Subject : CHEMISTRY - Set A
Code : 306 E (New)

Total Time Allowed: 60 minutes	Maximum Marks : 200	Total Questions : 50	Questions to be answered : 40

Q1. What product is obtained when chloroform reacts with oxygen in presence of light?

Options:
(1) Phosgene gas
(2) Phosphine gas
(3) Chlorine gas
(4) Hydrogen gas

Correct Answer: (1) Phosgene gas
Solution:
Chloroform ($CHCl_3$) reacts with oxygen (O_2) in the presence of light to form phosgene ($COCl_2$) and hydrogen chloride (HCl). The chemical equation is:

$$CHCl_3 + O_2 \longrightarrow COCl_2 + HCl$$

Phosgene is a highly toxic compound formed as a result of this reaction.

Quick Tip

Phosgene gas is highly poisonous and forms when chloroform is exposed to air and light. Store chloroform in tightly sealed, dark-colored containers.

Q2. Which among the following is a trihydric alcohol?

Options:
(1) Ethanol
(2) Glycerol
(3) Ethylene Glycol
(4) Phenol

Correct Answer: (2) Glycerol
Solution:
A trihydric alcohol contains three hydroxyl (−OH) groups. Among the given options: - Ethanol (C_2H_5OH) has one −OH group.
- Ethylene Glycol ($C_2H_4(OH)_2$) has two −OH groups.
- Glycerol ($C_3H_5(OH)_3$) has three −OH groups and is thus a trihydric alcohol.
- Phenol (C_6H_5OH) contains one hydroxyl group attached to an aromatic ring.
Hence, glycerol is the correct answer.

Quick Tip

Glycerol is used in the pharmaceutical and cosmetics industries due to its moisturizing properties.

Q3. Aspirin is also known as:

Options:
(1) Salicylic acid
(2) Ethyl Salicylic acid
(3) Methyl Salicylic acid
(4) Acetyl Salicylic acid

Correct Answer: (4) Acetyl Salicylic acid
Solution:
Aspirin is the common name for acetyl salicylic acid. It is synthesized by reacting salicylic acid ($C_7H_6O_3$) with acetic anhydride ($C_4H_6O_3$), producing aspirin and acetic acid as a by-product:

$$C_7H_6O_3 + C_4H_6O_3 \longrightarrow C_9H_8O_4 + CH_3COOH$$

Aspirin is a widely used drug with anti-inflammatory and analgesic properties.

Quick Tip

Aspirin inhibits enzymes responsible for pain and inflammation, making it an effective painkiller.

Q4. What is the IUPAC name of picric acid?

Options:
(1) 2-Nitrophenol
(2) 2,4,6-Trinitrophenol
(3) Ethyl Salicylic acid
(4) 2 aminophenol

Correct Answer: (2) 2,4,6-Trinitrophenol
Solution:
Picric acid is a derivative of phenol (C_6H_5OH) with three nitro groups ($-NO_2$) attached at the 2, 4, and 6 positions of the benzene ring. The chemical formula of picric acid is $C_6H_2(NO_2)_3OH$. The systematic IUPAC name is 2,4,6-Trinitrophenol.

Quick Tip

Picric acid is highly flammable and was used historically in explosives.

Q5. Why does Fluorine exhibit only -1 oxidation state?

Options:

(1) It is a halogen.
(2) It is a non-metal.
(3) It is small in size.
(4) It has no d orbitals.

Correct Answer: (4) It has no d orbitals

Solution:

Fluorine is the most electronegative element and lacks d orbitals in its valence shell. This restricts its ability to expand its octet or exhibit positive oxidation states. Fluorine can gain one electron to achieve the stable configuration of neon (Ne), resulting in an oxidation state of -1.

Quick Tip

Fluorine's high electronegativity and absence of d orbitals make it the strongest oxidizing agent.

Q6. Which among the following halogen exists in liquid state at room temperature?

Options:

(1) Fluorine
(2) Chlorine
(3) Bromine
(4) Iodine

Correct Answer: (3) Bromine

Solution:

At room temperature, bromine (Br_2) is a liquid with a reddish-brown color. This is due to moderate intermolecular forces between its molecules. Other halogens:
- Fluorine (F_2) and chlorine (Cl_2) are gases at room temperature.
- Iodine (I_2) is a solid at room temperature.

Quick Tip

Bromine is the only non-metallic element that exists as a liquid at room temperature.

Q7. The central atoms/ions in the coordination compounds are referred as _____.

Options:

(1) Lewis base
(2) Lewis acid
(3) Bronsted acid

(4) Bronsted base

Correct Answer: (2) Lewis acid
Solution:
In coordination compounds, the central atom or ion acts as a Lewis acid because it can accept electron pairs. The ligands, which donate electron pairs, act as Lewis bases.

Quick Tip

The central metal atom/ion in a coordination compound is often referred to as a Lewis acid because it can accept electron pairs from the ligands.

Q8. What is the IUPAC name of $[Pt(NH_3)_2Cl(NO_2)]$?
Options:
(1) Diamminechloridonitrito-N-platinum(II)
(2) Diamminechloridonitrito-N-platinum(III)
(3) Diamminechloridonitrito-O-platinum(II)
(4) Diammonia chloridonitrito-N-platinum(II)

Correct Answer: (1) Diamminechloridonitrito-N-platinum(II)
Solution:
The given complex is $[Pt(NH_3)_2Cl(NO_2)]$. In this complex:
- NH_3 (amine) is a neutral ligand.
- Cl (chloride) is a monoanionic ligand.
- NO_2 (nitrite) is a bidentate ligand with a N-coordination.
The IUPAC name is formed by naming the ligands first in alphabetical order, followed by the metal with its oxidation state. Therefore, the correct name is Diamminechloridonitrito-N-platinum(II).

Quick Tip

In coordination compounds, ligands are named first, followed by the metal and its oxidation state. Use the appropriate suffix to denote the oxidation state of the metal.

Q9. What is the product when glucose reacts with bromine water?
Options:
(1) Gluconic acid
(2) Glyceraldehyde
(3) Saccharic acid
(4) Oxime

Correct Answer: (3) Saccharic acid

Solution:
When glucose reacts with bromine water, it undergoes oxidation. The aldehyde group (−CHO) of glucose is oxidized to a carboxyl group (−COOH), forming saccharic acid (also known as glucaric acid). The chemical equation is:

$$C_6H_{12}O_6 + Br_2 + H_2O \longrightarrow C_6H_{10}O_8 + {}_2HBr$$

Saccharic acid is a sugar acid.

Quick Tip

Glucose reacts with bromine water to form saccharic acid, which is a strong oxidizing agent that can oxidize the aldehyde group to a carboxylic acid.

Q10. 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:

Options:
(1) (A) - (I), (B) - (II), (C) - (III), (D) - (IV)
(2) (A) - (IV), (B) - (III), (C) - (II), (D) - (I)
(3) (A) - (I), (B) - (III), (C) - (IV), (D) - (III)
(4) (A) - (IV), (B) - (I), (C) - (III), (D) - (II)

Correct Answer: (1) (A) - (I), (B) - (II), (C) - (III), (D) - (IV)
Solution:
- $Cr_2O_7^{2-}$: In this compound, the oxidation state of Cr is +6, hence (A) matches with (IV).
- MnO_4^-: In MnO_4^-, manganese has an oxidation state of +7, so (B) matches with (III).
- VO_3^-: In this ion, the oxidation state of vanadium is +5, so (C) matches with (II).
- FeF_6^{3-}: In this complex, iron has an oxidation state of +3, so (D) matches with (I).

Quick Tip

Remember, the oxidation state of the central atom is found by balancing the charges of the ligands in the complex.

Q11. What is the colour of copper compound formed in Fehling's test for aliphatic aldehydes?

Options:
(1) Green
(2) Blue
(3) Yellow
(4) Red brown

Correct Answer: (1) Green
Solution:
In Fehling's test, copper(II) ions (Cu^{2+}) react with aldehydes, especially aliphatic aldehydes, to form a green or red precipitate of copper(I) oxide (Cu_2O).

Quick Tip

In Fehling's test, a green color forms due to the reduction of copper(II) ions, which forms copper(I) oxide.

Q12. What is the major product formed when diazonium salt undergoes Gatterman reaction?

Options:
(1) Haloarene
(2) Aryl amine
(3) Phenol
(4) Diphenyl ether

Correct Answer: (1) Haloarene
Solution:
In the Gatterman reaction, a diazonium salt reacts with a halide (such as Cl_2 or Br_2) in the presence of a copper(I) catalyst to form a haloarene (aromatic halide).

Quick Tip

The Gatterman reaction is used for halogenation of aromatic compounds, forming haloarenes.

Q13. What is the major product of Carbylamine reaction?

Options:
(1) Cyanide
(2) Isocyanide
(3) Nitrile
(4) Alkane

Correct Answer: (2) Isocyanide
Solution:
In the Carbylamine reaction, primary amines react with chloroform ($CHCl_3$) in the presence of a base to form isocyanides (also known as isonitriles), which are highly reactive and typically have the structure R−N=C.

Quick Tip

Carbylamine reaction is used for the detection of primary amines, forming isocyanides as a characteristic product.

Q14. Which among the following is an essential amino acid?
Options:
(1) Glycine
(2) Alanine
(3) Valine
(4) Serine

Correct Answer: (3) Valine
Solution:
Essential amino acids are those that cannot be synthesized by the human body and must be obtained through diet. Valine is one of the essential amino acids, while glycine, alanine, and serine are non-essential.

Quick Tip

Valine is one of the branched-chain amino acids (BCAAs) that is essential for protein synthesis.

Q15. Arrange the following in increasing order of their pH values:
(A) p-Nitrophenol
(B) m-Cresol
(C) m-Nitrophenol
(D) Phenol

Options:
(1) (A) $< (B) < (C) < (D)$

(2)$(A) < (C) < (D) < (B)$
(3)$(B) < (A) < (C) < (D)$
(4)$(C) < (B) < (D) <$ (A)

Correct Answer: (2) (A)$< (C) < (D) <$(B)
Solution:
The pH values of the compounds depend on the electron-withdrawing or electron-donating groups attached to the aromatic ring:
- p−Nitrophenol is the most acidic due to the strong electron-withdrawing effect of the $-NO_2$ group at the para position.
- m−Nitrophenol is less acidic than p−Nitrophenol.
- Phenol is less acidic than m−Nitrophenol, as the hydroxyl group is weakly electron-donating.
- m−Cresol is the least acidic due to the electron-donating methyl group at the meta position.

Quick Tip

Electron-withdrawing groups like $-NO_2$ lower the pH, while electron-donating groups like $-CH_3$ increase the pH.

Q16. Which among the following is a biodegradable polymer?
Options:
(1) PVC
(2) Freon
(3) Nylon
(4) PHBV

Correct Answer: (4) PHBV
Solution:
Polyhydroxybutyrate-co-hydroxyvalerate (PHBV) is a biodegradable polymer, commonly used in the production of plastics. Unlike PVC, Freon, and Nylon, which are non-biodegradable, PHBV can be broken down by microorganisms.

Quick Tip

PHBV is used as an eco-friendly alternative to conventional plastics, as it decomposes naturally over time.

Q17. Which among the following is an antacid?
Options:
(1) Aspirin
(2) Zantac

(3) Equanil
(4) Noradrenaline

Correct Answer: (2) Zantac
Solution:
Zantac (ranitidine) is an antacid, commonly used to reduce stomach acid and treat heartburn. Aspirin, Equanil, and Noradrenaline are not antacids.

Quick Tip

Zantac is a histamine-2 blocker that decreases acid production in the stomach.

Q18. What is the numerical value of one Faraday in Coulombs?
Options:
(1) 96587
(2) 96487
(3) 99500
(4) 6.023

Correct Answer: (2) 96487
Solution:
One Faraday is equal to the charge on one mole of electrons, which is approximately 96487 Coulombs.

Quick Tip

Faraday's constant (96487 C/mol) is crucial in electrochemical calculations.

Q19. A first-order reaction has a half-life of 693 sec. What will its rate constant?
Options:
(1) 0.01 sec^{-1}
(2) 1 sec^{-1}
(3) 0.001 sec^{-1}
(4) 0.1 sec^{-1}

Correct Answer: (4) 0.1 sec^{-1}
Solution:
For a first-order reaction, the half-life is related to the rate constant by the equation:

$$t_{1/2} = \frac{0.693}{k}$$

Given that $t_{1/2} = 693\,\text{sec}$, we can solve for k:

$$k = \frac{0.693}{693} = 0.1\,\text{sec}^{-1}$$

Quick Tip

For first-order reactions, the rate constant can be calculated using the half-life formula.

Q20. For SN2 reaction, the increasing order of the reactivity of the following alkyl halides is:

(A) $CH_3CH_2CH_2CH_2Br$
(B) $CH_3CH_2CH(Br)CH_3$
(C) $(CH_3)_3CBr$
(D) $(CH_3)_2CHCH_2Br$

Options:
(1) (A) $<$ (B) $<$ (C) $<$ (D)
$(2)(A) < (C) < (B) < (D)$
$(3)(B) < (A) < (C) < (D)$
$(4)(C) < (B) < (D) <$(A)

Correct Answer: (2) (A)$<$ (C) $<$ (B) $<$(D)
Solution:
In an SN2 reaction, the reactivity of alkyl halides is determined by steric hindrance. Tertiary alkyl halides are the least reactive, and primary alkyl halides are the most reactive.
- (A) $CH_3CH_2CH_2Br$ is a primary alkyl halide.
- (C) $(CH_3)_3CBr$ is a tertiary alkyl halide, which is more reactive than primary alkyl halides.
- (B) $CH_3CH_2CH(Br)CH_3$ is a secondary alkyl halide, more reactive than tertiary.
- (D) $(CH_3)_2CHCH_2Br$ is also a secondary alkyl halide, but with lower steric hindrance.

Quick Tip

In SN2 reactions, the reactivity increases as the steric hindrance decreases. Primary halides react the fastest.

Q21. Which among the following is a strong field ligand?
Options:
(1) I^-
(2) Cl^-
(3) NH_3
(4) SCN^-

Correct Answer: (3) NH_3
Solution:
Ammonia (NH_3) is a strong field ligand as it can cause significant splitting of the d-orbitals in transition metal complexes. The other ligands, like I^- and Cl^-, are weaker

field ligands.

Quick Tip

Strong field ligands, like NH_3, cause greater splitting of d-orbitals in metal complexes, leading to low-spin configurations.

Q22. 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)
Options:
(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.

Correct Answer: (2) (D) $<$ (A) $<$ (B) $<$(C)
Solution:
Osmotic pressure is directly proportional to the molarity of the solution (the number of moles of solute per volume of solution):

$$\pi = \frac{nRT}{V}$$

where π is the osmotic pressure, n is the number of moles of solute, R is the gas constant, T is temperature, and V is the volume.
- For (D), the molarity is $\frac{0.2}{0.05} = 4\,\text{mol/L}$.
- For (A), the molarity is $\frac{0.5}{1} = 0.5\,\text{mol/L}$.
- For (B), the molarity is $\frac{0.25}{1} = 0.25\,\text{mol/L}$.
- For (C), the molarity is $\frac{0.1}{0.01} = 10\,\text{mol/L}$.
Thus, the correct order is (D) $<$ (A) $<$ (B) $<$(C).

Quick Tip

Osmotic pressure increases with the molarity of the solution. Smaller volumes and higher concentrations lead to higher osmotic pressures.

Q23. Arrange the following rate constant units in increasing order of their order of reaction:
Options:

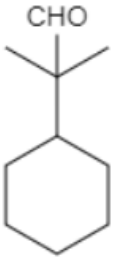
(A) sec^{-1}
(B) mol L^{-1} sec^{-1}
(C) mol^{-1} L sec^{-1}
(D) mol^{-2} L^2 sec^{-1}

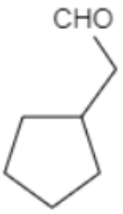
Correct Answer: (1) (C) $<$ (A) $<$ (B) $<$(D)
Solution:
For a reaction of order n, the units of the rate constant are determined by the rate law:
- For a zero-order reaction: rate $= k$, so k has units of concentration/time, i.e., sec^{-1}.
- For a first-order reaction: rate $= k[\text{A}]$, so k has units of mol L^{-1} sec^{-1}.
- For a second-order reaction: rate $= k[\text{A}]^2$, so k has units of mol^{-1} L sec^{-1}.
- For a third-order reaction: rate $= k[\text{A}]^3$, so k has units of mol^{-2} L^2 sec^{-1}.

Thus, the correct order is (C) $<$ (A) $<$ (B) $<$(D).

> Quick Tip
>
> The units of the rate constant depend on the reaction order. Higher-order reactions have more complex units involving concentration and time.

Q24. Which of the following compounds will undergo Aldol condensation reaction?

(A) 

(B) 

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

(D) HCHO

Options:
(A) CH_3CH_2CHO
(B) $C_6H_{10}CHO$
(C) $CH_3CH_2C(CH_3)_2CHO$
(D) HCHO

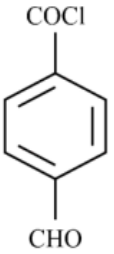
Correct Answer: (1) (A), (C) and (D) only
Solution:
Aldol condensation requires at least one $-CH_2$ group adjacent to a carbonyl group (C=O) to form an enolate ion, which then attacks another carbonyl compound.
- Compound (A) CH_3CH_2CHO is an aldehyde with a $-CH_2$ group adjacent to the car-

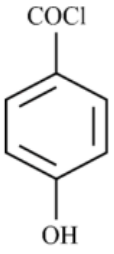
bonyl, making it capable of undergoing Aldol condensation.
- Compound (B) $C_6H_{10}CHO$ is a cyclic aldehyde (cyclohexanecarbaldehyde), which cannot form an enolate under normal Aldol conditions, so it does not undergo Aldol condensation.
- Compound (C) $CH_3CH_2C(CH_3)_2CHO$ is a β-hydroxy aldehyde, which can undergo Aldol condensation because of the presence of a $-CH_2$ group.
- Compound (D) HCHO, formaldehyde, can undergo Aldol condensation due to its ability to form an enolate and participate in the reaction.
Thus, the correct answer is (A), (C), and (D).

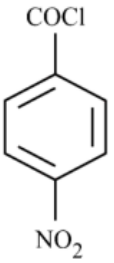
Quick Tip

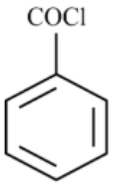
For Aldol condensation to occur, there must be at least one $-CH_2$ group adjacent to a carbonyl group, enabling the formation of the enolate ion.

Q25. Consider the following compounds:

(A) 

(B) 

(C) 

(D) 

Options:
(A) C_6H_5CHO
(B) C_6H_5OH
(C) $C_6H_5NO_2$
(D) C_6H_5COCl
Arrange these compounds in the increasing order of rate of hydrolysis:
Options:
(1) (B) $<(D)<(C)<(A)$
$(2)(B)<(D)<(A)<(C)$
$(3)(D)<(B)<(A)<(C)$
$(4)(A)<(D)<(B)<$ (C)

Correct Answer: (1) (B)< (D) < (C) <(A)
Solution:
The rate of hydrolysis of acyl chlorides (C_6H_5COCl) depends on the electron-donating and electron-withdrawing effects of the substituents on the aromatic ring.
- The electron-withdrawing groups (like $-NO_2$) increase the electrophilicity of the carbonyl carbon, making the acyl chloride more susceptible to nucleophilic attack (hydrolysis).
- The electron-donating groups (like $-OH$ in phenol) decrease the electrophilicity of the carbonyl carbon, reducing the rate of hydrolysis.
Therefore, the increasing order of the rate of hydrolysis is:

$$(B) < (D) < (C) < (A)$$

Quick Tip

Electron-withdrawing groups like $-NO_2$ increase the rate of hydrolysis by making the carbonyl carbon more electrophilic, while electron-donating groups like $-OH$ decrease the rate.

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

(A) Ti^{3+} (B) Nb^{3+}
(C) Cu^{+} (D) Y^{3+}

Options:
(1) (C) and (D) only
(2) (A), (B) and (D) only
(3) (A) and (B) only
(4) (A), (B), (C) and (D)

Correct Answer: (3) (A) and (B) only
Solution:
The color of aqueous solutions of ions arises from the presence of unpaired electrons in the d-orbitals, which undergo $d-d$ transitions under the influence of ligands (e.g., water molecules). Let us analyze each option:

1. Ti^{3+}: The electronic configuration is $[Ar]\,3d^1$. Since there is one unpaired electron in the d-orbitals, it exhibits a color in an aqueous solution.
2. Nb^{3+}: The electronic configuration is $[Kr]\,4d^2$. The presence of unpaired electrons in the d-orbitals also leads to a colored solution.
3. Cu^{+}: The electronic configuration is $[Ar]\,3d^{10}$. All d-orbitals are fully filled, so no $d-d$ transitions occur, and it is colorless in aqueous solution.

4. Y^{3+}: The electronic configuration is $[Kr]$. It lacks any d-electrons, hence it is colorless in an aqueous solution.

Therefore, the ions Ti^{3+} and Nb^{3+} are colored in aqueous solution.

Quick Tip

Transition metal ions with unpaired d-electrons are usually colored in aqueous solutions due to $d-d$ transitions. Fully filled or empty d-orbitals result in colorless solutions.

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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.

Options:
(1) (A) and (B) only
(2) (A), (C) and (D) only
(3) (A) and (C) only
(4) (B), (C) and (D) only

Correct Answer: (2) (A), (C) and (D) only
Solution:
Let us analyze each statement:

1. **(A)**: Diazonium salts of aromatic amines are *more stable* than diazonium salts of aliphatic amines because the aromatic ring stabilizes the diazonium group via resonance. Hence, this statement is **incorrect**.
2. **(B)**: Ethylamine is *soluble* in water due to hydrogen bonding between the amine group and water molecules. Hence, this statement is **incorrect**.
3. **(C)**: Gabriel phthalimide synthesis is specifically used for preparing primary amines, making this statement **correct**.
4. **(D)**: The $+R$-effect of the $-NH_2$ group activates the aromatic ring towards electrophilic substitution reactions, such as Friedel-Crafts acylation. Hence, this statement is **correct**.

Therefore, the correct statements are (C) and (D).

Quick Tip

Aromatic diazonium salts are more stable due to resonance, and primary amines are best prepared using Gabriel phthalimide synthesis. Always check for solubility and resonance effects in such questions.

Q28. Match the following:

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:
Options:
(1) (A) - (I), (B) - (III), (C) - (II), (D) - (I)
(2) (A) - (II), (B) - (III), (C) - (IV), (D) - (I)
(3) (A) - (I), (B) - (IV), (C) - (III), (D) - (II)
(4) (A) - (IV), (B) - (III), (C) - (I), (D) - (II)

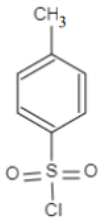
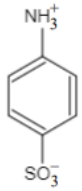
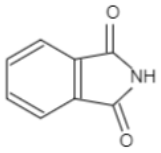
Correct Answer: (1) (A) - (I), (B) - (III), (C) - (II), (D) - (IV)
Solution:
- Mn^{2+} is associated with pyrolusite ore (I).
- Spin-only magnetic moment corresponds to the formula $\mu_s = \sqrt{n(n+2)}$ BM (III).
- MnO_2 corresponds to the highest oxidation states of manganese (II).
- Misch metal is an alloy of 4f metals and other elements like iron, sulfur, and carbon (IV).

Quick Tip

Misch metal is used for lighter flints and alloy applications.

Q29. Match List-I with List-II:
Choose the correct answer from the options given below:
Options:
(1) (A) - (II), (B) - (I), (C) - (IV), (D) - (III)
(2) (A) - (II), (B) - (I), (C) - (III), (D) - (IV)
(3) (A) - (I), (B) - (III), (C) - (IV), (D) - (II)
(4) (A) - (I), (B) - (II), (C) - (III), (D) - (IV)

Correct Answer: (2) (A) - (II), (B) - (I), (C) - (III), (D) - (IV)
Solution:
- (A) $COCl_2$ (phosgene) is a poisonous gas and is used in reactions to distinguish between primary, secondary, and tertiary amines. So, (A) corresponds to (II).

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

- (B) $C_6H_5SO_2Cl$ (benzenesulfonyl chloride) is used to distinguish between different amines, which corresponds to (I).
- (C) $C_6H_4NH_3^+$ (aniline) is used in the synthesis of primary amines, which corresponds to (III).
- (D) C_6H_5COOH (benzoic acid) can form a zwitterion in water, which corresponds to (IV).

Quick Tip

Phosgene ($COCl_2$) is a toxic compound used in distinguishing amines, while sulfonyl chlorides are commonly used for such reactions as well.

Q30. Which of the following is/are the bases of DNA?
Options:
(A) Adenine
(B) Uracil
(C) Thymine
(D) Cytosine

Choose the correct answer from the options given below:
Options:
(1) (A), (B) and (C) only
(2) (B) and (C) only
(3) (A), (C) and (D) only

(4) (A) and (B) only

Correct Answer: (3) (A), (C) and (D) only
Solution:
The bases of DNA are Adenine (A), Thymine (T), Cytosine (C), and Guanine (G). Uracil (B) is found in RNA, not DNA.

Quick Tip

Remember that in DNA, Uracil is replaced by Thymine as the base that pairs with Adenine.

Q31. 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:
Options:
(1) (A) - (I), (B) - (II), (C) - (III), (D) - (IV)
(2) (A) - (I), (B) - (III), (C) - (II), (D) - (IV)
(3) (A) - (I), (B) - (II), (C) - (IV), (D) - (III)
(4) (A) - (II), (B) - (IV), (C) - (I), (D) - (III)

Correct Answer: (1) (A) - (I), (B) - (II), (C) - (III), (D) - (IV)
Solution:
- Valine is a basic amino acid (I).
- Glycine is a neutral optically active amino acid (II).
- Lysine is an acidic amino acid (III).
- Glutamic acid is a neutral optically inactive amino acid (IV).

Quick Tip

Amino acids are classified based on the nature of their side chains, which determine their acidity, basicity, and optical activity.

Q32. Which of the following gases at 298 K and 1 atm pressure is having maximum solubility in water?
Options:
(1) Methanol, $K_H = 0.000018$
(2) Argon, $K_H = 40.3$
(3) Methane, $K_H = 0.41$

(4) CO_2, $K_H = 1.6$

Correct Answer: (4) CO_2, $K_H = 1.6$
Solution:
The Henry's law constant (K_H) indicates the solubility of gases in water. The lower the K_H value, the less soluble the gas. Among the options, CO_2 has the highest solubility in water due to its higher K_H.

Quick Tip

Higher K_H values indicate higher solubility of gases in water.

Q33. Which of the following solvents is having its lowest Ebulliometric constant?

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

Options:
(1) Chloroform
(2) Diethyl Ether
(3) Benzene
(4) Carbon disulfide

Correct Answer: (2) Diethyl Ether
Solution:
Ebulliometric constant is related to the boiling point of the solvent. Diethyl Ether has the lowest boiling point among the solvents listed, hence it will have the lowest Ebulliometric constant.

Quick Tip

The solvent with the lowest boiling point generally has the lowest Ebulliometric constant.

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 alkyl groups reduce the electrophilicity of the carbonyl carbon more effectively than in the former.

Q34. Which among the following compound is formed, when aldehyde reacts with HCN in presence of a base?
Options:
(1) Cyanide
(2) Isocyanide
(3) Cyanohydrin
(4) Hydrogen cyanide

Correct Answer: (3) Cyanohydrin
Solution:
When an aldehyde reacts with HCN in the presence of a base, it forms a cyanohydrin. This is a typical nucleophilic addition reaction where the cyanide ion adds to the carbonyl carbon of the aldehyde.

Quick Tip

Cyanohydrin formation is a common reaction of aldehydes with hydrogen cyanide (HCN) in the presence of a base.

Q35. The correct decreasing order of basic strength of following amines in aqueous solution is: Options:

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

(1) $CH_3NH_2 > (CH_3)_2NH > NH_3 > (CH_3)_3N$
(2) $CH_3NH_2 > (CH_3)_2NH > (CH_3)_3N > NH_3$
(3) $NH_3 > (CH_3)_3N > (CH_3)_2NH > CH_3NH_2$
(4) $(CH_3)_2NH > CH_3NH_2 > (CH_3)_3N > NH_3$

Correct Answer: (2) $CH_3NH_2 > (CH_3)_2NH > (CH_3)_3N > NH_3$
Solution:
The basic strength of amines is influenced by the number of alkyl groups attached to the nitrogen. Alkyl groups are electron-donating, which increases the electron density on the nitrogen, making it more basic. The order of basic strength is as follows:

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

This order indicates that methylamine (CH_3NH_2) is the most basic, followed by dimethylamine ($(CH_3)_2NH$), trimethylamine ($(CH_3)_3N$), and ammonia (NH_3) being the least basic.

Quick Tip

Alkyl groups increase the basicity of amines by donating electron density to the nitrogen atom, making it more likely to accept a proton.

Q36. A new C-C bond formation is possible in:
Options:
(A) Cannizzaro reaction
(B) Friedel-Crafts alkylation
(C) Clemmensen reduction
(D) Riemer-Tiemann reaction

Choose the correct answer from the options given below:
Options:
(1) (B) and (D) only
(2) (A), (B) and (D) only
(3) (B), (C) and (D) only
(4) (A), (B), (C) and (D)

Correct Answer: (2) (A), (B) and (D) only
Solution:
- Cannizzaro reaction: Involves the disproportionation of non-enolizable aldehydes, leading to the formation of a new C-C bond.
- Friedel-Crafts alkylation: Forms a new C-C bond by attaching an alkyl group to an aromatic ring.
- Clemmensen reduction: Does not form a new C-C bond; it reduces a carbonyl group to a methylene group.
- Riemer-Tiemann reaction: Forms a new C-C bond by introducing a formyl group into an aromatic ring.

Quick Tip

The Cannizzaro reaction, Friedel-Crafts alkylation, and Riemer-Tiemann reaction all involve the formation of new C-C bonds.

Q37. Which of the following will respond to Tollen's test?
Options:
(1) Ethanoic acid
(2) Methanoic acid
(3) Propanoic acid
(4) Butanoic acid

Correct Answer: (2) Methanoic acid
Solution:
Tollen's reagent is used to test for aldehydes. Methanoic acid (formic acid) is an aldehyde and will reduce Tollen's reagent to form a silver mirror. The other acids are carboxylic acids and will not react.

Quick Tip

Only aldehydes will react with Tollen's reagent to form a silver mirror, not carboxylic acids.

Q38. The order of reactivity of the given haloalkanes towards nucleophile is:
Options:
(1) $R_1 > R_2 > R_3$
(2) $R_1 < R_2 < R_3$
(3) $R_1 > R_2 < R_3$
(4) $R_2 > R_1 > R_3$
Correct Answer: (1) $R_1 > R_2 > R_3$
Solution:
In haloalkanes, the reactivity towards nucleophiles decreases as the number of alkyl groups increases due to the increase in steric hindrance. Thus, primary haloalkanes (R_1) are more reactive than secondary (R_2) and tertiary (R_3) haloalkanes.

Quick Tip

Steric hindrance decreases the reactivity of haloalkanes towards nucleophiles. Primary haloalkanes are the most reactive.

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.

Q39. Which transition metal is liquid at room temperature?
Options:
(1) Hg
(2) Cu
(3) Ag
(4) Au

Correct Answer: (1) Hg
Solution:
Mercury (Hg) is the only transition metal that is liquid at room temperature.

Quick Tip

Mercury is the only metal that remains liquid at room temperature, making it unique among transition metals.

Q40. Which is the hardest metal?
Options:
(1) Zn
(2) Cu
(3) Hg
(4) Cd

Correct Answer: (1) Zn
Solution:
Zinc (Zn) is the hardest metal among the given options.

Quick Tip

Zinc is harder than copper, mercury, and cadmium, making it the hardest among these metals.

Q41. In any row, melting points of these metals rise to a maximum at d^5. Which transition metal is an exception?
Options:
(1) Ti
(2) V
(3) Cr
(4) Mn

Correct Answer: (3) Cr
Solution:
Chromium (Cr) is the exception where the melting point does not follow the expected trend based on the d^5 configuration.

Quick Tip

Chromium is an exception in the trend of melting points, due to its unique electronic configuration.

Q42. Which transition metal has the highest melting point?
Options:
(1) Hf
(2) Ta

(3) W
(4) Re

Correct Answer: (3) W
Solution:
Tungsten (W) has the highest melting point among the transition metals.

Quick Tip

Tungsten has the highest melting point of any metal, making it useful for high-temperature applications.

Q43. How many electrons are needed in reduction of $Cr_2O_7^{2-}$ to Cr^{3+}?
Options:
(1) One
(2) Six
(3) Five
(4) Eight

Correct Answer: (2) Six
Solution:
The reduction of $Cr_2O_7^{2-}$ to Cr^{3+} requires the gain of six electrons.

Quick Tip

In the reduction of $Cr_2O_7^{2-}$ to Cr^{3+}, each chromium atom gains three electrons, so two chromium atoms require six electrons in total.

Q44. Which among the following compounds show metal excess defect due to anionic vacancy?
Options:
(1) ZnO
(2) NaCl
(3) FeO
(4) CdO

Correct Answer: (1) ZnO
Solution:
ZnO shows a metal excess defect due to anionic vacancy. This occurs because oxygen ions are missing, and this creates a charge imbalance, which is compensated by the excess zinc ions.

Quick Tip

In metal excess defects, there is an excess of metal cations due to the loss of anions.

Q45. Molar elevation constant is also known as:
Options:
(1) Ebullioscopic constant
(2) Gas constant
(3) Henry's constant
(4) Cryoscopic constant

Correct Answer: (1) Ebullioscopic constant
Solution:
The molar elevation constant is also known as the ebullioscopic constant, which is used in determining the elevation of boiling point.

Quick Tip

Ebullioscopic constant is used to measure the change in boiling point when a solute is dissolved in a solvent.

Q46. What is the overall order of the reaction?
Rate = $k[A]^{1/2}[B]^{3/2}$
Options:
(1) 2
(2) 0
(3) 1
(4) 0.5

Correct Answer: (3) 1
Solution:
The overall order of the reaction is the sum of the exponents of the concentration terms in the rate law. Here, the order is $1/2 + 3/2 = 2$.

Quick Tip

To find the order of a reaction, sum the exponents of the concentrations in the rate law expression.

Q47. Which term of molar conductivity is used when the concentration of electrolyte approaches zero?
Options:

(1) Infinite molar conductivity
(2) Zero molar conductivity
(3) Standard molar conductivity
(4) Limiting molar conductivity

Correct Answer: (4) Limiting molar conductivity
Solution:
Limiting molar conductivity refers to the conductivity of an electrolyte when its concentration approaches zero, at which point the ions in the solution are free to move without hindrance.

Quick Tip

Limiting molar conductivity is the conductivity of an electrolyte when it is in a dilute solution with an infinitesimally small concentration.

Q48. Kohlrausch law is related to which of the following term?
Options:
(1) Osmosis
(2) Diffusion
(3) Effusion
(4) Migration of ions

Correct Answer: (4) Migration of ions
Solution:
Kohlrausch's law is related to the migration of ions in an electrolyte, describing the limiting molar conductivity of an electrolyte at infinite dilution.

Quick Tip

Kohlrausch's law provides a way to calculate the limiting molar conductivity of electrolytes based on ion migration.

Q49. Which factor in Arrhenius equation corresponds to fraction of molecules having kinetic energy greater than activation energy?
Options:
(1) k
(2) $\ln A$
(3) RT
(4) $e^{-E_a/RT}$

Correct Answer: (4) $e^{-E_a/RT}$
Solution:
In the Arrhenius equation, the factor $e^{-E_a/RT}$ corresponds to the fraction of molecules

that have energy greater than the activation energy, determining the reaction rate.

Quick Tip

The factor $e^{-E_a/RT}$ in the Arrhenius equation reflects the probability that molecules will have sufficient energy to react.

Q50. What is another term used for probability factor (P) in collision theory?
Options:
(1) Temperature factor
(2) Compressibility factor
(3) Steric factor
(4) Concentration factor

Correct Answer: (3) Steric factor
Solution:
In collision theory, the probability factor (P) is also known as the steric factor, which accounts for the geometry and orientation of colliding molecules.

Quick Tip

The steric factor represents the effect of molecular orientation on the probability of successful collisions.
