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 $\times 10^{23}$.

Question 1

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

(square pyramidal, electrical, 74, 26, sp^3d^2, sp^3d, chemical, 68, 32, tetrahedral, yellow, white, iodoform, Lucas)

(i) A Galvanic cell converts _____ energy into _____ energy.

(ii) The percentage of unoccupied spaces in bcc and fcc arrangements are _____ and _____ respectively.

(iii) Propan-2-ol on reaction with iodine and sodium hydroxide gives _____ precipitate and the reaction is called _____test.

(iv) The geometry of $XeOF_4$ molecule is _____ and the hybridisation of xenon atom in the molecule is _____.

This Paper consists of 8 printed pages.

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

(i) During the course of an S_N1 reaction, the intermediate species formed is:

(1) a carbocation
(2) a free radical
(3) a carbanion
(4) an intermediate complex

(ii) Purification of aluminium by electrolytic refining is called:

(1) Serpeck's process
(2) Hoope's process
(3) Hall's process
(4) Baeyer's process

(iii) An aqueous solution of urea freezes at $-0{\cdot}186^oC$, K_f for water = $1{\cdot}86$ K kg mol^{-1}, K_b for water = $0{\cdot}512$ K kg mol^{-1}. The boiling point of urea solution will be:

(1) 373·065 K
(2) 373·186 K
(3) 373·512 K
(4) 373·0512 K

(iv) In the dehydration of alcohols to alkenes by heating with concentrated sulphuric acid, the initiation step is:

(1) formation of carbocation
(2) formation of an ester
(3) protonation of alcohol molecule
(4) elimination of water

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

(i)	Rate constant	(a)	Dialysis
(ii)	Biodegradable polymer	(b)	Glycine
(iii)	Zwitter ion	(c)	Arrhenius equation
(iv)	Purification of colloids	(d)	PHBV

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

(i) (1) Why does the density of transition elements increase from Titanium to Copper? (at. no. Ti = 22, Cu = 29)

(2) Why is zinc not regarded as a transition element?

(at. no. Zn = 30)

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

$$CH_3CN \xrightarrow{H_2O/H^+} A \xrightarrow{NH_3} B \xrightarrow{heat} C \xrightarrow{Br_2/KOH} D$$

(iii) Calculate the osmotic pressure of a solution prepared by dissolving 0·025g of K_2SO_4 in 2·0 litres of water at 25°C assuming that K_2SO_4 is completely dissociated. (mol. wt. of K_2SO_4 = 174 g mol^{-1})

(iv) What type of isomerism is shown by the following coordination compounds:

$[Pt\ Cl_2\ (NH_3)_4)]\ Br_2$ and $[Pt\ Br_2(NH_3)_4]\ Cl_2$.

Write their IUPAC names.

Question 2 **[2]**

(a) (i) Write the rate law expression for the reaction A + B + C → D + E , if the order of reaction is first, second and zero with respect to A, B and C, respectively.

(ii) How many times the rate of reaction will increase if the concentration of A, B and C are doubled in the equation given in (i) above?

OR

(b) The rate of reaction becomes four times when the temperature changes from 293 K to 313 K. Calculate the energy of activation (E_a) of the reaction assuming that it does not change with temperature. (R = 8·314 J K^{-1} mol^{-1})

Question 3 **[2]**

(a) How do antiseptics differ from disinfectants?

(b) State the role of the following chemicals in the food industry:

(i) Sodium benzoate

(ii) Aspartame

Question 4 **[2]**

An aromatic organic compound [A] on heating with NH_3 and Cu_2O at high pressure gives [B]. The compound [B] on treatment with ice cold solution of $NaNO_2$ and HCl gives [C], which on heating with Cu/HCl gives compound [A] again. Identify the compounds [A], [B] and [C]. Write the name of the reaction for the conversion of [B] to [C].

Question 5 **[2]**

Write the names of the monomers for each of the following polymers:

(a) Bakelite

(b) Nylon – 2 – nylon – 6

Question 6 **[2]**

Name the purine bases and pyrimidine bases present in RNA and DNA.

Question 7 **[2]**

(a) How will you obtain the following? (Give balanced equation.)

(i) Picric acid from phenol.

(ii) Ethyl chloride from diethyl ether.

OR

(b) How will you obtain the following? (Give balanced equation.)

(i) Anisole from phenol

(ii) Ethyl acetate from ethanol.

Question 8 **[2]**

40% of a first order reaction is completed in 50 minutes. How much time will it take for the completion of 80% of this reaction?

Question 9 **[3]**

(a) The freezing point of a solution containing 5·85g of NaCl in 100g of water is −3·348°C. Calculate van't Hoff factor 'i' for this solution. What will be the experimental molecular weight of NaCl?

(K_f for water = 1·86 K kg mol^{-1}, at. wt. Na = 23, Cl = 35·5)

OR

(b) An aqueous solution containing 12·48g of barium chloride ($BaCl_2$) in 1000g of water, boils at 100·0832°C. Calculate the degree of dissociation of barium chloride. (K_b for water = 0·52 K kg mol^{-1}, at. wt. Ba = 137, Cl = 35·5)

Question 10 **[3]**

Examine the defective crystal given below and answer the question that follows:

A^+	B^-	A^+	B^-	A^+
B^-		B^-	A^+	B^-
A^+	B^-	A^+		A^+
B^-	A^+	B^-	A^+	B^-

State if the above defect is stoichiometric or non-stoichiometric. How does this defect affect the density of the crystal? Also, write the term used for this type of defect.

Question 11 **[3]**

Give reason for each of the following:

(a) For ferric hydroxide sol the coagulating power of phosphate ion is more than chloride ion.

(b) Medicines are more effective in their colloidal form.

(c) Gelatin is added to ice creams.

Question 12 **[3]**

(a) For the complex ion $[Fe(CN)_6]^{3-}$, state:

(i) the type of hybridisation.

(ii) the magnetic behaviour.

(iii) the oxidation number of the central metal atom.

(b) Write the IUPAC name of $[Co(en)_2Cl_2]^+$ ion and draw the structures of its geometrical isomers.

Question 13 **[3]**

(a) Explain why:

(i) Mn^{2+} is more stable than Fe^{2+} towards oxidation to +3 state.

(At. no. of Mn = 25, Fe = 26)

(ii) Transition elements usually form coloured ions.

(iii) Zr and Hf exhibit similar properties.

(At. no. of Zr = 40, Hf = 72)

OR

(b) Complete and balance the following chemical equations:

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

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

(iii) $KMnO_4 + H_2SO_4 + FeSO_4 \rightarrow$ _____ + _____ + _____ + _____

Question 14 **[3]**

(a) Arrange the following in the increasing order of their basic strength:

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

(b) Give a balanced chemical equation to convert methyl cyanide to ethyl alcohol.

(c) What happens when benzene diazonium chloride reacts with phenol in weak alkaline medium? (Give balanced equation).

Question 15 **[3]**

Name the sulphide ore of Copper. Describe how pure copper is extracted from this ore.

Question 16 **[5]**

(a) (i) Calculate the emf and ΔG^o for the cell reaction at 25°C:

$Zn(s)\left|Zn^{2+}_{(aq)}\right| \left|Cd^{2+}_{(aq)}\right| Cd_{(s)}$

(0·1M) (0·01M)

Given $E^oZn^{2+}/Zn = -0 \cdot 763\ and\ \ E^oCd^{2+}/Cd = -0 \cdot 403V$

(ii) Define the following terms:

(1) Equivalent conductivity

(2) Corrosion of metals

OR

(b) (i) The specific conductivity of a solution containing 5 g of anhydrous $BaCl_2$ (mol. wt. = 208) in 1000 cm^3 of a solution is found to be 0·0058 $ohm^{-1}cm^{-1}$. Calculate the molar and equivalent conductivity of the solution.

(ii) What is an electrochemical series? How is it useful in predicting whether a metal can liberate hydrogen from acid or not?

Question 17 **[5]**

(a) (i) Explain why:

(1) Nitrogen does not form pentahalides.

(2) Helium is used for filling weather balloons.

(3) ICl is more reactive than I_2.

(ii) Draw the structures of the following:

(1) $HClO_4$

(2) H_3PO_3

OR

(b) (i) Explain why:

(1) Mercury loses its meniscus in contact with ozone.

(2) Halogens are coloured and the colour deepens on moving down in the group from fluorine to iodine.

(3) Hydride of sulphur is a gas while hydride of oxygen is a liquid.

(ii) Complete and balance the following reactions:

(1) $NaCl + MnO_2 + H_2SO_4 \rightarrow$ _____ + _____ + _____ + _____

(2) $KMnO_4 + SO_2 + H_2O \rightarrow$ _____ + _____ + _____

Question 18 **[5]**

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

(1) Benzaldehyde reacts with hydrazine.

(2) Acetic acid reacts with phosphorous pentachloride.

(3) Acetone reacts with sodium bisulphite.

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

(1) Ethanol and acetic acid

(2) Acetaldehyde and benzaldehyde

OR

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

(1) Clemmensen's reduction

(2) Rosenmund's reduction

(3) HVZ reaction

(ii) Explain why:

(1) Acetaldehyde undergoes aldol condensation, but formaldehyde does not.

(2) Acetic acid is a weaker acid as compared to formic acid.