ISC Solved Paper 2020

Chemistry

Class-XII

(Maximum Marks : 80)

(Time allowed : Three hours)

*Candidates are allowed an additional **15 minutes** for **only** reading the paper.*
*They must **NOT** start writing during this time.*

All questions are compulsory
Question 1 is of 20 marks having four sub parts, all of which are compulsory. Question numbers 2 to 8 carry 2 marks each, with any two questions having internal choice.
Question numbers 9 to 15 carry 3 marks each, with any two questions having an internal choice.
Question numbers 16 to 18 carry 5 marks each, with an internal choice.
All working, including rough work, should be done on the same sheet as, and adjacent to the rest of the answer.
The intended marks for questions or parts of questions are given in brackets [J.
Balanced equations must be given wherever possible and diagrams where they are helpful.
When solving numerical problems, all essential working must be shown.
In working out problems, use the following data:.
Gas constant R = 1.987 cal deg^{-1} mol^{-1} = 8.314 JK^{-1} mol^{-1} = 0.0821 dm^3 atm. 11 atm = / dm^3 atm = 101.3 J.
1 Faraday = 96500 coulombs. Avogadro's number = 6.023 × 10^{23}

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1. (a) Fill in the blanks by choosing the appropriate word/words from those given in the brakets : [4 × 1]

(iodoform, volume, mass, haloform, gram equivalent, choloroform, carbylamine, sp^3d^2, high, coke, d^2sp^3, low, gram mole, carbon monoxide)

(i) Equivalent conductivity is the conducting power of all the ions furnished by one .... of an electrolyte present in a definite .... of the solution.

(ii) Bleaching powder on treatment with ethanol or acetone gives .... This is an example of .... reaction.

(iii) Outer orbital complexes involve .... hybridisation and are .... spin complexes.

(iv) Zinc oxide is reduced by .... at 1673K to form zinc and ....

*__(b) Select the correct alternative from the choices given : [4 × 1]__

(i) The packing efficiency of simple cubic structure, body centered cubic structure and face centered cubic structure respectively is:
(1) 52.4%, 74%, 68%
(2) 74%, 68%, 52.4%
(3) 52.4%, 68%, 74%
(4) 68%, 74%, 52.4%

(ii) When acetone is treated with Grignard 's reagent, followed by hydrolysis,
(1) Secondary alcohol
(2) Tertiary alcohol
(3) Primary alcohol
(4) Aldehyde

***(iii)** Which of the following electrolytes is least effective in causing flocculation of positively charged ferric hydroxide sol?
(1) $K_3[Fe (CN)_6]$
(2) K_2CrO_4
(3) $K_4[Fe(CN)_6]$
(4) KBr

(iv) On heating an aliphatic primary amine with chloroform and alcoholic potassium hydroxide, the organic compound formed is an:
(1) Alkyl isocyanide
(2) Alkanol
(3) Alkanal
(4) Alkyl cyanide

(c) Match the following : [4 × 1]

(i)	Silicon and phosphorous	**(a)**	Acetaldehyde
(ii)	Iodoform test	**(b)**	Xenon hexafluoride
(iii)	Arrhenius equation	**(c)**	*n*-type of semiconductors
(iv)	Distorted octahedral structure	**(d)**	Frequency factor

***Out of Syllabus**

(d) Answer the following questions : [4 × 2]

(i) What is the common name of the polymer obtained by the polymerisation of caprolactam? Is it addition polymer or condensation polymer?

(ii) Why Zn^{2+} ions are colourless while Ni^{2+} ions are green and Cu^{2+} ions are blue in colour?

(iii) The molar conducitity of NaCl, CH_3COONa and HCl at infinite dilution is 126.45, 91.0 and 426.16 ohm^{-1} cm^2 mol^{-1} respectively. Calculate the molar conductivity (λ_m^∞) for CH_3 COOH at infinite dilution.

(iv) Identify the compounds A, B, C and D.

$$C_6H_5COOH \xrightarrow{SOCl_2} A \xrightarrow{NH_3} B \xrightarrow{Br_2/KOH} C \xrightarrow[0-5°C]{NaNO_2+HCl} D$$

Ans.

(a) (i) gram equivalent, volume

(ii) chloroform, holoform

(iii) sp^3d^2, high

(iv) coke (carbon), carbon monoxide

(c) (i) Silicon and phosphorous — n - type of semi conductors

(ii) Iodoform test — Acetaldehyde

(iii) Arrhenius reaction — Frequency factor

(iv) Distored octahedral structure — Xenon hexafluoride

(d) (i) Nylon -6, It is a condensation polymer.

(ii) Zn^{2+} ions are colourless because of completely filled *d* - orbital. Ni^{2+}ion are green due to the presence of unpaired electrons and Cu^{2+} ions also have an unpaired electron giving it a blue colour.

(iii) Given $\lambda^\infty_{NaCl} = 126.45$ ohm^{-1} cm^2 mol^{-1}

$\lambda^\infty_{CH_3COONa} = 91.0$ ohm^{-1} cm^2 mol^{-1}

$\lambda^\infty_{HCl} = 426.16$ ohm^{-1} cm^2 mol^{-1}

$\lambda^\infty_{CH_3COOH} = ?$

$\lambda^\infty_{CH_3COOH} = \lambda^\infty_{CH_3COONa} + \lambda^\infty_{HCl} - \lambda^\infty_{NaCl}$

$= 91.0 + 426.16 - 126.45$

$= 390.55$ ohm^{-1} cm^2 mol^{-1}

(iv) $C_6H_5COOH \xrightarrow{SOCl_2} C_6H_5COCl + SO_2 + HCl$

(A) Benzoyl chloride

$C_6H_5COCl \xrightarrow{NH_3} C_6H_5CONH_2 + HCl$

(A) (B) Benzamide

$C_6H_5CONH_2 \xrightarrow{Br/KOH} C_6H_5NH_2$

(B) (C) Aniline

$C_6H_5NH_2 \xrightarrow[0-5°C]{NaNO_2+HCl} C_6H_5N_2Cl + H_2O + NaCl$

(C) (D) Benzenediazonium chloride

***2. (a) An element has atomic weight 93 g mol^{-1} and density 11.5 g cm^{-3} If the edge length of its unit cell is 300 pm, identify the type of unit cell. (N_A = 6.023 ×10^{23} mol^{-1})**

OR

(b) Calculate the radius of copper atom. The atomic weight of copper is 63.55 g mol^{-1}. It crystallises in face centered cubic lattice and has density of 8.93 g cm^{-3} at 298K. (N_A = 6.023 × 10^{23} mol^{-1})

*3. Complete and balance the following chemical equations:

(i) $P_4 + NaOH + H_2O \xrightarrow[\text{Inert atm.}]{\text{heat}}$ .... + ...

(ii) $Cu + HNO_3 \rightarrow$ .... + ... + ...

dil. **[2]**

4. (i) Write the chemical equation for the reaction of glucose with bromine water.

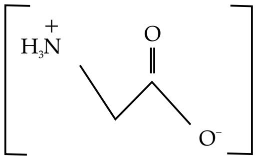
(ii) Write the zwitter ion structure of glycine. [2]

Ans. (i) $CH_2OH(CHOH)_4CHO \xrightarrow[\text{oxidation}]{Br_2/H_2O} CH_2OH(CHOH)_4COOH$

Glucose Gluconic acid

(ii) Zwitter ion structure of glycine

$\ddot{N}H_2CH_2COOH \sim \overset{+}{N}H_3\,CH_2COO^-$



***5. (i) How do antiseptics differ from disinfectants?**

(ii) Name a substance that can be used as an antiseptic as well as a disinfectant.

***6. An alloy of gold (Au) and cadmium (Cd) crystallises with a cubic structure in which gold atoms occupy the corners and cadmium atoms fit into the face centres. What is the formula of this alloy?**

7. (a) State reasons for the following :

(i) Ethylamine is soluble in water whereas aniline is insoluble in water.

(ii) Aliphatic amines are stronger bases than aromatic amines.

OR

(b) Complete and balance the following equations :

(i) $C_6H_5NH_2$ + CH_3COCl → .... + ...

(ii) $C_2H_5NH_2 + HNO_2 \rightarrow$ .... + ... + ...

Ans.

(a) (i) Ethylamine is soluble in water due to hydrogen bonding. Whereas in aniline, the phenyl group is bulky in size and has -I effect. As a result its hydrogen bonding with water is negligible. So it is insoluble in water.

(ii) In aliphatic amines the lone pair of nitrogen is easily donated while in aromatic amines the lone pair of nitrogen is delocalised with the aromatic ring, which makes it less available for electron donation. So they are weaker bases.

OR

(b) $C_6H_5NH_2 + CH_3COCl \rightarrow CH_3CONHC_6H_5 + HCl$

$C_2H_5NH_2 + HNO_2 \rightarrow C_2H_5OH + N_2 + H_2O$

***8. Draw the structure of xenon tetrafluoride molecule. State the hybridisation of the central atom and the geometry of the molecule.**

9. (a) Calculate the emf and ΔG for the given all at 25° C :

$Cr_{(s)} \mid Cr^{3+}$ (0.1M) || Fe^{2+} (0.01M) | $Fe_{(s)}$

Given $E^\circ_{Cr^{3+}/Cr} = -0.74V$, $E^\circ_{Fe^{2+}/Fe} = -0.44V$

(lF = 96500 C, R = 8.314 JK^{-1} mol^{-1} [3]

OR

(b) Calculate the degree of dissociation (α) of acetic acid, if its molar conductivity ($\wedge_m$) is 39.05 S cm^2 mol^{-1}

(Given $\lambda^\circ_{(H^+)}$ = 349.6 S cm^2 mol^{-1} and $\lambda^\circ_{(CH_3COO^-)}$ = 40.95 S cm^2 mol^{-1})

Ans.

(a) Cr(s)|Cr^{3+} (0.1 M)||Fe^{2+} (0.01 M) | Fe(s)

Anode reaction → $Cr(s) \rightarrow Cr^{3+} + 3e^-$ ...(i)× 2

Cathode reaction → $Fe^{2+} + 2e^- \rightarrow Fe$ ...(ii)× 3

Cell reaction → $2Cr + 3Fe^{2+} \rightarrow 2Cr^{3+} + 3Fe$

$E^\circ_{Cell} = E^\circ_{cathode} - E^\circ_{Anode}$

$= E^\circ_{Fe^{2+}/Fe} - E^\circ_{Cr/Cr3+}$

$= -0.44 - (-0.74)$

$= 0.30$ V

$$E_{Cell} = E^\circ_{Cell} - \frac{0.059}{6}\log\frac{[Cr^{3+}]^2[Fe]^3}{[Fe^{2+}]^3[Cr]}$$

$$= 0.30 - \frac{0.059}{6}\log\frac{(0.1)^2\times1^3}{(0.01)^3\times1^2}$$

$= 0.26$ V **Ans.**

OR

(b) The dgree of dissociation $\alpha = \Lambda_m/\lambda^\circ$

$\lambda^\circ_{(H^+)} = 349.6$ S cm^2 mol^{-1}

$\lambda^\circ_{(CH_3COO^-)} = 40.95$ S cm^2 mol^{-1}

$\lambda^\circ_{CH_3COOH} = \lambda^\circ_{CH_3COO^-} + \lambda^\circ_{H^+}$

$= 349.6 + 40.95$

$= 390.55$

$\alpha = \Lambda_m/\Lambda^\circ$

$= 39.05/390.5 = 0.1$ **Ans.**

***10. Name an important ore of silver. How is silver extracted from its sulphide ore? Give balanced chemical equations involved in the extraction of pure silver. [3]**

11. How will you convert the following

(i) Chlorobenzene to biphenyl

(ii) Propene to 1- bromopropane

(iii) Chlorobenzene to aniline

Ans. (i) Chlorobenzene to biphenyl - (By Fittig's reaction)

$$\underset{\text{Chlorobenzene}}{C_6H_5Cl} + 2Na + ClC_6H_5 \xrightarrow[\text{ether}]{\text{dry}} \underset{\text{Biphenyl}}{C_6H_5 - C_6H_5} + 2NaCl$$

(ii) Propene to 1-bromopropane - follows anti-Markovnikov's rule

$$\underset{\text{Propane}}{CH_3\text{–}CH = CH_2} + HBr \xrightarrow{\text{Peroxide}} \underset{\text{1-bromopropane}}{CH_3CH_2CH_2 - Br}$$

(iii) Chlorobenzene to aniline -

$$C_6H_5Cl \xrightarrow[623K,\,300atm]{NaOH} C_6H_5OH \xrightarrow{\text{Zn dust}} C_6H_6$$

$$C_6H_6 \xrightarrow[\text{Conc.}H_2SO_4]{\text{Conc.}HNO_3} C_6H_5NO_2 \xrightarrow{Sn/HCl} \underset{\text{Aniline}}{C_6H_5NH_2}$$

***12. Explain what is observed when:**

(i) A beam of light is passed through a colloidal solution.

(ii) An electric current is passed through a colloidal solution.

(iii) An electrolyte ($AlCl_3$) is added to a colloidal solution of arsenious sulphide (As_2S_3). [3]

13. (a) How will you convert the following: (Give balanced equation)

(i) Benzoyl chloride to benzaldehyde.

(ii) Methyl chloride to acetic acid.

(iii) Acetic acid to methane. [3]

OR

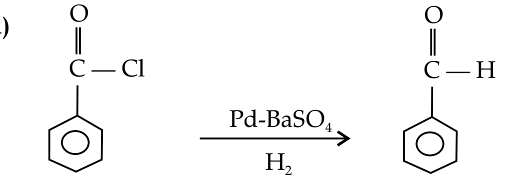
(b) A ketone A (C_4H_8O) which undergoes Iodoform reaction gives compound B on

*Out of Syllabus

reduction. B on heating with conc. H_2SO_4 at 443 K gives a compound C which forms ozonide D. D on hydrolysis with Zn dust gives only E. Identify the compounds A to E. Write the Iodoform reaction with compound A. **[3]**

Ans.

(a) (i)



Benzoyl chloride → Benzaldehyde

(ii) $CH_3Cl \xrightarrow{KCN} CH_3CN \xrightarrow{H_2O/H^+} CH_3COOH + NH_3$

Methyl chloride — Methyl cyanide — Acetic acid

(iii) $CH_3COOH + NaOH \rightarrow CH_3COONa + H_2O$

Sodium acetate

$CH_3COONa + NaOH \xrightarrow{CaO} CH_4 + NaCO_3$

Methane

OR

(b) $(C_4H_8O)\ CH_3-\overset{\overset{\displaystyle O}{\|}}{C}-CH_2-CH_3 \xrightarrow[2(H)]{\text{Raduction}}$

Ketone or Butane-2-one

(A)

$CH_3\ \underset{\underset{\displaystyle OH}{|}}{CH}-CH_2-CH_3 \xrightarrow[\text{Conc.}H_2SO_4]{443\ k}$

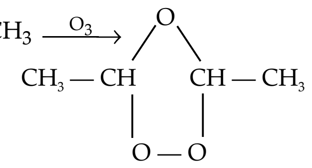
(B)

Butan-2-ol

$CH_3-CH=CH-CH_3 \xrightarrow{O_3}$

(C)

But-2-ene



(D)

Ozonide

$\xrightarrow[H_2O]{\text{Zn dust}} 2\ CH_3CHO$

(E)

Acetaldehyde

Iodoform reaction :

$2NaOH + I_2 \rightarrow NaI + NaIO + H_2O$

$CH_3-CH_2-\overset{\overset{\displaystyle O}{\|}}{C}-CH_3 + 3NaIO \rightarrow CH_3CH_2COONa$

Ketone

$+ CHI_3 + 2NaOH$

Iodoform

(Yellow ppt.)

14. A first order reaction is 50% completed in 30 minutes at 300 K and in 10 minutes at 320 K. Calculate the activation energy of the reaction. (R = 8.314 JK^{-1} mol^{-1}) **[3]**

Ans.

(a) (i) $t_{1/2} = \frac{0.693}{k}$ or $k = \frac{0.693}{t_{1/2}}$

$k_1 = \frac{0.693}{30}, k_2 = \frac{0.693}{10}$

$T_1 = 300\ K,\ T_2 = 320\ K.$

$R_2 = 8.314\ JK^{-1}\ mol^{-1}$

According to Arrhenius equations :

$$\log\frac{k_2}{k_1} = \frac{E_a}{2.303\ R}\left[\frac{1}{T_1} - \frac{1}{T_2}\right]$$

Putting the values

$$\log = \left[\frac{\frac{0.693}{10}}{\frac{0.693}{30}}\right] = \frac{E_a}{2.303 \times 8.314}\left[\frac{1}{300} - \frac{1}{320}\right]$$

$$\log 3 = \frac{E_a}{2.303 \times 8.314}\left[\frac{320-300}{300 \times 320}\right]$$

Or, $E_a = \frac{2.303 \times 8.314 \times 300 \times 320 \times \log 3}{20}$

$(\because \log 3 = 0.477)$

Or, $E_a = \frac{2.303 \times 8.314 \times 300 \times 320 \times 0.477}{20}$

$= 43839.29\ Jmol^{-1}$

$= 43.84\ kJmol^{-1}$ Ans.

15. Explain the following

(i) Transition metals and their compounds generally exhibit a paramagnetic behaviour.

(ii) There is an increase in density of elements from titanium (Z = 22) to copper (Z = 29) in the 3d series of transition elements.

(iii) $K_2Cr_2O_7$ acts as a powerful oxidising agent in acidic medium.

Ans.

(i) Transition metals and their compounds are paramagnetic in nature due to the presence of one or more unpaired electrons in *d*-sub shell.

(ii) In the 3*d* series of transition elements density increases from Ti to Cu because atomic radii keeps decreasing i.e., volume keeps decreasing but mass increases simultaneously.

(iii) $K_2Cr_2O_7$ acts as a powerful oxidising agents in acidic medium, it liberates nascent oxygen. The oxidation number is converted from +6 to +3.

$Cr_2O_7^{2-} + 14H^+ + 6e^- \rightarrow 2Cr^{3+} + 7H_2O$

16. (a) (i) The elevation in boiling point when 0.30 g of acetic is dissolved in 100 g of benzene is 0.0633°C. Calculate the molecular weight of acetic acid from this data. What conclusion can you draw about the molecular state of the solute in the solution?

(Given k_b for benzene = 2.53 kg mol^{-1}, at. wt. of C= 12, H = 1, O =16)

(ii) Determine the osmotic pressure of a solution prepared by dissolving 0.025 g of K_2SO_4 in 2 litres of water at 25° C, assuming that K_2SO_4 is completely dissociated.

(R = 0.0821 Lit-atm K^{-1} mol^{-1}, mol. wt. of K_2SO_4 = 174 g mol^{-1})

OR

(b) (i) An aqueous solution of a non-volatile solute freezes at 272.4 K, while pure water freezes at 273.0 K. Determine the following:

(Given K_f = 1.86 K kg mol^{-1}, K_b = 0.512 K kg mol^{-1} and vapour pressure of water at 298 K = 23.756 mm of Hg)

(1) The molality of solution

(2) Boiling point of solution

(3) The lowering of vapour pressure of water at 298 K

(ii) A solution containing 1.23g of calcium nitrate in 10g of water, boils at 100.975°C at 760 mm of Hg. Calculate the van 't Hoff factor for the salt at this concentration.

(K_b for water = 0.52 K kg mol^{-1}, mol. wt. of calcium nitrate = 164 g mol^{-1})

Ans.

(a) (i) $W_1 = 100$ g, $W_2 = 0.30$ g

$\Delta T_b = 0.0663$

$K_b = 2.53$ kg mol^{-1}

∴ molar mass of acetic acid

$$M_2 = \frac{K_b \times W_2 \times 1000}{\Delta T_b \times W_1}$$

$$= \frac{2.53 \times 0.30 \times 1000}{0.0633 \times 100}$$

$= 119.90$

Van't Hoff factor—

i = Normal molar mass/ Abnormal molar mass

$= 60/119.90$

$= 0.5$

∴ $i < 1$. So the solute (acetic acid) in associated.

(ii) Osmotic pressure $\pi = \frac{W_2RT}{M_2V}$

W_2 = Mass of K_2SO_4 = 0.025 g

$= 2.5 \times 10^{-2}$ g

M_2 = Molar Mass of K_2SO_4

$= 174$ g mol^{-1}

V = 2L, R = 0.0821 lit atm K^{-1} mol^{-1}

T = 25° = 298 K

$$\pi = \frac{2.5 \times 10^{-2} \times 0.0821 \times 298}{174 \times 2}$$

$= 1.76 \times 10^{-3}$ atm **Ans.**

(b) (i) Given : $K_f = 1.86$ K kg mol^{-1}

$K_b = 0.512$ K kg mol^{-1}

Vapour pressure of water = 23.756 mm of Hg

(1) Molality of solution :

$$m = \frac{\Delta T_f}{K_f}$$

$$= \frac{273 - 272.4}{1.86}$$

$= 0.332$ m.

(2) Boiling point of solution—

Depression in the freezing point

$K_f = 1.86$ Kg mol^{-1}

$\Delta T_b = K_b \times m$

$= 0.512 \times 0.332$

$= 0.164$ K

$\Delta T_f = 273 - 272.4$

$$m = \frac{\Delta T_f}{K_f} = \frac{273 - 272.4}{1.86}$$

$= 0.322$ m

Boiling point of the solution = 373 + 0.164

= 373.164 K

(3) Lowering of vapour pressure of water at 298 K.

$$= \frac{P_0 - P}{P_0}$$

$$= \frac{760 - 23.756}{760} = \frac{736.244}{760}$$

$= 0.9687$

(ii) Mass of Calcium nitrate (W_B) = 1.23 g

van't Hoff factor = ?

Solvent : water $M_B = 18$ g mol^{-1}

$W_A = 10$ g

Solution : Boiling temp. = 100. 975°C

Given $K_b = 0.52$ K kg mol^{-1}

W_B molar mass of $Ca(NO_3)_2$ = 164 g

$\Delta T_b = i\, K_b\, m$

$(T_b^S - T^0) = i\, K_b.m$

$$(100.975°C - 100°C) = \frac{i.K_b.W_B \times 1000}{M_B \times W_A}$$

$$0.975 = i \times 0.52 \times \frac{1.23 \times 1000}{164 \times 10}$$

$$i = \frac{0.975 \times 164 \times 10}{0.52 \times 1.23 \times 1000}$$

$= 2.5$

$i = 2.5$

17. (a) (i) Write the IUPAC names of the following complexes:

(1) $[Cu(NH_3)_4]SO_4$

(2) $[Co(en)_2]Cl_2]$

(3) $K_3[Al(C_2O_4)_3]$

(ii) With reference to the coordination complex ion $[Fe(H_2O)_6]^{2+}$ answer the following:

(At. no. of Fe = 26)

(1) Give the IUPAC name of the complex ion.

(2) What is the oxidation number of the central metal atom?

(3) How many unpaired electrons are there in the complex ion?

(4) State the type of hybridisation of the complex ion.

OR

(b) (i) Name of the type of isomerism exhibited by the following pairs of compounds:

(1) $[Co(ONO)(NH_3)_5]^{2+}$ and $[Co(NO_2)(NH_3)_5]^{2+}$

(2) $[Co(H_2O)_4Cl_2]$ Cl.2H_2O and $[Cr(H_2O)_5Cl]$ $Cl_2.H_2O$

(3) $[Co(NH_3)_6]$ [Cr (CN)$_6$] and $[Cr(NH_3)_6]$ $[Co(CN)_6]$

(ii) Using the valence bond approach, predict the shape, hybridisation and mangnetic behaviour of $[Ni(CO)_4]$. (at. no. of Ni = 28]

Ans.

(a) (i) (1) $[Cu(NH_3)_4]SO_4$

Tetraammine copper (II) sulphate

(2) [Co (en)$_2$ Cl$_2$]

Dichloridoethylenediamine cobalt (II)

(3) $K_3[Al(C_2O_4)_3]$

Potassium trioxalatoaluminate (III)

(ii) $[Fe(H_2O)_6]^{2+}$ complex

(1) IUPAC name — Hexaaqua iron (II) ion

(2) O.N. of central metal atom— + 2

(3) Number of unpaired electrons— 4

(4) Type of hybridisation—sp^3d^2

Fe, Z = 26 = [Ar]$4s^2 3d^6$

$Fe^{2+} - 3d^6 4s^0$

H_2O is a weak field ligand, no pairing of electrons takesplace. To accomodate lone pairs from six H_2O, one 4*s*, three p orbitals and two 4*d*-orbitals hybridise to give six sp^3d^2 hybrid orbitals.

oxidation state—

$$[\overset{x}{Fe}(\overset{0}{H_2O})_6]^{2+} - \text{Fe ion } = +2$$

$$x + 0 = 2$$

$$x = 2$$

OR

(b) (i) (1) Linkage isomerism — NO_2 group being ambidentate ligand.

(2) Hydrate isomerism

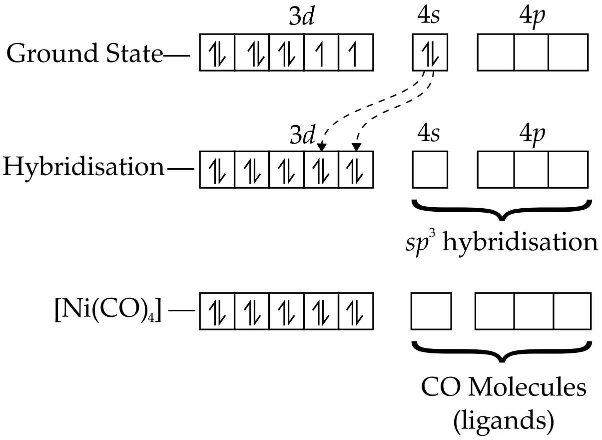
(3) Co-ordination isomerism.

(ii) According to valence bond approach complex $[Ni(CO)_4]$

Shape — Tetrahderal

Hybridisation — sp^3

Ni – Z = 28 = [Ar] $3d^8 4s^2$



18. (a) (i) Give balanced chemical equations for the following reactions:

(1) Phenol is treated with ice cold alkaline solution of benzene diazoniuum chloride.

(2) Diethyl ether is treated with phosphorous pentachloride.

(3) Ethyl alcohol is treated with thionyl chloride.

(ii) Give one chemical test each to distinguish between the following pairs of compounds:

(1) Ethanol and dimethyl ether

(2) Propan-1-ol and propan-2-ol

OR

(b) (i) Write chemical equations to illustrate the following name reactions:

(1) Williamson's synthesis

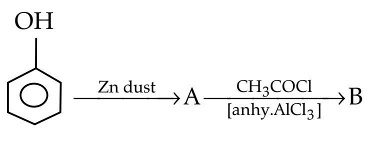
(2) Esterification reaction

(3) Reimer-Tiemann reaction

(ii) Identify the compounds A and B in the given reactions:

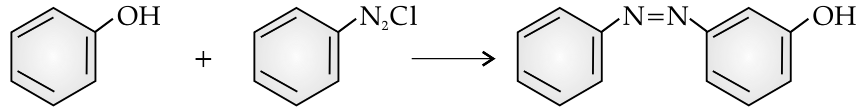
(1) $C_2H_5OH \xrightarrow[\Delta]{Cu} A \xrightarrow{dil.NaOH} B$

(2)



Ans.

(a) (i) (1)



Phenol | Benzene diazonium chloride ice cold alkaline solution | p - hydroxy azobenzene

(2) $C_2H_5OC_2H_5 + PCl_5 \rightarrow 2C_2H_5Cl + POCl_3$
Diethylether ethylchloride

(3) $CH_3CH_2OH + SOCl_2 \rightarrow CH_3CH_2Cl + SO_2 + HCl$
Ethyl alcohol ethylchloride

(ii) (1) Ethanol and dimethyl ether : Ethyl alcohol C_2H_5OH gives the iodoform test with Iodine, whereas dimethyl ether CH_3OCH_3 will not give this test.

(2) Propan-1-ol and propan-2-ol : When Lucas reagent (conc. HCl + $ZnCl_2$) is added to propan-2-ol, turbidity appears within 5 minutes but propan-1-ol does not give turbidity and solution remains clear.

OR

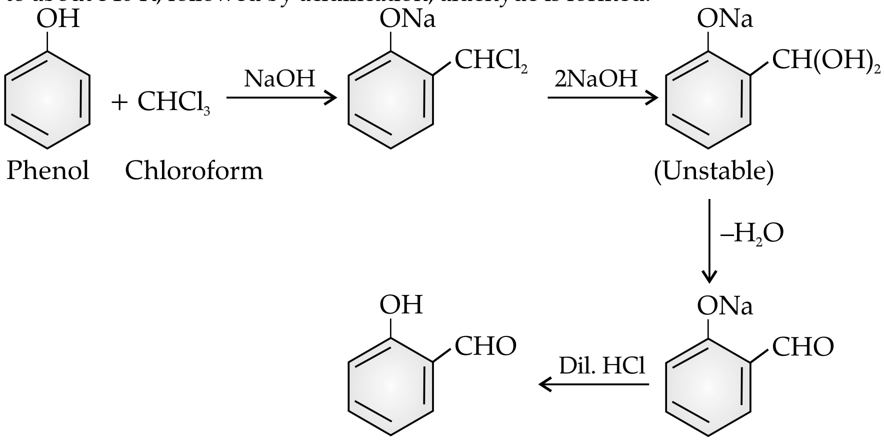
(b) (i) (1) Williamson's synthesis : It is the best laboratory method for the preparation of simple and mixed ethers.

$C_2H_5Br + C_2H_5ONa \rightarrow C_2H_5–O–C_2H_5 + NaBr$
Ethyl bromide Sodium ethoxide Diethyl ether

(2) Esterification reaction : An acid reacts with an alcohol to produce ester, is called esterification.

$CH_3COOH + CH_3CH_2OH \rightarrow CH_3COOCH_2CH_3 + H_2O$
acetic acid ethyl alcohol ethyl acetate

(3) Reimer-Tiemann reaction : In this reaction, phenol is heated with chloroform along with aqueous KOH/NaOH to about 340 K, followed by acidification, aldehyde is formed.

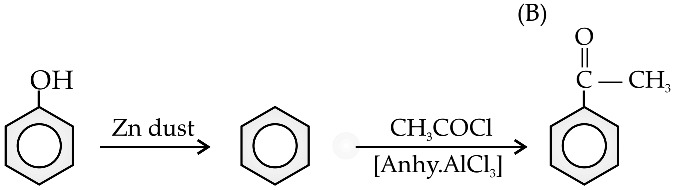


2-hydroxybenzaldehyde
(o-Salicylaldehyde)

(ii) (1) $C_2H_5OH \xrightarrow[\Delta\ 573\ K]{Cu} CH_3CHO\ (A) \xrightarrow{Dil.NaOH} CH_3–\underset{\underset{OH}{|}}{CH}–CH_2–CHO$

Aldol
(3-hydroxybutanal)
(B)

(2)



Phenol | Benzene (A) | (B) Acetophenone