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 **any two** questions having internal choice.*

*Question numbers 9 to 15 carry 3 marks each, with **any two** questions having an internal choice.*

Question numbers 16 to 18 carry 5 marks each, with an internal choice.

All working, including rough work, should be done on the same sheet as, and adjacent to
the rest of the answer.
The intended marks for questions or parts of questions are given in brackets [ ].
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}
1 l 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   **[4×1]**
      brackets:

      (increases, decreases, efficient, same as, 68, non-efficient, greater than, 74, less than,
      sp^{3}d^3, sp^{3}d^2, octahedral, distorted octahedral, remains same)

   (i)   Both ccp and hcp are _____ close packing and occupy about
          _____% of the available space.

   (ii)   The molar conductance of a solution _____ with dilution, while its
          specific conductance _____ with dilution.

   (iii) The geometry of XeF$_6$ molecule is _____ and the hybridization of
          Xe atom in the molecule is _____.

   (iv)   The acidic strength of phenol is _____ ethyl alcohol but _____
          nitro phenol.

(b) Complete the following statements by selecting the **correct alternative from** the **[4×1]** choices given:

(i) The molal freezing point constant of water is $1 \cdot 86$ K kg mol^{-1}. Therefore, the freezing point of $0 \cdot 1$M NaCl solution in water is expected to be:

  (1) $-1 \cdot 86^{o}$C

  (2) $-0 \cdot 372^{o}$C

  (3) $-0 \cdot 186^{o}$C

  (4) $+0 \cdot 372^{o}$C

(ii) Which among the following reacts fastest by S_N2 reaction:

  (1) $(CH_3)_3C – Br$

  (2) $(CH_3)_2CH\ Br$

  (3) $CH_3 – CH_2 – Br$

  (4) $CH_3 – Br$

(iii) When acetaldehyde is treated with Grignard reagent followed by hydrolysis, the product formed is:

  (1) Primary alcohol

  (2) Secondary alcohol

  (3) Carboxylic acid

  (4) Tertiary alcohol

(iv) Which of the following ores can be concentrated by froth floatation process:

  (1) Haematite

  (2) Calamine

  (3) Zinc blende

  (4) Bauxite

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

(i)	Disaccharide	(a)	Adsorption
(ii)	Arrhenius equation	(b)	Condensation polymer
(iii)	Dacron	(c)	Activation energy
(iv)	Freundlich isotherm	(d)	Sucrose

2

ISC SPECIMEN QUESTION PAPER 2018

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

   (i)   Calculate the mass of compound (molar mass = 256 g mol^{-1}) to be dissolved in 75 g of benzene to lower its freezing point by 0·48 K (K_f = 5·12 K kg mol^{-1}).

   (ii)   Write the IUPAC name of the complex $[Cr(NH_3)_4Cl_2]^+$. Which type of isomerism will be exhibited by it?

   (iii) Why do the transition elements have higher enthalpies of atomisation? In 3d series (Sc to Zn), which element has the lowest enthalpy of atomisation and why?

   (iv)   Write balanced chemical equations for *Carbylamine reaction* and *Diazotization reaction*.

Question 2   [2]

(a)   Identify the reaction order from each of the following rate constants:

   (i) $k = 2·3 \times 10^{-5}$ L mol^{-1} s^{-1}.

   (ii) $k = 3 \times 10^{-4}$ s^{-1}.

OR

(b)   Write *two* differences between '*order of reaction*' and '*molecularity of reaction*'.

Question 3   [2]

(a)   Differentiate between an *antiseptic* and a *disinfectant*.

(b)   Name a biodegradable detergent.

Question 4   [2]

What will be the major product obtained when 2-bromobutane reacts with alcoholic potassium hydroxide? State the type of reaction involved in it.

Question 5   [2]

Write the names of the monomers of the following polymers:

(a)   Nylon-6

(b)   Buna-N

Question 6   [2]

Explain the amphoteric behaviour of amino acids.

Question 7 [2]

(a) How is phenol converted to benzoic acid? Explain with the help of balanced chemical equations.

<div align="center">OR</div>

(b) Write the mechanism of acid dehydration of ethanol to yield ethene.

Question 8 [2]

A substance decomposes by following first order kinetics. If 50% of the compound is decomposed in 120 minutes, how long will it take for 90% of the compound to decompose?

Question 9 [3]

(a) Calculate the amount of $CaCl_2$ (molar mass = 111 g mol^{-1}) which must be added to 500 g of water to lower its freezing point by 2 K, assuming $CaCl_2$ is completely dissociated. (K_f for water = 1.86 K kg mol^{-1}).

<div align="center">OR</div>

(b) A solution containing 0·5 g of KCl dissolves in 100 g of water and freezes at $-0·24^o$ C. Calculate the degree of dissociation of the salt. (K_f for water = 1.86^o C).

Question 10 [3]

An element with density 10 g cm^{-3} forms a cubic unit cell with edge length of 3×10^{-8} cm. What is the nature of the cubic unit cell if the atomic mass of the element is 81 g mol^{-1}?

Question 11 [3]

Give reasons for the following observations:

(a) Physisorption decreases with an increase in temperature.

(b) Addition of alum purifies water.

(c) Brownian movement stabilizes colloidal solutions.

Question 12

[3]

(a) What type of isomers are $[Co(NH_3)_5Br]SO_4$ and $[Co(NH_3)_5SO_4]Br$.? Give a chemical test to distinguish between the two isomers.

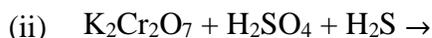(b) Write the structures of optical isomers of the complex ion $[Co(en)_2Cl_2]^+$.

Question 13 [3]

(a) Account for the following/Explain why:

(i) Transition metals exhibit variable oxidation states.

(ii) Zr (Z = 40) and Hf (Z = 72) have almost identical radii.

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

OR

(b)   Complete the following chemical equations:

    (i) $K_2Cr_2O_7 + H_2SO_4 + FeSO_4 \rightarrow$

    (ii) $K_2Cr_2O_7 + H_2SO_4 + H_2S \rightarrow$

    (iii) $KMnO_4 + H_2SO_4 + H_2C_2O_4 \rightarrow$

Question 14 [3]

Arrange the following as directed:

(a)   Increasing order of basic strength:

         Aniline, p – nitroaniline and p – toluidine.

(b)   Decreasing order of basic strength in gas phase:

    $C_2H_5NH_2$, $(C_2H_5)_2NH$, $(C_2H_5)_3N$ and NH_3.

(c)   Increasing order of solubility in water:

    $C_6H_5NH_2$, $(C_2H_5)_2NH$, $C_2H_5NH_2$.

Question 15 [3]

How is silver extracted from its ore? Explain the process with relevant equations.

Question 16 [5]

(a) (i) Resistance of a conductivity cell filled with 0.1 mol L^{-1} KCl solution is 100 Ω. If the resistance of the same cell when filled with 0.02 mol L^{-1} KCl solution is 520 Ω, calculate the conductivity and molar conductivity of 0.02 mol L^{-1} KCl solution. The conductivity of 0.1 mol L^{-1} KCl solution is $1.29 \times 10^{-2}\,\Omega^{-1}cm^{-1}$.
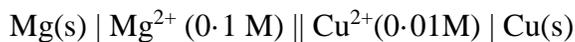
  (ii) Define the following terms:

    (1)   Limiting molar conductivity.

    (2)   Fuel cell.

OR

(b) (i) Calculate emf of the following cell at 298 K:

    $Mg(s) \,|\, Mg^{2+} (0.1\ M) \,||\, Cu^{2+}(0.01M) \,|\, Cu(s)$

    [Given $E^o_{cell} = +2.71$ V, 1 Faraday = 96500 C mol^{-1}]

  (ii) State Faraday's first law of electrolysis. Calculate the charge required in terms of Faraday for the reduction of 1 mole of Cu^{2+} to Cu.

Question 17   **[5]**

(a) (i) Account for the following/Explain why:
        (1) Interhalogens are more reactive than halogens.
        (2) N_2 is less reactive at room temperature.
        (3) Reducing character increases from NH_3 to BiH_3.

    (ii) Draw structures of the following:
        (1) $H_4P_2O_7$
        (2) XeF_4

<div align="center">OR</div>

(b) (i) Account for the following/Explain why:
        (1) PCl_5 exists but NCl_5 does not.
        (2) Fluorine is a stronger oxidising agent than chlorine.
        (3) Bond enthalpy of F_2 is less than that of Cl_2.

    (ii) Complete and balance the following reactions:
        (1) $FeSO_4 + H_2SO_4 + Cl_2 \longrightarrow$ ———— + ————
        (2) $P_4 + HNO_3 \longrightarrow$ ———— + ———— + ————

Question 18   **[5]**

(a) (i) Write the product(s) of the following reactions:
        (1) $CH_3COCH_3 +$ H_2NOH $\longrightarrow$
        (2) $2\ C_6H_5CHO + conc.\ NaOH \longrightarrow$
        (3) $CH_3COOH \xrightarrow{Cl_2/P}$

    (ii) Give *one* chemical test each to distinguish between the following pairs of compounds:
        (i) Benzaldehyde and Benzoic acid
        (ii) Propanal and Propanone

<div align="center">OR</div>

(b) (i) Write the chemical equations to illustrate the following name reactions:
        (1) Wolff-Kishner reduction.
        (2) Aldol condensation.
        (3) Cannizzaro reaction.

    (ii) Account for the following:
        (1) CH_3CHO is more reactive with HCN than CH_3COCH_3.
        (2) Carboxylic acids are stronger acids than phenol.