CBSE EXAMINATION PAPER-2023

CHEMISTRY

(Solved)

Time allowed : 3 hours | Maximum Marks : 18

General Instructions :

Read the following instructions carefully and follow them :

i. This question paper contains **18 questions.** All questions are **compulsory.**

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

iii. **Section A** – questions number **1 to 16** are multiple choice questions Each question carries **1 marks.**

iv. **Section B** – questions number **17 to 17** are very short answer Each question carries **2 marks.**

v. **Section C** – questions number **18 to 18** 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.

Which of the following is not true about enantiomers?

[1 Marks]

(A) They have the same specific rotation.

(B) They have the same chemical reactivity.

(C) They have the same density.

(D) They have the same melting or boiling point.

Explanation:

Enantiomers are chiral molecules that are mirror images of each other. They have the same chemical reactivity, density, and melting or boiling points, but they possess different specific rotations because they rotate plane-polarized light in opposite directions. Thus, the correct option is that they have the same specific rotation, which is not true.

Question 2.

Aspirin is obtained by the acetylation of which of the following compounds?

[1 Marks]

(A) Salicylic acid

(B) Phenol

(C) Acetyl salicylic acid

(D) Salicylaldehyde

Explanation:

The correct answer is Salicylic acid. Aspirin, also known as acetylsalicylic acid, is synthesized through the acetylation of salicylic acid, which introduces an acetyl group to the compound, leading to the formation of aspirin.

Question 3.

The reactivities of the carbonyl compounds HCHO (I), CH_3CHO (II) and CH_3COCH_3 (III) towards nucleophilic addition reaction decreases in the order:

[1 Marks]

(A) II > III > I

(B) I > III > II

(C) III > II > I

(D) I > II > III

Explanation: The reactivity of carbonyl compounds towards nucleophilic addition depends on the steric and electronic effects. Formaldehyde (HCHO, I) is the most reactive due to its less steric hindrance and stronger electrophilic character. Acetaldehyde (CH_3CHO, II) is less reactive than formaldehyde because the methyl group adds steric hindrance and

slightly donates electron density. Acetone (CH_3COCH_3, III), having two methyl groups, is the least reactive due to increased steric hindrance and lower electrophilicity. Therefore, the correct order of reactivity is I > II > III.

Question 4.

On hydrolysis, which of the following carbohydrates gives only glucose?

[1 Marks]

(A) Lactose

(B) Sucrose

(C) Starch

(D) Fructose

Explanation:

The correct answer is Starch. Starch is a polysaccharide made up entirely of glucose units. Upon hydrolysis, it breaks down into individual glucose molecules. Lactose and sucrose yield other monosaccharides upon hydrolysis; lactose yields glucose and galactose, while sucrose yields glucose and fructose.

Question 5.

Which of the following vitamins is water soluble?

[1 Marks]

(A) Vitamin E

(B) Vitamin A

(C) Vitamin D

(D) Vitamin C

Explanation:

Vitamin C is a water-soluble vitamin, meaning it dissolves in water and is readily absorbed by the body. In contrast, Vitamins A, E, and D are fat-soluble, which means they are stored in the body's fatty tissues.

Question 6.

The unit of the rate of reaction is the same as that of the rate constant for a:

[1 Marks]

(A) first order reaction

(B) it cannot be same

(C) zero order reaction

(D) second order reaction

Explanation:

The correct answer is 'first order reaction'. For a first order reaction, the rate of reaction is expressed as concentration per unit time (M/s), and the rate constant also has the same unit (s^{-1}). This means that their units are indeed the same, making this option correct.

Question 7.

Kohlrausch gave the following relation for strong electrolyte:

$\Lambda = \Lambda_0 - A\sqrt{C}$ Which of the following equality holds true?

[1 Marks]

(A) $\Lambda = \Lambda_0$ as $C \rightarrow 1$

(B) $\Lambda = \Lambda_0$ as $C \rightarrow 0$

(C) $\Lambda = \Lambda_0$ as $C \rightarrow \infty$

(D) $\Lambda = \Lambda_0$ as $C \rightarrow \sqrt{A}$

Explanation:

The correct option is $\Lambda = \Lambda_0$ as $C \rightarrow 0$. This is because at infinite dilution (when concentration C approaches zero), the conductivity of the electrolyte is at its maximum, and the limiting molar conductivity (Λ_0) reflects this complete dissociation. Thus, as C approaches 0, the term $A\sqrt{C}$ becomes negligible, leading to $\Lambda = \Lambda_0$.

Question 8.

An azeotropic mixture of two liquids has a boiling point higher than either of the two liquids when it:

[1 Marks]

(A) obeys Raoult's law.

(B) shows large positive deviation from Raoult's law.

(C) shows no deviation from Raoult's law.

(D) shows large negative deviation from Raoult's law.

Explanation:

The correct answer is 'shows large negative deviation from Raoult's law.' This is because a maximum boiling azeotrope, which has a boiling point higher than either of its components, results from large negative deviations from Raoult's law. The context explains that such mixtures involve stronger intermolecular attractions between the different components, leading to a boiling point that is higher than that of the individual liquids.

Question 9.

Which of the following colligative property is used to find the molar mass of proteins?

[1 Marks]

(A) Depression in freezing point

(B) Relative lowering of vapour pressure

(C) Elevation in boiling point

(D) Osmotic pressure

Explanation:

The correct option is 'Osmotic pressure' because it is a colligative property that depends on the number of solute particles in a solution. By measuring the osmotic pressure, we can determine the molar mass of the solute, which in this case can be proteins.

Question 10.

Among the following outermost configurations of transition metals which one shows the highest oxidation state?

[1 Marks]

(A) $3d^5 4s^2$

(B) $3d^3 4s^2$

(C) $3d^5 4s^1$

(D) $3d^6 4s^2$

Explanation:

The outermost configuration $3d^5 4s^1$ corresponds to the highest oxidation state because it indicates one electron in the 4s subshell and five in the 3d subshell, allowing the metal to lose a total of six electrons when oxidized, maximizing the oxidation state.

Question 11.

How many ions are produced in the solution from the complex $[Ni(NH_3)_6]Cl_2$?

[1 Marks]

(A) 5

(B) 3

(C) 2

(D) 4

Explanation:

The complex $[Ni(NH_3)_6]Cl_2$ dissociates into one $[Ni(NH_3)_6]^{2+}$ ion and two Cl^{-} ions in solution. Therefore, the total number of ions produced is 1 + 2 = 3.

Question 12.

Which of the following species is not expected to be a ligand?

[1 Marks]

(A) NH_3

(B) NH_4^+

(C) CO

(D) H_2O

Explanation:

The correct answer is NH_4^+. A ligand is a molecule that can donate a pair of electrons to a metal ion to form a coordinate bond. NH_4^+ (ammonium ion) does not have a lone pair of electrons to donate, whereas NH_3, CO, and H_2O do have available lone pairs to act as ligands.

Question 13.

Which of the following is the most stable complex species?

[1 Marks]

(A) $[Fe(C_2O_4)_3]^{3-}$

(B) $[Fe(CO)_5]$

(C) $[Fe(CN)_6]^{3-}$

(D) $[Fe(H_2O)_6]^{3+}$

Explanation:

$[Fe(CN)_6]^{3-}$ is the correct answer because cyanide (CN^-) is a strong field ligand that forms stable complexes with iron, resulting in a high degree of stability due to strong ligand field stabilization. In comparison, other ligands such as oxalate ($C_2O_4^{2-}$), carbon monoxide (CO), and water (H_2O) do not provide as much stability as cyanide.

Question 14.

Assertion (A) : Order and molecularity of a reaction are always same.

Reason (R) : Complex reactions involve a sequence of elementary reactions and the slowest step is rate determining.

[1 Marks]

(A) Assertion (A) is true, but Reason (R) is false.

(B) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A)

(C) Assertion (A) is false, but Reason (R) is true.

(D) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A).

Explanation:

Assertion (A) is false, but Reason (R) is true. The order of a reaction, which is determined by the rate law and the concentration of reactants, does not always match its molecularity, which is the number of molecules involved in an elementary reaction. Complex reactions can have different orders compared to their molecularity due to multiple steps involved.

Question 15.

Assertion (A) : Nucleophilic substitution of iodoethane is easier than chloroethane.

Reason (R): Bond energy of C Cl bond is less than C I bond.

[1 Marks]

(A) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A).

(B) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).

(C) Assertion (A) is true, but Reason (R) is false.

(D) Assertion (A) is false, but Reason (R) is true.

(E) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A).

Explanation:

Assertion (A) is true, but Reason (R) is false. The nucleophilic substitution of iodoethane is indeed easier than that of chloroethane because the C-I bond is weaker than the C-Cl bond, making it easier for the nucleophile to attack and displace the iodine atom. However, the reason given in (R) is incorrect as it states the opposite regarding bond energies.

Question 16.

Assertion (A): Zinc is not regarded as a transition element.

Reason (R): In zinc, 3d orbitals are completely filled in its ground state as well as in its oxidised state.

[1 Marks]

(A) Assertion (A) is false, but Reason (R) is true.

(B) Assertion (A) is true, but Reason (R) is false.

(C) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A).

(D) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).

Explanation:

Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A). Zinc is not regarded as a transition element because it does not have an incomplete d subshell in either its elemental or oxidized state, as its 3d orbitals are fully

filled. However, the reason does not explain why zinc is classified this way, since other factors also define transition metals.

Section B

Question 17.

Define fuel cell and write its two advantages.

[2 Marks]

Answer: Fuel cell: A fuel cell is a device that produces electricity directly through a chemical reaction between a fuel and an oxidizing agent without combustion.
Advantages of fuel cells: (1) Fuel cells are pollution free as they produce electricity without burning fuel and releasing harmful gases.
(2) They have higher efficiency of about 70% compared to thermal power plants which have about 40% efficiency.

Section C

Question 18. The polarity of C–X bond of alkyl halides is responsible for their nucleophilic substitution, elimination and their reaction with metal atoms to form organometallic compounds. Alkyl halides are prepared by the free radical halogenation of alkanes, addition of halogen acids to alkenes, replacement of OH group of alcohols with halogens using phosphorus halides, thionyl chloride or halogen acids. Aryl halides are prepared by electrophilic substitution of arenes. Nucleophilic substitution reactions are categorised into SN1 and SN2 on the basis of their kinetic properties. Chirality has a profound role in understanding the SN1 and SN2 mechanism.