ISC PAPER – 2020

CHEMISTRY

Paper-1
(Theory)

(Maximum Marks : 70) **(Time allowed : Three hours)**

(Candidates are allowed 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 two questions having internal choice.
Question numbers 9 to 15 carry 3 marks each, with 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 [ ].
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 K^{-1} mol^{-1}
1l atm = 1 dm^3 atm = 101·3 J. 1 Faraday = 96500 coulombs.
Avogadro's number = 6.023 × 10^{23}.

Question 1.

(a) *Fill in the blanks by choosing the appropriate word/ words from those given in the brackets :* [4 × 1]
(iodoform, volume, mass, haloform, gram equivalent, chloroform, 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 _____ hybridization 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, the product formed is:*
(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*

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

(i) *What is the common name of the polymer obtained by the polymerization 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 conductivity 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_3COOH at infinite dilution.*

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

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

Answers :

(a) (i) gram equivalent, volume
(ii) chloroform, haloform
(iii) sp^3d^2, high
(iv) coke, carbon monoxide

(b) (i) (3) (ii) (2) (iii) (4) (iv) (1)

(c) (i) — (c) (ii) — (a) (iii) — (d) (iv) — (b)

(d) (i) Nylon-6, addition polymer

(ii) Zn^{2+} ($3d^{10}$), No unpaired electron — colourless
Ni^{2+} ($3d^8$) Two unpaired electrons — green coloured
Cu^{2+} ($3d^9$), one unpaired electron, blue coloured

(iii) $\wedge_m^\infty(CH_3COOH) = \wedge_m^\infty(CH_3COO^-) + \wedge_m^\infty(H^+)$

$= \wedge_m^\infty(CH_3COONa) + \wedge_m^\infty(HCl) - \wedge_m^\infty(NaCl)$

$= 91 + 426.16 - 126.45$

$= 390.71$ ohm^{-1} cm^{-1} mol^{-1}

(iv) A – C_6H_5COCl
B – $C_6H_5CONH_2$
C – $C_6H_5NNH_2$
D – $C_6H_5N_2^+Cl^-$

Question 2. [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.*
($N_A = 6.023 \times 10^{23}$ 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.*
($N_A = 6.023 \times 10^{23}$ mol^{-1})

Answers :

(a) $A = 93$ g mol^{-1}
$\rho = 11.5$ gcm^{-3}
$a = 3 \times 10^{-8}$ cm
$N_A = 6.023 \times 10^{23}$ mol^{-1}

$$\rho = \frac{Z\,A}{N_0 . a^3}$$

$$Z = \frac{\rho . N_0\, a^3}{A}$$

$$= \frac{11.5 \times 6.023 \times 10^{23} \times (3 \times 10^{-8})^3}{93}$$

$$= \frac{11.5 \times 6.023 \times 27}{93} \times 10^{-1}$$

$$= \frac{1.15 \times 6.023 \times 27}{93} = 2.02$$

$Z = 2$

Type of unit cell – Body centered cubic

Or

(b) $A = 63.55$ g mol^{-1}
$Z = 4$
$\rho = 8.43$ g cm^{-3}
$N_A = 6.023 \times 10^{23}$ mol^{-1}

$$\rho = \frac{Z\,A}{N_0\, a^3}$$

$$a^3 = \frac{Z\,A}{N_0\,\rho}$$

$$= \frac{4 \times 63.55}{6.023 \times 10^{23} \times 8.93}$$

$$= \frac{4 \times 63.55}{6.023 \times 8.93} \times 10^{-23}$$

$$a = \frac{4 \times 635.5}{6.023 \times 8.93} \times 10^{-24}$$

$$a = \left(\frac{2542.0}{6.023 \times 8.93}\right)^{1/3} \times 10^{-8}\ \text{cm} = 3.62\ \text{Å}$$

For FCC unit cell,

$$\sqrt{2}a = 4r$$

$$4r = \sqrt{2}a$$

$$r = \frac{\sqrt{2}\,a}{4} = \frac{1.414 \times a}{4}$$

$$= \frac{1.414 \times 3.62}{4} = 1.278\ \text{Å}$$

Question 3. [2]

Complete and balance the following chemical equations:

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

(ii) $Cu + \underset{\text{dil.}}{HNO_3} \longrightarrow$ _____ + _____ + _____

Answers :

(i) $P_4 + 3NaOH + 3H_2O \xrightarrow[\text{Inert atm}]{\text{Heat}} 3NaH_2PO_3 + PH_3$

(ii) $3Cu + 8HNO_3 \longrightarrow 3\,Cu(NO_3)_2 + 2NO + 4H_2O$

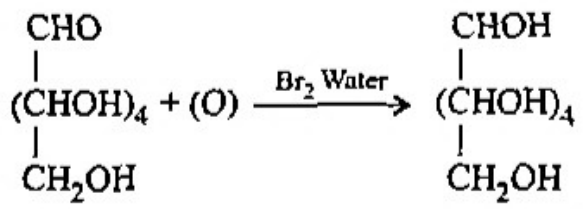
Question 4. [2]

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

(ii) *Write the zwitter ion structure of glycine.*

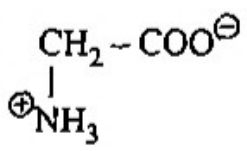
Answers :

(*a*) (*i*)



Glucose — Gluconic acid

(*ii*)



Question 5. [2]

(i) How do antiseptics differ from disinfectants?

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

Answers :

(*i*) Both antiseptics and disinfectant prevent the growth of micro-organisms and may even kill them but antiseptics are safe to be applied to the living tissues whereas disinfectants are not safe to be applied to living tissues.

(*ii*) 0.2% solution of phenol is antiseptic but 1% solution of it is disinfectant.

Question 6. [2]

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?

Answers :

(*a*) In one unit cell,

$$\text{No. of gold atoms} = 8 \times \frac{1}{8} = 1$$

$$\text{No. of cadmium atoms} = 6 \times \frac{1}{2} = 3$$

$$\text{Formula of the alloy} = AuCd_3 = Cd_3\,Au$$

Question 7. [2]

(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) $C_6H_5NH_2 + CH_3COCl \longrightarrow$ ____ + ____

(ii) $C_2H_5NH_2 + HNO_2 \longrightarrow$ ____ + ____ + ____

Answers :

(*a*) (*i*) This is because $C_2H_5NH_2$ can form H-bonds with water whereas in aniline larger hydrocarbon part prevents the formation of H-bonds with water.

(*ii*) This is because in aliphatic amines +I effect of alkyl group increases electron density over N-atom whereas in aromatic amines due to – R effect of benzene rings the electron density over N-atom decreases.

Or

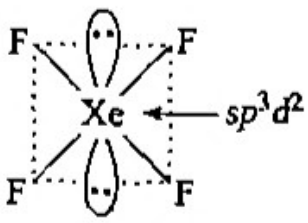
(*b*) (*i*) $C_6H_5NH_2 + CH_3COCl \rightarrow CH_3CO - NH - C_6H_5 + HCl$

(*ii*) $C_2H_5NH_2 + HONO \rightarrow C_2H_5OH + N_2 + H_2O$

Question 8. [2]

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

Answers :



Square planar

Question 9. [3]

(a) Calculate the emf and ΔG for the given cell at 25°C:

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

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

$(1F = 96500\ C,\ R = 8.314\ JK^{-1}\ mol^{-1})$.

Or

(b) Calculate the degree of dissociation (∝) of acetic acid, if its molar conductivity $(\wedge_m)$ *is 39.05 S cm² mol⁻¹*

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

Answers :

(*a*) (*i*) $Cr \rightarrow Cr^{3+} + 3e] \times 2$

$Fe^{2+} + 2e \rightarrow Fe] \times 3,\ n = 6$

$$E_{cell} = E^{\circ}_{cell} + \frac{0.0591}{n} \log \frac{(Fe^{2+})^3}{(Cr^{3+})^2}$$

$$= (-0.44 + 0.74) + \frac{0.0591}{6} \log \frac{(0.01)^3}{(0.1)^2}$$

$$= 0.30 + \frac{0.0591}{6} \log 10^{-4}$$

$$= 0.30 + (-4) \times \frac{.0591}{6} \log 10$$

$$= 0.30 - \frac{2}{3} \times .0591 \times 1 = 0.31 - \frac{0.1182}{3}$$

$$= 0.31 - 0.0394 = 0.271.$$

Or

(*b*) $\wedge_m^{(CH_3COOH)} = 39.05\ S\ cm^2\ mol^{-1}$

$\wedge^{\infty}_{m(CH_3COOH)} = \lambda^{\infty}_m(H^+) + \lambda^{\infty}_m(CH_3COO^-)$

$= 349.60 + 40.95$

$= 390.55\ S\ cm^2\ mol^{-1}$

$$\alpha = \frac{39.05}{390.55} = 0.0999 = 9.99\%$$

Question 10. [3]

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.

Answer :

Important ore of silver = Argentite , Ag_2S

Extraction of silver from argentite, Ag_2S ore

The various steps involved are :

1. Crushing of ore
2. Grinding
3. Concentration of the sulphide ore by leaching with a dilute solution of NaCN.
   $Ag_2S + 4NaCN + 2O_2 \rightleftharpoons 2Na[Ag(CN)_2] + Na_2SO_4$
4. Displacement of Ag
   $2Na[Ag(CN)_2] + Zn \rightarrow Na_2[Zn(CN)_4] + 2Ag\downarrow$
5. Refining of silver by electrorefining.

Question 11. [3]

How will you convert the following:

(i) Chlorobenzene to biphenyl

(ii) Propene to 1 - bromopropane

(iii) Chlorobenzene to aniline

Answers :

(*i*)

Chloro-benzene

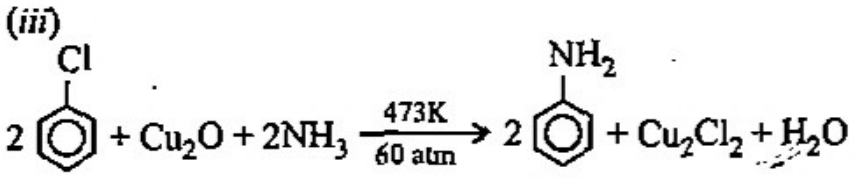
Biphenyl

(*ii*) $CH_3-\overset{}{C}H=CH_2 + HBr \xrightarrow[\text{Benzoyl peroxide}]{\text{(Organic Peroxide)}} CH_3-CH_2-\underset{Br}{CH_2}$

Propene

1 - bromopropane

(*iii*)



Aniline

Question 12. [3]

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).

Answers :

(*i*) The path of the light becomes visible. This effect is called Tyndall effect.

(*ii*) It gets coagulated. This process is called electrophoresis.

(*iii*) Coagulation of colloidal solution of As_2S_3 occurs.

Question 13. [3]

(a) How will you convert the following: (Given balanced equation)

(i) Benzoyl chloride to benzaldehyde.

(ii) Methyl chloride to acetic acid.

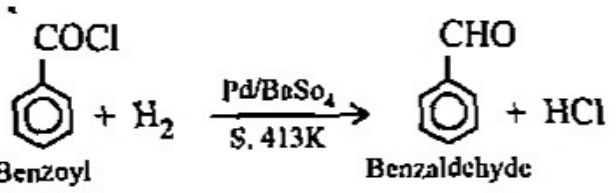
(iii) Acetic acid to methane

Or

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

Answers :

(*a*) (*i*)



Benzoyl Chloride

Benzaldehyde

(*ii*)

$CH_3Cl \xrightarrow{KCN} CH_3-CN \xrightarrow{H_2O/H^+} CH_3COOH$

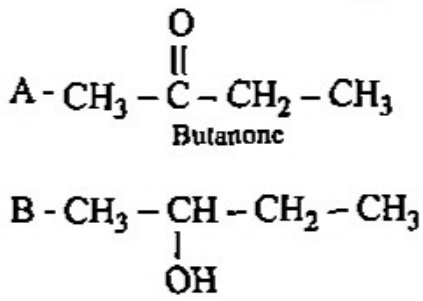
Methyl Chloride — Methyl Cyanide — Acetic acid

(*iii*) $CH_3COOH \xrightarrow{NaOH} CH_3COONa \xrightarrow[\Delta]{NaOH + CaO} CH_4$

Methane

Or

(*b*)



Butanone

Butan-2-ol

But-2-ene

Ozonide

Ethanal

$CH_3-\overset{O}{\overset{\|}{C}}-CH_2-CH_3 + 3I_2 + 4NaOH \xrightarrow{\Delta}$

Butanone

$CHI_3 + CH_3CH_2COONa + 3NaI + 3H_2O$

Idoform

Question 14. [3]

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

Answers :

According to Arrhenius equation

$$\log \frac{k_2}{k_1} = \frac{E_{act}}{2.303R}\left(\frac{T_2 - T_1}{T_1\ T_2}\right)$$

$T_1 = 300\ K$

$T_2 = 320\ K$

$R = \frac{8.314}{1000}\ kJ\ mol^{-1}\ K^{-1}$

$$\frac{k_2}{k_1} = \frac{\frac{0.693}{10}}{\frac{0.693}{30}} = 3$$

$$\therefore \quad \log 3 = \frac{E_{act}}{2.303 \times \frac{8.314}{1000}} \times \left(\frac{(320-300)}{320\times 300}\right)$$

$$E_{act} = \frac{0.4771 \times 2.303 \times 8.314}{1000} \times \frac{320\times 300}{20}$$

$= 43.85\ kJ$

Question 15. [3]

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.

Answers :

(*i*) This is due to the presence of unpaired electrons in $(n-1)\ d-$ orbitals.

(*ii*) This is due to the increase in atomic mass and decrease in atomic volume.

(*iii*) This is because in the presence of acidic medium such as dil H_2SO_4, it gives nascent oxygen which oxidises other substances.

$$K_2Cr_2O_7 + 4H_2SO_4 \longrightarrow K_2SO_4 + Cr_2(SO_4)_3 + 4H_2O + 3(O)$$

(Nascent oxygen)

Question 16. [5]

(a) (i) The elevation in boiling point when 0.30 g of acetic acid 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 K 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 298K

(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})

Answers :

(*a*) (*i*) $w_B = 0.30\ g$

$w_A = 100\ g$

$\Delta T_b = 0.0633°C$

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

Calculated molecular mass of CH_3COOH $M_B = 60$

$$\Delta T_b = i\,k_b \times \frac{w_B \times 1000}{w_A \times M_B}$$

$$0.0633 = \frac{i \times 2.53 \times 0.30 \times 1000}{100 \times 60}$$

$$i = \frac{0.0633 \times 100 \times 60}{2.53 \times 0.30 \times 1000}$$

$i = 0.5$

$$i = \frac{\text{Calculated molecular mass}}{\text{Observed molecular mass}}$$

$$\therefore \text{ Observed molecular mass} = \frac{120}{0.5} = 240.$$

Since observed molecular mass is double the theoretical value, there is association of acetic acid molecules to form dimers.

(*ii*) $w_B = 0.025\ g$

$w_B = 174\ g\ mol^{-1}$

$n = \frac{0.025}{174}$

$V = 2L$

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

$T = 298\ K$

$i = \alpha = 3$

$$\pi = i\,\frac{n_B RT}{V}$$

$$= 3 \times \frac{0.025}{2\times174} \times 0.0821\times298$$

$$= \frac{1.5\times0.025\times0.0821\times298}{174}$$

$$= 5.1 \times 10^{-3} \text{ atm}$$

Or

(b) (i) $\Delta T_f = 273 - 272.4$

$= 0.6$ K

$K_f = 1.86$ k kg mol^{-1}

$m = ?$

$\Delta T_f = K_f m$

(1) Molality, $m = \frac{0.6}{1.86} = 0.322$

(2) $K_b = 0.512$ k kg mol^{-1}

$\Delta T_b = K_b\, m$

$= 0.512 \times 0.322$

$\Delta T_{b'} = 0.165$ K

$\Delta T_{b'} = 373 + \Delta T_b$

Boiling point of solution

$\Delta T_{b'} = 373.165$ K

(3) we know that

$$\frac{P_{A^\circ} - P_A}{P_{A^\circ}} = X_B$$

$P_{A^\circ} = 23.756$ mm of H_g

$m = 0.322$

$$X_B = \frac{m}{m + \frac{1000}{18}}$$

$$X_B = \frac{0.322}{0.322 + 55.55} = 0.0057$$

$$\therefore \frac{P_{A^\circ} - P_A}{P_{A^\circ}} = x_B = 0.0057$$

Lowering of vapour pressure of water

$= P_{A^\circ} - P_A = 0.0057 \times 23.756$

$= 0.1354$ mm of Hg

(ii) $Ca(NO_3)_2 \rightleftharpoons Ca^{2+} + 2NO_3^-$

$$\Delta T_b = i\,K_b \cdot \frac{w_B \times 1000}{M_B w_A}$$

$\Delta T_b = 0.975$ K

$w_A = 10$ g

$w_B = 1.23$ g

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

$M_B = 164$ g mol^{-1}

$$0.975 = \frac{i\times0.52\times1.23\times1000}{164\times10}$$

$$i = \frac{0.975\times164\times10}{0.52\times1.23\times1000} = 2.5$$

Question 17. [5]

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

(1) $[Cu(NH_3)_4]SO_4$ (2) $[Co(en)_2Cl_2]$

(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.

(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) $[Cr(H_2O)_4Cl_2]\,Cl.2H_2O$ 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 an magnetic behaviour of $[Ni(CO)_4]$. (at. no. of Ni = 28)

Answers :

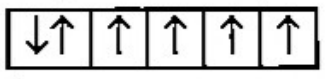
(a) (i) (1) tetraammine copper (II) sulphate

(2) dichloridotris (ethylenediamine) cobalt (II)

(3) potassium trioxalato aluminate (III)

(ii) (1) hexaaquairon (II) ion

(2) +2 (Fe^{2+} $1s^2\,2s^2\,2p^6\,3s^2\,3p^6\,3d^6$)



(3) 4

(4) sp^3d^2

Or

(b) (i) (1) Linkage isomerism

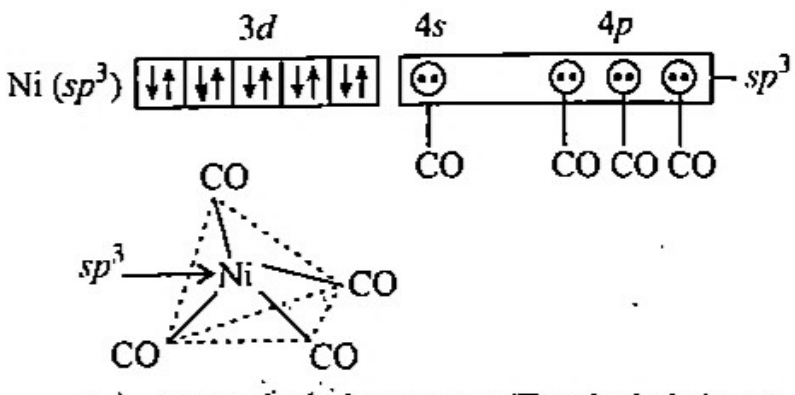
(2) Hydrate isomerism

(3) Coordination isomerism

(ii) In Ni $(CO)_4$, the central atom is Ni(O)

Atomic number of Ni = 28

Ni (O) $1s^2\,2s^2\,2p^6\,3s^2\,3p^6\,4s^2\,3d^8$



Regular tetrahedral geometry (Tetrahedral shape)

There is no unpaired electron in the complex, hence it is diamagetic.

Question 18. [5]

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

(1) Phenol is treated with ice cold alkaline solution of benzene diazonium 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-I-ol and propan-2-ol

Or

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

(1) Williamson's synthesis

(2) Esterification reaction

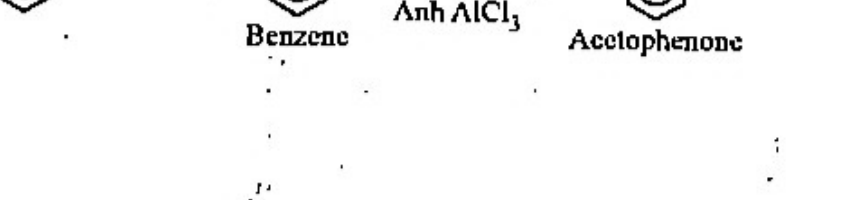
(3) Reimer-Tiemann reaction

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

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

(2)  $\xrightarrow{Zn\ dust} A \xrightarrow[(anhy.\ AlCl_3)]{CH_3COCl} B$

Answers :

(a) (i) (1) 

(2) $C_2H_5O\,C_2H_5 + PCl_5 \rightarrow 2C_2H_5Cl + POCl_3$

(3) $C_2H_5OH + SOCl_2 \rightarrow C_2H_5Cl + SO_2 \uparrow + HCl \uparrow$

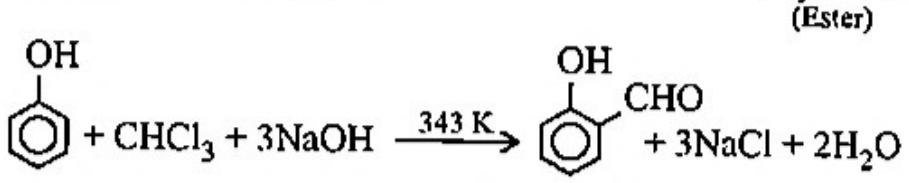
(ii) (1) C_2H_5OH gives iodoform Test (*i.e.*, yellow ppt. of Iodoform I_2 and NaOH solution) but dimethyl ether does not.

(2) Propan-2-ol gives iodoform test but propan-1-ol does not.

Or

(b) (i) (1) $\underset{\text{Ethyl bromide}}{C_2H_5Br} + \underset{\text{Sodium ethoxide}}{C_2H_5O^-\,Na^+} \xrightarrow{\text{Dry ether}} NaBr + \underset{\text{Diethyl ether}}{C_2H_5OC_2H_5}$

(2) $\underset{\text{Acetic acid}}{CH_3COOH} + \underset{\text{Ethyl alcohol}}{C_2H_5OH} \underset{}{\overset{\text{conc. } H_2SO_4\,\Delta}{\rightleftharpoons}} \underset{\substack{\text{Ethyl acetate}\\\text{(Ester)}}}{CH_3COOC_2H_5} + H_2O$

(3) 

Phenol — Salicylaldehyde

(ii) (1) $\underset{\substack{\text{Ethyl}\\\text{alcohol}}}{C_2H_5OH} \xrightarrow[\Delta]{Cu} \underset{\text{Acetaldehyde}}{CH_3CHO} \xrightarrow{NaOH} \underset{\text{Acetaldol}}{CH_3-\overset{\overset{OH}{|}}{\underset{\underset{H}{|}}{C}}-CH_2-CHO}$

(2)

Benzene — Acetophenone