CBSE EXAMINATION PAPER-2024

CHEMISTRY

(Solved)

Time allowed : 3 hours | Maximum Marks : 18

General Instructions :

Read the following instructions carefully and follow them :

i. This question paper contains **29 questions.** All questions are **compulsory.**

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

iii. **Section A** – questions number **1 to 14** are multiple choice questions Each question carries **1 marks.**

iv. **Section B** – questions number **15 to 16** are very short answer Each question carries **2 marks.**

v. **Section C** – questions number **17 to 29** 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 one of the following first row transition elements is expected to have the highest third ionization enthalpy ?

[1 Marks]

(A) Manganese (Z = 25)

(B) Vanadium (Z = 23)

(C) Chromium (Z = 24)

(D) Iron (Z = 26)

Explanation: Manganese (Z = 25) is expected to have the highest third ionization enthalpy among the given options. This is because Mn2+ has a d5 configuration, which is particularly stable due to its half-filled d subshell. The removal of an electron from this stable configuration requires significantly more energy, resulting in a higher third ionization enthalpy compared to the other elements provided.

Question 2.

Two among the three components of DNA are β-D-2-deoxyribose and a heterocyclic base. The third component is :

[1 Marks]

(A) Phosphoric acid

(B) Adenine

(C) Sulphuric acid

(D) Uracil

Explanation: The correct answer is Phosphoric acid. DNA consists of three main components: a sugar (β-D-2-deoxyribose), a nitrogenous base (which can be adenine, guanine, cytosine, or thymine), and a phosphate group (phosphoric acid). The context provided confirms that DNA's structure includes these components.

Question 3.

For an electrolyte undergoing association in a solvent, the vant factor :

[1 Marks]

(A) has negative value

(B) has zero value

(C) is always greater than one

(D) is always less than one

Explanation:

The correct answer is 'is always less than one'. This is because when an electrolyte associates, the number of particles in solution decreases compared to the number

expected based on the formula units, leading to a lower van 't Hoff factor (v) which is a measure of the degree of dissociation or association in the solution.

Question 4.

For the reaction X + 2Y → P, the differential form equation of the rate law is :

[1 Marks]

(A) -d[P]/dt = -d[X]/dt

(B) -2d[Y]/dt = +d[P]/dt

(C) 2d[P]/dt = -d[Y]/dt

(D) +d[X]/dt =-d[P]/dt

Explanation: The correct answer is 2d[P]/dt = -d[Y]/dt because in differential rate laws, the rate of change of reactants and products is related to their stoichiometric coefficients. For the reaction X + 2Y → P, the rate law can be expressed as -1/dX = -1/2dY = 1/dP, which leads to the differential form where changing concentration of Y affects P's formation at twice the rate.

Question 5.

Acetic acid reacts with PCl_5 to give :

[1 Marks]

(A) CCl_3 -COOH

(B) Cl -CH_2 -COOH

(C) Cl -CH_2 -COCl

(D) CH_3- COCl

Explanation: The correct answer is CH_3-COCl. Acetic acid (CH_3COOH) reacts with PCl_5 to form acetyl chloride (CH_3COCl) by replacing the hydroxyl (-OH) group with a chlorine atom, as the hydroxyl group behaves like that of alcohol and can be substituted when treated with PCl_5.

Question 6.

The formation of cyanohydrin from an aldehyde is an example of :

[1 Marks]

(A) nucleophilic addition

(B) electrophilic addition

(C) electrophilic substitution

(D) nucleophilic substitution

Explanation:

The correct answer is 'nucleophilic addition' because the reaction involves a nucleophile (cyanide ion) attacking the electrophilic carbonyl carbon of the aldehyde, leading to the formation of cyanohydrin.

Question 7.

The reaction of an alkyl halide with sodium alkoxide forming ether is known as :

[1 Marks]

(A) Reimer-Tiemann reaction

(B) Williamson synthesis

(C) Kolbe reaction

(D) Wurtz reaction

Explanation:

The correct answer is Williamson synthesis. In Williamson synthesis, an alkyl halide reacts with a sodium alkoxide to produce an ether. This reaction is a common method for synthesizing ethers from alcohols and alkyl halides.

Question 8.

The correct order of the ease of dehydration of the following alcohols by the action of conc. H_2SO_4 is :

[1 Marks]

(A) $(CH_3)_2CH-OH > (CH_3)_3C-OH > CH_3CH_2-OH$

(B) $(CH_3)_2CH-OH > CH_3CH_2-OH > (CH_3)_3C-OH$

(C) $CH_3CH_2-OH > (CH_3)_2CH-OH > (CH_3)_3C-OH$

(D) $(CH_3)_3C-OH > (CH_3)_2CH-OH > CH_3CH_2-OH$

Explanation: The correct order is $(CH_3)_3C-OH > (CH_3)_2CH-OH > CH_3CH_2-OH$. This is because tertiary alcohols dehydrate more easily than secondary, which in turn dehydrate more easily than primary alcohols. According to the provided context, the relative ease of dehydration follows the order: Tertiary > Secondary > Primary, which aligns with the structure of the given alcohols.

Question 9.

Which functional groups of glucose interact to form cyclic hemiacetal leading to pyranose structure ?

[1 Marks]

(A) Ketone group and hydroxyl group at C- 4

(B) Aldehyde group and hydroxyl group at C- 4

(C) Ketone group and hydroxyl group at C- 5

(D) Aldehyde group and hydroxyl group at C- 5

Explanation: The correct option is 'Aldehyde group and hydroxyl group at C- 5.' In glucose, the aldehyde group at C-1 reacts with the hydroxyl group at C-5 to form a cyclic hemiacetal, resulting in the pyranose structure, which is a six-membered ring.

Question 10.

Assertion (A) : When NaCl is added to water a depression in freezing point is observed.

Reason (R) : NaCl undergoes dissociation in water.

[1 Marks]

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

(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 false, but Reason (R) is true.

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

Explanation: Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A). The addition of NaCl to water causes dissociation into Na^+ and Cl^- ions, which disrupts the formation of ice, leading to a depression in the freezing point.

Question 11.

Assertion (A) : Separation of Zr and Hf is difficult.

Reason (R) : Zr and Hf have similar radii due to lanthanoid contraction.

[1 Marks]

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

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

(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:

Both Assertion (A) and Reason (R) are true, and Reason (R) is the correct explanation of Assertion (A). The similar ionic radii of Zr and Hf, resulting from the lanthanoid contraction, indeed make their separation challenging.

Question 12.

Assertion (A) : The pK_a of ethanoic acid is lower than that of Cl $-CH_2-$ COOH.

Reason (R) : Chlorine shows electron withdrawing (I) effect which increases the acidic character of Cl -CH 2- COOH.

[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 false, but Reason (R) is true. The pK_a of Cl-CH_2-COOH is actually lower than that of ethanoic acid due to the electron-withdrawing effect of chlorine, which does

increase the acidic character of $Cl-CH_2-COOH$. Therefore, while Reason (R) correctly describes the influence of chlorine on acidity, Assertion (A) is incorrect.

Question 13.

Assertion (A) : Aniline is a stronger base than ammonia.

Reason (R) : The unshared electron pair on nitrogen atom in aniline becomes less available for protonation due to resonance.

[1 Marks]

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

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

Explanation: Assertion (A) is false, but Reason (R) is true. Aniline is actually a weaker base than ammonia because the lone pair of electrons on the nitrogen atom in aniline is involved in resonance with the aromatic ring, which decreases its availability for protonation. Therefore, while the reason correctly describes the effect of resonance on aniline's basicity, the assertion that aniline is a stronger base than ammonia is incorrect.

Question 14.

Which of the following compounds will give a ketone on oxidation with chromic anhydride (CrO_3) ?

[1 Marks]

(A) $CH_3-CH_2-CH(OH)-CH_3$

(B) $(CH_3)_3C-OH$

(C) CH3CH2CH2OH

(D) (CH3)2CH -CH2OH

Explanation: The correct option is $(CH_3)_3C-OH$, which is a tertiary alcohol that does not undergo oxidation to form a ketone, but secondary alcohols like $CH_3-CH_2-CH(OH)-CH_3$ can be oxidized to ketones. Tertiary alcohols do not give ketones upon oxidation, whereas secondary alcohols do. Therefore, the ketone formed will be from the oxidation of a

suitable secondary alcohol, and the only option that fits this is CH_3-CH_2-CH(OH)-CH_3, which can form a ketone upon oxidation with CrO_3.

Section B

Question 15.

Calculate the potential of Iron electrode in which the concentration of

Fe2+ ion is 0·01 M.

($E^{o}Fe2+/Fe$ = 0·45 V at 298 K)

[Given : log 10 = 1]

[2 Marks]

Answer: The potential of the iron electrode is calculated using the Nernst equation:
$E = E^{o} - (0.0592 / n) * \log [Fe^{2+}]$
Here, E^{o} = 0.45 V, n = 2, and $[Fe^{2+}]$ = 0.01 M
So, E = 0.45 - (0.0592 / 2) * log 0.01
= 0.45 - 0.0296 * (-2) since log 0.01 = -2
= 0.45 + 0.0592
= 0.5092 V
Therefore, the potential of the iron electrode is approximately 0.51 V.

Question 16.

Define molecularity of the reaction. State any one condition in which a bimolecular reaction may be kinetically of first order

[2 Marks]

Answer: (a) Molecularity of a reaction is defined as the number of reacting species (atoms, ions, or molecules) that must collide simultaneously in an elementary reaction to bring about the chemical change. It is always a whole number like 1, 2, 3 and cannot be zero or a fraction.
(b) Condition when a bimolecular reaction is kinetically first order: If one reactant is in large excess so that its concentration remains nearly constant during the reaction, the rate depends effectively only on the concentration of the other reactant. Thus, the reaction appears to follow first order kinetics even though it is bimolecular in molecularity.

Section C

Question 17. Batteries and fuel cells are very useful forms of galvanic cell. Any battery or cell that we use as a source of electrical energy is basically a galvanic cell. However, for a battery to be of practical use it should be reasonably light, compact and its voltage should not vary appreciably during its use. There are mainly two types of batteries: primary batteries and secondary batteries. In the primary batteries, the reaction occurs only once and after use over a period of time the battery becomes dead and cannot be reused again, whereas the secondary batteries are rechargeable. Production of electricity by thermal plants is not a very efficient method and is a major source of pollution. To solve this problem, galvanic cells are designed in such a way that energy of combustion of fuels is directly converted into electrical energy, and these are known as fuel cells. One such fuel cell was used in the Apollo space programme.

Question 18.

Batteries and fuel cells are very useful forms of galvanic cell. Any battery or cell that we use as a source of electrical energy is basically a galvanic cell. However, for a battery to be of practical use it should be reasonably light, compact and its voltage should not vary appreciably during its use. There are mainly two types of batteries secondary batteries. primary batteries and In the primary batteries, the reaction occurs only once and after use over a period of time the battery becomes dead and cannot be reused again, whereas the secondary batteries are rechargeable. Production of electricity by thermal plants is not a very efficient method and is a major source of pollution. To solve this problem, galvanic cells are designed in such a way that energy of combustion of fuels is directly converted into electrical energy, and these are known as fuel cells. One such fuel cell was used in the Apollo space programme.

Answer the following questions :

Question 19.

Question 20.

Question 21.

Question 22.

Question 23.

Question 24.

Question 25.

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Question 26.

Batteries and fuel cells are very useful forms of galvanic cell. Any battery or cell that we use as a source of electrical energy is basically a galvanic cell. However, for a battery to be of practical use it should be reasonably light, compact and its voltage should not vary appreciably during its use. There are mainly two types of batteries secondary batteries. primary batteries and In the primary batteries, the reaction occurs only once and after use over a period of time the battery becomes dead and cannot be reused again, whereas the secondary batteries are rechargeable. Production of electricity by thermal plants is not a very efficient method and is a major source of pollution. To solve this problem, galvanic cells are designed in such a way that energy of combustion of fuels is directly converted into electrical energy, and these are known as fuel cells. One such fuel cell was used in the Apollo space programme. Answer the following questions :

Question 27.

Batteries and fuel cells are very useful forms of galvanic cell. Any battery or cell that we use as a source of electrical energy is basically a galvanic cell. However, for a battery to be of practical use it should be reasonably light, compact and its voltage should not vary appreciably during its use. There are mainly two types of batteries secondary batteries. primary batteries and In the primary batteries, the reaction occurs only once and after use over a period of time the battery becomes dead and cannot be reused again, whereas the secondary batteries are rechargeable. Production of electricity by thermal plants is not a very efficient method and is a major source of pollution. To solve this problem, galvanic cells are designed in such a way that energy of combustion of fuels is directly converted into electrical energy, and these are known as fuel cells. One such fuel cell was used in the Apollo space programme. Answer the following questions :

Question 28.

Batteries and fuel cells are very useful forms of galvanic cell. Any battery or cell that we use as a source of electrical energy is basically a galvanic cell. However, for a battery to be of practical use it should be reasonably light, compact and its voltage should not vary appreciably during its use. There are mainly two types of batteries secondary batteries. primary batteries and In the primary batteries, the reaction occurs only once and after use

over a period of time the battery becomes dead and cannot be reused again, whereas the secondary batteries are rechargeable. Production of electricity by thermal plants is not a very efficient method and is a major source of pollution. To solve this problem, galvanic cells are designed in such a way that energy of combustion of fuels is directly converted into electrical energy, and these are known as fuel cells. One such fuel cell was used in the Apollo space programme. Answer the following questions :

Question 29. Batteries and fuel cells are very useful forms of galvanic cell. Any battery or cell that we use as a source of electrical energy is basically a galvanic cell. However, for a battery to be of practical use it should be reasonably light, compact and its voltage should not vary appreciably during its use. There are mainly two types of batteries secondary batteries. primary batteries and In the primary batteries, the reaction occurs only once and after use over a period of time the battery becomes dead and cannot be reused again, whereas the secondary batteries are rechargeable. Production of electricity by thermal plants is not a very efficient method and is a major source of pollution. To solve this problem, galvanic cells are designed in such a way that energy of combustion of fuels is directly converted into electrical energy, and these are known as fuel cells. One such fuel cell was used in the Apollo space programme.