ISC Class 12 Chemistry Question Paper Solution 2017

CHEMISTRY THEORY (PAPER-1)

Part I (20 marks)

Answer all questions

Question 1

(a) Fill in the blanks by choosing the appropriate word/words from those given in the brackets: **[5]**

(iodoform, acetaldehyde, positive, greater, acidic, acetone, disaccharide, negative, increases, glucose, decreases, chloroform, polysaccharide, lactose, lesser, basic, cationic hydrolysis, anionic hydrolysis)

(i) Calcium acetate on heating gives _____ which gives _____ on heating with iodine and sodium hydroxide solution.

(ii) On dilution of a solution, its specific conductance _____ while its equivalent conductance_____.

(iii) Sucrose is a _____ and yields upon hydrolysis, a mixture of _____ and fructose.

(iv) More _____ is the standard reduction potential of a substance, the _____ is its ability to displace hydrogen from acids.

(v) An aqueous solution of CH_3COONa is_____ due to _____.

(b) Complete the following statements by selecting the **correct alternative from** the choices given: **[5]**

(i) In a face centered cubic lattice, atom (A) occupies the corner positions and atom (B) occupies the face centre positions. If one atom of (B) is missing from one of the face centered points, the formula of the compound is:

(1) A_2B_5

(2) A_2B_3

(3) AB_2

(4) A_2B

(ii) The half-life period of a first order reaction is 20 minutes. The time required for the concentration of the reactant to change from 0·16 M to 0·02M is:

(1) 80 minutes

(2) 60 minutes

(3) 40 minutes

(4) 20 minutes

(iii) For a spontaneous reaction ΔG^o *and* E^o *cell* will be respectively:

(1) -ve and +ve

(2) +ve and -ve

(3) +ve and +ve

(4) -ve and -ve

(iv) The conjugate acid of HPO_4^{2-} is:

(1) H_3PO_3

(2) H_3PO_4

(3) $H_2PO_4^-$

(4) PO_4^{3-}

(v) The polymer formed by the condensation of hexamethylenediamine and adipic acid is:

(1) Teflon

(2) Bakelite

(3) Dacron

(4) Nylon-66

(c) Answer the following questions: **[5]**

(i) Why the freezing point depression (ΔT_f) of 0·4M NaCl solution is nearly twice than that of 0·4M glucose solution?

(ii) Identify the order of reaction from each of the following units of rate constant (k):

(a) mol L^{-1} sec^{-1}

(b) mol^{-1} L sec^{-1}

(iii) Specific conductivity of 0·20 M solution of KCl at 298 K is 0·025 S cm^{-1}. Calculate its molar conductivity.

(iv) Name the order of reaction which proceeds with a uniform rate throughout?

(v) What are the products formed when phenol and nitrobenzene are treated separately with a mixture of concentrated sulphuric acid and concentrated nitric acid?

(d) Match the following: **[5]**

(i)	Diazotisation	(a)	Bakelite
(ii)	Argentite	(b)	Nernst equation
(iii)	Thermosetting plastics	(c)	Aniline
(iv)	Electrochemical cell	(d)	Ethylenediamine
(v)	Bidentate ligand	(e)	Froth floatation process

Comments of Examiners

(a) (i) Many candidates wrote 'acetaldehyde' instead of 'acetone' in the first blank. A few candidates wrote 'chloroform' instead of 'iodoform' in the second blank.

(ii) Many candidates interchanged (reversed) the answer instead of 'decreases' and 'increases' they wrote 'increases' and 'decreases'.

(iii) Instead of 'disaccharide' many candidates wrote 'polysaccharide' in the first blank. Few wrote 'lactose' in place of 'glucose' for the second blank.

(iv) Some candidates wrote 'positive' instead of negative' in the first blank. For the second blank, instead of 'greater' a few candidates wrote 'more' which was not given in the list of words.

(v) Some candidates wrote 'acidic' in place of 'basic' in the first blank. Instead of 'anionic hydrolysis' some candidates wrote 'cationic hydrolysis' in the second blank.

(b) (i) Some candidates wrote A_2B_3 or AB_2 instead of A_2B_5.

(ii) Most of the candidates were able to calculate the answer correctly i.e. 60 minutes but some candidates wrote 40 minutes or 20 minutes also.

(iii) The correct option was '-ve and +ve' but some candidates gave incorrect options also.

(iv) Instead of $H_2PO_4^-$ some candidates wrote other options such as PO_4^{3-}, H_3PO_4 etc. which were not correct.

(v) Instead of Nylon-66 which was the correct answer, some candidates wrote Dacron or Teflon which was not correct.

(c) (i) Many candidates wrote that NaCl is a strong electrolyte and glucose is a non-electrolyte. However, they were not able to explain that colligative property is directly proportional to number of moles in solutions. In a few cases, van't Hoff factor was not given.

(ii) Instead of zero order and 2nd order reaction, some candidates wrote 1st order and zero order reaction.

(iii) Most of the candidates calculated the value of molar conductivity correctly, but some candidates wrote the answer with incorrect unit.

(iv) Instead of zero order reaction some candidates wrote first order and second order reactions.

Suggestions for teachers

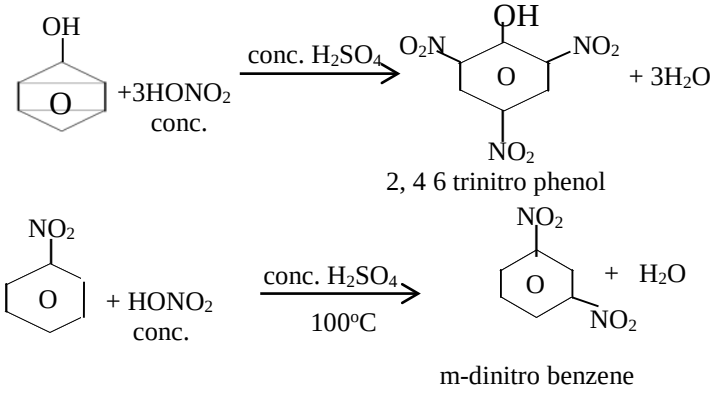
- Insist upon writing organic reactions with conditions.
- The relationship between specific conductance,equivalent conductance, specific conductivity and molar conductivity should be explained to students.
- Ask students to learn carbohydrates, types of carbohydrates, chemical properties, etc.
- Electrochemical series and identification of anode and cathode on the basis of standard electrode potential must be explained thoroughly to students.
- Salt hydrolysis of all types of salts must be explained with suitable examples.
- Explain the calculations to find the number of atoms in various types of cubic unit cells. Give practice to find the formula of the compound.
- More practice should be given in numerical problems based on half-life period.
- Instruct students to write the answer to any numerical problem with correct unit.
- Explain the conditions for spontaneous process in terms of ΔG° and E° to the students.
- Bronsted-Lowry's concept and conjugate acid – base pairs should be explained clearly to the students.
- Monomers and their polymers should be explained in a tabular form.
- Explain how the value of van't Hoff factor changes for electrolytes and non-electrolytes by taking different examples.
- Give adequate practice in class in calculating the units of rate constant (k) for different order reactions.
- Sufficient practice should be given to students to represent zero, first and second order reactions graphically.
- Directive influence of various functional groups in aromatic compounds should be clearly explained to students.

(v) Most of the candidates failed to explain that OH group is ortho and para directing group. The concept of directive influence was not very clear to many candidates.

(d) Most of the candidates attempted this part correctly. A few candidates gave incorrect answers also, such as diazotization was matched with ethylenediamine and bidentate ligand was matched with aniline.

MARKING SCHEME

Question 1

(a)	(i)	acetone, iodoform
	(ii)	decreases, increases
	(iii)	disaccharide, glucose
	(iv)	negative, greater
	(v)	basic, anionic hydrolysis
(b)	(i)	(1) or A_2B_5
	(ii)	(2) or 60 minutes
	(iii)	(1) or -ve and +ve
	(iv)	(3) or $H_2PO_4^-$
	(v)	(4) or Nylon-66
(c)	(i)	$NaCl \rightarrow Na^+ + Cl^-$ (is an electrolyte) 0·4M 0·4M 0·4M Glucose → Glucose (non electrolyte) 0·4M 0·4M Number of moles increases (doubles) in NaCl solution. Hence, the depression in freezing point is nearly twice than that of glucose solution.
	(ii)	(a) Zero order reaction (b) 2nd order reaction
	(iii)	Molar conductivity $\Lambda_m = \frac{1000 \times K}{M}$ or $= \frac{1000 \times 0{\cdot}025}{0{\cdot}20}$ $= 125\ S\ cm^2\ mol^{-1}$
	(iv)	Zero order reaction.
	(v)	

(d)	Match the following:			
	(i)	Diazotisation	(c)	Aniline
	(ii)	Argentite	(e)	Froth floatation process
	(iii)	Thermosetting plastics	(a)	Bakelite
	(iv)	Electrochemical cell	(b)	Nernst equation
	(v)	Bidentate ligand	(d)	Ethylenediamine

Part II (50 marks)

SECTION A

Answer any two questions.

Question 2

(a) (i) Determine the freezing point of a solution containing 0·625 g of glucose ($C_6H_{12}O_6$) dissolved in 102·8 g of water. **[2]**
(Freezing point of water = 273 K, K_f for water = 1·87K kg mol^{-1}, at. wt. C = 12, H = 1, O = 16)

(ii) A 0·15 M aqueous solution of KCl exerts an osmotic pressure of 6·8 atm at 310 K. Calculate the degree of dissociation of KCl. (R = 0·0821 Lit. atm K^{-1} mol^{-1}). **[2]**

(iii) A solution containing 8·44 g of sucrose in 100 g of water has a vapour pressure 4·56 mm of Hg at 273K. If the vapour pressure of pure water is 4·58 mm of Hg at the same temperature, calculate the molecular weight of sucrose. **[1]**

(b) (i) When ammonium chloride and ammonium hydroxide are added to a solution containing both Al^{3+} and Ca^{2+} ions, which ion is precipitated first and why? **[2]**

(ii) A solution of potassium chloride has no effect on litmus whereas, a solution of zinc chloride turns the blue litmus red. Give a reason. **[2]**

(c) How many sodium ions and chloride ions are present in a unit cell of sodium chloride crystal? **[1]**

Comments of Examiners

(a) (i) The value of ΔT_f was calculated correctly by most of the candidates but some candidates added the value of ΔT_f to 273 instead of subtracting this value from 273.

(ii) Many candidates calculated the value of van't Hoff factor (i) correctly but some candidates failed to calculate the value of degree of dissociation (α) for KCl.

(iii) Most of the candidates calculated the molecular weight of sucrose correctly but some candidates wrote the incorrect unit.

(b)(i) Many candidates wrote that Al^{3+} ions will be precipitated first. A few candidates wrote that Ca^{2+} ions will precipitate first. The concept of common ion effect and solubility product was not considered by many candidates.

(ii) Many candidates gave correct explanation for KCl but for $ZnCl_2$ some candidates wrote anionic hydrolysis instead of cationic hydrolysis.

(c) Some candidates wrote the coordination number 6:6 instead of 4 Na^+ and 4 Cl ions.

Suggestions for teachers

- While teaching, enough practice should be given in solving numerical problems. Ask students to write the formula, do the substitution and give the answer with the correct unit.
- While teaching abnormal molecular weights, calculation of van't Hoff factor (i) along with degree of dissociation/ association must be clearly explained to the students.
- More practice should be given to students in solving numerical problems for calculation of molecular weights of nonvolatile substances.
- Quantitative inorganic analysis should be explained by using solubility product and common ion effect.
- Explain that the salts of strong acid and strong base such as KCl do not undergo hydrolysis hence the solution is neutral. Whereas salt of strong acid and weak base ($ZnCl_2$) undergo cationic hydrolysis hence solution is acidic
- Diagram of unit cell should be drawn and explained. The difference between coordination number and number of constituent particles should be explained

MARKING SCHEME

Question 2

(a)	(i)	K_f = 1·87 K kg mol^{-1}, w = 0·625g , W = 102·8 g, m = 180 $\Delta T_f = \frac{1000 k_f \cdot w}{m\, W} = \frac{1000 \times 1 \cdot 87 \times 0 \cdot 625}{180 \times 102 \cdot 8}$ $\Delta T_f = 0 \cdot 06316\ K$ Freezing point of solution = 273 - 0·06316 = 272.93684 K
	(ii)	C = 0·15M, $\pi = 6 \cdot 8\ atm$, $T = 310\ K$, $R = 0 \cdot 0821$ L atm $K^{-1}mol^{-1}$ $KCl \rightarrow K^+ + Cl^-$ (n = 2)

		$\pi = i\ CRT$ 6·8 = i ×0·15×0·0821×310 i = $\frac{6·8}{0·15×0·0821×310} = 1·7812$ Degree of dissociation (α) = $\frac{i-1}{n-1} = \frac{1·7812-1}{2-1}$ = 0.7812 or =78·12%
	(iii)	P^0 = 4·58 mm of Hg, P = 4·56 mm of Hg, w = 8·44g, W = 100 g, M = 18 g mol^{-1} ΔP = 4·58 - 4·56 = 0·02 mm of Hg. m = $\frac{P^0×w×M}{\Delta P\ W} = \frac{4·58×8·44×18}{0·02×100} = 347·90\ g\ mol^{-1}$
(b)	(i)	Al^{3+} ion will be precipitated first. The Ksp value of $Al(OH)_3$ is less as compared to $Ca(OH)_2$. Therefore, the ionic conc. product of $[Al^{3+}]$ and $[OH^-]$ ion will exceed the solubility product. The conc. of OH^- ion is not sufficient (due to C.I.E) to exceed the solubility product of (Ca^{2+}) and $[OH^-]$ due to high Ksp value.
	(ii)	KCl is a salt of strong acid and strong base hence do not hydrolyse with H^+ and OH^- of water. Hence, the aq solution of KCl is neutral and has no effect on litmus $ZnCl_2$ is salt of strong acid and weak base hence undergo cationic hydrolysis, therefore, the number of H^+ ions increases in solution and turns blue litmus red.
(c)	Number of Na^+ = 4 Number of Cl^- = 4	

Question 3

(a) (i) Lead sulphide has face centered cubic crystal structure. If the edge length of the unit cell of lead sulphide is 495 pm, calculate the density of the crystal. (at. wt. Pb = 207, S = 32) **[1]**

(ii) For the reaction: $2H_2 + 2NO \rightleftharpoons 2H_2O + N_2$, the following rate data was obtained: **[3]**

S.No.	[NO] mol L^{-1}	[H_2] mol L^{-1}	Rate: mol L^{-1} sec^{-1}
1	0·40	0·40	$4·6×10^{-3}$
2	0·80	0·40	$18·4×10^{-3}$
3	0·40	0·80	$9·2×10^{-3}$

Calculate the following:

(1) The overall order of reaction.

(2) The rate law.

(3) The value of rate constant (k).

(b) (i) The following electrochemical cell is set up at 298 K: **[2]**

$Zn/Zn^{2+}\ (aq)(1M)//\ Cu^{2+}(aq)(1M)/Cu$

Given → E^oZn^{2+}/Zn = - 0·761V, E^oCu^{2+}/Cu = + 0·339 V

(1) Write the cell reaction.

(2) Calculate the emf and free energy change at 298 K.

(ii) Answer the following: **[2]**

(1) What is the effect of temperature on ionic product of water (Kw)?

(2) What happens to the ionic product of water (Kw) if some acid is added to it?

(c) Frenkel defect does not change the density of the ionic crystal whereas, Schottky defect lowers the density of ionic crystal. Give a reason. **[2]**

Comments of Examiners

(a)(i) Some candidates calculated the density without converting the unit of edge length from pm to cm. Some candidates took an incorrect value of Z. The unit of density was also incorrectly mentioned.

(ii) Several candidates calculated the overall order of reaction directly without showing the calculation. A few candidates were not able to calculate the value of rate constant (k).

(b) (i) Most of the candidates gave the cell reaction and emf of the cell correctly. Some candidates were not able to calculate the value of free energy change (ΔG°) because they didn't know the correct equation. Many candidates did not write negative sign before the value of (ΔG°).

(ii)(1) Many candidates wrote that the ionic product of water (k_w) remains the same instead of writing that the value of k_w increases with increase in temperature (k_w α temperature).

(2) Instead of writing that the value of k_w remains constant on the addition of acid several candidates wrote the value of k_w increases.

(c) Cation was not specified by many candidates for Frenkel defect. Also for Schottky defect, many candidates wrote atoms instead of cations and anions.

Suggestions for teachers

- Stress upon that the value of Z changes with type of unit cells.
- Give more practice in solving numerical problems based on density, edge length, etc.
- More practice must be given on numerical problems based on order of reaction. Emphasize on step by step calculations.
- Insist that students must practice the numerical problems based on electrochemistry.
- Defects in crystals must be explained with the help of diagrams. How the density of the crystal changes due to these defects should also be explained.

MARKING SCHEME

Question 3

(a)	(i)	Density (d) = $\frac{Z\times M}{N_A\times a^3}$ or $\frac{4\times 239}{6\cdot 023\times 10^{23}\times(495\times 10^{-10})^3}$ $= 13\cdot 087\ g/cm^3$
	(ii)	For reaction $2NO + 2H_2 \rightarrow 2H_2O + N_2$ Rate $= k\,[NO]^p\,(H_2)^q$ (i) $4\cdot 6\times 10^{-3} = k(0\cdot 4)^P\,(0\cdot 4)^q$ (ii) $18\cdot 4\times 10^{-3} = k(0\cdot 8)^p\,(0\cdot 4)^q$ (iii) $9\cdot 2\times 10^{-3} = k(0\cdot 4)^p(0\cdot 8)^q$ Dividing eq (ii) by eq (i)

$\frac{18{\cdot}4\times10^{-3}}{4{\cdot}6\times10^{-3}} = \left(\frac{0{\cdot}8}{0{\cdot}4}\right)^{p}$

$4 = (2)^{p}$

$p = 2$

Dividing eq (iii) by eq(i)

$\frac{9{\cdot}2\times10^{-3}}{4{\cdot}6\times10^{-3}} = \left(\frac{0{\cdot}8}{0{\cdot}4}\right)^{q}$

$2 = (2)^{q}$

$q = 1$

(i) Over all order of reaction

Rate = k $[NO]^2$ $[H_2]^1$

Order of reaction = 2 + 1 = 3

(ii) Rate law = rate = $k[NO]^2[H_2]^1$

(iii) Rate constant (k) = $\frac{rate}{(A)^3} = \frac{4{\cdot}6\times10^{-3}}{(0{\cdot}4)^3}$

k = 0· 071875 $mol^{-2}L^2s^{-1}$

(b) (i) (1) Cell reaction: $Zn(s) + Cu^{2+}(aq) \rightarrow Zn^{2+}(aq) + Cu(s)$

(2) $E^0cell = E^0$ (cathode) – E^0(anode)

= 0·339 V – (- 0·761V)

= 1·10 V

$\Delta G^o = -nFE^0$

= -2×96500×1·10

= -212300 J

= -212·3 k.J

(ii) (1) As the temperature is increased, the value of K_w will also increase (K_w α temperature)

(2) When acid is added to water, the value of K_w remains constant.

(c)

- Frenkel defect arises due to presence of holes in the cationic lattice site and cation occupies an interstitial position. Hence, density remains the same.
- Schottky defect arises when same number of cations and anions are missing from their normal site and a pair of holes are formed hence density decreases.

Question 4

(a) (i) Name the law or principle to which the following observations conform: **[3]**

(1) When water is added to a 1·0 M aqueous solution of acetic acid, the number of hydrogen ion (H^+) increases.

(2) When 9650 coulombs of electricity is passed through a solution of copper sulphate, 3·175 g of copper is deposited on the cathode (at.wt. of Cu = 63·5).

(3) When ammonium chloride is added to a solution of ammonium hydroxide, the concentration of hydroxyl ions decreases.

(ii) What is the difference between the order of a reaction and its molecularity? **[2]**

(b) (i) Explain why high pressure is required in the manufacture of sulphur trioxide by contact process. State the law or principle used. **[2]**

(ii) Calculate the equilibrium constant (Kc) for the formation of NH_3 in the following reaction: **[1]**

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$$

At equilibrium, the concentration of NH_3, H_2 and N_2 are $1{\cdot}2\times10^{-2}$, $3{\cdot}0\times10^{-2}$ and $1{\cdot}5\times10^{-2}$ M respectively.

(c) Explain the following: **[2]**

(i) Hydrolysis of ester (ethyl acetate) begins slowly but becomes fast after some time.

(ii) The pH value of acetic acid increases on addition of a few drops of sodium acetate.

Comments of Examiners

(a)(i) 1. Instead of 'Ostwald's dilution law' many candidates wrote 'common ion effect'.

2. Some candidates wrote only 'Faraday's Law' or 'Faraday's IInd Law' instead of 'Faraday's 1st Law of electrolysis'.

3. Instead of 'Common ion effect' some candidates wrote 'Le Chatelier's principle'.

(ii) Some candidates were not able to write one pair of difference correctly. The concept of order of reaction and molecularity was not clear to many candidates.

(b)(i) Many candidates mentioned the name of the Law correctly but failed to give the requirement of high pressure in the manufacture of SO_3.

(ii) Most of the candidates solved the numerical correctly. Some candidates did not substitute the correct values in the formula hence got incorrect value of Kc. The unit of Kc was also not mentioned correctly by many candidates.

(c)(i) A number of candidates did not write that acetic acid acts as an auto catalyst.

(ii) A few candidates wrote only 'common ion effect' but failed to explain that H^+ ion concentration decreases as the dissociation of acetic acid is suppressed.

Suggestions for teachers

- Insist upon that students must learn the laws/principles and their applications after understanding thoroughly.
- Explain Molecularity and order of reaction to students with suitable examples.
- Le Chatelier's principle and its application in various chemical reactions at equilibrium must be clearly explained to students.
- Method to calculate equilibrium constants (k_c) for different reactions should be given more practice and the answer must be given along with the correct unit.
- Explain different types of catalysts to students.
- Explain the relationship of pH value with the concentration of $[H^+]$ ion. Common ion effect should be explained clearly.

MARKING SCHEME

Question 4

<table>
<tr><td>(a)</td><td>(i)</td><td>(1)</td><td colspan="4">Ostwald’s dilution law.</td></tr>
<tr><td></td><td></td><td>(2)</td><td colspan="4">Faraday’s 1st law of electrolysis</td></tr>
<tr><td></td><td></td><td>(3)</td><td colspan="4">Common ion effect</td></tr>
<tr><td></td><td>(ii)</td><td colspan="5"><table>
<tr><td></td><td>Order of reaction</td><td></td><td>Molecularity</td></tr>
<tr><td>1</td><td>Order of reaction is the sum of exponents in the rate law equation.</td><td>1</td><td>Molecularity is the total number of molecules of reactants taking part in a particular step of reaction</td></tr>
<tr><td>2</td><td>Order of reaction may have fractional values or it may be zero.</td><td>2</td><td>There is always a whole number other than zero.</td></tr>
</table></td></tr>
<tr><td>(b)</td><td>(i)</td><td colspan="5">$2SO_2 + O_2 \rightleftharpoons 2SO_3$
Formation of SO_3 takes place with decrease in volume, when pressure is increased the equilibrium will shift in that direction where volume is less. Hence the forward reaction is favoured with high pressure.
Le Chatelier’s principle: When a stress is applied on a system at equilibrium, the system behaves in such a way so as to counteract the stress.</td></tr>
<tr><td></td><td>(ii)</td><td colspan="5">$K_c = \frac{[NH_3]^2}{[N_2]\,[H_2]^3} = \frac{(1{\cdot}2\times10^{-2})^2}{(1{\cdot}5\times10^{-2})(3{\cdot}0\times10^{-2})^3}$
$K_c = 3{\cdot}55 \times 10^2\ mol^{-2}\ L^2$</td></tr>
<tr><td>(c)</td><td>(i)</td><td colspan="5">$CH_3COOC_2H_5 + H_2O \rightarrow CH_3COOH + C_2H_5OH$
auto catalyst
Acetic acid formed during the reaction acts as auto catalyst hence after some time, the rate of reaction increases.</td></tr>
<tr><td></td><td>(ii)</td><td colspan="5">Due to common ion effect, the dissociation of acetic acid decreases hence concentration of H^+ ion decreases. The pH value is inversely proportional to H^+ ion concentration. Therefore, the pH value of the solution increases.</td></tr>
</table>

SECTION B

Answer any two questions.

Question 5

(a) Write the formula of the following compounds: **[2]**

(i) Potassium trioxalatoaluminate(III)

(ii) Hexaaquairon(II) sulphate.

(b) Name the types of isomerism shown by the following pairs of compounds: **[1]**

(i) $[Cu(NH_3)_4][PtCl_4]$ and $[Pt(NH_3)_4][CuCl_4]$

(ii) $[Co(Pn)_2Cl_2]^+$ and $[Co(tn)_2Cl_2]^+$

(c) For the coordination complex ion $[Co(NH_3)_6]^{3+}$ **[2]**

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

(ii) What is the oxidation number of cobalt in the complex ion?

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

(iv) State the magnetic behaviour of the complex ion.

Comments of Examiners

(a) (i) Many candidates mentioned only 'K' in place of 'K_3' in the formula $K_3[Al(C_2O_4)_3]$. In some cases, the orders of central metal atom and ligand was reversed. The formula of ligand was also not written correctly by many candidates.

(ii) Some candidates wrote Fe after H_2O in the formula of the compound e.g. $[H_2O)_6$ Fe]SO_4 instead of [Fe $(H_2O)_6$] SO_4 which was incorrect.

(b)(i) A few candidates wrote 'coordinate isomerism' instead of 'coordination isomerism'. Some candidates also wrote linkage and ionisation isomerism which were not correct.

(ii) A number of candidates were not able to identify the ligands in the formula hence, gave incorrect answers.

(c)(i) Many candidates wrote incorrect spelling in the IUPAC name of the complex ion. Instead of double 'aa' and double 'mm', a single 'a' and a single 'm' was written. Some did not write the word 'ion'.

(ii) Most of the candidates wrote the correct oxidation number i.e. +3 but a few candidates wrote -3 which was not correct.

(iii)Many candidates reported sp^3d^2 hybridisation instead of d^2 sp^3 hybridisation.

(iv) A few candidates wrote the magnetic behaviour of given complex ion as 'paramagnetic' instead of 'diamagnetic'.

Suggestions for teachers

- The IUPAC system of nomenclature should be strictly followed while writing the name or formula of any coordination compound.
- Give enough practice to students in writing the name of coordination compounds and their structures.
- Different types of isomerism in coordination compounds should be taught with examples.
- Rules of nomenclature must be explained to students with emphasis on correct spelling .
- Calculation of oxidation state of the central metal atom or ion should be explained clearly to students.
- Explain Valence Bond Theory in detail. Give enough practice by taking different examples.
- How magnetic behavior changes by paired and unpaired electrons should be discussed.

MARKING SCHEME

Question 5

(a)	(i)	$K_3[Al(C_2O_4)_3]$
	(ii)	$[Fe(H_2O)_6]SO_4$
(b)	(i)	Coordination isomerism.
	(ii)	Ligand isomerism.
(c)	(i)	hexaamminecobalt(III) ion.
	(ii)	+3
	(iii)	d^2sp^3 hybridisation
	(iv)	diamagnetic

Question 6

(a) Give balanced equations for the following reactions: **[3]**

(i) Potassium permanganate is heated with concentrated hydrochloric acid.

(ii) Lead sulphide is heated with hydrogen peroxide.

(iii) Ozone is treated with potassium iodide solution.

(b) Discuss the theory involved in the manufacture of sulphuric acid by contact process. **[2]**

Comments of Examiners

(a)(i) Many candidates wrote either incorrect or incomplete chemical equation for potassium permanganate heated with concentrated hydrochloric acid. In some cases, the equations were unbalanced.

(ii) A few candidates wrote unbalanced equation for the Lead sulphide heated with hydrogen peroxide.

(iii) The chemical equation written for Ozone treated with potassium iodide solution was not balanced and the products written were also incorrect in several cases. In some equations, oxygen was missing.

(b) 'Heat' was not mentioned in the equation to obtain SO_3. The catalyst was not written. To prepare oleum ($H_2S_2O_7$), concentrated H_2SO_4 was not used.

Suggestions for teachers

- More practice should be given in writing complete and balanced equations.
- Oxidising nature of H_2 O_2 should be emphasized.
- How ozone oxidises I^- to I_2 should be explained.
- Emphasis should be given on writing complete and correct equations in the manufacture of sulphuric acid by contact process.

MARKING SCHEME

Question 6

(a)	(i)	$2KMnO_4 + 16HCl \xrightarrow{heat} 2KCl + 2MnCl_2 + 8H_2O + 5Cl_2$
	(ii)	$PbS + 4H_2O_2 \rightarrow PbSO_4 + 4H_2O$
	(iii)	$2KI + H_2O + O_3 \rightarrow 2KOH + I_2 + O_2$
(b)	Theory: $S + O_2 \xrightarrow{heat} SO_2$ or $4FeS_2 + 11O_2 \rightarrow 2Fe_2O_3 + 8SO_2$ Catalytic oxidation of SO_2 $2SO_2 + O_2 \xrightarrow{Pt\ or\ V_2\ 05} 2SO_3 \quad \Delta H = -heat$ $SO_3 + H_2SO_4 \rightarrow H_2S_2O_7$ Conc. oleum $H_2S_2O_7 + H_2O \rightarrow 2H_2SO_4$	

Question 7

(a) (i) What are the types of hybridisation of iodine in interhalogen compounds IF_3, IF_5 and IF_7, respectively? **[3]**

(ii) Draw the structure of xenon hexafluoride (XeF_6) molecule and state the hybridisation of the central atom.

(b) Give the balanced equations for the conversion of argentite (Ag_2S) to metallic silver. **[2]**

Comments of Examiners

(a)(i) Hybridisation of iodine in interhalogen compounds IF_3,IF_5 and IF_7 respectively was not correctly mentioned by some candidates. The candidates wrote dsp^3, d^2sp^3 and d^3sp^3 instead of sp^3d, sp^3d^2 and sp^3d^3.

(ii)Many candidates were able to draw six covalent bonds between XeF_6, but they did not show the lone pair. Some wrote sp^3d^2 hybridisation instead of sp^3d^3 .

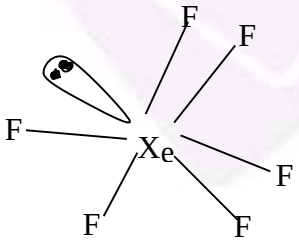
(b) Many candidates wrote either incorrect or incomplete equations for the conversion of argentite to metallic silver. Candidates did not mention reversible sign for reaction of Ag_2S with NaCN. Some candidates wrote incorrect formula of the complex compound.

Suggestions for teachers

- The concept of hybridization should be explained to students by taking various examples in class.
- Explain the compounds of Xenon with fluorine, their geometry, hybridization and structure in detail.
- Advise students to write proper balanced equations for extraction of metals.

MARKING SCHEME

Question 7

(a)	(i)	IF_3 – Sp^3d IF_5 – Sp^3d^2 IF_7 – Sp^3d^3
	(ii)	 Sp^3d^3 hybridisation
(b)		$Ag_2S + 4NaCN \rightleftharpoons 2Na[Ag(CN)_2] + Na_2S$ $2Na[Ag(CN)_2] + Zn \rightarrow Na_2[Zn(CN)_4] + 2Ag$

SECTION C

*Answer any **two** questions.*

Question 8

(a) How can the following conversions be brought about:

(i) Acetaldehyde to propan-2-ol. **[1]**

(ii) Nitrobenzene to p-aminoazobenzene. **[1]**

(iii) Acetic acid to methylamine. **[2]**

(iv) Aniline to benzene. **[1]**

(b) (i) How will you distinguish between primary, secondary and tertiary amines by Hinsberg's test? **[1]**

(ii) Why do alcohols possess higher boiling points as compared to those of corresponding alkanes? **[1]**

(c) Identify the compounds A, B and C: **[3]**

(i) $C_6H_5COOH \xrightarrow{Pcl_5} A \xrightarrow{H_2-Pd/BaSO_4} B \xrightarrow[\text{distil}]{KCNalc} C$

(ii) $H-C\equiv C-H \xrightarrow[dilH_2SO_4+H_gSO_4]{H_2O} A \xrightarrow[[Ni]]{H_2} B \xrightarrow[\text{conc } H_2SO_4]{140^oC} C$

Comments of Examiners

(a) (i) Most of the candidates wrote the conversion correctly, from acetaldehyde to propan-2-ol by using Grignard's reagent.

(ii) Many candidates converted nitrobenzene to aniline but could not correctly complete the conversion upto p-amino azobenzene.

(iii) Some candidates did not show heat after the formation of ammonium acetate to give acetamide.

(iv) Aniline was directly converted to benzene by some candidates without the formation of benzene diazonium chloride.

(b) (i) Solubility of 1° amine in KOH and insolubility of 2° amine was missed by many candidates. For 3° amine, some candidates wrote 'clear solution', although it does not react.

(ii) Many candidates were not able to write the correct reason.

(c) (i) Compounds A and B were identified correctly by most of the candidates but compound C i.e. benzoin was not identified correctly by several candidates.

Suggestions for teachers

- More practice should be given in conversion of organic compound s. Every step of conversion must be shown with proper reagent/conditions.
- Conversion of nitrobenzene to aniline and then C_6HsN_2Cl is an important aspect of many conversions hence must be practiced in class
- Insist that candidates give detailed explanation of the reaction by mentioning the solution, precipitate and the effect of addition of KOH
- How the extent of intermolecular hydrogen bonding affects the boiling point of alcohols should be explained to students.
- Insist that students must learn all the important name reactions. Stress upon writing the complete balanced equations with the correct conditions/reagents.
- More practice should be given in identification of organic compounds.

(ii) Many candidates identified compounds A and B i.e. CH_3CHO and C_2H_5OH correctly but some were not able to identify compound C.

MARKING SCHEME

Question 8

(a)	(i)	$CH_3MgBr + CH_3-\underset{\underset{H}{|}}{C}=O \rightarrow CH_3-\overset{\overset{CH_3}{|}}{\underset{\underset{H}{|}}{C}}-OMgBr \xrightarrow{HOH} CH_3-\overset{\overset{CH_3}{|}}{\underset{\underset{H}{|}}{C}}-OH + Mg(OH)Br$
	(ii)	$C_6H_5NO_2 \xrightarrow[6[H]]{Sn/HCl} C_6H_5NH_2 \xrightarrow[0^o-5^oC]{NaNO_2+HCl} C_6H_5N_2Cl$ $C_6H_5N_2Cl + C_6H_5NH_2 \rightarrow C_6H_5\text{-}N=N\text{-}C_6H_4NH_2 + HCl$ (p-aminoazobenzene)
	(iii)	$CH_3COOH \xrightarrow{+NH_3} CH_3COONH_4 \xrightarrow{\Delta} CH_3CONH_2 \xrightarrow{Br_2/KOH} CH_3NH_2$
	(iv)	$C_6H_5NH_2 \xrightarrow[0^o-5^oC]{NaNO_2+HCl} C_6H_5N_2Cl \xrightarrow[Cu+]{H_3PO_2,H_2O} C_6H_6$
(b)	(i)	1^o amine $\xrightarrow[KOH]{C_6H_5SO_2Cl}$ *clear solution* $\xrightarrow{HCl}$ an insoluble substance 2^o amine $\xrightarrow[KOH]{C_6H_5SO_2Cl}$ *An insoluble substance* $\xrightarrow{HCl}$ no change(insoluble) 3^o amine $\xrightarrow[KOH]{C_6H_5SO_2Cl}$ *no reaction (insoluble)* $\xrightarrow{HCl}$ clear solution
	(ii)	In alcohols, inter molecular hydrogen bonding occurs due to which the boiling point of alcohols are higher than those of corresponding alkanes. Alkanes do not form hydrogen bond.
(c)	(i)	A = C_6H_5COCl B = C_6H_5CHO C = $C_6H_5-\underset{\underset{H}{|}}{\overset{\overset{OH}{|}}{C}}-\overset{\overset{O}{||}}{C}-C_6H_5$
	(ii)	A - CH_3CHO B CH_3CH_2OH C $CH_3CH_2-O\,CH_2CH_3$

Question 9

(a) Give balanced equations for the following name reactions: **[3]**

(i) Friedel-Crafts reaction (alkylation)

(ii) Williamson's synthesis

(iii) Aldol condensation

(b) Give chemical test to distinguish: **[3]**

(i) Ethyl alcohol and sec-propyl alcohol

(ii) Acetaldehyde and acetic acid

(c) (i) Deficiency of which vitamin causes the following diseases: **[4]**

(1) Scurvy

(2) Night blindness

(ii) Write two differences between globular and fibrous proteins.

Comments of Examiners

(a) (i) Some candidates wrote Friedel Crafts acylation instead of Friedel-Crafts alkylation. The catalyst use in the reaction was not mentioned in a few cases.

(ii)Williamson's synthesis reaction was well attempted by most of the candidates.

(iii) Many candidates did not mention the catalyst - dilute NaOH. Some wrote the catalyst as, 'concentrated NaOH;

(b) (i)Most of the candidates could give correct observations with Lucas test or with Victor Meyer's test. Some candidates wrote the iodoform test which cannot be used to distinguish ethyl alcohol and sec-propyl alcohol.

(ii)Tollens reagent test and Fehling's solution test were mentioned in many answers but the observations in several cases were not correct.

(c)(i) (1)This part was answered correctly by most of the candidates.

(2)Some candidates wrote vitamin D/ vitamin B instead of 'Vitamin A'.

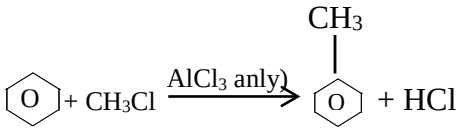
(ii)Many candidates could not differentiate between globular protein and fibrous protein correctly. They wrote that globular proteins are globule like and fibrous proteins are fibre like. A few candidates gave examples only.

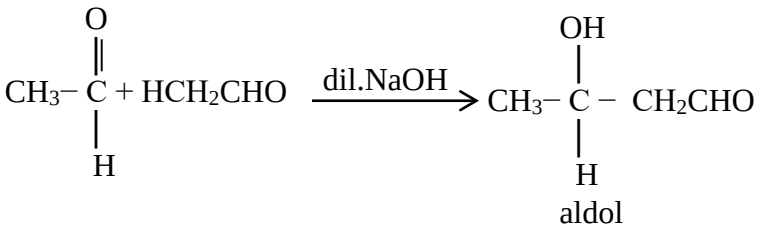
Suggestions for teachers

- Advise students to read the question carefully and then answer as per the requirement.
- Insist that the students learn named organic reactions with the conditions and should write balanced equations with proper conditions/reagents.
- Insist that students use proper reagents and write correct observations to distinguish between the organic compounds.
- Instruct students to write a positive test for one compound, its observation and reagent, along-with a negative test for the other compound.
- Sources and deficiency related diseases caused by different vitamins should be discussed in detail.
- Differences should be given in a tabular form in terms of action, pH and solubility . Merely examples are not considered as differences.

MARKING SCHEME

Question 9

(a)	Friedel – Crafts reaction (alkylation)	
	(i)	
	(ii)	Williamson's synthesis $CH_3CH_2Br + NaOCH_3 \rightarrow CH_3CH_2 - O - CH_3 + NaBr$

	(iii)	 aldol
(b)	Chemical test:	
	(i)	Ethyl alcohol and sec-propyl alcohol Victor Meyer's Test – Ethyl alcohol gives red colour solution Sec-propyl alcohol gives blue colour solution Lucas Test – Ethyl alcohol does not react with Lucas reagent at room temperature and does not produce turbidity. Sec-propyl alcohol reacts with Lucas reagent and produce turbidity within 5 minutes. *(or any other suitable test)*
	(ii)	Acetaldehyde and acetic acid: Silver mirror test: Acetaldehyde gives silver mirror test with Tollen's reagent. Acetic acid does not give this test. Fehling's solution test: Acetaldehyde gives red precipitate with Fehling's solution. Acetic Acid does not give this test. $NaHCO_3$ Test: Acetic acid gives brisk effervescence of CO_2, Acetaldehyde does give this test. $FeCl_3$ Test: On adding aq. $FeCl_3$ to acetic acid, blood red colouration is produced. Acetaldehyde does not give this test. *(or any other suitable test)*
(c)	(i)	(1) Vitamin C (2) Vitamin A
	(ii)	

	Globular Protein	Fibrous protein
1	These proteins are soluble in water	These proteins are insoluble in water
2	They are very sensitive to changes in pH, temperature	They are stable to moderate changes in pH and temperature
3	Possess folded spheroids structure	Possess thread like structures.

Question 10

(a) An aliphatic unsaturated hydrocarbon (A) when treated with H_gSO_4/H_2SO_4 yields a compound (B) having molecular formula C_3H_6O. (B) on oxidation with concentrated HNO_3 gives two compounds (C) and (D). Compound (C) when treated with PCl_5 gives compound (E). (E) when reacts with ethanol gives a sweet-smelling liquid (F). Compound (F) is also formed when (C) reacts with ethanol in the presence of concentrated H_2SO_4. **[4]**

(i) Identify the compound A, B, C, D, E and F.

(ii) Give the chemical equation for the reaction of (C) with chlorine in the presence of red phosphorous and name the reaction.

(b) Answer the following: **[3]**

(i) What is the common name of the polymer obtained by the polymerization of caprolactum? Is it an addition polymer or a condensation polymer?

(ii) Name the two organic compounds which have the same molecular formula C_2H_6O. Will they react with PCl_5? If they react, what are the products formed?

(c) Give balanced equations for the following reactions: **[3]**

(i) Methyl magnesium bromide with ethyl alcohol.

(ii) Acetic anhydride with phosphorous pentachloride.

(iii) Acetaldehyde with hydroxylamine.

Comments of Examiners

(a)(i) Identification of compound 'A', an aliphatic unsaturated hydrocarbon was not done correctly by some candidates. Many candidates failed to identify compound 'D' also.

(ii) HVZ reaction was identified correctly by most of the candidates. Some candidates wrote the reaction with higher homologue of CH_3COOH.

(b)(i) Many candidates identified the polymer correctly as Nylon 6, but the type of polymer was mentioned as 'addition' instead of 'condensation polymer'. A few candidates wrote 'Nylon 66'.

(ii) Some candidates mentioned that dimethyl ether will not react with PCl_5.

(c)(i) Most of the candidates wrote C_2H_6 instead of CH_4.

(ii) Chemical equations written by many candidates were not balanced. In some cases, the formula of acetic anhydride was incorrect.

(iii) Some candidates failed to write the correct formula of hydroxylamine. Several candidates did not mention that water is formed in the reaction.

Suggestions for teachers

- More practice should be given to students to solve such question in which the identification of compounds is based on different chemical reactions.
- Teach polymers, their monomers as well as the type of polymerization in detail. Explain the chemical properties of alcohols and ether.
- Insist that students learn the reactions involving Grignard's reagent.
- Stress upon writing complete and balanced equations.

MARKING SCHEME

Question 10

(a)	(i)	A = $CH_3C{\equiv}CH$ B = CH_3COCH_3 C = CH_3COOH D = $HCOOH$ E = CH_3COCl F = $CH_3COOC_2H_5$

	(ii)	$CH_3COOH + Cl_2 \xrightarrow{\text{Red P}} ClCH_2COOH + HCl$ HVZ reaction.
(b)	(i)	Nylon 6 Condensation polymer.
	(ii)	$CH_3CH_2OH + PCl_5 \rightarrow CH_3CH_2Cl + POCl_3 + HCl$ Ethyl alcohol $CH_3{-}O{-}CH_3 + PCl_5 \rightarrow 2CH_3Cl + POCl_3$ Dimethyl ether
(c)	Balanced equations for the asked reactions:	
	(i)	$CH_3MgBr + C_2H_5OH \rightarrow CH_4 + Mg\begin{matrix}Br\\OC_2H_5\end{matrix}$
	(ii)	$CH_3CO.O.OCCH_3 + PCl_5 \rightarrow 2CH_3COCl + POCl_3$
	(iii)	$CH_3CHO + H_2NOH \rightarrow CH_3CH = NOH + H_2O$

Note: For questions having more than one correct answer/solution, alternate correct answers/solutions, apart from those given in the marking scheme, have also been accepted.

GENERAL COMMENTS

Topics found difficult by candidates

- Relative molecular mass and mole: Numerical problems of freezing point, van't Hoff factor, degree of dissociation.
- Chemical kinetics: Calculation of order of reaction, unit of different order reaction, value of rate constant (k), difference between order of reaction and molecularity.
- Solid state: Calculation of density of unit cells, number of ions in the unit cell of NaCl.
- Ionic equilibria: Solubility product, salt hydrolysis, ionic product of water.
- Chemical equilibrium: Le Chatelier's principle
- Electrochemistry: Electrolytic conductance, calculation of emf and free energy change.
- Coordination compounds: Nomenclature, isomerism, hybridisation etc.
- Balanced chemical equations of inorganic compounds.
- Conversion of organic compound, named organic reactions, chemical test to distinguish between organic compounds.
  Biomolecules, deficiency of vitamins.

Concepts in which candidates got confused

- Depression in freezing point and the freezing point of solution.
- Abnormal molecular weights and degree of dissociation.
- Common ion effect and solubility product.
- Order of reaction and unit of rate constant (k) for different order reactions.
- Schottky defect, Frenkel defect and density of crystals.
- Coordination isomerism and Ligand isomerism.
- Specific conductance and equivalent conductance.
- Gibbs free energy and emf of cell in terms of spontaneity.
- Named organic reactions
- Polymers and monomers, addition and condensation polymers.
- Globular and fibrous proteins.

Suggestions for candidates

- Read the question properly and then answer accordingly
- Avoid selective study
- Practice numerical problems regularly, solve the numerical stepwise with correct formula and write the answer with correct unit.
- Practice writing balanced chemical equations with necessary conditions.
- Nomenclature should always be as per IUPAC norms.
- Learn proper tests to distinguish different organic compounds.
- Be neat in your work. Write the correct question numbers.
- Learn to write the key words in your answer.
- Time your paper, keep time for rechecking to avoid careless mistakes.
- Be very regular in your studies.