CHEMISTRY

Paper – 1

(THEORY)

Three hours and a quarter

(The first 15 minutes of the examination are for reading the paper only.

Candidates must NOT start writing during this time).

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*Answer **all** questions in Part I. From Part II, answer any four questions from Section A, any three questions from Section B and any two questions from Section C.*

All workings, including rough work, should be done on the same sheet as, and adjacent to the rest of the answer.

The intended marks for 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}

PART I (40 marks)

Answer **all** *questions.*

Question 1.

(a) Correct the following statements. **[4]**

(i) Colligative properties are used for determining melting and boiling points.

(ii) An invariant system has three degrees of freedom.

(iii) Electrical neutrality in the electrochemical cell is maintained by the electrode potential.

(iv) Freezing of water involves increase in randomness and decrease in

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(b) Each question is followed by four possible choices of answers. Choose the correct answer and write it in your answer sheet. **[1**

(i) Bleaching property of hydrogen peroxide is due to its

A reducing property.

B oxidizing property.

C thermal unstability.

D acidic nature.

(ii) Which acid is the strongest?

A HCOOH.

B CH_3COOH.

C Cl_3CCOOH.

D $ClCH_2COOH$.

(iii) Buffer solution is a mixture of

A weak base and weak acid.

B weak base and strong acid.

C weak acid and conjugate acid.

D weak acid and its conjugate base.

(iv) One of the raw material to form nylon 66 is

A adipic acid.

B butadiene.

C ehtylene.

D isoprene.

(v) Hydrogenation of benzoyl chloride in presence of Pd and $BaSO_4$ gives

A benzyl alcohol.

B benzaldehyde.

C benzoic acid.

D phenol.

(vi) 1.0g of radioactive isotope was found to reduce to 125 mg after 24 hours, the half-life of the isotope is

A 4 hours.

B 6 hours.

C 8 hours.

D 24 hours.

(vii) Which of the following has the highest bond angle?

A CH_4

B NH_3

C BeF_2

D H_2O

(viii) Electromeric effect arises due to

A polarity in the molecule.

B electrons in sigma bond.

C distortion of the electron cloud.

D demand of the attacking reagent.

(ix) When glucose is heated with Fehling's solution, it gives a precipitate of

A Cu.

B CuO.

C Cu_2O.

D Cu_2O_2.

(x) Which of the following compound is optically active?

A 1-Bromobutane

B 2-Bromobutane

C 2-Bromo-2-methylpropane

D 1-Bromo-2-methylpropane

(c) Fill in the blanks choosing appropriate words given in brackets. Write the correct answers in your answer sheet. **[6]**

(*ethyl alcohol, anode, formaldehyde, toluene, cathode, ether, ammonia, aldehyde, benzene*)

(i) In a galvanic cell, the movement of current in the external circuit is from …… to ……...

(ii) Urotropine is obtained by the reaction of …….. with …….

(iii) A tincture of iodine contains iodine in potassium iodide and ……

(iv) When phenol is distilled with zinc, ….. …. is formed.

(d) Match the items of column A with the items in column B. Rewrite the correct pairs in your answer sheet. **[4]**

Column A	**Column B**
(i) anisotropic	(a) lead sulphide
(ii) glasses	(b) strong base Vs. weak acid
(iii) electrophiles	(c) hydroxyl ion
(iv) methyl orange	(d) tin stone
(v) nucleophiles	(e) silver glance
(vi) phenolphthalein	(f) silicon
(vii) galena	(g) graphite
(viii)cassiterite	(h) strong acid Vs. weak base
	(i) super cooled liquids
	(j) NO_2^+

(e) Answer the following questions.

(i) Derive the mathematical form of the First Law of Thermodynamics and identify the various terms involved. **[2]**

(ii) Name the compounds given below: **[2]**

(a) $K_4[Fe(CN)_6]$

(b) $(C_2H_5)_4Pb$

(iii) Define Henry's Law. **[1]**

(iv) Write *two* uses of silver nitrate. **[1]**

(v) Define Inductive effect. **[1]**

(vi) What would you observe when acidified potassium permanganate reacts with oxalic acid. **[1]**

(vii) Write the IUPAC names of the following: **[2]**

(a) CH_3CN

(b) CH_3NC

(viii) Name the reagent that can be used to differentiate an aldose and ketose. **[1]**

(ix) How many asymmetric carbon atoms are present in COOH . CHOH . CHOH . COOH? **[½]**

(x) Draw all the possible isomers of the acid mentioned in (ix). **[1½]**

(xi) What is the monomer unit of PVC? **[1]**

(xii) Name *two* colloids. **[1]**

(xiii) What is Vant Hoff factor (*i*)? **[1]**

This booklet contains 12 pages.

PART II

SECTION A (28 marks)

Answer any **four** *questions.*

Question 2.

(a) An aqueous solution of cane sugar freezes at -0.372°C. Calculate the molaity of the solution. [The cryoscopic constant (K_f) of water is 1.86 K mol^{-1} Kg^{-1}] **[2]**

(b) The boiling point of 0.1M $BaCl_2$ is higher than the boiling point of 0.1M urea. Give a reason. **[2]**

(c) On the basis of molecular Orbital Theory, state the following for O_2 and O_2^+: **[3]**

(i) electronic configuration

(ii) bond order

(iii) diamagnetic / paramagnetic

Question 3.

(a) A piece of wood was found to have C^{14} / C^{12} ratio 0.7 times that in a living plant. Calculate the period when the plant died. [Half life of C^{14} = 5760 years] **[3]**

(b) Complete and balance the following nuclear equations. **[1]**

(i) $_{28}Ni^{58} + {}_1H^1 \rightarrow \ldots\ldots\ldots\ldots + {}_0n^1$

(ii) $_{15}P^{31} + \ldots\ldots\ldots \rightarrow {}_{15}P^{32} + {}_1H^1$

(c) (i) Give the graphical representation of Arrhenious equation showing the variation of rate constant with temperature. **[2]**

(ii) How will you find the energy of Activation from the above graph? **[1]**

Question 4.

(a) On the basis of copper crystal, answer the following: **[2]**

(i) nature of bond holding the particles together.

(ii) type of unit cell.

(b) 10g of an organic compound is present in $100cm^3$ of water. You are provided with $100cm^3$ of ether to recover it from water. Show by calculation that it is better to use two lots of $50cm^3$ ether rather than in one lot of $100cm^3$. The given organic compound is 4 times soluble in ether than in water. **[4]**

(c) What type of hybridization exists in diamond and graphite? **[1]**

Question 5.

(a) If the solubility of the sparingly soluble salt silver chromate (Ag_2CrO_4) is 'S'. How can you relate its solubility with its solubility product? **[2]**

(b) For a standard cell, **[3]**

$Cu_{(s)} / Cu^{2+}{}_{(aq)} // Ag^{+}{}_{(aq)} / Ag_{(s)}$

Given $E^0\ Cu^{2+} / Cu = +\ 0.34v$ and $E^0\ Ag^{+} / Ag = +\ 0.80v$

(i) Identify the cathode and anode.

(ii) Write the reaction taking place at the cathode and anode.

(iii) Calculate the standard cell potential (e.mf).

(c) What is a catalytic promoter? Mention its significance in chemical processes. **[2]**

Question 6.

(a) Based on the collision theory, explain the factors which affect the rate of a reaction. **[3]**

(b) Define Phase rule? Write its mathematical form. What will be the degree of freedom for water system at the triple point? **[2]**

This booklet contains 12 pages.

(c) Cations of Group IV are precipitated as sulphide in ammonical medium. Explain the statement. **[2]**

Question 7.

(a) The resistance of 0.05N solution of an electrolyte is 200 Ohms. Calculate **[2]**

(i) conductance.

(ii) specific conductance.

The cell constant of the conductivity cell is 2.0 cm^{-1}.

(b) Aqueous solution of ammonium chloride is acidic while that of sodium acetate is basic. Prove this statement. **[2]**

(c) Plot a graph of neutron to proton. Show the belt of stability in the graph. What does it signify? **[3]**

SECTION B (18 marks)

Answer any **three** *questions.*

Question 8.

(a) How is copper extracted from copper pyrites? Give the equations for the chemical changes involved. **[4]**

(b) The reaction: $RX + OH^- \rightarrow ROH + X^-$ is found to be first order. **[2]**

(i) What type of reaction does RX undergo?

(ii) Name an alkyl halide which undergoes this type of reaction.

Question 9.

(a) Write the balanced equations for the following: **[2]**

(i) Hydrochloric acid is added to sodium thiosulphate solution.

(ii) Hydrogen sulphide is bubbled through copper sulphate solution.

(b) State the type of reaction by choosing the options given in brackets.
(*electrophilic / nucleophilic - substitution, addition, elimination*)

(i) Propylene with hydrogen bromide

(ii) Benzene with chlorine in the presence of ferric chloride

(iii) Isobutyl bromide with aqueous alkali

(iv) 2-bromo propane with alcoholic alkali

Question 10.

(a) Mention any *three* uses of organometallic compounds. **[3]**

(b) (i) How is silicon carbide manufactured from SiO_2? **[2]**

(ii) Mention *one* of its use and the corresponding property. **[1]**

Question 11.

(a) The standard enthalpy change and the standard entropy change for a reaction: $H_2 + I_2 \rightarrow 2HI$ at 298 K are 52.0 KJ and 165.2 JK^{-1} respectively. Is the reaction spontaneous or not? Justify your answer. **[3]**

(b) (i) State the Second law of thermodynamics in terms of entropy. **[1]**

(ii) Differentiate between an open and an isolated system. **[2]**

SECTION C (14 marks)

Answer any **two** *questions.*

Question 12.

(a) Perform the following conversions: **[4]**

(i) acetic acid to methylamine

(ii) acetone to propane

(iii) oxalic acid to formic acid

(b) Write notes on the following:

(i) Zwitter ion

(ii) Soap

Question 13.

(a) Complete the following and name the reaction. **[4]**

(i) $C_6H_5Cl + 2Na + C_6H_5Cl \rightarrow$ …….. + ……

(ii) $C_6H_5NH_2 + CHCl_3 + KOH \rightarrow$ …….. + ……. + ……

(b) Carry out the following conversions: **[3]**

(i) starch to glucose

(ii) glucose to fructose

Question 14.

(a) Compound 'A' has molecular formula $C_2H_4O_2$. On chlorination with phosphorus pentachloride, a compound 'B' is formed. The compound 'B' on further reaction with ammonia forms 'C'. The product 'C' reacts with bromine water and alkali giving 'D'. Identify A, B, C and D. **[4]**

(b) Give the reactions for the synthesis of the following polymers: **[3]**

(i) Terylene

(ii) Teflon