Chemistry-Set A Question Paper With Solutions

Question 1

What product is obtained when chloroform reacts with oxygen in presence of light?

Option A: Phosgene gas

Option B: Phosphine gas

Option C: Chlorine gas

Option D: Hydrogen gas

Correct Answer: Option A

Solution:

When chloroform (**CHCl**) is exposed to oxygen in the presence of light, a reaction occurs that produces phosgene gas (**COCl**), which is highly toxic. This reaction happens due to the breakdown of chloroform molecules facilitated by light energy, which allows them to react with oxygen molecules.

Quick Tip

Phosgene gas is hazardous and was historically used as a chemical weapon. Handle chloroform with care, avoiding light exposure.

Question 2

Which among the following is a trihydric alcohol?

Option A: Ethanol

Option B: Glycerol

Option C: Ethylene Glycol

Option D: Phenol

Correct Answer: Option B

Solution:

Glycerol (CHO) is a trihydric alcohol, containing three hydroxyl (-OH) groups attached to carbon atoms. The presence of these hydroxyl groups gives it high affinity for water, making it useful in applications such as cosmetics and pharmaceuticals.

Quick Tip

The prefix ”tri-” in trihydric indicates the presence of three hydroxyl (OH) groups.

Question 3

Aspirin is also known as:

Option A: Salicylic acid

Option B: Ethyl Salicylic acid

Option C: Methyl Salicylic acid

Option D: Acetyl Salicylic acid

Correct Answer: Option D

Solution:

Aspirin is chemically known as acetyl salicylic acid (ASA). It is synthesized by acetylating salicylic acid, reducing its acidity and making it easier on the stomach than salicylic acid alone. Aspirin is commonly used as an anti-inflammatory and analgesic.

Quick Tip

Remember, ”Acetyl” in acetyl salicylic acid refers to the modification that makes aspirin less irritating to the stomach.

Question 4

What is the IUPAC name of picric acid?

Option A: 2-Nitrophenol

Option B: 2,4,6-Trinitrophenol

Option C: Ethyl Salicylic acid

Option D: 2-aminophenol

Correct Answer: Option B

Solution:

Picric acid is chemically known as 2,4,6-Trinitrophenol. This compound has three nitro groups (-NO) attached to a benzene ring, giving it highly explosive properties, which is why it was historically used in munitions.

Quick Tip

”Trinitro-” refers to the presence of three nitro groups in the compound, making it highly reactive.

Question 5

Why does Fluorine exhibit only -1 oxidation state?

Option A: It is a halogen.

Option B: It is a non-metal.

Option C: It is small in size.

Option D: It has no d orbitals.

Correct Answer: Option D

Solution:

Fluorine exhibits only the -1 oxidation state because it is highly electronegative and lacks d orbitals, preventing it from adopting positive oxidation states. Its strong pull on electrons keeps it stable in the -1 state.

Quick Tip

Fluorine is the most electronegative element and stabilizes with a -1 charge due to its small size and absence of d orbitals.

Question 6

Which among the following halogen exists in liquid state at room temperature?

Option A: Fluorine

Option B: Chlorine

Option C: Bromine

Option D: Iodine

Correct Answer: Option C

Solution:

Bromine is the only halogen that exists as a liquid at room temperature. Due to its moderate molecular weight and the van der Waals forces between its molecules, bromine remains in a liquid state at standard conditions, unlike other halogens that are gases or solids at room temperature.

Quick Tip

Remember: Only bromine among halogens is a liquid at room temperature.

Question 7

The central atoms/ions in coordination compounds are referred to as

Option A: Lewis base

Option B: Lewis acid

Option C: Bronsted acid

Option D: Bronsted base

Correct Answer: Option B

Solution:

In coordination chemistry, the central atom or ion acts as a Lewis acid because it can accept electron pairs from ligands (Lewis bases) that coordinate with it. This electron pair acceptance helps form the coordination complex.

Quick Tip

Think of the central metal ion in complexes as a Lewis acid—it accepts electrons!

Question 8

What is the IUPAC name of $[Pt(NH_3)_2Cl(NO_2)]$?

Option A: Diamminechloridonitrito-N-platinum(II)

Option B: Diamminechloridenitrito-N-platinum(III)

Option C: Diamminechloridonitrito-O-platinum(II)

Option D: Diammonia chloridonitrito-N-platinum(II)

Correct Answer: Option A

Solution:

In the coordination compound $[Pt(NH_3)_2Cl(NO_2)]$, the ligands are named in alphabetical order: "diammine" (for the two NH_3 groups), followed by "chlorido" (for Cl^-) and "nitrito-N" (for NO_2 attached via nitrogen). The oxidation state of platinum here is +2, denoted as "(II)" in the name. Therefore, the IUPAC name is "Diamminechloridonitrito-N-platinum(II)".

Quick Tip

When naming coordination compounds, list ligands alphabetically, and specify coordination via elements when needed (e.g., nitrito-N if attached through nitrogen).

Question 9

What is the product when glucose reacts with bromine water?

Option A: Gluconic acid

Option B: Glyceraldehyde

Option C: Saccharic acid

Option D: Oxime

Correct Answer: Option A

Solution:

When glucose is treated with bromine water, it undergoes mild oxidation at the aldehyde group to form gluconic acid. This reaction is commonly used as a qualitative test to identify glucose, as bromine water selectively oxidizes the aldehyde group.

Quick Tip

Bromine water is a mild oxidizing agent that converts glucose to gluconic acid without affecting other functional groups.

Question 10

Match List I with List II for the oxidation state of central atoms:

List I	List II
(A) $Cr_2O_7^{2-}$	(I) +3
(B) MnO_4^-	(II) +5
(C) VO_3^-	(III) +7
(D) FeF_6^{3-}	(IV) +6

Choose the correct answer from the options given below:

Option A: (A) - (I), (B) - (II), (C) - (III), (D) - (IV)

Option B: (A) - (IV), (B) - (III), (C) - (II), (D) - (I)

Option C: (A) - (I), (B) - (II), (C) - (IV), (D) - (III)

Option D: (A) - (IV), (B) - (I), (C) - (III), (D) - (II)

Correct Answer: Option B

Solution:

The oxidation states for each compound are as follows:

- $Cr_2O_7^{2-}$: Chromium (Cr) is in the +6 oxidation state.
- MnO_4^-: Manganese (Mn) is in the +7 oxidation state.
- VO_3^-: Vanadium (V) is in the +5 oxidation state.
- FeF_6^{3-}: Iron (Fe) is in the +3 oxidation state.

Quick Tip

Matching oxidation states requires understanding of common oxidation states of transition metals in their compounds.

Question 11

What is the color of copper compound formed in Fehling's test for aliphatic aldehydes?

Option A: Green

Option B: Blue

Option C: Yellow

Option D: Red brown

Correct Answer: Option D

Solution:

Fehling's test involves the reaction of aliphatic aldehydes with Fehling's solution, resulting in the formation of a red-brown precipitate of copper(I) oxide. This reaction is specific to aldehydes and can help differentiate them from ketones.

Quick Tip

Fehling's test is used to detect aldehydes; a red-brown precipitate indicates a positive result.

Question 12

What is the major product formed when diazonium salt undergoes Gatterman reaction?

Option A: Haloarene

Option B: Aryl amine

Option C: Phenol

Option D: Diphenyl ether

Correct Answer: Option A

Solution:

The Gatterman reaction involves the replacement of the diazonium group (-N) in diazonium salts with a halogen atom. In this reaction, a diazonium salt reacts with copper powder and the corresponding halide acid (HCl or HBr) to yield a haloarene.

Quick Tip

Gatterman reaction is used for introducing halogens (Cl or Br) into aromatic compounds.

Question 13

What is the major product of Carbylamine reaction?

Option A: Cyanide

Option B: Isocyanide

Option C: Nitrile

Option D: Alkane

Correct Answer: Option B

Solution:

In the Carbylamine reaction, primary amines react with chloroform (CHCl) and an alcoholic solution of potassium hydroxide to produce isocyanides (also known as carbylamines), which have a characteristic foul odor.

Quick Tip

The Carbylamine reaction is a test for primary amines, as only primary amines produce isocyanides.

Question 14

Which among the following is an essential amino acid?

Option A: Glycine

Option B: Alanine

Option C: Valine

Option D: Serine

Correct Answer: Option C

Solution:

Valine is classified as an essential amino acid, meaning it cannot be synthesized by the human body and must be obtained through diet. Essential amino acids are critical for protein synthesis and other metabolic functions.

Quick Tip

Essential amino acids cannot be synthesized by the body and must come from dietary sources.

Question 15

Arrange the following in increasing order of their pH values:

(A) p-Nitrophenol (B) m-Cresol

(C) m-Nitrophenol (D) Phenol

Choose the correct answer from the options given below:

Option 1: (A) < (B) < (C) < (D)

Option 2: (A) < (C) < (D) < (B)

Option 3: (B) < (A) < (D) < (C)

Option 4: (C) < (B) < (D) < (A)

Correct Answer: Option 4

Solution:

The pH values are determined by the acidic strength of each compound. p-Nitrophenol, having an electron-withdrawing group, is the most acidic, followed by m-Cresol and m-Nitrophenol. Phenol, with no substituents, is the least acidic among these compounds.

Quick Tip

Acidic strength in phenols increases with electron-withdrawing groups like nitro (-NO) on the ring.

Question 16

Which among the following is a biodegradable polymer?

Option A: PVC

Option B: Freon

Option C: Nylon

Option D: PHBV

Correct Answer: Option D

Solution:

PHBV (Poly-3-hydroxybutyrate-co-3-hydroxyvalerate) is a biodegradable polymer often used in medical and agricultural applications. It degrades naturally in the environment, making it eco-friendly, unlike PVC or Nylon.

Quick Tip

Biodegradable polymers like PHBV break down naturally, reducing environmental impact.

Question 17

Which among the following is an antacid?

Option A: Aspirin

Option B: Zantac

Option C: Equanil

Option D: Noradrenaline

Correct Answer: Option B

Solution:

Zantac (ranitidine) is commonly used as an antacid to treat conditions caused by excessive stomach acid, like heartburn and ulcers. It works by reducing stomach acid production.

Quick Tip

Antacids like Zantac neutralize or reduce stomach acid, relieving heartburn and indigestion.

Question 18

What is the numerical value of one Faraday in Coulombs?

Option A: 96587

Option B: 96487

Option C: 99500

Option D: 6.023

Correct Answer: Option A

Solution:

One Faraday is equal to 96587 Coulombs, which represents the charge of one mole of electrons or 1 mole of electric charge.

Quick Tip

Faraday's constant (96587 C) is essential in calculations involving electric charge in electrochemistry.

Question 19

A first-order reaction has a half-life of 693 sec. What will be its rate constant?

Option A: 0.01 sec^{-1}

Option B: 1 sec^{-1}

Option C: 0.001 sec^{-1}

Option D: 0.1 sec^{-1}

Correct Answer: Option A

Solution:

For a first-order reaction, the rate constant k can be calculated using the formula $k = \frac{0.693}{\text{half-life}}$. Substituting the given half-life, $k = \frac{0.693}{693} = 0.001$ sec^{-1}.

Quick Tip

The rate constant for first-order reactions can be quickly found using $k = 0.693/\text{half-life}$.

Question 20

For an SN_2 reaction, arrange the following alkyl halides in increasing order of reactivity:

(A) $CH_3CH_2CH_2CH_2Br$ (B) $CH_3CH_2CH(Br)CH_3$

(C) $(CH_3)_3CBr$ (D) $(CH_3)_2CHCH_2Br$

Choose the correct answer from the options given below:

Option 1: (A) < (B) < (C) < (D)

Option 2: (A) < (C) < (B) < (D)

Option 3: (B) < (A) < (D) < (C)

Option 4: (C) < (B) < (D) < (A)

Correct Answer: Option 3

Solution:

For SN_2 reactions, primary alkyl halides react faster than secondary and tertiary halides. Therefore, the increasing order of reactivity is (B) ¡ (A) ¡ (D) ¡ (C).

Quick Tip

SN_2 reactivity order: Primary > Secondary > Tertiary due to steric hindrance.

Question 21

Which among the following is a strong field ligand?

Option A: I^-

Option B: Cl^-

Option C: NH_3

Option D: SCN^-

Correct Answer: Option C

Solution:

NH_3 is a strong field ligand according to the spectrochemical series. It causes a large crystal field splitting energy, making it suitable for low-spin complexes.

Quick Tip

Strong field ligands create larger crystal field splitting, resulting in low-spin configurations.

Question 22

Arrange the following in increasing order of their osmotic pressure generation at 298 K:

(The cell wall is permeable to water and not to the solute molecules)

(A) If a cell containing 0.5 moles of solute dissolved in 1 L of water is immersed in pure water.
(B) If a cell containing 0.25 moles of solute dissolved in 1 L of water is immersed in pure water.
(C) If a cell containing 0.1 moles of solute dissolved in 0.01 L of water is immersed in pure water.
(D) If a cell containing 0.2 moles of solute dissolved in 0.05 L of water is immersed in pure water.

Choose the correct answer from the options given below:

Option 1: (C) < (B) < (A) < (D)

Option 2: (D) < (A) < (B) < (C)

Option 3: (B) < (A) < (D) < (C)

Option 4: (C) < (A) < (B) < (D)

Correct Answer: Option 1

Solution:

Osmotic pressure is directly proportional to the concentration of solute. Higher molarity (moles of solute per liter of solution) results in higher osmotic pressure. Therefore, the increasing order of osmotic pressure is (C) < (B) < (A) < (D).

Quick Tip

Osmotic pressure increases with solute concentration. Remember, higher molarity means higher osmotic pressure.

Question 23

Arrange the following rate constant units in increasing order of their order of reaction:

(A) sec^{-1}

(B) $mol\ L^{-1}\ sec^{-1}$

(C) $mol^{-1}\ L\ sec^{-1}$

(D) $mol^{-2}\ L^{2}\ sec^{-1}$

Choose the correct answer from the options given below:

Option 1: (C) < (A) < (B) < (D)

Option 2: (C) < (B) < (A) < (D)

Option 3: (B) < (A) < (C) < (D)

Option 4: (A) < (B) < (C) < (D)

Correct Answer: Option 1

Solution:

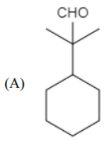
The rate constant's unit depends on the reaction order. For example, a first-order reaction has units of sec^{-1}, while second- and higher-order reactions involve units of concentration (mol/L) raised to varying powers. Thus, arranging by increasing order gives (C) < (A) < (B) < (D).

Quick Tip

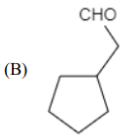
For zero-order reactions, rate constant units are $mol\ L^{-1}\ sec^{-1}$; for first-order, it's sec^{-1}; higher orders involve powers of concentration.

Question 24

Which of the following compounds will undergo Aldol condensation reaction?



(A)



(B)

CH_3-CH_2-C(CH_3)$_2$-CH_2CHO

(C)

HCHO

(D)

Choose the correct answer from the options given below:

Option 1: (A), (C) and (D) only

Option 2: (B) and (C) only

Option 3: (B), (C) and (D) only

Option 4: (A), (B), (C) and (D)

Correct Answer: Option 1

Solution:

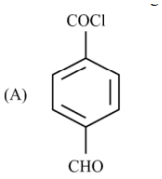
Aldol condensation requires compounds with at least one alpha-hydrogen atom. Compounds (A), (C), and (D) have alpha-hydrogens, allowing them to undergo Aldol condensation. Compound (B), however, lacks an alpha-hydrogen, so it does not participate in this reaction.

Quick Tip

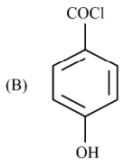
For Aldol condensation, look for compounds with alpha-hydrogens next to carbonyl groups.

Question 25

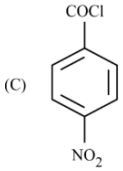
Consider the following compounds:



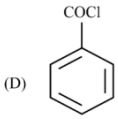
(A)



(B)



(C)



(D)

Arrange these compounds in the increasing order of rate of hydrolysis:

Option 1: (B) < (D) < (C) < (A)

Option 2: (B) < (D) < (A) < (C)

Option 3: (D) < (B) < (A) < (C)

Option 4: (A) < (D) < (B) < (C)

Correct Answer: Option 2

Solution:

The rate of hydrolysis depends on the electron-withdrawing and electron-donating effects of substituents. Compound (B) with an electron-donating hydroxyl group has the slowest hydrolysis rate. Compound (C) with a strong electron-withdrawing nitro group increases the hydrolysis rate, while compound (A) with an aldehyde and compound (D) without any substituent show intermediate rates. The correct order of increasing rate of hydrolysis is (B) < (D) < (A) < (C).

Quick Tip

Electron-withdrawing groups increase the rate of hydrolysis in aromatic acyl chlorides, while electron-donating groups decrease it.

Question 26

Which of the following ions will be coloured in the aqueous solution?

(A) Ti^{3+}

(B) Nb^{3+}

(C) Cu^{+}

(D) Y^{3+}

Choose the correct answer from the options given below:

Option 1: (C) and (D) only

Option 2: (A), (B) and (D) only

Option 3: (A) and (B) only

Option 4: (A), (B), (C) and (D)

Correct Answer: Option 3

Solution:

In aqueous solutions, ions with unpaired d-electrons exhibit color. Ti^{3+} and Nb^{3+} have unpaired d-electrons, while Cu^{+} and Y^{3+} do not, hence they do not show color in aqueous solution.

Quick Tip

For transition metals, the presence of unpaired electrons in d-orbitals is essential for color in aqueous solutions.

Question 27

The correct statement/statements from the options given below is/are:

(A) Diazonium salts of aromatic amines are less stable than diazonium salts of aliphatic amines.

(B) Ethylamine is insoluble in water.

(C) Gabriel phthalimide synthesis can be used to prepare primary amines.

(D) Because of +R-effect of $-NH_2$ group, aniline will undergo Friedel-Crafts acylation reaction.

Choose the correct answer from the options given below:

Option 1: (A) and (B) only

Option 2: (A), (C) and (D) only

Option 3: (A) and (C) only

Option 4: (B), (C) and (D) only

Correct Answer: Option 2

Solution:

Statements (A), (C), and (D) are correct. Diazonium salts of aromatic amines are more stable than those of aliphatic amines, Gabriel synthesis is used for preparing primary amines, and the +R effect of $-NH_2$ in aniline allows it to undergo Friedel-Crafts acylation.

Quick Tip

Diazonium salts of aromatic amines are stable due to resonance, unlike those of aliphatic amines.

Question 28

Match List-I with List-II:

List-I		List-II	
(A)	Mn^{2+}	(I)	Pyrolusite ore
(B)	Spin only Magnetic Moment	(II)	An alloy of 4f metal, iron and traces of S, C, Al and Ca
(C)	MnO_2	(III)	$\mu_s = \sqrt{n(n+2)}$ BM
(D)	Misch metal	(IV)	Highest oxidation states

Choose the correct answer from the options given below:

Option 1: (A) - (IV), (B) - (III), (C) - (II), (D) - (I)

Option 2: (A) - (II), (B) - (III), (C) - (I), (D) - (IV)

Option 3: (A) - (IV), (B) - (III), (C) - (I), (D) - (II)

Option 4: (A) - (I), (B) - (III), (C) - (IV), (D) - (II)

Correct Answer: Option 3

Solution:

- (A) Mn^{2+} corresponds to the highest oxidation states.

- (B) Spin-only magnetic moment follows the formula $\mu_s = \sqrt{n(n+2)}$ BM.

- (C) MnO_2 is found in pyrolusite ore.

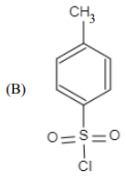
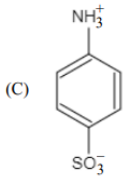
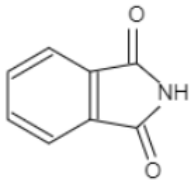
- (D) Misch metal is an alloy of 4f metal with iron, sulfur, carbon, aluminum, and calcium.

Quick Tip

Remember, magnetic moments for transition metals can be calculated using $\mu_s = \sqrt{n(n+2)}$ BM.

Question 29

Match List-I with List-II:

List-I	(Compound)	List-II	(Property)
(A)	$COCl_2$	(I)	To distinguish between primary, secondary and tertiary amines
(B)	(B) 	(II)	Poisonous gas
(C)	(C) 	(III)	Synthesis of primary amines
(D)	(D) 	(IV)	Zwitter ion

Choose the correct answer from the options given below:

Option 1: (A) - (II), (B) - (I), (C) - (IV), (D) - (III)

Option 2: (A) - (II), (B) - (I), (C) - (III), (D) - (IV)

Option 3: (A) - (I), (B) - (II), (C) - (IV), (D) - (III)

Option 4: (A) - (I), (B) - (II), (C) - (III), (D) - (IV)

Correct Answer: Option 2

Solution:

- (A) $COCl_2$ (phosgene) is a poisonous gas.
- (B) The compound in (B) can be used to distinguish between primary, secondary, and tertiary amines.
- (C) The compound in (C) is used in the synthesis of primary amines.
- (D) The compound in (D) exists as a zwitter ion due to the presence of both acidic and basic groups.

Quick Tip

Zwitter ions have both positive and negative charges within the same molecule, typically found in amino acids and similar compounds.

Question 30

Which of the following is/are the bases of DNA?

(A) Adenine

(B) Uracil

(C) Thymine

(D) Cytosine

Choose the correct answer from the options given below:

Option 1: (A), (B) and (C) only

Option 2: (B) and (C) only

Option 3: (A), (C) and (D) only

Option 4: (A) and (B) only

Correct Answer: Option 3

Solution:

DNA bases include adenine (A), thymine (T), cytosine (C), and guanine (G). Uracil (U) is found in RNA, not DNA.

Quick Tip

For DNA, remember the bases: adenine, thymine, cytosine, and guanine.

Question 31

Match List-I with List-II:

List-I	(Amino Acid)	List-II	(Nature of Amino Acid)
(A)	Valine	(I)	Basic amino acid
(B)	Glycine	(II)	Neutral optically active amino acid
(C)	Lysine	(III)	Acidic amino acid
(D)	Glutamic acid	(IV)	Neutral optically inactive amino acid

Choose the correct answer from the options given below:

Option 1: (A) - (I), (B) - (II), (C) - (III), (D) - (IV)

Option 2: (A) - (I), (B) - (III), (C) - (II), (D) - (IV)

Option 3: (A) - (I), (B) - (II), (C) - (IV), (D) - (III)

Option 4: (A) - (II), (B) - (IV), (C) - (I), (D) - (III)

Correct Answer: Option 4

Solution:

- (A) Valine is a neutral optically active amino acid.

- (B) Glycine is a neutral optically inactive amino acid.

- (C) Lysine is a basic amino acid.

- (D) Glutamic acid is an acidic amino acid.

Quick Tip

Optical activity in amino acids depends on the presence of a chiral center. Glycine lacks a chiral center and is optically inactive.

Question 32

Which of the following gases at 298 K and 1 atm pressure is having maximum solubility in water?

(A) Methanal, $K_H = 0.000018$

(B) Argon, $K_H = 40.3$

(C) Methane, $K_H = 0.41$

(D) CO_2, $K_H = 1.6$

Choose the correct answer from the options given below:

Option 1: Methanal

Option 2: Argon

Option 3: Methane

Option 4: CO_2

Correct Answer: Option 1

Solution:

The solubility of a gas in water is inversely proportional to the value of Henry's constant, K_H. Methanal has the lowest K_H value, thus it is the most soluble gas in water.

Quick Tip

The lower the Henry's constant, the higher the solubility of the gas in water.

Question 33

Which of the following solvents is having its lowest Ebullioscopic constant?

Solvent	Boiling Point (K)
Chloroform	334.4
Diethyl Ether	307.8
Benzene	353.3
Carbon disulphide	319.4

Choose the correct answer from the options given below:

Option 1: Chloroform

Option 2: Diethyl Ether

Option 3: Benzene

Option 4: Carbon disulphide

Correct Answer: Option 2

Solution:

Diethyl Ether has the lowest boiling point among the given solvents, and thus has the lowest Ebullioscopic constant.

Quick Tip

Ebullioscopic constants are directly related to boiling points; lower boiling points mean lower constants.

Read the following passage and answer the next five questions based on it.

Aldehydes are generally more reactive than ketones in nucleophilic addition reactions due to steric and electronic reasons. Sterically, the presence of two large groups in ketones hinders the attack of nucleophile to carbonyl carbon than in aldehydes. Electronically, aldehydes are more reactive than ketones because two alkyl groups reduce the electrophilicity of the carbonyl carbon more effectively than in the former.

Question 34

Which among the following compound is formed when aldehyde reacts with HCN in presence of base?

(A) Cyanide

(B) Isocyanide

(C) Cyanohydrin

(D) Hydrogen cyanide

Choose the correct answer from the options given below:

Option 1: Cyanide

Option 2: Isocyanide

Option 3: Cyanohydrin

Option 4: Hydrogen cyanide

Correct Answer: Option 3

Solution:

When an aldehyde reacts with HCN in the presence of a base, cyanohydrin is formed as a product due to nucleophilic addition.

Quick Tip

Remember, HCN addition to aldehydes forms cyanohydrins, which have a -C(OH)(CN) group.

Question 35

The correct decreasing order of basic strength of following amines in aqueous solution is:

CH_3NH_2, $(CH_3)_2NH$, $(CH_3)_3N$, NH_3

Choose the correct answer from the options given below:

Option 1: $CH_3NH_2 > (CH_3)_2NH > NH_3 > (CH_3)_3N$

Option 2: $CH_3NH_2 > (CH_3)_2NH > (CH_3)_3N > NH_3$

Option 3: $NH_3 > (CH_3)_3N > (CH_3)_2NH > CH_3NH_2$

Option 4: $(CH_3)_2NH > CH_3NH_2 > (CH_3)_3N > NH_3$

Correct Answer: Option 2

Solution:

In aqueous solution, the basic strength order for amines is influenced by inductive effects and steric factors. Dimethylamine $((CH_3)_2NH)$ is more basic than methylamine CH_3NH_2 and trimethylamine $((CH_3)_3N)$, while ammonia (NH_3) is the least basic.

Quick Tip

Inductive effects increase basicity in amines, but steric hindrance can reduce it, especially for trialkylamines.

Question 36

A new C-C bond formation is possible in:

(A) Cannizzaro reaction

(B) Friedel-Crafts alkylation

(C) Clemmensen reduction

(D) Riemer-Tiemann reaction

Choose the correct answer from the options given below:

Option 1: (B) and (D) only

Option 2: (A), (B) and (D) only

Option 3: (B), (C) and (D) only

Option 4: (A), (B), (C) and (D)

Correct Answer: Option 2

Solution:

Friedel-Crafts alkylation and Riemer-Tiemann reactions involve the formation of new C-C bonds. Cannizzaro reaction does not form a new C-C bond, and Clemmensen reduction only reduces carbonyl compounds.

Quick Tip

Reactions involving new C-C bond formation are key in organic synthesis for building larger molecules.

Question 37

Which of the following will respond to Tollen's test?

Option 1: Ethanoic acid

Option 2: Methanoic acid

Option 3: Propanoic acid

Option 4: Butanoic acid

Correct Answer: Option 2

Solution:

Methanoic acid (formic acid) is the only acid among the given options that contains an aldehyde group, making it capable of responding to Tollen's test.

Quick Tip

Tollen's test is specific for aldehydes; formic acid, with its -CHO group, can respond positively.

Question 38

The order of reactivity of the given haloalkanes towards nucleophile is:

Choose the correct answer from the options given below:

Option 1: RI $>$ RBr $>$ RCl

Option 2: RCl $>$ RBr $>$ RI

Option 3: RBr $>$ RCl $>$ RI

Option 4: RBr $>$ RI $>$ RCl

Correct Answer: Option 1

Solution:

The reactivity order towards nucleophiles is influenced by bond strength. The C-I bond is the weakest among C-X bonds, making RI the most reactive.

Quick Tip

In general, the reactivity of haloalkanes towards nucleophiles decreases as the bond strength increases.

Read the following passage and answer the next five questions based on it.

The transition metals are very hard and have low volatility. Their melting and boiling points are high. In any row, the melting points of these metals rise to a maximum at d^5 and fall regularly as atomic number increases. The high melting points of these metals are attributed to the involvement of greater number of electrons from (n – 1)d in addition to ns electrons in the interatomic metallic bonding.

Question 39

Which transition metal is liquid at room temperature?

Option 1: Hg

Option 2: Cu

Option 3: Ag

Option 4: Au

Correct Answer: Option 1

Solution:

Mercury (Hg) is the only transition metal that exists as a liquid at room temperature.

Quick Tip

Mercury is unique among transition metals for its liquid state at standard room temperature.

Question 40

Which is the hardest metal?

Option 1: Zn

Option 2: Cu

Option 3: Hg

Option 4: Cd

Correct Answer: Option 2

Solution:

Copper is considered the hardest among the given metals due to its high ductility and strength compared to others in the list.

Quick Tip

Copper's high hardness makes it useful for applications requiring durability and wear resistance.

Question 41

In any row, melting points of these metals rise to a maximum at d^5. Which transition metal is an exception?

Option 1: Ti

Option 2: V

Option 3: Cr

Option 4: Mn

Correct Answer: Option 4

Solution:

In the periodic trend of melting points, manganese (Mn) is an exception as it does not follow the typical increase to a maximum at d^5 due to its electronic configuration.

Quick Tip

Transition metals generally reach peak melting points around d^5, but Mn is an exception.

Question 42

Which transition metal has the highest melting point?

Option 1: Hf

Option 2: Ta

Option 3: W

Option 4: Re

Correct Answer: Option 3

Solution:

Tungsten (W) has the highest melting point of all elements, attributed to its strong metallic bonding and high atomic weight.

Quick Tip

Tungsten is often used in applications requiring high temperatures due to its exceptionally high melting point.

Question 43

How many electrons are needed in reduction of $Cr_2O_7^{2-}$ to Cr^{3+}?

Option 1: One

Option 2: Six

Option 3: Five

Option 4: Eight

Correct Answer: Option 2

Solution:

The reduction of $Cr_2O_7^{2-}$ to Cr^{3+} requires 6 electrons as each chromium atom undergoes a 3-electron reduction from +6 to +3 oxidation state.

Quick Tip

Remember: $Cr_2O_7^{2-}$ to Cr^{3+} reduction involves six electrons because each Cr atom changes by 3 oxidation states.

Question 44

Which among the following compounds show metal excess defect due to anionic vacancy?

Option 1: ZnO

Option 2: NaCl

Option 3: FeO

Option 4: CdO

Correct Answer: Option 1

Solution:

ZnO shows metal excess defect due to anionic vacancies, especially at high temperatures, making it a non-stoichiometric compound with free electrons.

Quick Tip

Metal oxides like ZnO can show metal excess defects by losing oxygen atoms at high temperatures.

Question 45

Molal elevation constant is also known as:

Option 1: Ebullioscopic constant

Option 2: Gas constant

Option 3: Henry's constant

Option 4: Cryoscopic constant

Correct Answer: Option 1

Solution:

The molal elevation constant, also known as the ebullioscopic constant, relates to the increase in boiling point of a solvent due to a solute.

Quick Tip

Ebullioscopic constant = boiling point elevation constant.

Question 46

What is the overall order of the reaction?

Rate = $k[A]^{1/2}\ [B]^{3/2}$

Option 1: 2

Option 2: 0

Option 3: 1

Option 4: 0.5

Correct Answer: Option 1

Solution:

The order of the reaction is the sum of the powers of concentration terms in the rate law. Here, the reaction order is 1/2 + 3/2 = 2.

Quick Tip

The overall order is found by adding the exponents in the rate expression.

Question 47

Which term of molar conductivity is used when the concentration of electrolyte approaches zero?

Option 1: Infinite molar conductivity

Option 2: Zero molar conductivity

Option 3: Standard molar conductivity

Option 4: Limiting molar conductivity

Correct Answer: Option 4

Solution:

Limiting molar conductivity is the molar conductivity when the concentration of the electrolyte approaches zero.

Quick Tip

Limiting molar conductivity is observed at infinite dilution.

Question 48

Kohlrausch law is related to which of the following term?

Option 1: Osmosis

Option 2: Diffusion

Option 3: Effusion

Option 4: Migration of ions

Correct Answer: Option 4

Solution:

Kohlrausch's law explains the migration of ions and states that the limiting molar conductivity of an electrolyte can be represented as the sum of the individual ion conductivities.

Quick Tip

Kohlrausch's law is useful for calculating conductivities at infinite dilution.

Question 49

Which factor in the Arrhenius equation corresponds to the fraction of molecules having kinetic energy greater than activation energy?

Option 1: ln k

Option 2: ln A

Option 3: RT

Option 4: $e^{-Ea/RT}$

Correct Answer: Option 4

Solution:

The term $e^{-Ea/RT}$ in the Arrhenius equation represents the fraction of molecules that have kinetic energy equal to or greater than the activation energy.

Quick Tip

This exponential term indicates the temperature dependence of reaction rates.

Question 50

What is another term used for the probability factor (P) in collision theory?

Option 1: Temperature factor

Option 2: Compressibility factor

Option 3: Steric factor

Option 4: Concentration factor

Correct Answer: Option 3

Solution:

The steric factor, also known as the probability factor, accounts for the orientation of molecules during collisions in collision theory.

Quick Tip

Steric factor reflects the likelihood of reactants being oriented properly for a reaction.
