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).

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 working, including rough work, should be done on the same sheet as, and adjacent to the rest of the answer in the answer booklet.

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.*** **[5]**

(i) The crystal lattice is the smallest repeating unit in a crystal.

(ii) The vapour pressure of a solution is directly proportional to the mole fraction of the solute.

(iii) The hydrogen ion concentration and the pH of a solution increases when a weak acid is diluted.

(iv) Chlorination of methane is an example of nucleophillic substitution reaction.

(v) Potash alum is prepared by mixing hot equimolar solutions of K_2SO_4 and $Al_2(SO_4)_3$.

(b) ***Each question is followed by four possible choices of answers. Choose the correct answer and write it in your answer sheet.*** **[10]**

(i) A triple point is

A monovariant.

B bivariant.

C trivariant.

D non-variant.

(ii) When ${}_{10}A^{32}$ emits two alpha and two beta particles, the number of neutrons in the daughter nucleus is

A 14.

B 15.

C 16.

D 17.

(iii) The solution having the highest freezing point is

A 0.2 M glucose.

B 0.1 M $BaCl_2$.

C 0.2 M NaCl.

D 0.1 M urea.

(iv) The hydrolysis of methyl cyanide yields

A acetamide.

B ethyl amine.

C acetaldehyde.

D acetic anhydride.

(v) For a spontaneous reaction

A ΔH and ΔS are positive.

B ΔH and ΔS are negative.

C ΔH is positive, ΔS is negative.

D ΔH is negative, ΔS is positive.

(vi) When acetaldehyde reacts with hydrogen cyanide the product formed is

A acetaldoxime.

B ethylcyanate.

C cyanohydrin.

D aldol.

(vii) The rate of reaction during the hydrolysis of ethyl bromide depends on the concentration of

A ethyl bromide and alkali.

B ethyl bromide and water.

C alkali and acid.

D water and acid.

(viii) The conjugate base of H_2CO_3 is

A H^+.

B OH^-.

C H_3O^+.

D HCO_3^-.

(ix) In respect to Arrhenius equation $K = Ae^{-Ea/RT}$, all are correct **EXCEPT**

A K stands for dissociation constant.

B E_a can be calculated by slope.

C value of R is 8.314 Jk^{-1} $mole^{-1}$.

D A is a constant.

(x) Which of the following expressions is true for an adiabatic process?

A $P\Delta V = 0$

B $\Delta E = q$

C $q = w$

D $q = 0$

(c) ***Fill in the blanks choosing appropriate word/s given in the brackets below. Write the correct answers in your answersheet.*** **[6]**

(adsorption, carbylamine, dissacharide, monosaccharide, intermediate complex formation, Hoffman, soap, detergent, cancer treatment, smoke screen)

(i) Sucrose is an example of ……….

(ii) When coconut oil is stirred and warmed with caustic potash, ………. is formed.

(iii) The best way to reduce the length of carbon chain in an amide is by …….. reaction.

(iv) The heterogeneous catalysis is better explained by ………. theory.

(v) Radioactive phosphorus (P^{32}) can be used in ……….

(vi) During the extraction of copper, the ore can be reduced only after the removal of ……….

(d) ***Match the compounds of Column A with the compounds in Column B. The compounds in Column B are the starting compounds used in the preparation of compounds in Column A. Rewrite the correct pairs in your answer sheet.*** **[4]**

Column A	Column B
(i) Chlorobenzene	(a) toluene
(ii) Benzaldhyde	(b) methanol
(iii) Formaldehyde	(c) acetaldehyde
(iv) Ether	(d) aniline
	(e) urea
	(f) ethanol
	(g) benzene sulphonic acid

(e) ***Answer the following questions.***

(i) What are organometallic compounds? **[1]**

(ii) Give the chemical equation for the preparation of glycine from chloroacetic acid. **[1]**

(iii) Aromatic alcohols are weakly acidic. Give a reason. **[1]**

(iv) Why do acetone and aldehyde undergo similar type of reactions? **[1]**

(v) How is glucose prepared from starch? **[1]**

(vi) The resistance of 0.09 M solution contained in a cell was found to be 332 ohm. Calculate the molar conductance of the solution. (Cell constant = 0.333 cm^{-1}) **[2]**

(vii) Give ***two*** points of differences between reversible and irreversible processes. **[2]**

(viii) What is the condition required for geometrical isomerism? Give an example of a compound which undergoes geometrical isomerism. **[2]**

(ix) Differentiate between synthetic and natural polymers with an example each. **[2]**

(x) Draw the molecular orbital diagram for H_2 molecule and find its bond order. **[2]**

PART II (60 marks)

SECTION A (28 marks)

Answer any **four** *questions.*

Question 2.

(a) A mountain trekker carries a bottle each of pure water and an energy drink containing 100gm/litre of glucose. At what temperature would these two liquids freeze? Give a reason for your answer. ($K_f = 1.86\ K mol^{-1}\ kg^{-1}$) **[3]**

(b) Give reasons for the following: **[3]**

(i) $ZnCl_2$ gives a precipitate with NH_4OH but not with a mixture of NH_4OH and NH_4Cl.

(ii) pH of pure water remains the same when CH_3COONH_4 is dissolved.

(c) What are Schottky defects? **[1]**

Question 3.

(a) An old religious artifact showed C^{14} activity of 16.2 disintegration per second, while a freshly made sample showed C^{14} activity of 160 disintegration per second. How old is the religious artifact? ($T_{1/2}$ of ^{14}C = 5730 yrs.) **[3]**

(b) Which of the following has a higher dipole moment? Give ***one*** reason. **[2]**

(i) CO_2

(ii) H_2O

(c) Write short notes on: **[2]**

(i) Tyndal effect

(ii) Hydrophillic colloids

Question 4.

(a) If you were provided with the following four half electrodes to construct a galvanic cell as a part of a Chemistry project, which two electrodes would you choose to construct a cell in order to produce the highest emf. Justify your choice with working details. **[3]**

(i)	Cu^2+ / Cu	$E° = ^+0.34v$
(ii)	Ag^+ / Ag	$E° = ^+0.80v$
(iii)	Al^{3+} / Al	$E° = ^-1.67v$
(iv)	Zn^{2+} / Zn	$E° = ^-0.76v$

(b) With the help of chemical equations, outline the preparation of AS_2S_3 solution. How can it be purified? **[2]**

(c) Differentiate between diamond and graphite on the basis of: **[2]**

(i) crystal structure

(ii) co-ordination number

(iii) hybridization

(iv) electrical conductivity

Question 5.

(a) The solubility product of lead bromide is 8×10^{-5}. Calculate its solubility in: **[3]**

(i) pure water.

(ii) 0.2M NaBr solution.

(b) Explain the following giving appropriate examples: **[2]**

(i) moderator in a nuclear reactor

(ii) nuclear fission

(c) What will happen if copper is added to silver nitrate solution? Give a reason for your answer. (E^0 of Cu = $^+0.34$v, E^0 of Ag = 0.80v) **[2]**

Question 6.

(a) For a chemical reaction, A + B → C, the following data were obtained:

Experiment No.	Conc. of [A]	Conc. of [B]	Rate of reaction
1.	1.2×10^{-2}	1.2×10^{-2}	2.4×10^{-4}
2.	1.2×10^{-2}	3.6×10^{-2}	2.16×10^{-3}
3.	3.6×10^{-2}	3.6×10^{-2}	6.48×10^{-3}

(i) Write the rate law for this reaction.

(ii) Calculate the rate constant.

(b) Give a suitable reason for the following: **[3]**

(i) Crystalline solids are anisotropic.

(ii) Rate of reaction decreases with time.

(iii) H_2O is more polar than H_2S.

(c) State the Distribution Law. **[1]**

Question 7.

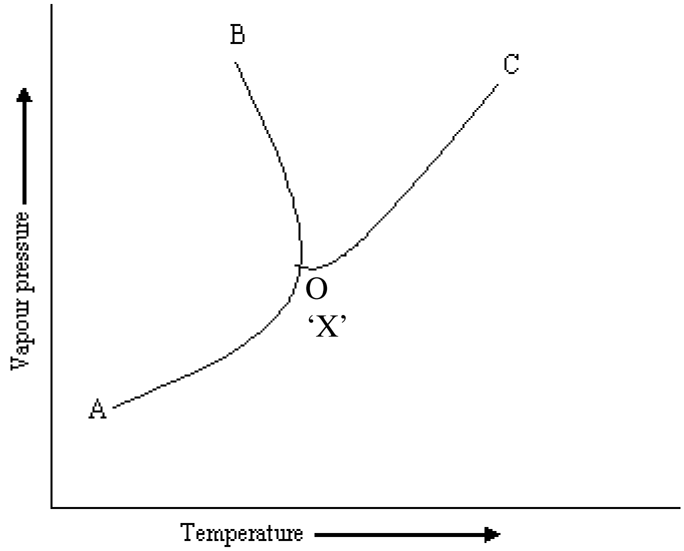
(a) Find the osmotic pressure of human blood if it is isotonic with an intravenous injection fluid containing 54 gm of glucose per litre at 37°C. **[2]**

(b) Sort the odd compound out from the following list and give a reason for your answer. **[2]**

(i) SO_3, H_2SO_4, CO_2, $HClO_2$

(ii) H_2S, H_2O, NH_3, HF

(c) Given below is the phase diagram of water. Study the diagram and answer the questions that follow.



(i) Name the curve OC.

(ii) What does the area BOC represent?

(iii) What will happen if the component at point 'X' is sufficiently cooled?

(iv) Find the degrees of freedom along AO.

SECTION B (18 marks)

Answer any three questions.

Question 8.

(a) (i) Name the chief ore of lead. **[½]**

(ii) How is it extracted from the ore using coke as the reducing agent? **[3½]**

(b) How are $CH_3CHCHCHO$ and $ClCH_2COOH$ different from each other on the basis of electron displacement effects? **[2]**

Question 9.

(a) (i) How is the First Law of Thermodynamics guided by the Law of Conservation of Energy? **[1]**

(ii) Give its mathematical form. **[1]**

(iii) Outline ***two*** limitations of the First Law of Thermodynamics. **[1]**

(b) One mole of a gas is allowed to expand isothermally and reversibly from a volume of 5 dm^3 to 50 dm^3 at 273K. Calculate W and ΔE, assuming ideal behavior of the gas. **[2]**

(c) What are nucleophiles? Give ***one*** example. **[1]**

Question 10.

(a) Explain the manufacture of iodine from sea-weeds. **[3]**

(b) Complete and balance the equations: **[2]**

(i) $Na_2S_2O_3 + I_2 \rightarrow$ ……….

(ii) $AgNO_3 + NaOH \rightarrow$ ……….

(c) What is Gibb's free energy? **[1]**

Question 11.

(a) Give the IUPAC name of the following complex compounds and identify the cation part of each: **[2]**

(i) $K_4Fe\ [CN]_6$

(ii) $[Cu\ (NH_3)_4]\ (OH)_2$

(b) Give ***two*** points of differences between: **[2]**

(i) hydrogenation of ethene and chlorination of ethane

(ii) free radical and electrophile

(c) (i) 'Silicones are all temperature lubricants'. Justify. **[1]**

(ii) What is Wilkinson's catalyst? **[1]**

SECTION C (14 marks)

Answer any **two** *questions.*

Question 12.

(a) Complete and balance the following equations: **[4]**

(i) $C_6H_5Cl + HNO_3 \xrightarrow[\Delta]{Conc.H_2SO_4}$ ....

(ii) $C_6H_5COCl + H_2 \xrightarrow{Pd / BaSO_4}$ ....

(iii) $CH_3COOH + PCl_5 \rightarrow$ ....

(iv) $C_2H_5OC_2H_5 + HI \xrightarrow{Cold}$ ....

(b) (i) Why is sucrose known as 'invert sugar'? **[1]**

(ii) Differentiate between starch and cellulose. **[1]**

(c) Name a bond present in isocyanides but not in cyanides. **[1]**

Question 13.

(a) An organic compound 'A' with molecular formula $C_4H_{10}O$ reacts with acetyl chloride to form a compound 'B'. Compound 'B' further reacts with ammonia to produce compound 'C' which undergoes Hoffman's reaction. Compound 'B' also undergoes hydrolysis to form compound 'D' which gives effervescence with sodium carbonate. Identify the compounds A, B, C and D. **[4]**

(b) (i) What is an asymmetric carbon atom? **[1]**

(ii) Give the structure of glycine. **[1]**

(iii) What is meant by saponification? **[1]**

Question 14.

(a) Perform the following conversions: **[3]**

(i) benzene to aniline

(ii) chlorobenzene to toluene

(iii) phenol to picric acid

(b) (i) How does racemic mixture differ from meso form in an optical activity?

(ii) What type of isomerism is exhibited by the compound having molecular formula C_4H_8? **[1]**

(c) (i) 'PVC can be recycled'. Support the statement. **[1]**

(ii) Name the product formed when ethylamine reacts with chloroform and alcoholic KOH. **[1]**