CBSE EXAMINATION PAPER-2022

CHEMISTRY

(Solved)

Time allowed : 3 hours | Maximum Marks : 11

General Instructions :

Read the following instructions carefully and follow them :

i. This question paper contains **5 questions.** All questions are **compulsory.**

ii. This question paper is divided into **3 sections.**

iii. **Section A** – questions number **1 to 1** are very short answer Each question carries **2 marks.**

iv. **Section B** – questions number **2 to 4** are short answer Each question carries **3 marks.**

v. **Section C** – questions number **5 to 5** are case based questions

vi. There is no overall choice given in the question paper. However, an internal choice has been provided in few questions.

vii. Use of calculator is NOT allowed.

Section A

Question 1.

In a plot of ∧m against the square root of concentration (C1/2) for strong and weak electrolyte, the value of limiting molar conductivity of a weak electrolyte cannot be obtained graphically. Suggest a way to obtain this value. Also state the related law, if any.

[2 Marks]

Answer: The limiting molar conductivity (∧°m) of a weak electrolyte can be obtained using Kohlrausch's law of independent migration of ions. According to this law, the limiting molar conductivity of an electrolyte is the sum of the contributions of its constituent ions. For example, for sodium chloride, if λ°Na+ is the limiting molar conductivity of sodium ions

and $\lambda^{\circ}Cl^-$ for chloride ions, then $\Lambda^{\circ}m$ for NaCl can be calculated as $\Lambda^{\circ}m = \lambda^{\circ}Na^+ + \lambda^{\circ}Cl^-$. Therefore, by knowing the individual contributions of the ions, we can determine the limiting molar conductivity of weak electrolytes even if it cannot be measured graphically.

Section B

Question 2.

A compound 'A' (C_2H_4O) on oxidation gives 'B' ($C_2H_4O_2$). 'A' undergoes Iodoform reaction to give yellow precipitate and reacts with HCN to form the compound 'C'. 'C' on hydrolysis gives 2-hydroxypropanoic acid. Identify the compounds 'A', 'B' and 'C'. Write down equations for the reactions involved.

[3 Marks]

Answer: The compound 'A' is ethanol (C_2H_5OH), which upon oxidation yields 'B', ethanoic acid ($C_2H_4O_2$). The iodoform reaction confirms that 'A' has a methyl group adjacent to the hydroxyl group, leading to a yellow precipitate of iodoform (CHI_3). When ethanol reacts with HCN, it forms a cyanohydrin, which is 'C', specifically 2-hydroxypropionitrile (C_2H_5OH). Upon hydrolysis, this compound forms 2-hydroxypropanoic acid ($C_3H_6O_3$). The relevant reactions can be summarized as follows: 1. $C_2H_5OH + [O] \rightarrow CH_3COOH + H_2O$ 2. $C_2H_5OH + I_2 + NaOH \rightarrow CHI_3 + NaOH + H_2O$ (iodoform reaction) 3. $C_2H_5OH + HCN \rightarrow C_2H_5(OH)CN$; and 4. $C_2H_5(OH)CN + H_2O \rightarrow C_3H_6O_3$.

Question 3.

Observe the given figure and answer the following questions :(i) (a) Write the expression for adsorption of gases on solids in the form of an equation. (ii)What is the slope of the graph ? (iii)What does the intercept of the line represent ?

[3 Marks]

Answer: The expression for the adsorption of gases on solids can be represented by the equation: $AP_1 = P_{10} - P_1$, which relates the pressure of the gas to its adsorption on a solid surface. In this equation, AP_1 represents the change in pressure, P_{10} is the initial pressure, and P_1 is the equilibrium pressure after adsorption. The slope of the graph indicates the extent of adsorption, reflecting how the quantity of gas adsorbed changes with pressure. The intercept of the graph represents the theoretical maximum amount adsorbed when pressure is zero, demonstrating how adsorption initially occurs even under low pressure conditions.

Question 4.

Answer the following questions on the basis of the figure given below :(i) Which element in 3d series has lowest enthalpy of atomisation ?(ii) Why do metals of the second and third series have greater enthalpies of atomisation ? (iii) Why are enthalpies of atomisation of transition metals quite high ?

[3 Marks]

Answer: In the 3d series, the element with the lowest enthalpy of atomisation is Scandium (Sc). This is primarily because it has fewer d-electrons contributing to its metallic bonding compared to its counterparts. Furthermore, metals in the second and third transition series exhibit greater enthalpies of atomisation due to the increased number of d-electrons that allow for stronger metallic bonds. The presence of multiple oxidation states, as well as greater interactions among d-orbitals, enhances the strength of metal-metal bonding. Hence, transition metals display higher enthalpies of atomisation compared to non-transition metals, due to their more complex electronic configurations and stronger inter-atomic metallic bonding.

Section C

Question 5. The rate law for a chemical reaction relates the reaction rate with the concentrations or partial pressures of the reactants. For a general reaction aA + bB → C with no intermediate steps in its reaction mechanism, meaning that it is an elementary reaction, the rate law is given by r = k[A]^x[B]^y, where [A] and [B] express the concentrations of A and B in moles per litre. Exponents x and y vary for each reaction and are determined experimentally. The value of k varies with conditions that affect reaction rate, such as temperature, pressure, surface area, etc. The sum of these exponents is known as overall reaction order. A zero order reaction has a constant rate that is independent of the concentration of the reactants. A first order reaction depends on the concentration of only one reactant. A reaction is said to be second order when the overall order is two. Once we have determined the order of the reaction, we can go back and plug in one set of our initial values and solve for k.