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 wherever applicable:

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

(i) Which of the following process shows an increase in entropy?

A freezing

B evaporation

C condensation

D crystallisation

(ii) On adding an acid to water, the concentration of

A H^+ ions increases and OH^- ions decreases.

B H^+ ions increases and OH^- ions increases.

C H^+ ions decreases and OH^- ions decreases

D H^+ ions decreases and OH^- ions increases.

(iii) Cannizzaro's reaction is given by

A CH_3COCH_3.

B CH_3CH_2CHO.

C C_2H_5OH.

D HCHO.

(iv) Which is the correct bond order of N_2^{2-}?

A 1.5

B 2

C 2.5

D 3

(v) The polymerization of terephthalic acid and ethylene glycol produces

A polystyrene

B polyethene

C terylene

D teflon

(vi) Which of the following pair of solution is isotonic?

A 0.1M $CaCl_2$ and 0.1M KCl

B 0.1M AgCl and 0.1M $MgCl_2$

C 0.1M glucose and 0.1M urea

D 0.1 M NaCl and 0.1M Na_2CO_3

(vii) Which chemical reaction converts chlorobenzene to toluene?

A Friedel-craft's reaction

B Rosenmund's reaction

C Wurtz-fittig reaction

D Kolbe's reaction

(viii) When methyl cyanide is boiled with an alkali or acid the product formed is

A acetamide

B acetic acid

C formic acid

D acetic anhydride

(ix) Which of the properties is most commonly possessed by an electrophile?

A negative charge

B vacant orbital

C electron rich

D lone pair

(x) The alkali required to manufacture washing soap is

A ammonium hydroxide

B potassium hydroxide

C calcium hydroxide

D sodium hydroxide

(b) Correct the following statements by changing the underlined words: **[5]**

(i) <u>Normality</u> is the number of moles of solute present in one litre of the solution.

(ii) Isochoric process is a process in which the <u>pressure</u> of the system remains constant throughout the reaction.

(iii) A carbon atom bonded to four different atoms or groups is called <u>symmetric</u> carbon.

(iv) The total number of electrons in O_2^- is sixteen.

(v) Vinyl and allyl ions are example of stable carbanions.

(c) Fill in the blanks choosing appropriate word/s given in the brackets. Write the correct answers in your answer sheet. **[5]**

(*four, six, eight, Frenkel, Schottky, sodium chloride, sodium sulphate, pyridine, ethylenediamine, nitrogen dioxide, nitrogen monoxide*)

(i) When a radioactive element $^{232}_{90}X$ loses ……. α-particles and ……. β-particles, it produces $^{208}_{82}X$.

(ii) ……. defect decreases the density of crystal.

(iii) The compound which has continuous solubility curve is …….

(iv) ……. is an example of bidentate ligand.

(v) When nitrous acid reacts with acidified potassium iodide,……. gas is liberated.

(d) Match the items of Column A with the items of Column B. Rewrite the correct pairs in your answer sheet. **[5]**

Column A	**Column B**
i) Iodoform	a. ethylamine
ii) Bicarbonate test	b. benzaldehyde
iii)Phthalein test	c. formaldehyde
iv)Dimethyl phenyl amine test	d.diethyl ether
v) Carbylamine test	e. acetone
	f. formic acid
	g. phenol

(e) Answer the following questions.

(i) Differentiate between lyophilic sols and lyophobic sols. **[1]**

(ii) Sucrose on hydrolysis produces glucose and fructose.
What is the order of the reaction? **[1]**

(iii) What do you understand by the term salt hydrolysis? **[1]**

(iv) A 0.02M NaCl solution offered a resistance of 62 ohms in a conductivity cell. If the cell constant of the cell is 0.367 cm^{-1}, what would be the molar conductivity? **[2]**

(v) High temperature always favours the spontaneity of an endothermic process and low temperature favours the spontaneity of exothermic process. Explain. **[2]**

(vi) What is an alloy? Name the alloy used for making bell. **[1]**

(vii) Which non-metal is obtained from bone ash? **[1]**

(viii) Distinguish between homolytic fission and heterolytic fission. **[1]**

(ix) What happens when starch is treated with dil. H_2SO_4? Write the chain structure of the product. **[2]**

(x) If amino acetic acid is electrolysed at pH 6.1, it does not move to either of the electrodes. Explain. **[1]**

(xi) How is PVC prepared? **[1]**

(xii) Write the type of isomerism exhibited by the following compounds: **[1]**

A. Lactic acid

B. 2-butene

PART II

*Answer **nine** questions choosing **four** from Section A, **three** from Section B and **two** from Section C*

SECTION A (28 marks)

Answer any **four** *questions.*

Question 2.

(a) Calculate the mole fraction of acetic acid in its aqueous solution containing 20% by mass of acetic acid. **[2]**

(b) (i) State the group displacement law. **[1]**

(ii) If a radioactive element of group 16 or VI A undergoes α-particle emission, in which group of the periodic table will the daughter element be found? **[1]**

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

(i) Water has lower molecular weight than hydrogen sulphide, but water is liquid while hydrogen sulphide is gas at room temperature.

(ii) Crystalline solids are anisotropic whereas amorphous solids are isotropic.

(iii) Physisorption decreases with the increase in temperature.

Question 3.

(a) The rate of first order reaction is 3×10^{-3} mol L^{-1} s^{-1} when the concentration of reactant A is 0.1M. What will be the rate of reaction when the concentration of the reactant is 0.01M? **[2]**

(b) Explain Henry's law on the basis of Le-chatelier's principle. Write ***two*** limitations of Henry's law. **[2]**

(c) (i) What does amphiprotic substance mean? **[1]**

(ii) Sort out the conjugate pairs of acids and bases in the following reactions. **[2]**

A. $H_2S + H_2O \rightleftharpoons H_3O^+ + HS^-$

B. $H_2O + CO_3^{-2} \rightleftharpoons HCO_3^- + OH^-$

Question 4.

(a) (i) Draw a well labelled diagram of zinc-copper Galvanic cell. **[2]**

(ii) Write the reactions taking place at the electrodes. **[1]**

(b) State the type of hybridization of the given molecules and write whether they are polar or non-polar. **[2]**

A. carbon dioxide

B. carbon tetrachloride

(c) The solubility product of silver chloride is 1.06×10^{-10} at 25°C. What is the solubility in **[2]**

A. pure water,

B. 0.2M sodium chloride solution at the same temperature.

Question 5.

(a) Complete the following reactions:

(i) $^{24}_{11}Na + {}^{4}_{2}He \rightarrow {}^{26}_{12}Mg + ...$

(ii) $^{38}_{19}K + 2\,{}^{1}_{0}n \rightarrow {}^{39}_{19}K + ...$

(iii) $^{11}_{5}B + {}^{1}_{1}H \rightarrow {}^{8}_{4}Be + ...$

(iv) $^{14}_{7}N + {}^{4}_{2}He \rightarrow {}^{17}_{9}F + ...$

(b) How will you account for the following properties of graphite? **[2]**

(i) good conductor of electricity

(ii) slippery nature

(c) What happens when, **[2]**

(i) sodium chloride is added to hydrated ferric oxide solution?

(ii) a beam of light is passed through a colloidal solution?

(d) What kind of nuclear reaction is considered to be the principal source of energy in: **[1]**

(i) the stars and hydrogen bomb?

(ii) an atom bomb?

Question 6.

(a) (i) What would be the value of van't Hoff factor for 0.0711 molal solution of Na_2SO_4 which freezes at -0.32°C? [K_f for water is 1.86°C mol^{-1}] **[1]**

(ii) How does the conductivity of metal and semi-conductor vary with increase in temperature? **[1]**

(b) Determine the reduction potential of zinc electrode immersed in 2M $ZnSO_4$ solution. $\left[E^0_{Zn^{2+}/Zn} = -0.76V\right]$ **[2]**

(c) (i) Arrange the following in increasing bond order and state the magnetic property of each. N_2, H_2^+, O_2^{2-}, N_2^+ **[2]**

(ii) What is flocculation or coagulation value? **[1]**

Question 7.

(a) An organic compound is 5 times more soluble in ether than in water. Calculate the mass of organic compound which can be extracted from 100 cm^3 of an aqueous solution containing 11.5 g of organic compound by using 50 cm^3 of ether. **[2]**

(b) A first order reaction takes 30 minutes for 25% decomposition to take place. Calculate $t_{\frac{1}{2}}$. **[2]**

(c) (i) Explain the behaviour of ideal and non-ideal solutions. **[2]**

(ii) How is a buffer solution prepared? **[1]**

SECTION B (18 marks)

Answer any **three** *questions.*

Question 8.

(a) 5 moles of a gas expands against a constant pressure of 2 atmospheres from volume 8 litres to 12 litres. In doing so it absorbs 200 J heat from the surroundings. Determine the change in internal energy of the process. **[2]**

(b) Classify the following reactions as free radical substitution, electrophilic substitution or nucleophilic substitution. **[1]**

(i) $(C_2H_5)_3CCl + H_2O \rightarrow (C_2H_5)_3COH + HCl$

ii) $CH_4 + Cl_2 \rightarrow CH_3Cl + HCl$

(c) (i) Explain how iodine is manufactured from sea weeds and give a balanced chemical equation. **[2]**

(ii) What happens when copper sulphate solution is treated with excess of ammonium hydroxide? **[1]**

Question 9.

(a) How is pure silver extracted by cyanide process? Write the balanced chemical equations where ever necessary. **[3]**

(b) Write the balanced chemical equation for the reaction of hydrogen peroxide and lead sulphide and state the property shown by hydrogen peroxide.

(c) Give ***one*** example of a: **[2]**

(i) neutral nucleophile,

(ii) positive electrophile,

(iii) neutral electrophile,

(iv) negative nucleophile.

Question 10.

(a) (i) Determine the entropy change (ΔS) at 27°C, when 2.5 moles of ideal gas expands isothermally and reversibly from 8 litres to 80 litres. **[2]**

(ii) What are the products formed when ozone combines with moist iodine? **[1]**

(b) Write the formula of the following complex compounds: **[2]**

(i) Hexa-ammine cobalt (III) chloride

(ii) Tetracarbonyl nickel (0)

(iii) Wilkinson's catalyst

(iv) Ethyl magnesium bromide

(c) How is sulphide ore concentrated? **[1]**

Question 11.

(a) (i) Study the reaction and explain the type of electron displacement shown in

$$A{=}B \xrightarrow[\text{reagent removed}]{\text{reagent added}} A^{+} - \overline{\ddot{B}}\,.$$ **[2]**

(ii) Calculate the oxidation number of iron in $K_4[Fe(CN)_6]$. **[1]**

(b) (i) Differentiate between extensive property and intensive property with examples. **[2]**

(ii) Give a balanced chemical equation for the reaction taking place between bromine and a hot concentrated alkali. **[1]**

SECTION C (14 marks)

Answer any **two** *questions.*

Question 12.

(a) Complete and balance the following equations: **[3]**

(i) $CH_3CH_2OCH_2CH_3 + 2Cl_2 \xrightarrow{dark} \ldots\ldots\ldots + 2HCl$

(ii) $6HCHO + 4NH_3 \rightarrow \ldots\ldots\ldots + 6H_2O$

(iii) $CH_3CONH_2 + Br_2 + 4KOH \xrightarrow{heat} \ldots\ldots\ldots + 2KBr + K_2CO_3 + 2H_2O$

(b) Draw all possible isomers of tartaric acid. Which of these isomers is optically inactive? **[2]**

(c) Write the equation and name the main product formed when glycine reacts with copper carbonate. **[1]**

(d) What are fats and oils? **[1]**

Question 13.

(a) Give reasons for the following:

(i) Nitration of phenol is ortho and para directive whereas nitration of benzaldehyde is meta directive. **[2]**

(ii) Benzene undergoes electrophilic substitution reaction more readily than addition reaction. **[1]**

(b) What do you observe when, **[2]**

(i) fructose is warmed with excess phenyl hydrazine.

(ii) glucose is warmed with bromine water.

(c) Complete the equation, $C_2H_5NH_2 + C_2H_5I \rightarrow \ldots\ldots\ldots\ldots$ **[1]**

(d) Give the IUPAC names for the following compounds: **[1]**

(i) Methyl cyanide

(ii) Methyl isocyanide

Question 14.

(a) A compound with molecular formula $C_2H_4O_2$ (A) on treatment with ethanol in presence of conc. H_2SO_4 gives a compound 'B' with a pleasant smell. Compound 'B' on treatment with ammonia gives compound 'C'. Compound 'C' on reduction with P_2O_5 gives a cyanide. Identify A,B and C.

(b) Write the kekule structures of benzene. **[1]**

(c) Name the product formed in the reaction, $C_6H_5Cl + Mg \xrightarrow{\text{dry ether}} \ldots\ldots..$ **[1]**

(d) Write ***two*** functional isomers of $C_4H_{10}O$. **[1]**

(e) Write the monomers of nylon 66. **[1]**