ISC Class 12 Chemistry Question Paper Solution 2019

Question 1

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

(more than, primary, cathode, Lucas reagent, two, four, less than, Grignard's reagent, tertiary, anode, zero, equal to, three)

(i) The elevation of boiling point of 0·5 M K_2SO_4 solution is _____that of 0·5 M urea solution. The elevation of boiling point of 0·5 M KCl solution is _____ that of 0·5 M K_2SO_4 solution.

(ii) A mixture of conc. HCl and anhydrous $ZnCl_2$ is called _____ which shows maximum reactivity with _____ alcohol.

(iii) In electrolytic refining the impure metal is made _____ while a thin sheet of pure metal is used as _____.

(iv) When the concentration of a reactant of first order reaction is doubled, the rate of reaction becomes _____ times, but for a _____ order reaction, the rate of reaction remains the same.

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

(i) The cell reaction is spontaneous or feasible when emf of the cell is:

(1) negative

(2) positive

(3) zero

(4) either positive or negative

(ii) Which, among the following polymers, is a polyester:

(1) melamine

(2) bakelite

(3) terylene

(4) Polythene

(iii) The correct order of increasing acidic strength of the oxoacids of chlorine is:

(1) $HClO_3 < HClO_4 < HClO_2 < HClO$

(2) $HClO < HClO_2 < HClO_3 < HClO_4$

(3) $HClO_2 < HClO < HClO_4 < HClO_3$

(4) $HClO_3 < HClO_4 < HClO < HClO_2$

(iv) A catalyst is a substance which:

(1) changes the equilibrium constant of the reaction.

(2) increases the equilibrium constant of the reaction.

(3) supplies energy to the reaction.

(4) shortens the time to reach equilibrium.

(c) Match the following**:** **[4×1]**

(i)	Diazotisation	(a)	Anisotropic
(ii)	Crystalline solid	(b)	Reimer-Tiemann reaction
(iii)	Phenol	(c)	Diphenyl
(iv)	Fittig reaction	(d)	Aniline

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

(i) (1) Which trivalent ion has maximum size in the Lanthanoid series i.e. Lanthanum ion (La^{3+}) to Lutetium ion (Lu^{3+})?
(at. no. of Lanthanum = 57 and Lutetium = 71)

(2) Explain why Cu^{2+} is paramagnetic but Cu^{+} is diamagnetic.
(at. no. of Cu = 29)

(ii) When a coordination compound $CoCl_3 \cdot 6NH_3$ is mixed with $AgNO_3$, three moles of AgCl are precipitated per mole of the compound. Write the structural formula and IUPAC name of the coordination compound.

(iii) Calculate the boiling point of urea solution when 6 g of urea is dissolved in 200 g of water.

(K_b for water = 0·52 K kg mol^{-1}, boiling point of pure water = 373 K, mol. wt. of urea = 60)

(iv) Identify the compounds A, B, C and D in the given reaction:

$$HC \equiv CH \xrightarrow[Hg^{2+}/H_2SO_4]{H_2O} A \xrightarrow[K_2Cr_2O_7+H_2SO_4]{[O]} B \xrightarrow{Ca(OH)_2} C \xrightarrow[\text{dry distillation}]{\text{heat}} D$$

Comments of Examiners

(a) (i) Some candidates wrote *less than* and *more than* instead of *more than* and *less than*. A few candidates wrote only *more* and *less*.

(ii) Some candidates wrote only *Lucas* instead of *Lucas reagent* in the first blank. For the second blank, instead of *tertiary* some candidates wrote *primary*.

(iii) Many candidates interchanged the answer writing *cathode* and *anode* instead of *anode* and *cathode*.

(iv) Majority of candidates wrote the digits (2, 4, 0), which were not mentioned in the list of words, in place of the words. Some candidates wrote *double* instead of *two* in the first blank, while a few candidates wrote *two* instead of *zero* in the second blank.

(b) (i) Some candidates wrote *negative* or *either positive or negative* instead of *positive* which was the correct answer.

(ii) Instead of *terylene*, a few candidates wrote *polythene*, *melamine*, or *bakelite*.

(iii) A few candidates wrote the incorrect option for the correct order of increasing acidic strength of the oxoacids of chlorine such as $HClO_3 < HClO_4 < HClO_2 < HClO$.

(iv) Some candidates, instead of writing *shortens the time to reach equilibrium*, wrote *supplies energy to the reaction*. A few candidates wrote *changes the equilibrium constant of the reaction*.

(c) Most of the candidates matched the given items correctly. However, some candidates matched 'diazotisation' with 'Diphenyl', 'Fittig reaction' with 'Anisotropic' and 'Phenol' with 'Aniline'.

(d) (i) (1) Most of the candidates wrote the correct answer.

(2) Most candidates did not write the correct explanation for the paramagnetic character of Cu^{2+} and diamagnetic character of Cu^{+}. Some candidates did not write the correct electronic configuration of Cu^{2+} and Cu^{+}.

(ii) Many candidates did not write the correct IUPAC name of the compound. Several candidates were unable to write the oxidation state of the central metal atoms. A few candidates, instead of writing the correct formula $[Co(NH_3)_6]Cl_3$ wrote $[Co(NH_3)_6]NO_3$.

Suggestions for teachers

- Advise to pick the words given as such from the brackets rather than writing their own.
- Clearly explain the relationship between magnitude of colligative property and the number of moles.
- Discuss the application of Lucas Reagent in detail.
- Explain the process of electro refining thoroughly.
- Clearly discuss the relationship between the rate of reaction and the concentration of different order reactions.
- Explain to the students, the relationship between the spontaneity and the emf of the cell.
- Advise students to learn Monomers and their polymers in a tabular form.
- Teach acidic strength of oxo acids using oxidation number.
- Explain the correct definition and the role of catalyst in a chemical reaction.
- Give adequate practice for different named organic reactions.
- Teach the properties of crystalline solids to the students in detail.
- Clearly explain Lanthanoid contraction to students.
- Discuss diamagnetic and paramagnetic behaviour of ions in detail.
- Point out to the students the electronic configuration for atoms as well as ions clearly.
- Interpret to the students the structural formula and IUPAC names of coordination compounds.
- Give adequate practice to the students for the calculation of ΔT_b .
- Explain to the students that the boiling point of the solution is always more than boiling point of the solvent.
- Give adequate practice to students on conversion of organic compounds.

(iii) Several candidates wrote the boiling point of urea as 372.74 K instead of 373.26 K. A few candidates, instead of adding ΔT_b to the boiling point of the solvent, subtracted the value of ΔT_b from the boiling point of the solvent.

(iv) Most of the candidates identified the compound 'A' as CH_2=CHOH instead of CH_3CHO, 'B' as CH_3CHO instead of CH_3COOH. Many candidates were unable to identify compounds 'C' and 'D' in the given reaction.

MARKING SCHEME

Question 1

(a)	(i)	More than, less than		
	(ii)	Lucas reagent, tertiary		
	(iii)	Anode, cathode		
	(iv)	Two, zero		
(b)	(i)	2 or positive		
	(ii)	3 or terylene		
	(iii)	2 or $HClO < HClO_2 < HClO_3 < HClO_4$		
	(iv)	4 or shortens the time to reach equilibrium		
(c)	(i)	Diazotisation	(d)	Aniline
	(ii)	Crystalline solid	(a)	Anisotropic
	(iii)	Phenol	(b)	Reimer-Tiemann reaction
	(iv)	Fittig reaction	(c)	Diphenyl

(d)	(i)	(1)	La^{3+}
		(2)	Cu^{2+} is paramagnetic because it contains unpaired electron in d orbital, Cu^{+} is diamagnetic as no unpaired electron is present.
	(ii)	$[Co(NH_3)_6]\ Cl_3$ hexaammine cobalt (III) chloride	
	(iii)	$\Delta T_b = \frac{1000 \times k_b \times w}{m \times W}$ OR $= \frac{1000 \times 0{\cdot}52 \times 6}{60 \times 200}$ $= 0{\cdot}26$ K Boiling point of solution = 373 + 0·26 = 373·26 K	
	(iv)	A = CH_3CHO B = CH_3COOH C = $(CH_3COO)_2Ca$ D = CH_3COCH_3	

Question 2

[2]

(a) For the reaction A + B $\rightarrow$ C + D, the initial rate for different reactions and initial concentration of reactants are given below:

S. No.	Initial Conc.		Initial rate
	[A] mole L^{-1}	[B] mole L^{-1}	(mole L^{-1} sec^{-1})
1	1·0	1·0	2×10^{-3}
2	2·0	1·0	4×10^{-3}
3	4·0	1·0	8×10^{-3}
4	1·0	2·0	2×10^{-3}
5	1·0	4·0	2×10^{-3}

(i) What is the overall order of reaction?

(ii) Write the rate law equation.

OR

(b) 25% of a first order reaction is completed in 30 minutes. Calculate the time taken in minutes for the reaction to go to 90% completion.

Comments of Examiners

(a) (i) Although majority of the candidates found the individual order with respect to each reactant [A] and [B] correctly, they did not write the overall order of the reaction correctly.

(ii) Some candidates, instead of writing rate = $k[A]^1[B]^0$, wrote the rate law equation incorrectly, e.g. rate = $[A]^1[B]^0$. A few candidates wrote rate = 2×10^{-3} $[1]^1[1]^0$.

(b) Some candidates used the incorrect formula for the 1st order rate constant. A few candidates calculated the incorrect value of rate constant. According to the question, the answer was supposed to be given in minutes for 90% completion of the reaction, but a few candidates expressed the answer in seconds.

Suggestions for teachers

- Explain clearly with examples, the calculation of the order of the reaction and rate law equation for different order reaction.
- Give adequate practice of numerical problems of first order reaction in chemical kinetics.
- Insist that the students write the correct unit for time and rate constant.

MARKING SCHEME

Question 2

(a)	(i)	Overall order of reaction = 1 + 0 = 1
	(ii)	Rate Law equation= rate = $k[A]^1 [B]^o$ OR rate = k[A]
	OR	
(b)	a = 100, x = 25, t = 30 min $k = \frac{2{\cdot}303}{t} \log_{10} \frac{a}{(a-x)}$ or $k = \frac{2{\cdot}303}{30} \log_{10} \frac{100}{(100-25)}$ or $k = \frac{2{\cdot}303}{30} \log_{10} \frac{100}{75}$ $k = 9{\cdot}59\times10^{-3}min^{-1}$ $t = \frac{2{\cdot}303}{k} \log \frac{100}{(100-90)}$ or $= \frac{2{\cdot}303}{9{\cdot}59\times10^{-3}} \log_{10} \frac{100}{10}$ t = 240·15 min.	

Question 3

[2]

(i) Name the type of drug which lowers the body temperature in high fever condition.

(ii) What are *tranquilizers*? Give *one* example of a tranquilizer.

Comments of Examiners

(i) Many candidates, instead of writing *antipyretics* as the answer, wrote *analgesics*. A few candidates wrote names of medicines such as paracetamol, aspirin, etc.

(ii) Majority of the candidates did not write the correct definition of 'tranquilizer'. Many candidates did not give the correct example.

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Suggestions for teachers

- Discuss the unit 'Chemistry in everyday life' in detail.
- With suitable examples, illustrate the use of chemicals in medicine.
- Teach definitions with suitable examples.
- Advise the students to do the self-study of this topic several times.

MARKING SCHEME

Question 3

(i)	Antipyretics
(ii)	The chemical substances used for the treatment of stress, mild and severe mental diseases, anxiety and induce sleep are called tranquilizers. Examples: Equanil, veronal, valium, etc. *(any one)* *(or any other correct example)*

Question 4

[2]

Write the balanced chemical equation for each of the following:

(i) Chlorobenzene treated with ammonia in the presence of Cu_2O at 475 K and 60 atm.

(ii) Ethyl chloride treated with alcoholic potassium hydroxide.

Comments of Examiners

(i) Majority of the candidates did not write the by-product i.e., HCl. A few candidates wrote $C_6H_5N_2Cl$ in place of $C_6H_5NH_2$.

(ii) Many candidates, instead of writing that the reaction of C_2H_5Cl with alcoholic KOH gives ethene (C_2H_4), wrote that C_2H_5OH and KCl are formed.

Suggestions for teachers

- Lay stress on the importance of writing balanced chemical equations.
- Clarify to the students that Ethyl chloride when treated with alcoholic KOH undergoes dehydrohalogenation reaction whereas aqueous KOH undergoes hydrolysis.

MARKING SCHEME

Question 4

(i)	$2C_6H_5Cl + 2NH_3 + Cu_2O \xrightarrow[60\ atm]{475K} 2\ C_6H_5NH_2 + Cu_2Cl_2 + H_2O$ **OR** $C_6H_5Cl + NH_3 \xrightarrow[60\ atm]{Cu2O,\ 475K} C_6H_5NH_2 + HCl$
(ii)	$CH_3CH_2Cl + KOH\ (alc) \rightarrow CH_2 = CH_2 + KCl + H_2O$

Question 5

[2]

(i) Name the monomer and the type of polymerisation that takes place when PTFE is formed.

(ii) Name the monomers of nylon 6, 6.

Comments of Examiners

(i) Majority of the candidates wrote the correct name of the monomer i.e. *tetrafluoroethene*. However, some candidates wrote *tetrafluoroethane*. A few candidates wrote *condensation polymerisation* instead of *addition polymerisation*.

(ii) Many candidates wrote *Hexamethyldiamin*e instead of *Hexamethylenediamine*. Some candidates wrote only one monomer instead of two. A few candidates wrote the name of the monomer as *Caprolactum* which is a monomer of Nylon 6.

Suggestions for teachers

- Clarify polymer to the students explaining their formation by writing the reaction.
- Teach students to write polymers and monomers and their uses in a tabular form. Ask them to learn the correct pair of monomers for a polymer.

MARKING SCHEME

Question 5

(i)	$CF_2 = CF_2$, Addition Polymerisation
(ii)	hexamethylenediamine and adipic acid

Question 6

[2]

Name two water soluble vitamins and the diseases caused by their deficiency in the diet of an individual.

Comments of Examiners

Some candidates, instead of writing Vitamins B and C as water soluble vitamins, wrote the incorrect answers such as *A*, *D* and *E* which are fat soluble vitamins. Deficiency diseases for water soluble vitamins were not written correctly by a few candidates.

Suggestions for teachers

- Clearly explain the types of vitamins, their sources and diseases caused by their deficiency.
- Help students differentiate between water soluble and fat soluble vitamins.

MARKING SCHEME

Question 6

Water soluble vitamins are B and C.

Disease caused by deficiency of vitamin B are beriberi, dermatitis, pernicious anaemia, etc.

Disease caused by deficiency of vitamin C is Scurvy.

Question 7

[2]

(a) How will you obtain the following (give balanced chemical equations)?

(i) Benzene from phenol.

(ii) Iodoform from ethanol.

OR

(b) How will you obtain the following (give balanced chemical equations)?

(i) Salicylaldehyde from phenol.

(ii) Propan–2–ol from Grignard's reagent.

Comments of Examiners

(a) (i) Most of the candidates did not write ZnO as a by-product. Many candidates did not show heating.

(ii) Several candidates did not write the complete reaction including the by-product. In some answer scripts the equation was unbalanced. A few candidates wrote incorrect formula for iodoform.

(b) (i) Common errors made by candidates were:

- Equations were not balanced;
- The formula for salicylaldehyde was written as 4-hydroxybenzaldehyde, instead of 2-hydroxybenzaldehyde.

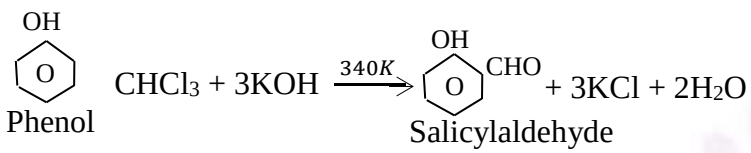
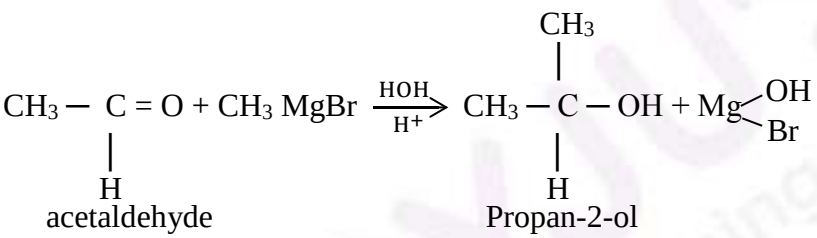
(ii) Majority of candidates wrote incomplete equations. Some candidates did not write the by-product Mg(OH)Br. Some candidates did not write H_2O for hydrolysis.

Suggestions for teachers

- Explain clearly to the students that the by-product/s in all the organic reactions must be written.
- Give adequate practice in writing conversion of organic compounds with balanced equations.
- Train students in writing balanced organic reactions.
- Teach named organic reactions with proper conditions, catalyst and formulas for the reactants and products.

MARKING SCHEME

Question 7

(a)	(i)	$C_6H_5OH + Zn \xrightarrow{\Delta} C_6H_6 + ZnO$ Phenol Benzene
	(ii)	$CH_3CH_2OH + 4I_2 + 6NaOH \xrightarrow{\Delta} CHI_3 + HCOONa + 5NaI + 5H_2O$ ethanol Iodoform
	OR	
(b)	(i)	 Phenol Salicylaldehyde
	(ii)	 acetaldehyde Propan-2-ol

Question 8

[2]

Show that for a first order reaction the time required to complete 75% of reaction is about 2 times more than that required to complete 50% of the reaction.

Comments of Examiners

Majority of the candidates attempted this question well. Some candidates wrote incorrect formula for 1st order kinetics. A few candidates substituted the value of (a - x) as *75* instead of *25*.

Suggestions for teacher

Give adequate practice to students in solving numerical problems based on order of reactions, rate constant and half-life period.

MARKING SCHEME

Question 8

$k = \frac{2{\cdot}303}{t} \log_{10} \frac{a}{a-x}$ or

$t_{75\%} = \frac{2{\cdot}303}{k} \log \frac{100}{25}$ or

$t_{75\%} = \frac{2{\cdot}303}{k} \log \times 0.602$

$t_{75\%} = \frac{1{\cdot}386}{k}$

$t_{50\%} = \frac{2{\cdot}303}{k} \log \frac{100}{50}$

$t_{50\%} = \frac{2{\cdot}303}{k} \log 2$ or $= \frac{2{\cdot}303}{k} \times 0.3010$

or $= \frac{0{\cdot}693}{k}$

From the values calculated $t_{75\%}$ is 2 times more than $t_{50\%}$

Question 9

[3]

(a) When 0·4g of oxalic acetic acid is dissolved in 40g of benzene, the freezing point of the solution is lowered by 0·45K. Calculate the degree of association of acetic acid. Acetic acid forms dimer when dissolved in benzene.

(K_f for benzene = 5·12 K kg mol^{-1}, at. wt. C = 12, H = 1, O = 16)

OR

(b) A solution is prepared by dissolving 9·25g of non-volatile solute in 450ml of water. It has an osmotic pressure of 350mm of Hg at 27°C. Assuming the solute is non-electrolyte, determine its molecular mass.

(R = 0·0821 lit atm K^{-1} mol^{-1})

Comments of Examiners

(a) Most of the candidates were able to calculate the value of van't Hoff factor 'i' correctly. Some candidates were unable to calculate the correct value for the degree of association (α).

(b) Although most of the candidates used the correct formula for the calculation of molecular mass of non-volatile solute by using osmotic pressure method, some substituted the incorrect values in the formula.
Many candidates did not convert the osmotic pressure and the volume of water correctly as per the requirement of the problem. Some candidates, instead of taking the value of 'R' as 0.0821 took it as 8.314.

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Suggestions for teachers

- Clearly explain to the students, the calculation of van't Hoff factor (i) along with degree of dissociation / association.
- Give adequate practice in solving numerical problems for calculation of molecular weight of non-volatile substances.
- Tell students that in osmotic pressure method, the involved physical quantities like temperature, volume and the osmotic pressure should be substituted in the formula in appropriate units.
- Advise students to take the value of constant as provided in the question paper , with proper units.

MARKING SCHEME

Question 9

(a)

$M_{(obs)} = \frac{1000 \times K_f \times w}{\Delta T_f . W}$

or

$= \frac{1000 \times 5 \cdot 12 \times 0 \cdot 4}{0 \cdot 45 \times 40}$

$= 113 \cdot 77 \text{ g mol}^{-1}$

Van't Hoff factor (i) $= \frac{normal\ molecular\ weight}{observed\ molecular\ weight} = \frac{60}{113 \cdot 77}$

$i = 0 \cdot 527$

Degree of association $(\alpha) = \frac{1-i}{1-\frac{1}{n}}$ or $\frac{1-0 \cdot 527}{1-\frac{1}{2}}$

$= 0 \cdot 946 = 94 \cdot 6\%$

OR

(b)	Given: w = 9·25 g, V = 450 mL $= \frac{450}{1000} =$ 0·45 litre R = 0·0821 L *atm* K^{-1} mol^{-1} T = 273 + 27 = 300 K , $\pi = \frac{350}{760} = 0 \cdot 46\ atm$ $\pi V = \frac{w}{m} RT$ $\frac{350}{760} \times \frac{450}{1000} = \frac{9 \cdot 25 \times 0 \cdot 0821 \times 300}{m}$ m = $\frac{9 \cdot 25 \times 0 \cdot 0821 \times 300}{\frac{350}{760} \times \frac{450}{1000}}$ = 1099·36 g mol^{-1}

Question 10

[3]

An element occurs in body centered cubic structure. Its density is 8·0 g/cm^3. If the cell edge is 250 pm, calculate the atomic mass of an atom of this element.
(N_A = 6·023 ×10^{23})

Comments of Examiners

Most of the candidates attempted this question correctly. Some candidates did not convert the edge length into 'cm' from 'pm'. A few candidates took the value of Z (number of atoms) for body centered cubic unit cell as *four* instead of *two*.

Suggestions for teachers

- Give adequate practice in solving numerical problems based on density of unit cell.
- Explain the different types of unit cells, the unit of density and edge length of the unit cell.

MARKING SCHEME

Question 10

Given: a = 250 pm = 250×10^{-10} cm

Density (ρ) = 8g cm^{-3}, z = 2 (for bcc)

N_A = 6·023×10^{23}

Density (ρ) = $\frac{Z \times M}{N_A \times a^3}$ or

M = $\frac{P \times N_A \times a^3}{Z}$

M = $\frac{8 \cdot 0 \times 6 \cdot 023 \times 10^{23} \times (250 \times 10^{-10})^3}{2}$

M = 37·64 g mol^{-1}

Question 11

[3]

Describe the role of the following:

(i) Cryolite in the extraction of aluminium from pure alumina.

(ii) NaCN in the extraction of silver from a silver ore.

(iii) Coke in the extraction of iron from its oxides.

Comments of Examiners

(i) Some candidates wrote that cryolite is used in the extraction of Aluminium from alumina to reduce the boiling point of mixture instead of *to reduce the melting point.*

(ii) Many candidates wrote NaCN is used in the extraction of silver from silver ore *as a depressant* instead of *as a leaching agent.* A few candidates, instead of writing that silver ore forms soluble complex with NaCN, wrote that it forms insoluble complex.

(iii) Several candidates wrote that coke was used to extract iron from its oxide ore instead of writing *reducing agen*t. Some candidates wrote that coke is used as a fuel.

Suggestions for teachers

- Explain in detail the role of cryolite in the extraction of aluminium from pure alumina.
- Clearly explain the extraction of silver with balanced chemical equation.
- Discuss the use and importance of each reagent during extraction.
- Advise students to learn the metallurgy of metals in detail.

MARKING SCHEME

Question 11

(i)	In order to decrease the melting point of mixture and to increase the conductivity of alumina (Al_2O_3), cryolite is added in the extraction of aluminium.
(ii)	When silver ore is treated with NaCN solution, silver ore gets dissolved and forms a soluble complex whereas impurities remain insoluble.
(iii)	Coke reduces CO_2 to CO which helps in the reduction of iron oxide to iron. Or $CO_2\ (g) + C\ (s) \rightarrow 2CO\ (g)$ $Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$

Question 12

[3]

(i) Write the IUPAC names of the following:

(1) $K_3[Fe(C_2O_4)_3]$

(2) $[Co(NH_3)_5Cl]SO_4$

(ii) $[Fe(CN)_6]^{4-}$ is a coordination complex ion.

(1) Calculate the oxidation number of iron in the complex.

(2) Is the complex ion diamagnetic or paramagnetic?

(3) What is the hybridisation state of the central metal atom?

(4) Write the IUPAC name of the complex ion.

Comments of Examiners

(i) (1) Several candidates wrote *trisoxalato* as the IUPAC name of $K_3[Fe(C_2O_4)_3]$ instead of writing *trioxalato* and wrote *iron* in place of *ferrate*. Many candidates calculated oxidation state of the central metal atom incorrecltly.

(2) Majority of the candidates wrote *pentammine* as the IUPAC name of $[Co(NH_3)_5Cl]SO_4$. Some candidates wrote the oxidation state of cobalt as (II) or (IV) instead of (III).

(ii) (1) Most of the candidates wrote the correct oxidation number i.e. +2.

(2) A few candidates gave the answer as *paramagnetic*.

(3) A few candidates, instead of writing d^2sp^3 hybridisation, wrote sp^3d^2.

(4) Majority of the candidates did not write the word ion in the IUPAC name hexacyanoferrate (II) ion. A few candidates wrote *iron* instead of *ferrate.*

Suggestions for teachers

- Teach in detail, the rules for nomenclature of coordination compounds and give adequate practice to the students in the application of these rules.
- Lay stress on the importance of correct alphabetical order ligands, use of 'bis-', 'tris-' and how to calculate the oxidation number of the central metal atom.
- Discuss the method of determining the type of hybridisation, magnetic behaviour and oxidation state by using valance bond theory.
- Train students to write *ion* at the end of the IUPAC nomenclature for complex ions.

MARKING SCHEME

Question 12

(i)	(1)	Potassiumtrioxalatoferrate (III)
	(2)	Pentaamminechloridocobalt (III) sulphate
(ii)	(1)	+2
	(2)	Diamagnetic
	(3)	$d^2\ sp^3$
	(4)	Hexacyanoferrate (II) ion

Question 13

[3]

(a) Explain why:

(i) Transition elements form alloys.

(ii) Zn^{2+} salts are white whereas Cu^{2+} salts are coloured.

(iii) Transition metals and their compounds act as catalyst.

OR

(b) Complete and balance the following chemical equations.

(i) $KMnO_4 + H_2SO_4 + H_2C_2O_4 \rightarrow$ _____ + _____ + _____ + _____

(ii) $K_2Cr_2O_7 + H_2SO_4 + KI \rightarrow$ _____ + _____ + _____ + _____

(iii) $K_2Cr_2O_7 + H_2SO_4 + FeSO_4 \rightarrow$ _____ + _____ + _____ + _____

Comments of Examiners

(a) (i) Most of the candidates, instead of writing *similar size of atoms*, wrote *vacant d-orbital* or *small size*.

(ii) Many candidates did not explain the concept of paired, unpaired electrons and d-d transition but wrote only the electronic configuration of Zn^{2+} and Cu^{2+} ions.

(iii) Most candidates, instead of writing *vacant d-orbital* or *presence of active centre*, wrote *unpaired electron* or *small size*.

(b) Majority of the candidates were unable to write the correct chemical equations. Common errors made by the candidates were:

(i) The equations were not balanced.

(ii) The by-products were not written in the equations.

(iii) The formulae of products were incorrect - $Cr(SO_4)_3$ instead of $Cr_2(SO_4)_3$ or $Fe(SO_4)_3$ instead of $Fe_2(SO_4)_3$.

Suggestions for teachers

- Explain the importance of d-block elements in detail, with the help of suitable diagrams and examples.
- Advise students, to write the key words such as similar size / vacant d-orbital / unpaired electron in d-orbital / d-d transition / variable valency etc. while writing the answers of reasoning type of questions.
- Give adequate practice to students in writing complete and balanced chemical equations.
- Elucidate oxidising and reducing properties of $K_2Cr_2O_7$ and $KMnO_4$ in class.

MARKING SCHEME

Question 13

(a)	(i)	The atomic radii of transition elements in any series are not much different and hence can replace each other easily in lattice.
	(ii)	Zn^{2+} does not have any unpaired electron while Cu^{2+} has unpaired electron and can undergo d-d transition emitting colour.
	(iii)	Transition elements have variable oxidation state giving unstable intermediates, thus act as catalyst.
		OR
(b)	(i)	$2KMnO_4 + 3H_2SO_4 + 5H_2C_2O_4 \rightarrow K_2SO_4 + 2MnSO_4 + 8H_2O + 10CO_2$
	(ii)	$K_2Cr_2O_7 + 7H_2SO_4 + 6KI \rightarrow 4K_2SO_4 + Cr_2(SO_4)_3 + 7H_2O + 3I_2$
	(iii)	$K_2Cr_2O_7 + 7H_2SO_4 + 6FeSO_4 \rightarrow 3Fe_2(SO_4)_3 + K_2SO_4 + Cr_2(SO_4)_3 + 7H_2O$

Question 14

[3]

Give balanced equations for the following:

(i) Aniline is treated with bromine water.

(ii) Ethylamine is heated with chloroform and alcoholic solution of potassium hydroxide.

(iii) Benzene diazonium chloride is treated with ice cold solution of aniline in acidic medium.

Comments of Examiners

(i) Most of the candidates wrote the incorrect product such as *ortho* or *paradibromo aniline* instead of *2.4.6 tribromo aniline*. Many candidates wrote an unbalanced equation. Some candidates did not write the by-product i.e. HBr.

(ii) A number of candidates wrote *ethyl cyanide* instead of *ethyl isocyanide*. A few candidates wrote an unbalanced equation and did not write the by-product i.e. H_2O.

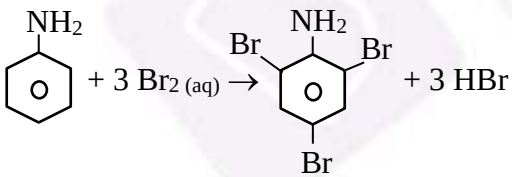
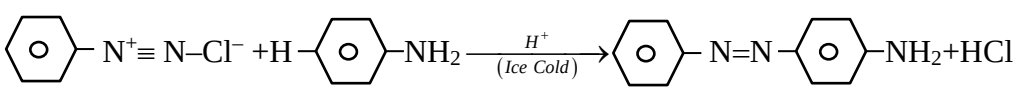
(iii) Many candidates were unable to write the correct formula of the main product. Several candidates showed the double bond between –N=N- as single bond. Some candidates did not show HCl as a by-product.

Suggestions for teachers

- Train students to write balanced equations for all types of chemical reactions with appropriate conditions/reagents.
- Lay emphasis on named organic reactions, ensuring that the students write the by-product in all organic reactions.

MARKING SCHEME

Question 14

(i)	
(ii)	$C_2H_5NH_2 + CHCl_3 + 3KOH_{(alc)} \rightarrow C_2H_5N \equiv C + 3\,KCl + 3\,H_2O$
(iii)	 p-amino azobenzene

Question 15

[3]

Define the following terms with suitable examples:

(i) Peptisation

(ii) Electrophoresis

(iii) Dialysis

Comments of Examiners

(i) Most of the candidates did not write the correct definition of peptisation. They either wrote the definition for coagulation or peptide linkage. Many candidates did not write the correct example.

(ii) Majority of the candidates explained and defined electrophoresis as *electrolysis*. Several candidates, instead of mentioning movement of colloidal particles, mentioned *charge separation*. Many candidates did not give the correct examples.

(iii) Several candidates did not mention the removal of dissolved impurities (crystalloids) from colloids through semi-permeable membrane. Some candidates wrote incorrect examples.

Suggestions for teachers

Familiarise the students with terms such as peptisation, electrophoresis, dialysis, coagulation, etc. with the examples related to daily life.

MARKING SCHEME

Question 15

(i)	**Peptisation:** The process of conversion of a fresh precipitate into colloidal solution by shaking it with dispersion medium in the presence of electrolyte is called peptisation. Example: Red coloured solution of Fe $(OH)_3$ is obtained when freshly prepared precipitate is treated with small amount of $FeCl_3$ solution.
(ii)	**Electrophoresis:** The movement of colloidal particles under an applied electric potential is called electrophoresis. Positively charged particles move towards cathode, while negatively charged particles move towards the anode. Example: purification of sewage water, proteins, etc.
(iii)	**Dialysis:** It is the process of removing a dissolved substance from a colloidal solution by means of diffusion through a suitable membrane. The molecules or ions diffuse through membrane and pure colloidal solution is left behind. Example: removal of sugar from blood in diabetic patients.

Question 16

[5]

(a) (i) Calculate the mass of silver deposited at cathode when a current of 2 amperes is passed through a solution of $AgNO_3$ for 15 minutes.

(at. wt. of Ag = 108, 1 F = 96,500 C)

(ii) Calculate the emf and ΔG for the cell reaction at 298 K

$$Mg_{(s)} \left| Mg^{2+}_{(0{\cdot}1M)} \right\| Cu^{2+}_{(0{\cdot}01M)} \left| Cu_{(s)} \right.$$

Given $E^{o}_{cell} = 2{\cdot}71V$

1F = 96,500 C

OR

(b) (i) Define the following terms:

(1) Specific conductance

(2) Kohlrausch's Law

(ii) The resistance of a conductivity cell containing 0·001 M KCl solution at 298 K is 1500 ohm. What is the cell constant and molar conductivity of 0·001 M KCl solution, if the conductivity of this solution is

$0{\cdot}146 \times 10^{-3}$ ohm^{-1} cm^{-1} at 298 K?

Comments of Examiners

(a) (i) Majority of the candidates made an error in the calculation of equivalent weight of silver, writing *54* instead of *108*. Many candidates did not express the answer with the unit. Some candidates took the time taken in minutes instead of seconds. A few candidates did not use the correct formula.

(ii) Many candidates wrote an incorrect formula for Nernst equation. Instead of calculating ΔG, some candidates calculated ΔGo which was not asked. A few candidates did not express the answer with the negative sign.

(b)(i) (1) Several candidates wrote an incorrect definition of specific conductance and also wrote an incorrect formula.

(2) Instead of defining the term, some candidates wrote only the formula. A few candidates did not mention *infinite dilution*.

(ii) Most of the candidates were able to calculate the correct values of cell constant and molar conductivity but were unable to express the answer with the correct unit.

Suggestions for teachers

- Lay emphasis on the practice of numerical problems based on Faraday's laws of electrolysis, Nernst equation. cell constant, molar conductivity and specific conductivity.
- Advise students to read the numerical problems carefully and train them to express the answer with proper unit.
- Explain terms like specific conductance, molar conductance, equivalent conductance and Kohlrausch's law, etc. with key words.

MARKING SCHEME

Question 16

(a)	(i)	Given: at. wt. of Ag = 108, Time = 15 minutes = 15 ×60 = 900 s. w = z it or $w = \frac{E}{96500}\ it$ or $\frac{Atomic\ weight}{Charge \times 96500} \times it$ $= \frac{108}{1 \times 96500} \times 2 \times 900$ = 2·0145 g
	(ii)	$E_{cell} = E^0_{cell} - \frac{0{\cdot}0591}{n} \log \frac{[Mg^{2+}]}{[Cu^{2+}]}$ $E_{cell} = 2 \cdot 71 - \frac{0{\cdot}0591}{2} \log \frac{[0{\cdot}1]}{[0{\cdot}01]}$ $= 2 \cdot 71 - 0 \cdot 02955$ = 2·68045 V $\Delta G = -nFE$ $= -2 \times 96500 \times 2 \cdot 68045$ J = −517326·85 J or −517·326 kJ

(b)	(i)	(1)	Specific conductance: It is conductance of a conductor whose length is 1 cm and area of cross section is equal to 1 cm^2. It is equal to the reciprocal of specific resistance of the conductor.
		(2)	Kohlrausch's Law: The molar conductivity at infinite dilution of an electrolyte is equal to the sum of the molar conductances of its cations and anions, with each conductance term multiplied by the number of respective ions present in the formula unit of the electrolyte.
	(ii)	Given: Conductivity $\kappa = 0{\cdot}146\times10^{-3}$ ohm^{-1} cm^{-1} R = 1500 ohm Cell constant= $\left(\frac{l}{a}\right) = \kappa \times R$ $= 0{\cdot}146 \times10^{-3}\times1500$ Cell constant = $0{\cdot}219$ cm^{-1} $\wedge m = \frac{\kappa\times volume}{molarity} = \frac{\kappa\times1000}{0{\cdot}001} = \frac{0{\cdot}146\times10^{-3}\times1000}{0{\cdot}001}$ = 146 ohm^{-1} cm^2 mol^{-1}	

Question 17

[5]

(a) (i) Explain why:

(1) Fluorine has lower electron affinity than chlorine.

(2) Red phosphorus is less reactive than white phosphorous.

(3) Ozone acts as a powerful oxidising agent.

(ii) Draw the structures of the following:

(1) XeF_6

(2) IF_7

OR

(b) (i) Explain why:

(1) Interhalogen compounds are more reactive than the related elemental halogens.

(2) Sulphur exhibits tendency for catenation but oxygen does not.

(3) On being slowly passed through water, PH_3 forms bubbles but NH_3 dissolves.

(ii) Complete and balance the following reactions:

(1) $P_4 + H_2SO_4 \rightarrow$ _____ + _____ + _____

(2) $Ag + HNO_3 \rightarrow$ _____ + _____ + _____
(dilute)

Comments of Examiners

(a) (i) (1) Most candidates could not give proper reasoning as to why fluorine has lower electron affinity than chlorine.

(2) Many candidates did not mention polymeric structure and tetrahedral link for red phosphorous and angular strain for white phosphorous.

(3) Majority of the candidates explained the oxidizing property of ozone without using the keyword *nascent oxygen*.

(ii)(1) Several candidates did not show the lone pair of electrons on Xe atom in the structure of XeF_6.

(2)Many candidates did not show the pentagonal bipyramidal structure of IF_7. A few candidates incorrectly showed extra lone pair of electrons on iodine.

(b) (i) (1) The point that *X-X' bond is weaker than X-X bond* was not mentioned by many candidates. Instead they wrote that inter halogen compounds form hydrogen bond.

(2) Most of the candidates wrote incorrect reasons like, *down the group catenation property increases*, instead of writing that S-S bond is stronger than O-O bond.

(3) Majority of the candidates did not mention that intermolecular hydrogen bonding in NH_3 is responsible for higher solubility of NH_3 in water.

(ii) (1) A few candidates were unable to write the correct product(s) and were not able to give the balanced equations. Instead of H_3PO_4 some candidates wrote H_3PO_3.

(2) Instead of NO, some candidates wrote one of the products as NO_2.

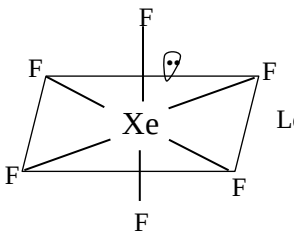
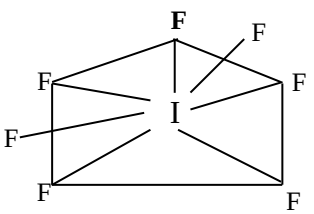
Suggestions for teachers

- Teach the p-block elements with general characteristics and discuss more of reasoning questions in class.
- Highlight the geometry of hybridisation and lone pair presence in the structure.
- Explain, on the basis of VESPR theory, how the shape and geometry are affected by the lone pairs.
- Explain the comparison of bond energy of inter halogen compounds and halogens.
- Teach the comparative properties of p-block elements in detail.
- Explain, on the basis of hydrogen bonding, the solubility of NH_3 and PH_3 in water.
- Give more practice in writing complete and balance chemical equations.

MARKING SCHEME

Question 17

(a)	(i)	(1)	F has lower electron affinity than Cl due to its small size of atom, hence electron density on F atom is very high.
		(2)	Red phosphorus has a polymeric structure and consist of P_4 tetrahedra linked together, hence it is less reactive than white phosphorous.
		(3)	Ozone is a powerful oxidising agent because it can easily decompose to give an atom of nascent oxygen which is more reactive than O_2; $O_3 \rightarrow O_2 + [O]$

	(ii)	(1)	 Lone pair must be shown
		(2)	 Pentagonal bipyramidal
	OR		
(b)	(i)	(1)	Interhalogen compounds X –X′ are more reactive than halogens X – X because X - X′ bonds are weaker than X – X bonds.
		(2)	Bond energy of S-S bond is greater than O-O bond. Due to small size of oxygen atom, it has greater lp-bp repulsion hence O-O bond is weaker than S-S bond. Therefore, sulphur shows the property of catenation.
		(3)	PH_3 does not form intermolecular H-bond due to large atomic size of Phosphorous while NH_3 forms intermolecular H-bond with water hence it becomes soluble.
	(ii)	(1)	$P_4 + 10H_2SO_4 \rightarrow 4H_3PO_4 + 10SO_2 + 4H_2O$
		(2)	$3Ag + 4HNO_3 \rightarrow 3AgNO_3 + NO + 2H_2O$ (dil)

Question 18

[5]

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

(1) Acetaldehyde reacts with hydrogen cyanide.

(2) Acetone reacts with phenyl hydrazine.

(3) Acetic acid is treated with ethanol and a drop of conc. H_2SO_4.

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

(1) Acetone and benzaldehyde.

(2) Phenol and benzoic acid.

OR

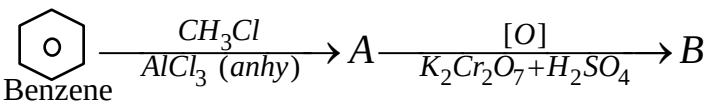
(b) (i) Write chemical equations to illustrate the following name reactions:

(1) Aldol condensation.

(2) Cannizzaro's reaction.

(3) Benzoin condensation.

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

(1) 

(2) $CH_3COCH_3 \xrightarrow[HNO_3\ (conc.)]{[O]} A \xrightarrow{PCl_5} B$

Comments of Examiners

(a) (i) (1) The chemical formula for the product was written incorrectly by some candidates.

(2) Many candidates did not write the by-product. Some candidates, instead of writing the reaction of acetone with phenyl hydrazine, wrote the reaction of acetone with hydrazine.

(3) Most candidates wrote the correct product, but a few candidates did not write H_2O as the by-product.

(ii)(1) Several candidates wrote incorrect observations for iodoform test of acetone. Some candidates also mentioned Fehling's test which is not given by both acetone and benzaldehyde.

(2) Most of the candidates wrote test with neutral $FeCl_3$. A few candidates gave incorrect observations.

(b) (i) (1) For 'Aldol condensation', many candidates used HCHO or C_6H_5CHO instead of CH_3CHO which contains α – hydrogen atom. Some candidates, instead of writing *dilute NaOH*, wrote only NaOH.

(2) For Cannizzaro's reaction, several candidates used acetaldehyde instead of formaldehyde and benzaldehyde. A few candidates did not use concentrated NaOH.

(3) Many candidates, for 'Benzoin Condensation', did not write the reagent *alcoholic KCN* not realizing that without this reagent the reaction would not occur. Some candidates wrote the structure of 'Benzoin' incorrectly.

Suggestions for teachers

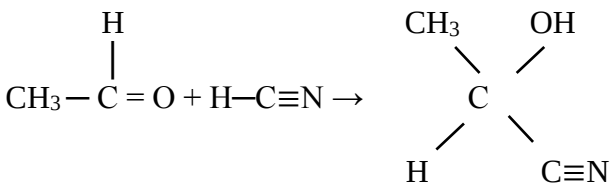
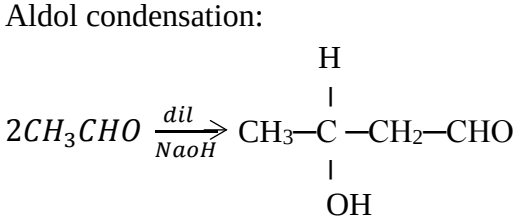
- Give adequate practice in writing organic reactions.
- Lay emphasis on writing correct balanced equations.
- Demonstrate and ask students to perform these chemical tests for better understanding.
- Insist that the students use proper reagents and write correct observations to distinguish between the organic compounds.
- Explain the importance of reagents and catalysts in named organic reactions.
- Give sufficient practice in identification of organic compounds as practicing such conversions will make students perfect and will help in better understanding.

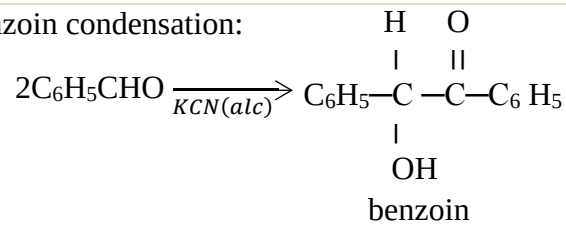
(ii)(1) Compound 'A' i.e. toluene was identified correctly by most of the candidates. Some candidates identified Compound 'B' as benzaldehyde instead of benzoic acid.

(2) Most candidates identified the compound 'A' i.e. acetic acid correctly. Some candidates wrote acetaldehyde also. Compound 'B' i.e. acetyl chloride was incorrectly identified by many candidates.

MARKING SCHEME

Question 18

(a)	(i)	(1)	
		(2)	
		(3)	$CH_3COOH + C_2H_5OH \underset{H_2SO_4}{\overset{conc.}{\rightleftharpoons}} CH_3COOC_2H_5 + H_2O$
	(ii)	(1)	Acetone + $NaHSO_3$ → white crystalline precipitate **or** Acetone + I_2 + NaOH → yellow crystalline precipitate Benzaldehyde will not respond to the above tests. (*Or any other relevant test*)
		(2)	Phenol + Br_2 water $\xrightarrow{\Delta}$ white precipitate **or** Phenol + neutral $FeCl_3$ → violet colouration while benzoic acid will not respond to the above test. (*Or any other relevant test*)
	OR		
(b)	(i)	(1)	Aldol condensation:  aldol

		(2)	Cannizzaro's reaction: $2HCHO + \underset{\text{Conc.}}{NaOH} \rightarrow CH_3OH + HCOONa$
		(3)	Benzoin condensation:  benzoin
	(ii)	(1)	A ⇒ Toluene or $C_6H_5CH_3$ B ⇒ Benzoic acid or C_6H_5COOH
		(2)	A ⇒ Acetic acid or CH_3COOH B ⇒ Ethanoyl chloride or CH_3COCl

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

- Rate law equation, order of reaction and numerical problems based on half-life period.
- Numerical problems based on depression in freezing point, calculation of degree of association, determination of molecular mass using colligative properties. Faraday's laws of electrolysis, calculation of e.m.f. using Nernst equation and free energy change (ΔG) of the cell.
- Role of chemicals/substances in the extraction of aluminium, silver and iron.
- Nomenclature of coordination compounds, hybridisation and magnetic behaviour.
- Surface chemistry, definition of certain terms related to colloidal state.
- Name of organic reactions, conversion of organic compounds, chemical tests to distinguish the organic compounds.
- Name and structure of monomers and the type of polymerisation.
- Types of vitamins, fat soluble and water soluble. Diseases caused by their deficiency.
- Reasoning questions of p and d blocks.

Suggestions for candidates

- Be regular and systematic in your studies.
- Utilise the additional reading time given to read the question paper.
- Read the question carefully and comprehend what is required before attempting the question.
- Avoid selective study. Give equal importance to all the topics as questions are asked from every unit/chapter.
- Learn to write balanced chemical equations with the conditions/reagents/catalysts used in that reaction (inorganic and organic chemistry).
- Solve numerical problems following the proper steps i.e. formula, substitution (take all the physical quantities in same system of unit), calculation and answer with proper/required unit.
- Write neatly and legibly.
- Write the correct question numbers as mentioned in the question paper.
- Learn to write the key words in the answer.
- Do not waste time in attempting additional questions given as internal choices.
- Keep enough time for rechecking and avoid careless mistakes.
- Practice IUPAC nomenclature and isomerism of the coordination compounds.

Concepts in which candidates got confused

- Relation between elevation of boiling point and number of moles of solute in solution.
- Increasing order of acidic strength of the oxoacid and inductive effect.
- The ionic size of La^{3+} and Lu^{3+}.
- Diamagnetic and paramagnetic nature of complex ions.
- Peptisation, electrophoresis and dialysis in colloidal state.
- Difference between ΔG and ΔG^{o}.
- Specific conductance and Kohlrausch's Law.
- Reactions of inorganic compounds and their balanced equations.