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 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 melting points of crystalline and amorphous solids are not definite.

(ii) The equation for the relative lowering of vapour pressure when solute remains normal is $\frac{P - P_s}{P_s} = X_{solute}$.

(iii) The degree of ionization decreases with dilution.

(iv) Tertiary butyl halide and alcoholic potassium hydroxide undergo electrophillic elimination reaction.

(v) Silicon carbide is prepared by heating a mixture of sand, coke, saw dust and alkali in an electric furnace.

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

(i) The solubility of a gas increases with the increase of

A volume of the gas.

B concentration.

C temperature.

D pressure.

(ii) The number of neutrons in a parent nucleus X which gives $_7N^{14}$ nucleus after two successive β-emissions would be

A 6.

B 7.

C 8.

D 9.

(iii) The relative lowering of vapour pressure of a solvent by the addition of a solute is

A equal to the mole fraction of the solute.

B equal to the mole fraction of the solvent.

C directly proportional to the molality of the solution.

D directly proportional to the molarity of the solution.

(iv) When primary amines are treated with chloroform and caustic potash in C_2H_5 (ethyl alcohol), the product is

A a secondary amine.

B a nitro compound.

C an isocyanide.

D a cyanide.

(v) In an adiabatic process, which of the following is *true*?

A $q = 0$

B $q = +w$

C $\Delta E = q$

D $P\Delta V = 0$

(vi) Which of the following is the strongest acid?

A Cl_2CHCH_2COOH

B $CH_3CHClCOOH$

C CH_3CCl_2COOH

D CH_3CH_2COOH

(vii) The +I-effect is shown by

A F.

B CH_3.

C C_6H_5.

D - OH.

(viii) Which of the following solution cannot act as a buffer?

A $CH_3COOH + CH_3COONa$.

B $H_3PO_4 + NaH_2PO_4$.

C $NaHPO_4 + H_3PO_4$.

D $HCl + NH_4Cl$.

(ix) When temperature is increased, the rate of reaction also increases because of the

A lowering of activation energy.

B increase in the number of collisions.

C decrease in the number of collisions.

D decrease in the number of activated molecules.

(x) Which of the following is *true* for a spontaneous process at all the conditions of temperature?

A ΔS = +ve; ΔH = +ve

B ΔS = +ve; ΔH = -ve

C ΔS = -ve; ΔH = +ve

D ΔS = -ve; ΔH = -ve

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

(slag, glucose, oxidation, free valencies, secondary amino group, oxidizing agent, fructose, hydrogenation, primary amino group, reducing agent)

(i) A monosaccharide which is sweeter than sucrose is …….

(ii) Vegetable ghee is manufactured by the ……. of oils in the presence of nickel as a catalyst.

(iii) Carbyl amine reaction is a test for …….

(iv) During the extraction of tin, stannous oxide reacts with silicon dioxide to form ……

(v) The catalytic activity of solid surfaces is mainly due to the number of …….

(vi) Sulphites are converted to sulphates in bromine water because bromine is a …….

(d) ***Match the names of reactions in Column A with the names of compounds they produce in Column B. Rewrite the correct pairs in your answer sheet.***

Column A	**Column B**
(i) Carbyl amine reaction	(a) ether
(ii) Cannizzaro's reaction	(b) alcohol
(iii) Rosenmund's reaction	(c) aldehyde
(iv) Williamson's synthesis	(d) cyanide
	(e) isocyanide
	(f) aldol
	(g) alkane

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

(i) Give ***one*** use of Wilkinson's catalyst. **[1]**

(ii) Glycine is known as a dipolar ion. Give a reason. **[1]**

(iii) How is the reaction of benzaldehyde and benzoic acid similar when both react with concentrated HNO_3? **[1]**

(iv) Acetyl chloride fumes in moist air. Explain. **[1]**

(v) Give a chemical equation for the hydrolysis of starch. **[1]**

(vi) What is the relationship between Faraday (F), Avogadro's number (N_A) and charge in an electron (e)? Explain each term briefly. **[2]**

(vii) Write ***two*** differences between reversible and irreversible processes. **[2]**

(viii) Explain metamerism by taking an example of $C_4H_{10}O$. **[2]**

(ix) Explain the following terms with examples. **[2]**

1. homo polymer
2. co-polymer

(x) Find the bond order and magnetic property of He_2^+. **[2]**

PART II (28 marks)

SECTION A

Answer any **four** *questions.*

Question 2.

(a) A solution of a non-volatile solute with molecular mass 342 is obtained by dissolving 17.1 gm of it in 500 gm of water. Calculate the osmotic pressure of the solution at 27°C. **[3]**

(b) (i) The concentration of hydroxyl ion (OH^- ion) in aqueous ammonia decreases on the addition of solid ammonium chloride (NH_4Cl). Explain. **[2]**

(ii) Give reasons why blood is considered to be a good example of a buffer solution? **[1]**

(c) Name the type of lattice system present in sodium chloride and copper crystals. **[1]**

Question 3.

(a) Draw a plot of neutrons to protons showing the nuclear stability of atoms.

What happens to the $\frac{n}{P}$ ratio during the emission of: **[3]**

(i) α- particle?

(ii) β- particle?

(b) Water and ammonia have sp^3 hybridization yet their bond angles are different. Give a reason. **[2]**

(c) What is Tyndall effect? Why do colloidal solutions show this phenomenon? **[2]**

Question 4.

(a) When zinc electrode is connected with standard hydrogen electrode, the flow of electrons is from zinc electrode to SHE (Standard Hydrogen Electrode). However the flow of electrons is opposite when SHE is connected with silver electrode. Justify the statement. **[3]**

(b) Write ***four*** applications of colloids in our daily life. **[2]**

(c) Distinguish between crystalline and amorphous solids. **[2]**

Question 5.

(a) What is the relationship between solubility and the solubility product for a cell reaction, $Ag_2CrO_4 \rightleftharpoons 2Ag^+ + CrO_4^{2-}$, by assuming 'S' as solubility? Determine the solubility product if 'S' is 5.0×10^{-5}. **[3]**

(b) Complete the following nuclear reactions. **[2]**

(i) $^{13}_{7}N \rightarrow .....+_{+1}e^0$

(ii) $^{27}_{14}Si \rightarrow {}^{27}_{13}Al + ...$

(iii) $..... \xrightarrow{stable} {}^{24}_{12}Mg + {}_{-1}\beta^0$

(iv) $^{12}_{6}C(stable) + ... \rightarrow {}^{13}_{7}N + {}_{0}n^1$

(c) The standard electrode potentials for the following cell reaction is:

$Zn + Cu^{2+} \rightarrow Zn^{2+} + Cu$

$E^0_{Zn/Zn^{2+}} = -0.762v$ and $E^0_{Cu^{2+}/Cu} = +0.3$v

(i) Calculate the emf of the cell. **[1]**

(ii) Is the reaction spontaneous or non-spontaneous? Why? **[1]**

Question 6.

(a) The rate constant for a reaction $A \rightarrow B$ is 4.5×10^{-3} min.$^{-1}$. If the initial concentration of A is 1M, calculate the rate of reaction after one hour. **[3]**

(b) (i) Why is diamond a bad conductor of electricity whereas graphite is a good conductor? **[1]**

(ii) The following reaction is a first order reaction: $C_2H_5Cl + KOH \rightarrow C_2H_5OH + KCl$. What will happen to the rate of reaction if the concentration of ethyl chloride (C_2H_5Cl) is doubled? Why? **[1]**

(iii) Write any ***one*** difference between Bonding molecular orbital and Antibonding molecular orbital. **[1]**

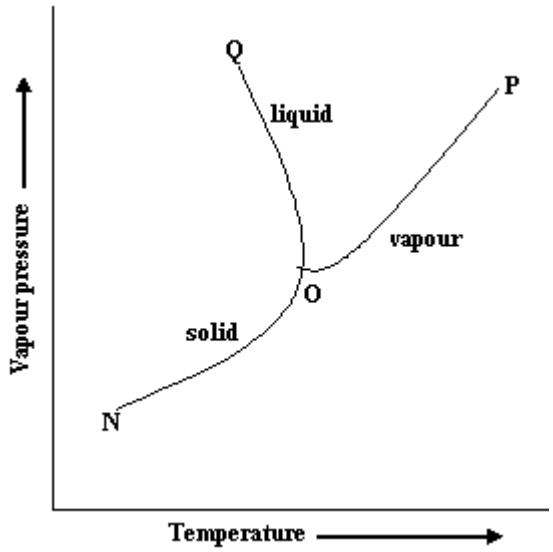
(c) Write ***two*** conditions for the validity of the Distribution Law. **[1]**

Question 7.

(a) In cold weather, water gets frozen causing damage to car radiators. Ethylene glycol ($C_2H_6O_2$) is used as an anti-freeze agent. Calculate the amount of ethylene glycol to be added to 6 kg of water to prevent from freezing at -0.3°C.
(K_f of water = 1.86 K kg, mol^{-1}) **[2]**

(b) Why is water a liquid while hydrogen sulphide (H_2S) a gas though the molecular weight of hydrogen sulphide is higher than that of water? **[2]**

(c) The phase diagram for ice water-water vapour system is given below. Study the diagram and answer the questions that follow.



(i) Write down the mathematical expression for the phase rule. **[1]**

(ii) What do the curves OP, OQ and ON represent? **[1½]**

(iii) What is the name given to the point O? **[½]**

SECTION B (18 marks)

Answer any **three** *questions.*

Question 8.

(a) Write the chemical equations for the reactions involved in the extraction of silver from Ag_2S (Argentite) by the cyanide process. **[4]**

(b) (i) An alkyl halide undergoing hydrolysis to give alcohol is a first order reaction. Why? **[½]**

(ii) What happens to the rate of reaction if concentration of R-X is doubled? **[½]**

(iii) What type of reaction does RX undergo? **[½]**

(iv) Name the type of alkyl halide that undergoes the above reaction. **[½]**

Question 9.

(a) What will happen to the entropy during the following conversions? Explain your answer. **[3]**

(i) evaporation of water

(ii) heating of limestone

(iii) crystallization of sodium chloride from its saturated solution.

(b) Calculate the maximum work done for the isothermal and reversible expansion of 5 moles of an ideal gas from a pressure of 2 atm to 10 atm at 25°C.
($R = 8.314 \times 10^7$ ergs K^{-1} $mole^{-1}$) **[2]**

(c) Define mesomeric effect. **[1]**

Question 10.

(a) (i) Outline the preparation of bromine from sea water. **[2]**

(ii) State the product formed when bromine reacts with water. **[1]**

(b) Write the balanced equations for the following reactions.

(i) ozone is passed through a solution of potassium iodide **[1]**

(ii) silver oxide with hydrogen peroxide **[1]**

(c) Write the mathematical expression for work done during adiabatic expansion of an ideal gas. **[1]**

Question 11.

(a) Give the chemical formula for the following complex compounds.

(i) potassium hexa cyano ferrate (III)

(ii) potassium di iodo argentate (I)

(b) In the following reactions, identify the type of reactions taking place (substitution, addition and elimination) and the type of reactants (electrophillic or nucleophillic). **[2]**

(i) ethylene with hydrogen chloride

(ii) ethyl chloride with aqueous potassium hydroxide

(c) (i) Give ***one*** reaction to show that nitrous acid acts as an oxidizing agent. **[1]**

(ii) It is of great industrial importance and commonly known as TEL in industry. Name the compound and also write its formula. **[1]**

SECTION C (14 marks)

Answer any **two** *questions.*

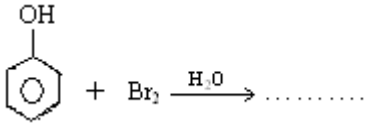
Question 12.

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

(i) $HCHO + NH_3 \rightarrow$ …….

(ii) $CH_3COCH_3 + I_2 + KOH \rightarrow$ …….

(iii)



(iv) $C_6H_5Cl + Na + ClCH_3 \xrightarrow{\text{dry ether}}$ …….

(b) Give ***one*** chemical reaction which differentiates glucose from fructose. Write their relevant equations. **[2]**

(c) Write the IUPAC name of $CH_3 - \underset{\displaystyle CH_3}{\underset{|}{CH}} - CH_2 - C \equiv N$. **[1]**

Question 13.

(a) (i) Predict the products A, B, C and D for the following reaction.

$$CH_3CHO \xrightarrow{[O]} A \xrightarrow{PCl_5} B \xrightarrow{NH_3} C \xrightarrow[heat]{Br_2/NaOH} D$$

(ii) Convert the following. **[2]**

1. acetone to propane
2. oxalic acid to formic acid

(b) (i) State ***two*** conditions of optical isomerism. **[1]**

(ii) What is iso-electric point? Give ***one*** example. **[1]**

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

Question 14.

(a) A compound 'A' (molecular formula C_7H_6O) on treatment with a strong alkali solution gives product 'B' and alcohol. 'B' on treatment with phosphorus penta chloride gives product 'C'. 'C' on reduction gives the same compound 'A'. Identify A, B and C. **[3]**

(b) Why are meso and racemic tartaric acid optically inactive? Explain with the help of a diagram. **[2]**

(c) (i) 'Vulcanised rubbers are thermosetting polymer'. Support the statement. **[1]**

(ii) Why is the B.P of alkyl cyanide higher than that of alkyl isocyanide? **[1]**