

DO NOT WRITE ANYTHING HERE

- (ix) If the energy of activated complex lies close to the energy of reactants, it means that the reaction is _____
- | | |
|---------------------------------|----------------|
| A. Slow | B. Fast |
| C. Reaction does not take place | D. Endothermic |
- (x) After three half lives of a reaction, the % fraction of the amount left is _____
- | | |
|----------|--------|
| A. 75% | B. 50% |
| C. 12.5% | D. 25% |
- (xi) For the reaction $H_2 + I_2 \rightleftharpoons 2HI$ the value of $K_c = 64$. If the volume of the container is reduced to one half of its original volume, the value of K_c is _____
- | | |
|-------|-------|
| A. 48 | B. 16 |
| C. 64 | D. 32 |
- (xii) Which of the following solutes will depress the freezing point of water the least, if one mole of each is added?
- | | |
|-------------------|-------------|
| A. $NaCl$ | B. $CaCl_2$ |
| C. $C_6H_{12}O_6$ | D. $AlCl_3$ |
- (xiii) How many moles of oxygen atoms are there in 0.5 moles of $Ca(ClO_3)_2$?
- | | |
|--------------|------------|
| A. 3 moles | B. 6 moles |
| C. 0.5 moles | D. 1 mole |
- (xiv) Which metal will dissolve in galvanic cell containing copper and silver electrodes?
($Cu^{++} / Cu = +0.34V$ $Ag / Ag^+ = -0.80V$)
- | | |
|-----------------|------------------|
| A. Copper | B. Silver |
| C. Both A and B | D. None of these |
- (xv) What is the unit cell with crystallographic dimensions $a = b \neq c$ and $\alpha = \beta = \gamma = 90^\circ$?
- | | |
|---------------|---------------|
| A. Cubic | B. Tetragonal |
| C. Monoclinic | D. Rhombic |
- (xvi) For a chemical reaction $CH_3COOH \rightleftharpoons CH_3COO^- + H^+$ _____
- | | |
|----------------------|--------------------------|
| A. $\Delta H < zero$ | B. $\Delta H = 0$ |
| C. $\Delta H > zero$ | D. $\Delta H = Negative$ |
- (xvii) During the electrolysis of aqueous solution of $NaCl$ using inert electrodes _____
- | | |
|-------------------------------|--------------------------------|
| A. H_2 liberates at cathode | B. Cl_2 liberates at cathode |
| C. Na deposits at anode | D. O_2 evolves at anode |

For Examiner's use only:

Total Marks:

17

Marks Obtained:



CHEMISTRY HSSC-I

Time allowed: 2:35 Hours

Total Marks Sections B and C: 68

NOTE: Sections 'B' and 'C' comprise pages 1-2 and questions therein are to be answered on the separately provided answer book. Answer any fourteen parts from Section 'B' and any two questions from Section 'C'. Use supplementary answer sheet i.e. Sheet-B if required. Write your answers neatly and legibly.

SECTION – B (Marks 42)

Q. 2 Attempt any FOURTEEN parts. The answer to each part should not exceed 5 to 6 lines. (14 x 3 = 42)

- (i) A sample of $AlCl_3$ contains 5.4×10^{24} Cl^- ions. Calculate:
- Number of Formula units of $AlCl_3$ 01
 - Number of Al^{+3} ions in the sample 01
 - Mass of the sample 01
($Al = 27$; $Cl = 35.5$)
- (ii) a. The rate of filtration can be increased by using Fluted Filter Paper. Why? 1.5
b. During crystallization process, why do some crystals appear coloured? How will the undesirable colours of crystals be removed? 1.5
- (iii) a. State Avogadro's Law. 01
b. Calculate the number of molecules in $1050cm^3$ of CO_2 at $25^\circ C$ and 800 mm Hg pressure. 02
- (iv) a. Define **Molar heat of Vaporization** and **Molar heat of Sublimation**. 02
b. Explain why heat of sublimation of a substance is greater than heat of vaporization. 01
- (v) Why is it impossible to determine both the position as well as momentum of an electron in an atom simultaneously? 03
- (vi) a. What is ionization energy? Why is the 1st I.E < 2nd I.E and so on? 02
b. Why does the I.E increase along the period? 01
- (vii) For the processes taking place at constant pressure, prove $\Delta H = q_p$. 03
- (viii) Calculate the value of K_p for the synthesis of NH_3 according to the equation : 03
$$N_2 + 3H_2 \rightleftharpoons 2NH_3 \quad K_c = 6 \times 10^{-2} \text{ at } 500^\circ C$$
- (ix) a. Define Molality. 01
b. What is the Molality of 10% w/w $NaCl$ solution? 02
- (x) a. What is Electrode Potential? 01
b. Standard electrode potential values are given: 02
$$Zn / Zn^{+2} = +0.76V \quad ; \quad Cu^{+2} / Cu = +0.34V$$

Calculate emf of the cell. Also write the complete cell equation.
- (xi) a. What is the Order of Reaction? 01
b. A study of kinetics of a reaction $A + B \rightarrow$ Product, gave the following data: 02

Exp#	[A]	[B]	Initial rate
I	1.00	0.15	4.2×10^{-6}
II	2.00	0.15	8.4×10^{-6}
III	1.00	0.20	5.6×10^{-6}

Calculate the order of reaction.

(xii)	a.	Define Salt Hydrolysis.	01
	b.	Why is the aqueous solution of $NaCl$ neutral and that of NH_4Cl acidic?	02
(xiii)		Balance the Redox Equation by Ion Electron method in acidic medium:	03
		$Cr_2O_7^{2-} + Cl^- \rightarrow Cr^{+3} + Cl_2$	
(xiv)		The solubility of MgF_2 is $7.6 \times 10^{-2} g dm^{-3}$ at $25^\circ C$. Calculate its solubility product (Mg=24 ; F=19)	03
(xv)	a.	What is Enthalpy?	01
	b.	Under what conditions $\Delta H = \Delta E$	02
(xvi)		Give reasons:	
	a.	The dipole moment of CO_2 and CS_2 is zero, but that of SO_2 is 1.62 D.	1.5
	b.	Pi bonds are more diffused than sigma bonds.	1.5
(xvii)		Calculate the Energy, Frequency and Wavelength of radiations emitted when electron jumps from $n=4$ to $n=2$ of hydrogen atom.	03
(xviii)	a.	Why do the boiling points of noble gases increase down the group?	1.5
	b.	Freshly cut surface of the metal is shiny. Why?	1.5
(xix)		Verify Graham's Law of diffusion from kinetic gas equation.	03

SECTION – C (Marks 26)

Note: Attempt any TWO questions. All questions carry equal marks. (2 x 13 = 26)

Q. 3	a.	(i) Define Stoichiometry. What assumptions are made while performing Stoichiometric calculations?	03
		(ii) 50 g each of NH_4Cl and $Ca(OH)_2$ reacted together according to the equation: $2NH_4Cl + Ca(OH)_2 \rightarrow 2NH_3 + CaCl_2 + 2H_2O$. Calculate the mass of NH_3 formed. (N = 14 ; Cl = 35.5 ; Ca = 40)	04
	b.	(i) Using kinetic gas equation $PV = \frac{1}{3} mN\bar{c}^2$, work out an expression which relates the average kinetic energy of the gas molecules to the absolute temperature.	04
		(ii) Why is the volume of a gas generally expressed in $g dm^{-3}$ rather than $g cm^{-3}$?	02
Q. 4	a.	(i) Give the main postulates of VSEPR theory.	04
		(ii) Explain the structure and geometry of $BeCl_2$ and $SnCl_2$ on the basis of VSEPR theory.	04
	b.	What is Atomic Orbital Hybridization? Explain hybridization in Ethene and Water .	05
Q. 5	a.	(i) What are Buffers? How do the buffers act?	04
		(ii) What is the pH of a solution containing 7.2 g of sodium benzoate C_6H_5COONa in one dm^3 of 0.02 M benzoic acid C_6H_5COOH . ($K_a = 6.4 \times 10^{-5}$).	04
	b.	How does the Arrhenius equation help to determine the energy of activation?	05



CHEMISTRY HSSC-I

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SECTION – B (Marks 42)

Q. 2 Attempt any FOURTEEN parts. The answer to each part should not exceed 5 to 6 lines. (14 x 3 = 42)

- (i) A sample of MCl_2 contains 63.964% of chlorine. Calculate: 02, 01
- a. Molar mass of M b. Mass of 2.45 moles of the sample
- (ii) Consider the distribution of I_2 between two immiscible layers (CCl_4 / H_2O). State Partition law. Give expression of distribution coefficient and suggest reason that I_2 dissolves in water in the presence of KI . 01,01,01
- (iii) How does quantitative statement of Charles's law help in the derivation of Absolute Zero? 03
- (iv) a. Table given below shows the boiling points of some compounds:
- | Name | Ethane | Hexane | Isodecane |
|------------------------|------------------|-----------------|------------------|
| <i>b.p</i> $^{\circ}C$ | $-88.6^{\circ}C$ | $68.7^{\circ}C$ | $327.0^{\circ}C$ |
- Suggest reasons for the difference in their boiling points. 02
- b. Define the term Polarizability. 01
- (v) Derive expression for the potential energy of bounded electron. 03
- (vi) a. In periodic table, the ionization energies increase from left to right but actually it drops from beryllium to boron. Give the reason. 02
- b. Calculate the electron affinity for the process $X_{(g)} + 2e^- \rightarrow X_{(g)}^{-2}$
- First electron affinity = -141 kJ mol^{-1} . Second electron affinity = 798 kJ mol^{-1} . 01
- (vii) The enthalpy of formation of one mole of gaseous water is $-242.2 \text{ kJ mol}^{-1}$ at $100^{\circ}C$. Calculate ΔE for the formation of one mole H_2O at $100^{\circ}C$. 03
- (viii) Predict the effect of the following on the equilibrium position of $PCl_{5(g)} \rightleftharpoons PCl_{3(g)} + Cl_{2(g)}$
- a. Concentration of products becomes doubled. 1.5
- b. The volume of the system is reduced to one half. 1.5
- (ix) a. Derive the expression for ionization constant of a base. 02
- b. K_b value of aniline is $4.7 \times 10^{-7} \text{ mol dm}^{-3}$. Calculate its pK_b value. 01
- (x) Define **Ebullioscopic** and **Cryoscopic constants**. 03
- (xi) Balance the following equation by Ion-electron method: 03
- $Cr(OH)_3 + SO_4^{-2} \rightarrow CrO_4^{-2} + SO_3^{-2}$ (basic media).
- (xii) Using standard reduction potentials of $E^{\circ} Cr^{3+} / Cr = -0.74V$, $E^{\circ} Ag^+ / Ag = 0.80V$
- a. Calculate emf of the cell. b. Which cell will be positive pole? 01,01
- c. Give equation for the overall chemical reaction. 01
- (xiii) Justify the statement that collision frequency and orientation of molecules are necessary conditions for determining the proper rate of reaction. 03

(xiv) For a general reaction, $A + 5B \rightarrow Product$, the rate law has been found to be:

$$\frac{-d[A]}{dt} = K[A][B]^2$$

- a. Define Order of reaction. Justify with reason that $\frac{+d[A]}{dt}$ is negative. 01,01
- b. What would happen to the rate if we double the concentration of A and B? 01
- (xv) Sketch the shapes of NCl_3 and BF_3 using VSEPR theory. Explain the origin of differing in shape. 03
- (xvi) Explain with reasons that:
- a. $\Delta H_{sub} > \Delta H_{vap} > \Delta H_{fusion}$ 1.5
- b. Evaporation of a liquid occurs at the surface of the liquid. 1.5
- (xvii) Calculate the ionization energy value in $kJ\ mol^{-1}$ for He^+ ion. Give the units of ϵ_0 and \bar{v} . 03
- (xviii) van der Waals constant for some gases is given below:
- | Gas | O_2 | NH_3 | CO_2 | H_2 |
|-----|-------|--------|--------|-------|
| 'a' | 1.360 | 4.170 | 3.590 | 0.245 |
- a. What is the significance of "a"? Derive its SI units. 02
- b. Which gas has the highest critical temperature? Explain with reasons. 01
- (xix) About 99% of the universe consists of plasma. What is **Plasma** and **Metastable** state? 03

SECTION – C (Marks 26)

Note:-

Attempt any TWO questions. All questions carry equal marks.

(2 x 13 = 26)

- Q. 3** a. Calculate the mass of Cl_2 gas evolved when 61.3 grams, 90% by mass of sample of $KMnO_4$ is allowed to react with $275\ cm^3$ HCl solution (27% by mass with density $1.14\ g\ cm^{-3}$)
- $$2KMnO_{4(aq)} + 16HCl_{(aq)} \rightarrow 2KCl_{(aq)} + 2MnCl_{(aq)} + 5Cl_{2(g)} + 8H_2O_{(l)}$$
- 06
- b. Describe Kinetic interpretation of absolute temperature by applying kinetic gas equation. 04
- c. Define Azeotropic mixture. Why does HCl / H_2O system exhibit negative deviation? 01,02
- Q. 4** a. What is Metallic bond? Explain its formation by both **Electron gas theory** and **Molecular Orbital theory**. 01+2.5+2.5
- b. VSEPR theory demands that lone pair occupies more space than bond pair. Explain with reasons. Also write the limitations of VSEPR theory? 02,02
- c. When Cu is immersed in $1M$ of $CuSO_4$ solution, an equilibrium is set up between the metal atoms and ions in the solution. Moreover, the electrode gets positive charge. Explain with reasons. 03
- Q. 5** a. Moseley studied X-rays spectrum of various elements.
- (i) What are the conclusions drawn by Moseley from a detailed analysis of the spectra. 03
- (ii) What is the origin of X-rays? 02
- b. (i) What is Lattice energy? Explain the factors affecting Lattice energy. 01,02
- (ii) Draw fully labelled Born-Haber cycle for the formation of KBr . 02
- c. How does catalyst affect the rate of reaction? Also describe by means of graph. 02,01