CBSE EXAMINATION PAPER-2022

CHEMISTRY

(Solved)

Time allowed : 3 hours | Maximum Marks : 14

General Instructions :

Read the following instructions carefully and follow them :

i. This question paper contains **6 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 5** are short answer Each question carries **3 marks.**

v. **Section C** – questions number **6 to 6** 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.

Define rate of reaction. Write two factors that affect the rate of reaction.

[2 Marks]

Answer: The rate of reaction is defined as the change in concentration of a reactant or product per unit time. It measures how quickly reactants are converted into products. Factors that influence the rate include the concentration of reactants and temperature. An increase in the concentration of reactants generally speeds up the reaction, as there are more particles available for collisions. Similarly, raising the temperature increases the

energy and movement of particles, resulting in more frequent and effective collisions, thus enhancing the reaction rate.

Section B

Question 2.

A first order reaction is 50% complete in 40 minutes. Calculate the time required for the completion of 90% of reaction.

[Given: log 20.3010, log 10=1]

[3 Marks]

Answer: To calculate the time required for the completion of 90% of a first-order reaction, we'll start with the known half-life and the relationship between the rate constant (k) and half-life (t1/2). For first-order reactions, t1/2 = 0.693/k. Given that 50% of the reaction is complete in 40 minutes, we find k using k = 0.693 / 40 min = 0.017325 min^{-1}. Now, for 90% completion, we use the first-order kinetics formula: t = (2.303 / k) * log($[A]_0$ / [A]). Here, $[A]_0$ is the initial concentration and [A] for 90% completion is 10% of the original amount. Thus, we calculate t = (2.303 / 0.017325) * log(10) = (2.303 / 0.017325) * 1 = 132.74 minutes.

Question 3.

Write the structures of A, B and C in the following reactions:

[3 Marks]

Answer: In the context of the general reaction A + B ⇌ C + D, let's consider A as a reactant that can represent hydrogen (H_2), B as oxygen (O_2), and product C as water (H_2O). The balanced chemical equation for the reaction is: $2H_2 + O_2 \rightleftharpoons 2H_2O$. In this reaction, A ($H_2$) and B ($O_2$) combine to form C ($H_2O$) in a redox process where the oxidation states change. Structure A (H_2) consists of two hydrogen atoms bonded together, while structure B (O_2) comprises two oxygen atoms. The product C (H_2O) is composed of two hydrogen atoms covalently bonded to one oxygen atom, representing the water molecule formed in this combination reaction. Understanding these structures is crucial in analyzing the reactions and their equilibrium concentrations.

Question 4.

Define transition elements. Which of the d-block elements may not be regarded as the transition elements ? Why transition metals generally form coloured compounds?

[3 Marks]

Answer: Transition elements, primarily those found in the d-block of the periodic table, are defined as elements that have partially filled d orbitals in their elemental or common oxidation states. They exhibit characteristic properties that differentiate them from other elements, including variable oxidation states, paramagnetic behavior due to unpaired electrons, and significant catalytic activity. However, elements such as scandium (Sc) and zinc (Zn) are typically not regarded as transition elements. Scandium has an empty d orbital in its stable ion, while zinc possesses a completely filled d orbital, leading to a lack of variable oxidation states typical of transition metals. The distinct colors associated with many transition metal compounds arise from the presence of partially filled d orbitals. When light hits these compounds, d-d transitions occur, where electrons jump between different energy levels within the d orbitals. This absorption of light corresponds to specific wavelengths, with the complementary colors being observed. Additionally, the formation of complexes with different ligands can also alter the energies of these d orbitals, further contributing to the variety of colors seen in transition metal compounds.

Question 5.

Write any three differences between physisorption and chemisorption..

[3 Marks]

Answer: Physisorption and chemisorption are two distinct processes of adsorption with notable differences. Firstly, physisorption involves weak van der Waals forces, resulting in a low binding energy (typically less than 40 kJ/mol), whereas chemisorption involves strong chemical bonds, leading to higher binding energy (often exceeding 80 kJ/mol). Secondly, physisorption is generally a reversible process, meaning adsorbates can be easily desorbed, while chemisorption tends to be irreversible due to the formation of stable chemical bonds. Lastly, physisorption occurs rapidly and often at lower temperatures, while chemisorption usually requires higher temperatures to overcome activation energy, thus being a slower process. Understanding these differences is crucial in fields like chromatography and catalyst design where adsorption plays a significant role.

Section C

Question 6. Aldehydes, ketones and carboxylic acids are some of the important classes of organic compounds containing the carbonyl group. These are highly polar molecules due to the higher electronegativity of oxygen relative to carbon in the carbonyl group. Aldehydes are prepared by dehydrogenation or controlled oxidation of primary alcohols and controlled reduction of acyl halides. Ketones are prepared by oxidation of secondary alcohols and hydration of alkynes. Aldehydes and ketones undergo nucleophilic addition reactions onto the carbonyl group but carboxylic acids do not undergo nucleophilic addition reaction. The alpha (α) - hydrogens of aldehydes and ketones are acidic.

Therefore, aldehydes and ketones having at least one α-hydrogen undergo Aldol condensation.