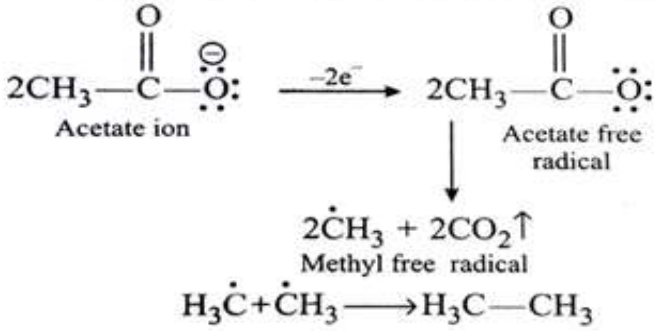
Ans.

$$2CH_3COONa + 2H_2O \xrightarrow{\text{Electrolysis}} CH_3—CH_3 + 2CO_2 + H_2 + 2NaOH$$

Reaction takes place by free radical mechanism :



SECTION D

28. **(A)** Write definition of adsorption.

Ans. The accumulation of molecular species at the surface rather than in the bulk of a solid or liquid is termed adsorption. The molecular species or substance, which concentrates or accumulates at the surface is termed adsorbate and the material on the surface of which the adsorption takes place is called adsorbent.

(B) What happen's when an electric current is passed through colloidal solution ?

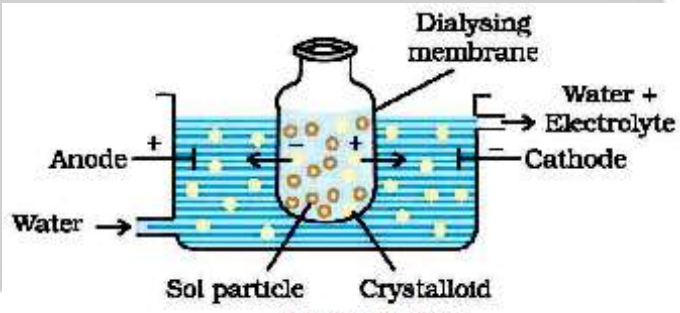
Ans. The colloidal particles move towards oppositely charged electrodes, get discharged and precipitated.

(C) Why alum is added for purification of water ?

Ans. The water obtained from natural sources often contains suspended impurities.Alum is added to such water to coagulate the suspended impurities and make water fit for drinking purposes.

(D) Draw a labelled diagram of electron-dialysis method for purification of colloidal solutions.

Ans.



Electro-dialysis

OR

(A) Write definition of chemical adsorption.

Ans. When the forces of attraction existing between adsorbate and adsorbent are strong chemical bonds, the adsorbtion called chemical adsorption. In chemical adsorption, the adsorbate forms product by reaction at the surface of adsorbent.

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(B) What happen's when a beam of light is passed through the colloidal solution ?

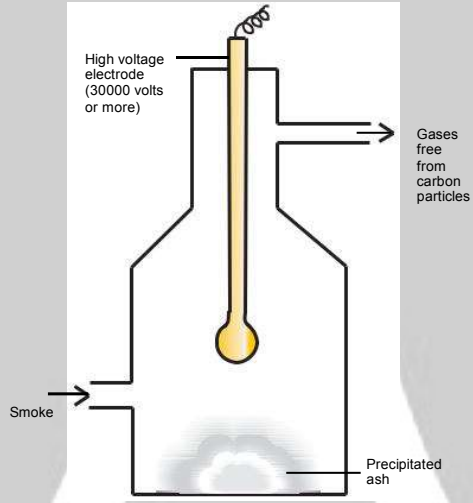
Ans. Tyndall effect is observed .The Tyndall effect is due to the fact that colloidal particles scatter light in all directions in space. This scattering of light illuminates the path of beam in the colloidal dispersion.

(C) Why the colour of sky appears blue ?

Ans. Dust particles along with water suspended in air scatter blue light which reaches our eyes and the sky looks blue to us.

(D) Draw a leabelled diagram of cottrel smoke precipitator.

Ans.



Cottrell smoke precipitator

29. **(A)** Write oxidation state of nitrogen in nitric acid.

Ans. HNO_3

$1 + x + (-2)3 = 0$

$x = +5$

(B) What happen's when sulphur reacts with concentrated H_2SO_4 ? Give chemical equation.

Ans. $3S + 2H_2SO_4 \longrightarrow 3SO_2 + 2H_2O$

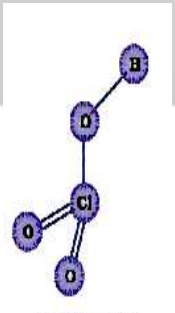
S oxidised by concentrated Sulphuric acid

(C) Why helium is used an diluent for oxygen in modern diving apparatus ?

Ans. He is used as a diluent for oxygen in modern diving apparatus because of its very low solubility in blood.

(D) Draw the structure of $HClO_3$.

Ans.



Chloric acid

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OR

(A) Write hybridised state of nitrogen atom in ammonia

Ans. Nitrogen atom is SP^3 hydridised in ammonia

(B) What happen's when carbon reacts with concentrated H_2SO_4? Give chemical equation.

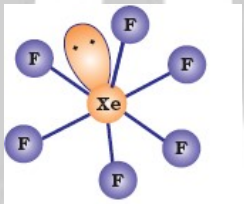
Ans. $C + 2H_2SO_4 \longrightarrow CO_2 + 2SO_2 + 2H_2O$

(C) Why interhalogen compounds are more reactive than halogen compounds?

Ans. Interhalogen compounds are more reactive than halogens . This is because X – X' bond in interhalogens is weaker than X – X bond in halogens.

(D) Draw the structure of XeF_6.

Ans.



Distorted octahedral

30. **(A)** Write chemical equation of Finkelstein reaction.

Ans. R–Cl or R–Br + NaI $\xrightarrow[\text{(Finkelstein reaction)}]{\text{Acetone or Methanol}}$ R–I + NaCl or NaBr

(B) Why aryl halides are less reactive towards nucleophilic substitution reactions? Explain.

Ans. As result of resonance, C–Cl bond acquires a partial double bond character. Thus, the bond cleavage in haloarene is difficult than haloalkane (where carbon is attached to halogen by a pure single bond) and thus, they are less reactive towards nucleophilic substitution reaction.

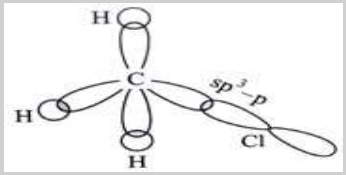
(C) Arrange the following alkyl halides in increasing order of their reactivity twoards S_N2 reaction.

$CH_3–CH_2–Cl$, $(CH_3)_2CH–Cl$ $(CH_3)_3C–Cl$

Ans. $CH_3 - CH_2 - Cl > (CH_3)_2 CH - Cl > (CH_3)_3 C - Cl$

(D) Draw the orbital diagram of CH_3Cl.

Ans.



OR

(A) Write chemical equation of Wurtz-Fitting reaction.

Ans. Wurtz-Fitting reaction :

$$\underset{\text{Iodobenezene}}{C_6H_5 - I} + 2Na + I - \underset{\substack{\text{Methyl}\\\text{Iodide}}}{CH_3} \xrightarrow[\text{ether}]{\text{Dry}} \underset{\text{Toluene}}{C_6H_5CH_3} + 2\,NaI$$

(B) The reaction of alkyl chloride with aqueous KOH leads to the formation of alcohols but in presence of alcoholic KOH, alkenes are major products. Explain.

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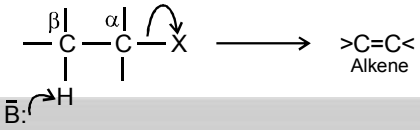
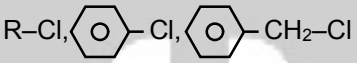
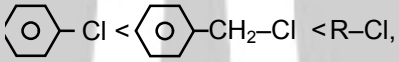
Ans. In aqueous medium, KOH ionises readily to form OH^- ions which behave as a powerful nucleophile and cause nucleophilic substitution. These OH^- ions being highly hydrated in aqueous medium, cannot abstract a proton (H^+) form β-carbon. Hence elimination does not take place. But in alcoholic medium the ionisation of the base (KOH) is poor. So OH^- ions behave as weak nucleophile and the substitution is chacked. Actually KOH in presence of alcoholic medium gives E_2 elimination reaction to form alkene.



(C) Arrange the following halogen derivatives in increasing order of their reactivity towards nucleophile substitution reaction.

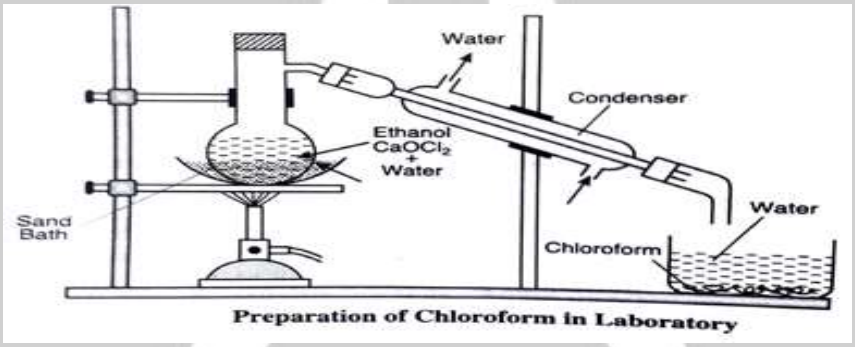


Ans.



(D) Draw a labelled diagram of laboratory method of preparation of chloroform.

Ans.



Preparation of Chloroform in Laboratory

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