CBSE EXAMINATION PAPER-2024

CHEMISTRY

(Solved)

Time allowed : 3 hours

Maximum Marks : 12

General Instructions :

Read the following instructions carefully and follow them :

i. This question paper contains **16 questions.** All questions are **compulsory.**

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

iii. **Section A** – questions number **1 to 12** are multiple choice questions Each question carries **1 marks.**

iv. **Section B** – questions number **13 to 13** are very short answer Each question carries **2 marks.**

v. **Section C** – questions number **14 to 16** 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 acids represents Vitamin C?

[1 Marks]

(A) Benzoic acid

(B) Saccharic acid

(C) Gluconic acid

(D) Ascorbic acid

Explanation:

The correct answer is Ascorbic acid, as it is the chemical name for Vitamin C, which is vital for various bodily functions, including the maintenance of healthy skin, blood vessels, bones, and cartilage.

Question 2.

Rosenmund reduction is used for the preparation of Aldehydes. The catalyst used in this reaction is.

[1 Marks]

(A) Iron (II) oxide

(B) Pd-$BaSO_4$

(C) $HgSO_4$

(D) Anhydrous $AlCl_3$

Explanation:

The correct answer is Pd-$BaSO_4$. In the Rosenmund reduction, palladium on barium sulfate (Pd-$BaSO_4$) is used as a catalyst to selectively reduce acyl chlorides to aldehydes in the presence of hydrogen.

Question 3.

Which alkyl halide from the given options will undergo SN1 reaction faster?

[1 Marks]

(A) $(CH_3)_3C-Br$

(B) CH_3-CH_2-Br

(C) $(CH_3)_2CH-Br$

(D) $(CH_3)_3C-CH_2-Br$

Explanation:

The correct option is $(CH_3)_3C-Br$, which is a tertiary alkyl halide. SN1 reactions generally proceed more quickly with tertiary substrates due to the stability of the carbocation formed during the reaction. In contrast, primary and secondary alkyl halides do not stabilize the carbocation as effectively, making $(CH_3)_3C\text{-}Br$ the fastest to undergo an SN1 reaction.

Question 4.

From the elements of 3d series given below, which element shows the maximum number of oxidation states?

[1 Marks]

(A) Manganese

(B) Titanium

(C) Scandium

(D) Chromium

Explanation:

Manganese shows the maximum number of oxidation states in the 3d series, with a total of seven oxidation states ranging from -3 to +7, due to its electronic configuration and the ability to lose or share its 3d and 4s electrons.

Question 5.

Identify the tertiary amine from the following:

[1 Marks]

(A) $CH_3{-}NH{-}CH_2{-}CH_3$

(B) $CH_3{-}CH(NH_2){-}CH_3$

(C) $(C_2H_5)_2CHNH_2$

(D) $CH_3{-}N(CH_3){-}CH_3$

Explanation:

The correct answer is $CH_3{-}N(CH_3){-}CH_3$, which is a tertiary amine. Tertiary amines have the structure R_3N, where R represents alkyl groups. In this case, the nitrogen atom is bonded to three methyl groups (CH_3), which classifies it as tertiary. The other options represent primary or secondary amines based on their structures.

Question 6.

Nucleophilic addition of Grignard reagent to ketones followed by hydrolysis with dilute acids forms

[1 Marks]

(A) Tertiary alcohol

(B) Alkene

(C) Primary alcohol

(D) Secondary alcohol

Explanation:

The correct answer is 'Tertiary alcohol' because when a Grignard reagent adds to a ketone, it forms a tertiary alcohol after hydrolysis. According to the context provided, nucleophilic addition to ketones yields a tertiary alcohol, while primary alcohols are produced from aldehydes.

Question 7.

In a given graph of zero order reaction, the slope and intercept are:

[1 Marks]

(A) Slope = k, Intercept = $[R]_0$

(B) Slope = k/2.303, Intercept = $\ln[R]_0$

(C) Slope = -k/2.303, Intercept = n

(D) Slope = -k, Intercept = $[R]_0$

Explanation:

The correct option is 'Slope = -k, Intercept = $[R]_0$'. In a zero-order reaction, the concentration of the reactant [R] decreases linearly over time, so the graph of [R] vs. time has a slope equal to -k (where k is the rate constant) and the y-intercept is the initial concentration $[R]_0$.

Question 8.

Assertion (A): p-nitrophenol is less acidic than phenol. Reason

(R): Nitro group is electron withdrawing and helps in the stabilization of p-nitrophenoxide ion.

[1 Marks]

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

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

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

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

Explanation:

Assertion (A) is false, but Reason (R) is true. p-Nitrophenol is actually more acidic than phenol due to the strong electron-withdrawing effect of the nitro group, which stabilizes the p-nitrophenoxide ion. This contradicts the assertion.

Question 9.

Assertion (A): Benzoic acid does not undergo Friedel–Crafts reaction. Reason

(R): Carboxyl group is deactivating and the catalyst aluminium chloride gets bonded to the carboxyl group.

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

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

Explanation:

Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A). While it's true that the carboxyl group is a deactivating group that prevents Friedel-Crafts reactions, the explanation that aluminium chloride bonds to the carboxyl group is inaccurate. The main reason for the lack of reaction is the electron-withdrawing nature of the carboxyl group, which decreases the electrophilicity of the aromatic ring.

Question 10.

Assertion (A): Fructose is a reducing sugar.

Reason (R): Fructose does not reduce Fehling solution and Tollen's reagent.

[1 Marks]

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

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

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

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

Explanation:

Assertion (A) is true, but Reason (R) is false. Fructose is indeed a reducing sugar as it can reduce Fehling's solution and Tollen's reagent under certain conditions, despite it being a ketose, which may not react as easily as aldoses.

Question 11.

The general electronic configuration of d-block elements is :

[1 Marks]

(A) $(n-1)d^{1-10}$ ns^{1-2}

(B) $(n-1)d^{10}$ $ns^{2\ -3}$

(C) $(n-1)$ d^{0} ns^{1-2}

(D) $(n-1)d^{10}$ ns^{1-2}

Explanation:

The correct option is $(n-1)d^{10}$ ns^{1-2} because d-block elements, which include transition metals, typically have their outermost electrons filling the d subshell. The general configuration indicates that the d-subshell can hold a maximum of 10 electrons while the s-subshell can hold 2, leading to the configuration of $(n-1)d^{10}$ ns^{1-2}.

Question 12.

Consider the following reaction :

[-1 Marks]

(A) A- Methanol, B -Potassium formate

(B) A- Ethanol, B -Potassium formate

(C) A- Methanol, B -Potassium acetate

(D) A- Methanol, B -Potassium Ethanol

Explanation: The reaction produces methanol (CH3OH), which contains the alcohol -OH group, and potassium formate (HCOOK) as the products. Therefore, the correct option is A- Methanol, B -Potassium formate.

Section B

Question 13. 18 g of a non-volatile solute is dissolved in 200 g of H_2O that freezes at 272.07 K. Calculate the molecular mass of the solute (Kf for water = 1.86 K kg mol^{-1}).

[2 Marks]

Answer: Given: Mass of solute (w_2) = 18 g, Mass of solvent (w_1) = 200 g, Freezing point of solution = 272.07 K, Normal freezing point of water = 273.15 K, K_f = 1.86 K kg mol^{-1}

Step 1: Calculate freezing point depression, ΔT_f = 273.15 K - 272.07 K = 1.08 K

Step 2: Use formula for molecular mass $M = (K_f * w_2 * 1000) / (\Delta T_f * w_1)$

Step 3: Substitute values: $M = (1.86 * 18 * 1000) / (1.08 * 200) = (33480) / (216) = 155$ g/mol

Answer: Molecular mass of the solute is 155 g/mol.

Section C

Question 14. The nature of bonding, structure of the coordination compound can be explained to some extent by valence bond theory. The central metal atom/ion makes available a number of vacant orbitals equal to its coordination number. The appropriate atomic orbitals (s, p and d) of the metal hybridise to give a set of equivalent orbitals of definite geometry such as square planar, tetrahedral, octahedral and so on. A strong covalent bond is formed only when the orbitals overlap to the maximum extent. The d-orbitals involved in the hybridisation may be either inner d-orbitals i.e. (n-1)d or outer d-orbitals i.e. nd. The complexes formed are called inner orbital complex (low spin complex) and outer orbital complex (high spin complex) respectively. Further, the complexes can be paramagnetic or diamagnetic in nature. The drawbacks of this theory are that this involves number of assumptions and also does not explain the colour of the complex.

Question 15.

Question 16.

20. The nature of bonding, structure of the coordination compound can be explained to some extent by valence bond theory. The central metal atom/ion makes available a number of vacant orbitals equal to its coordination number. The appropriate atomic orbitals (s, p and d) of the metal hybridise to give a set of equivalent orbitals of definite geometry such as square planar, tetrahedral, octahedral and so on. A strong covalent bond is formed only when the orbitals overlap to the maximum extent. The d-orbitals involved in the hybridisation may be either inner d-orbitals i.e. (n—l) d or outer d-orbitals i.e. nd. The complexes formed are called inner orbital complex (low spin complex) and outer orbital complex (high spin complex) respectively. Further, the complexes can be paramagnetic or diamagnetic in nature. The drawbacks of this theory are that this involves number of assumptions and also does not explain the colour of the complex.

Answer the following questions :
