Chemistry-Set D Question Paper With Solutions

Question 1 : 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 2 : 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 3 : 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 4 : 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:

The ebullioscopic constant (K_b) of a solvent is proportional to the boiling point of the solvent. Diethyl ether has the lowest boiling point among the given solvents at 307.8 K, which implies it has the lowest ebullioscopic constant.

The relationship is derived from the boiling point elevation formula, where a lower boiling point corresponds to a smaller value of K_b. Thus, diethyl ether has the lowest ebullioscopic constant.

Quick Tip

Ebullioscopic constants are crucial for determining molecular weights of solutes through boiling point elevation experiments.

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 5 : 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 6 : 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 4

Solution:

The basic strength of amines in aqueous solution depends on their ability to donate a lone pair of electrons on the nitrogen atom, as well as solvation effects. Let us analyze the compounds:

- **$(CH_3)_2$NH (Dimethylamine):** It has two methyl groups, which are electron-donating and increase electron density on nitrogen, making it the most basic in aqueous solution. The strong solvation of the protonated amine also contributes to its high basicity.
- **CH_3NH_2 (Methylamine):** With one electron-donating group, it is less basic than dimethylamine but still more basic than other amines.
- **$(CH_3)_3$N (Trimethylamine):** The steric hindrance from three bulky methyl groups reduces solvation of the protonated species, lowering its basicity compared to dimethylamine and methylamine.
- **NH_3 (Ammonia):** Ammonia lacks any electron-donating groups, making it the least basic among the given compounds.

Thus, the correct decreasing order of basic strength is:

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

Quick Tip

In aqueous solutions, solvation effects significantly influence basic strength. Steric hindrance can reduce solvation and thus lower basicity.

Question 7 : 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 1

Solution:

Let us analyze the reactions for the possibility of C–C bond formation:

- **(A) Cannizzaro reaction:** This is a redox reaction where one molecule of an aldehyde is oxidized and another is reduced, but no new C–C bond is formed.
- **(B) Friedel-Crafts alkylation:** This involves the formation of a new C–C bond through the alkylation of an aromatic ring using an alkyl halide and a Lewis acid catalyst.
- **(C) Clemmensen reduction:** This reaction reduces carbonyl compounds (aldehydes or ketones) to hydrocarbons, but it does not involve the formation of a new C–C bond.
- **(D) Reimer-Tiemann reaction:** This reaction forms a new C–C bond by introducing a formyl group to the aromatic ring of phenols.

Thus, new C–C bond formation is possible only in **(B) Friedel-Crafts alkylation** and **(D) Reimer-Tiemann reaction**.

Quick Tip

Reactions involving aromatic compounds often lead to C–C bond formation, particularly in electrophilic aromatic substitution reactions like Friedel-Crafts alkylation.

Question 8 : 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 9 : 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 of haloalkanes towards nucleophiles is governed by the strength of the carbon-halogen bond. The weaker the bond, the easier it is for a nucleophile to displace the halogen atom. The bond strength decreases in the order:

$$C - F > C - Cl > C - Br > C - I$$

For nucleophilic substitution reactions:

- **RI:** The C–I bond is the weakest due to iodine's large atomic size and low bond dissociation energy, making it the most reactive towards nucleophiles.
- **RBr:** The C–Br bond is weaker than the C–Cl bond but stronger than the C–I bond, so bromoalkanes are less reactive than iodoalkanes but more reactive than chloroalkanes.
- **RCl:** The C–Cl bond is stronger than both C–Br and C–I bonds, making chloroalkanes the least reactive among the three.

Thus, the correct order of reactivity of haloalkanes is:

RI $>$ RBr $>$ RCl.

Quick Tip

In nucleophilic substitution, reactivity increases as the bond dissociation energy decreases, which is directly related to the size and electronegativity of the halogen atom.

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 10 : 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 is liquid at room temperature due to its weak metallic bonding caused by its fully filled d^{10} electron configuration.

Quick Tip

Transition metals exhibit a wide range of melting points, but only a few, like Au and Hg, can exist in liquid form under specific conditions.

Question 11 : 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 12 : 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:

Manganese (**Mn**) is an exception to the trend of melting points peaking at d^5 due to its complex electron configuration and weak metallic bonding.

Quick Tip

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

Question 13 : 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 among transition metals due to its strong metallic bonds formed by its high number of unpaired d-electrons.

Quick Tip

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

Question 14 : 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+} involves the following half-reaction:

$$Cr_2O_7^{2-} + 14H^+ + 6e^- \rightarrow 2Cr^{3+} + 7H_2O$$

Here, six electrons are required to reduce two chromium atoms from their +6 oxidation state in dichromate to +3 in Cr^{3+}.

Quick Tip

Remember that in redox reactions, electrons required are calculated based on changes in oxidation states of all atoms involved.

Question 15 : 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 2

Solution:

In **NaCl**, metal excess defect occurs due to the presence of anionic vacancies, which are often occupied by electrons to maintain electrical neutrality. This is a common defect in alkali halides.

Quick Tip

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

Question 16 : 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 17 : 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 18 : 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:

The **Limiting molar conductivity** is the value of molar conductivity when the concentration of an electrolyte approaches zero, i.e., at infinite dilution.

Quick Tip

Standard molar conductivity is significant for characterizing electrolyte properties and is often measured at infinite dilution.

Question 19 : 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 20 : 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 21: 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:

In collision theory, the probability factor (**P**) is also referred to as the **Steric factor**. It accounts for the orientation of molecules during collisions.

Quick Tip

Concepts like molar conductivity, Kohlrausch law, and Arrhenius equation are key to understanding electrolyte behavior and reaction kinetics.

Question 22 : 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 4

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 23 : 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 3

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 24 : 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 25 : 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 1

Solution:

The compound contains:

NH_3: "Diammine" (neutral ligand),

Cl: "Chlorido" (negative ligand),

NO_2: "Nitrito-N" (attached via nitrogen),

Pt: Platinum with an oxidation state of +2.

Thus, the correct IUPAC name is **Diamminechloridonitrito-N-platinum(II)**.

Quick Tip

Ensure correct alphabetical arrangement of ligands and explicitly indicate the atom of coordination for ambidentate ligands like NO_2^- (nitrito-N or nitrito-O).

Question 26 : 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 1

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 27 : 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 28 : 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 29 : 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 30 : 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 1

Solution:

When glucose reacts with bromine water, the aldehyde group in glucose is selectively oxidized to a carboxylic acid group, forming **Gluconic acid**.

Quick Tip

Reactions with bromine water are specific for functional group identification, particularly aldehydes in organic chemistry.

Question 31 : 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 32 : 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 33 : 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 34 : What is the major product of Carbylamine reaction?

Option A: Cyanide

Option B: Isocyanide

Option C: Nitrile

Option D: Alkane

Correct Answer: Option 2

Solution:

In the Carbylamine reaction, a primary amine reacts with chloroform and a base to produce an **Isocyanide**, which is characterized by a foul odor.

Quick Tip

The Carbylamine reaction is a key identification test for primary amines in organic chemistry.

Question 35 : 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 36 : 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 2

Solution:

The pH of phenolic compounds depends on their ability to donate protons and the effect of substituents on the benzene ring. Substituents that are electron-withdrawing increase acidity (lower pH), while electron-donating groups decrease acidity (higher pH). Let us analyze the compounds:

- **p-Nitrophenol (A):** The nitro group (-NO_2) is an electron-withdrawing group and strongly increases the acidity, resulting in the lowest pH.
- **m-Nitrophenol (C):** The nitro group in the meta position is less effective at withdrawing electrons compared to the para position, so it has a slightly higher pH than (A).
- **Phenol (D):** Without any strong electron-withdrawing or donating groups, phenol has a higher pH compared to nitrophenols.
- **m-Cresol (B):** The methyl group (-CH_3) is an electron-donating group, which decreases the acidity and results in the highest pH.

Thus, the increasing order of pH values is: **(A)** < **(C)** < **(D)** < **(B)**

Quick Tip

Electron-withdrawing groups like -NO_2 lower pH by increasing acidity, while electron-donating groups like -CH_3 increase pH by decreasing acidity.

Question 37 : 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 38 : 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 39 : 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 2

Solution:

One Faraday is the charge of one mole of electrons, equal to **96500 Coulombs**.

Quick Tip

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

Question 40 : 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 3

Solution:

For a first-order reaction, $k = \frac{0.693}{t_{1/2}}$. Substituting $t_{1/2} = 693$ sec:

$$k = \frac{0.693}{693} = 0.001 \text{ sec}^{-1}.$$

Thus, the rate constant is **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 41 : 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 4

Solution:

S_N2 reactions occur fastest with primary alkyl halides because steric hindrance is minimal, allowing the nucleophile to attack more easily. Tertiary alkyl halides are the least reactive due to significant steric hindrance.

Reactivity order based on steric hindrance:

- $(CH_3)_3CBr$ (C): Tertiary halide, least reactive.
- $CH_3CH_2CH(Br)CH_3$ (B): Secondary halide, more reactive than tertiary.
- $(CH_3)_2CHCH_2Br$ (D): Primary halide, highly reactive.
- $CH_3CH_2CH_2CH_2Br$ (A): Least steric hindrance, most reactive.

Thus, the correct increasing order of reactivity is:

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

Quick Tip

S_N2 reactivity decreases with increasing steric hindrance around the carbon atom attached to the halogen.

Question 42 : 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 43 : 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 3

Solution:

The osmotic pressure (π) is directly proportional to the molarity ($C = \frac{\text{moles of solute}}{\text{volume of solution}}$):

- (A): $C = \frac{0.5}{1} = 0.5$
- (B): $C = \frac{0.25}{1} = 0.25$
- (C): $C = \frac{0.1}{0.01} = 10$
- (D): $C = \frac{0.2}{0.05} = 4$

Thus, the increasing order of osmotic pressure is:

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

Quick Tip

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

Question 44 : 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 3

Solution:

The units of the rate constant depend on the order of the reaction. For a reaction of order n, the rate constant k has units:

$$\text{Units of } k = \text{mol}^{1-n}\text{L}^{n-1}\text{sec}^{-1}$$

- (A) sec^{-1} corresponds to a first-order reaction ($n = 1$).
- (B) mol L^{-1} sec^{-1} corresponds to a zero-order reaction ($n = 0$).
- (C) mol^{-1} L sec^{-1} corresponds to a second-order reaction ($n = 2$).
- (D) mol^{-2} L^2 sec^{-1} corresponds to a third-order reaction ($n = 3$).

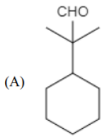
Thus, the increasing order of rate constant units is:

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

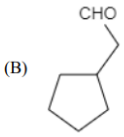
Quick Tip

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 45 : 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 2

Solution:

Aldol condensation occurs between compounds containing at least one α-hydrogen atom. An α-hydrogen is present on a carbon atom adjacent to the carbonyl group ($C = O$).

(A) Cyclohexanone with an aldehyde group: Does not participate as the cyclohexane group does not have an α-hydrogen.

(B) Cyclopentanone with an aldehyde group: Contains α-hydrogens and can participate.

(C) $CH_3CH_2C(CH_2)_2CH_2CHO$: Contains α-hydrogens and can participate.

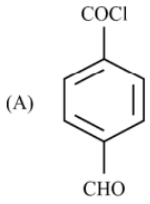
(D) Formaldehyde ($HCHO$): Does not have α-hydrogens and cannot participate.

Thus, the compounds (B) and (C) undergo Aldol condensation.

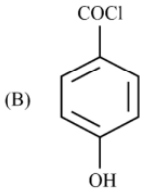
Quick Tip

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

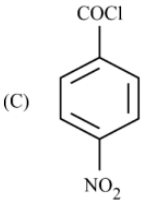
Question 46 : Consider the following compounds:



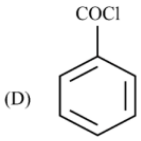
(A)



(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 47 : 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 48 : 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 49 : 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

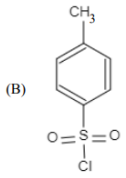
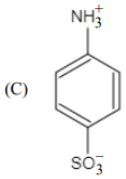
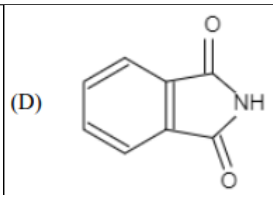
Solution:

- (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 50 : 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)		(II)	Poisonous gas
(C)		(III)	Synthesis of primary amines
(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 1

Solution:

Let us match the compounds to their corresponding properties:

- **(A) $COCl_2$ (Phosgene):** A highly toxic compound, classified as a **Poisonous gas (II)**.
- **(B) $C_6H_4SO_2Cl$ (Benzene sulfonyl chloride):** Used in the Hinsberg test to **distinguish between primary, secondary, and tertiary amines (I)**.
- **(C) $C_6H_5SO_3NH_3^+$:** A zwitter ion, as it contains both positive and negative charges simultaneously, matching with **(IV)**.
- **(D) $NHCHC_6H_4CO$:** Related to the Gabriel synthesis, which is used for the **synthesis of primary amines (III)**.

Thus, the correct matching is:

$$(A) - (II), (B) - (I), (C) - (IV), (D) - (III).$$

Quick Tip

Understanding functional groups and their specific reactions is key to solving matching problems effectively.