CUET UG (Chemistry) - 23 May 2025 Shift 2

Question1

Wood spirit is known as

1. Ethanol

2. Propanol
3. Methanol
4. Methoxymethane

Options:

A. 1

B. 2

C. 3

D. 4

Answer: C

Solution:

Methanol, CH3OH, also known as 'wood spirit', was produced by destructive distillation of wood. Nowadays, most of the methanol is produced by catalytic hydrogenation of carbon monoxide at high pressure and temperature and in the presence of ZnO – Cr2O3 catalyst.

Question2

What are the products of the following reaction in neutral solution?

$$MnO_4^- + S_2O_3^{2-} + H_2O \rightarrow ?$$

$$(1)\ MnO_2, SO_3^{2-}, H^+$$

$$(2)\ MnO_2, SO_2, HO^-$$

$$(3)\ MnO_2, SO_4^{2-}, HO^-$$

$$(4)\ Mn^{2+}, SO_4^{2-}, H^+$$

Options:

A. 1

B. 2

C. 3

D. 4

Answer: C

Solution:

In neutral or faintly alkaline solutions, thiosulphate ($S_2O_3^{2-}$) is oxidised by permanganate ion (MnO_4^-) almost quantitatively to sulphate and MnO_2:

$$8MnO_4^- + 3S_2O_3^{2-} + H_2O \rightarrow 8MnO_2 + 6SO_4^{2-} + 2OH^-$$

Question3

When 1 mol of $CrCl_3 \cdot 6H_2O$ is treated with excess $AgNO_3$, 3 mol of AgCl are obtained.

The conductivity of the solution will correspond to:

1. 1:1 electrolyte
2. 1:2 electrolyte
3. 2:1 electrolyte
4. 1:3 electrolyte

Options:

A. 1

B. 2

C. 3

D. 4

Answer: D

Solution:

1 mole of $CrCl_3 \cdot 6H_2O$ reacts with excess $AgNO_3$ to produce 3 moles of AgCl, implying that all three Cl^- ions are acting as counter ions located outside the coordination sphere.

Therefore, the formula of the coordination complex is $[Cr(H_2O)_6]Cl_3$.

Now, when this compound is hydrolysed, it will dissociate into a cation complex $[Cr(H_2O)_6]^{3+}$ and three chloride ions, $3Cl^-$.

Hence, the ratio of cations to anions is $1:3$ which corresponds to the conductivity of the solution.

$Ag^+(aq) + Cl^-(aq) \rightarrow AgCl$

$[Cr(H_2O)_6]Cl_3 \rightarrow [Cr(H_2O)_6]^{3+} + 3Cl^-$

Question4

Predict the order of decreasing reactivity of the following compounds towards SN1 reaction.

$$(A)\ C_6H_5CH_2Br$$

$$(B)\ C_6H_5CH(C_6H_5)Br$$

$$(C)\ C_6H_5CH(CH_3)Br$$

$$(D)\ C_6H_5C(CH_3)(C_6H_5)Br$$

Choose the correct answer from the options given below:

1. (A), (B), (C), (D)
2. (D), (A), (C), (B)
3. (D), (B), (C), (A)
4. (A), (C), (B), (D)

Options:

A. 1

B. 2

C. 3

D. 4

Answer: C

Solution:

$$C_6H_5C(CH_3)(C_6H_5)Br > C_6H_5CH(C_6H_5)Br > C_6H_5CH(CH_3)Br > C_6H_5CH_2Br \text{ (SN1)}$$

Of the two secondary bromides, the carbocation intermediate obtained from $C_6H_5CH(C_6H_5)Br$ is more stable than that obtained from $C_6H_5CH(CH_3)Br$ l

Therefore, the former bromide is more reactive than the latter in SN1 reactions.

Question5

Identify the correct statements for the behavior of ethane-1,2-diamine as a ligand.

(A) it is a neutral ligand

(B) it is a bidentate ligand

(C) it is an ambidentate ligand

(D) it is a chelating ligand

Choose the correct answer from the options given below:

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

Options:

A. 1

B. 2

C. 3

D. 4

Answer: A

Solution:

Ethylenediamine (en) and oxalate (ox^{2-}) are common examples of bidentate ligands.

Since ethylenediamine (en) binds through two nitrogen atoms, it is bidentate (B).

It is also a neutral ligand (A) since it does not bear any charge, and because bidentate ligands usually lead to ring formation, they are also chelating ligand

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Question6

Which one of these tripositive ions is the most stable in aqueous solution?

(1) Cr^{3+}

(2) Ti^{3+}

(3) V^{3+}

(4) Mn^{3+}

Options:

A. 1

B. 2

C. 3

D. 4

Answer: A

Solution:

Electronic configuration for each ion:

Cr (Z = 24): [Ar] $3d^5\,4s^1$

Cr^{3+}: [Ar] $3d^3$

Ti (Z = 22): [Ar] $3d^2\,4s^2$

Ti^{3+}: [Ar] $3d^1$

V (Z = 23): [Ar] $3d^3\,4s^2$

V^{3+}: [Ar] $3d^2$

Mn (Z = 25): [Ar] $3d^5\,4s^2$

Mn^{3+}: [Ar] $3d^4$

In an aqueous solution, water molecules surround the metal ion, forming an octahedral complex.

According to Crystal Field Theory (CFT), this splits the d-orbitals into two sets:

t_{2g} (lower energy, 3 orbitals) and e_g (higher energy, 2 orbitals)

Electrons fill the lower energy t_{2g} set first:

$Ti^{3+}(d^1) : t_{2g}^1$

$V^{3+}(d^2) : t_{2g}^2$

$Cr^{3+}(d^3) : t_{2g}^3$

$Mn^{3+}(d^4) : t_{2g}^3 e_g^1$

The Cr^{3+} ion has a t_{2g}^3 configuration, which is a perfectly half-filled t_{2g} subshell.

This gives extra stability. Hence, Cr^{3+} is the most stable ion among the given choices.

Question7

$Cr_2O_7^{2-}$ dissolves in aqueous NaOH to give:

(1) Cr_2O_3

(2) $Cr(OH)_3$

(3) CrO_4^{2-}

(4) CrO_3

Options:

A. 1

B. 2

C. 3

D. 4

Answer: C

Solution:

The chromates and dichromates are interconvertible in aqueous solution depending upon the pH of the solution.

Dichromate ion ($Cr_2O_7^{2-}$) produces chromate ion (CrO_4^{2-}) and a water molecule in basic solutions like NaOH.

$$2\,CrO_4{}^{2-} + 2\,H^+ \longrightarrow Cr_2O_7{}^{2-} + H_2O$$
$$Cr_2O_7{}^{2-} + 2\,OH^- \longrightarrow 2\,CrO_4{}^{2-} + H_2O$$

Question8

The correct increasing reactivity order for SN2 reaction for the following compounds

(A) Benzyl Chloride

(B) Methyl Chloride,

(C) Isopropyl Chloride

(D) Tertiary butyl Chloride

Choose the correct answer from the options given below:

1. (A), (B), (D), (C)
2. (A), (B), (C), (D)
3. (A), (D), (C), (B)
4. (D), (C), (B), (A)

Options:

A.

1

B.

2

C.

3

D.

4

Answer: D

Solution:

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

Explanation: SN_2 reactivity is governed by steric hindrance (bulkiness). The reaction needs a clear path for a "backside attack." Less bulk = faster reactio

(A) Benzyl (1°): Also has low bulk, but it's even faster than methyl. The adjacent benzene ring helps stabilize the transition state, lowering the reaction's

(B) Methyl: Least bulky (only small H atoms). Very fast SN_2.

(C) Isopropyl (2°): Very bulky. Very slow SN_2.

(D) Tertiary butyl (3°): Most bulky. No SN_2 reaction. (Least Reactive)

Question9

The order of a certain reaction with respect to Cl^- ion is -1.

The Cl^- is

1. A catalyst
2. A promotor
3. An inhibitor
4. Always a product molecule

Options:

A. 1

B. 2

C. 3

D. 4

Answer: C

Solution:

Rate Law: The order of a reaction tells how the rate depends on the concentration of a species.

In this case, Rate $\propto [Cl^-]^{-1}$.

This can be rewritten as Rate $\propto \frac{1}{[Cl^-]}$.

This means that as the concentration of the Cl^- ion increases, the overall reaction rate decreases.

A substance that decreases the rate of a reaction is called an inhibitor. A catalyst would increase the rate, leading to a positive reaction order (like $+1$).

Question10

Lack of Vitamin B1 causes:

1. Beri beri
2. Rickets

3. Convulsions

4. Scurvy

Options:

A.

1

B.

2

C.

3

D.

4

Answer: A

Solution:

Sl. No.	Name of Vitamins	Sources	Deficiency diseases
1.	**Vitamin A**	Fish liver oil, carrots, butter and milk	**Xerophthalmia** (hardening of cornea of eye), **Night blindness**
2.	**Vitamin B1** (Thiamine)	Yeast, milk, green vegetables and cereals	**Beri beri** (loss of appetite, retarded growth)
3.	**Vitamin B2** (Riboflavin)	Milk, eggwhite, liver, kidney	**Cheilosis** (fissuring at corners of mouth and lips), digestive disorders and burning sensation of the skin.
4.	**Vitamin B6** (Pyridoxine)	Yeast, milk, egg yolk, cereals and grams	**Convulsions**
5.	**Vitamin B12**	Meat, fish, egg and curd	**Pernicious anaemia** (RBCs deficient in haemoglobin)
6.	**Vitamin C** (Ascorbic acid)	Citrus fruits, amla and green leafy vegetables	**Scurvy** (bleeding gums)
7.	**Vitamin D**	Exposure to sunlight, fish and egg yolk	**Rickets** (bone deformities in children) and **osteomalacia** (soft bones and joint pain in adults)
8.	**Vitamin E**	Vegetable oils like wheat germ oil, sunflower oil, etc.	Increased **fragility of RBCs** and **muscular weakness**
9.	**Vitamin K**	Green leafy vegetables	Increased **blood clotting time**

Question11

The correct sequence of attachment of sugar, base and phosphoric acid in a nucleic acid is

(A) Formation of phosphodiester linkage

(B) Attachment of base to 1' position of sugar

(C) Selection of appropriate base and sugar

(D) Attachment of phosphoric acid

Choose the correct answer from the options given below:

1. (C), (B), (D), (A)
2. (A) , (C), (B), (D)
3. (B) , (A), (D), (C)
4. (C), (B), (A), (D)

Options:

A. 1

B. 2

C. 3

D. 4

Answer: A

Solution:

(C) **Arrange components:** Select the correct sugar (deoxyribose for DNA, ribose for RNA) and base (A, T, C, G, or U).

(B) **Make nucleoside:** Attach the base to the 1' carbon of sugar.

D) **Make nucleotide:** Add the phosphate group (from phosphoric acid) to the 5' carbon of the sugar.

(A) **Make chain**: Link the phosphate group of one nucleotide (at its 5' position) to the 3' carbon of the next nucleotide's sugar by a phosphodiester bond.

Question12

Match List-I with List-II

List-I	List-II
(A) Wurtz-Fittig reaction	(I) CH3COCI and Anhyd. AlCl3
(B) Chiral	(II) CFCs
(C) Friedel-Crafts Acylation	(III) Alkylarene
(D) Freons	(IV) Non-superimposable mirror images

Choose the correct answer from the options given below:

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

Options:

A.

1

B.

2

C.

3

D.

4

Answer: A

Solution:

(A) **Wurtz-Fittig** reaction is used to synthesize **alkylarenes** (an alkyl group attached to an aromatic ring).

(B) **Chiral** molecules are defined by having **non-superimposable mirror images** (enantiomers).

(C) **Friedel-Crafts Acylation** uses an acyl halide (like CH3COCl) and a **Lewis acid catalyst** (like Anhyd. AlCl3).

(D) **Freons -** Freons are a brand name for a group of synthetic chemical compounds called **chlorofluorocarbons (CFCs)** and hydrochlorofluorocarbons (HCFCs), which are derived from methane or ethane.

Question13

Which of the following statements, with reference to a solution, are correct?

(A) The osmotic pressure of the solution is proportional to the molarity of the solute.

(B) The elevation of the boiling point (ΔT_b) is directly proportional to the molal concentration of the s

(C) The unit of K_b is K kg^{-1} mol^{-1}.

(D) $\Delta T_b = T_b^0 - T_b$.

Choose the correct answer from the options given below:

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

(2) (A) and (B) only

(3) (C) and (D) only

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

Options:

A. 1

B. 2

C. 3

D. 4

Answer: B

Solution:

Boiling point elevation means the solution boils at a higher temperature than the pure solvent.

Therefore, $\Delta T_b = T_b - T_b^0$, where T_b is the boiling point of the solution and T_b^0 is the boiling point of the pure solvent.

Hence, statement (D) is incorrect, and the rest are correct.

Question14

Reaction of Ethene with Bromine in CCl4 will result in

1. Gem-Dibromide
2. Vicinal- Dibromide
3. Vinylic-Dibromide
4. Allylic-Bromide

Options:

A.

1

B.

2

C.

3

D.

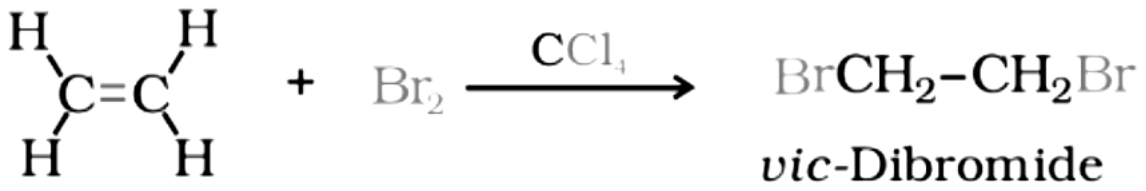
Answer: B

Solution:

Addition of halogens: In the laboratory, addition of bromine in

CCl_4

, to an alkene resulting in discharge of reddish brown colour of bromine constitutes an important method for the detection of double bond in a molecule. The ad
results in the synthesis of vic-dibromides, which are colourless.



Question15

Which of the following compound will form a cyclic product on reaction with ethylene glycol?

1. Acetone
2. Ethylether
3. Benzoic acid
4. Benzyl alcohol

Options:

A. 1

B. 2

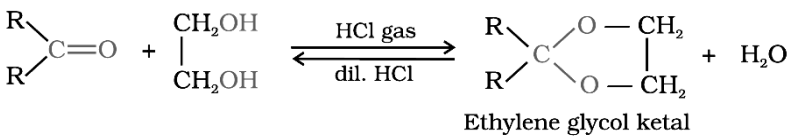
C. 3

D. 4

Answer: A

Solution:

Ketones react with ethylene glycol in the presence of dry hydrogen chloride to form cyclic products known as ethylene glycol ketals.



Question16

Which of the following reagents can be used to convert Ethanol to Ethanal?

(A) Chromium trioxide in Pyridine and HCI

(B) Heated Copper at 573 K

(C) Anhydrous Chromium trioxide

(D) Acidic KMnO4

Choose the correct answer from the options given below:

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

Options:

A. 1

B. 2

C. 3

D. 4

Answer: B

Solution:

Converting a primary alcohol to an aldehyde requires a **mild oxidizing agent** or a **dehydrogenation** reaction that stops at the aldehyde stage.

● (B) Heated Copper at 573 K: This is a classic dehydrogenation method for primary alcohols. It converts primary alcohols to aldehydes without further oxidation to carboxylic acids.

$$CH_3CH_2OH \xrightarrow[573\ K]{Cu} CH_3CHO + H_2$$

● (A) **Chromium trioxide in Pyridine and HCl (PCC):** PCC is a mild oxidizing agent that converts primary alcohols to aldehydes.

● (C) **Anhydrous Chromium trioxide (CrO3)**: While CrO3 is an oxidizing agent, without a specific solvent (like pyridine for PCC), it often leads to over-oxidation of primary alcohols to carboxylic acids.

● (D) **Acidic KMnO4:** This is a **strong oxidizing agent**. It will oxidize ethanol to ethanoic acid (acetic acid), not stop at ethanal.

Question17

Arrange the following ligands in decreasing order of field strength in spectrochemical series.

(A) Br-

(B) H2O

(C) OH-

(D) CO

Choose the correct answer from the options given below:

1. (D), (B), (C), (A)
2. (A), (C), (B), (D)
3. (B), (A), (D), (C)
4. (C), (B), (D), (A)

Options:

A. 1

B. 2

C. 3

D. 4

Answer: A

Solution:

ligands can be arranged in a series in the order of increasing field strength as given below:

$I^- < Br^- < SCN^- < Cl^- < S^{2-} < F^- < OH^- < C_2O_4^{2-} < H_2O < NCS^-$

$< edta^{4-} < NH_3 < en < CN^- < CO$

Such a series is termed as **spectrochemical series**. It is an experimentally determined series based on the absorption of light by complexes with different ligands.

Question18

For the reaction:

$2N_2O_5 \rightarrow 4NO_2 + O_2$

At a given instant of time, the rate and rate constant are 1.02×10^{-4} mol $L^{-1}s^{-1}$ and 3.4×10^{-5} s^{-1}, respectively.

The concentration of N_2O_5 at that time will be:

(1) 3.0 mol L^{-1}

(2) 1.713 mol L^{-1}

(3) 1.02×10^{-4} mol L^{-1}

(4) 3.4×10^{-5} mol L^{-1}

Options:

A. 1

B. 2

C. 3

D. 4

Answer: A

Solution:

$$\text{The unit of the rate constant (k) is } s^{-1}. \text{ This indicates a first-order reaction.}$$

$$\text{For a first-order reaction, the rate law is: Rate} = k[A]$$

$$\text{For the reaction } 2N_2O_5 \rightarrow 4NO_2 + O_2, \text{ the rate law is: Rate} = k[N_2O_5]$$

$$\text{Given:}$$

$$\text{Rate} = 1.02 \times 10^{-4}\,\text{mol L}^{-1}\text{s}^{-1}$$

$$k = 3.4 \times 10^{-5}\,\text{s}^{-1}$$

$$[N_2O_5] = \frac{\text{Rate}}{k}$$

$$N_2O_5] = \frac{1.02 \times 10^{-4}\,\text{mol L}^{-1}\text{s}^{-1}}{3.4 \times 10^{-5}\,\text{s}^{-1}}$$

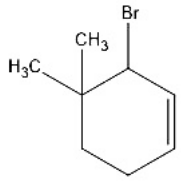
$$N_2O_5] = \left(\frac{1.02}{3.4}\right) \times \left(\frac{10^{-4}}{10^{-5}}\right)\text{mol L}^{-1}$$

$$N_2O_5] = 0.3 \times 10^{1}\,\text{mol L}^{-1}$$

$$\boxed{[N_2O_5] = 3.0\,\text{mol L}^{-1}}$$

Question19

The IUPAC name of the given compound is



1. 3-Bromo-4,4-dimethyl-cyclohexene
2. 1-Bromo-2,2-dimethyl-cyclohexene
3. 1,1-dimethyl-2-bromo-cyclohexene
4. 1,1-dimethyl-2-bromo-cyclohexane

Options:

A. 1

B. 2

C. 3

D. 4

Answer: A

Solution:

CORRECT IUPAC **3-Bromo-4,4-dimethylcyclohex-1-ene.**

1. **Cyclohexene:** 6-membered ring with one double bond.

2. **Numbering**: Double bond carbons are C1 and C2. Numbering (counter-clockwise) gives substituents the lowest possible positions:

- C1: Double bond starts
- C2: Double bond ends
- C3: Bromine
- C4: Two Methyl groups

3. **Name:** Alphabetical order: Bromo, then dimethyl.

Question20

Isomerism shown by the complex pair $Co(NH_3)_5(NO_3)]SO_4$ and $Co(NH_3)_5(SO_4)]NO_3$ is:

1. Hydrate isomerism
2. lonization isomerism
3. Coordination isomerism
4. Linkage isomerism

Options:

A. 1

B. 2

C. 3

D. 4

Answer: B

Solution:

This form of isomerism arises when the counter ion in a complex salt is itself a potential ligand and can displace a ligand which can then become the counter ion. An example is provided by the ionisation isomers.

$[Co(NH_3)_5(NO_3)]SO_4$ and $[Co(NH_3)_5(SO_4)]NO_3$

Question21

Decide which of the following atomic numbers are the atomic numbers of the inner transition elements

(A) 59

(B) 95

(C) 102

(D) 74

Choose the correct answer from the options given below:

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

Options:

A. 1

B. 2

C. 3

D. 4

Answer: B

Solution:

Inner transition elements are the f-block elements, consisting of the Lanthanides and Actinides.

- **Lanthanides:** Atomic numbers 57 (La) to 71 (Lu). They fill the 4f orbital.
- **Actinides:** Atomic numbers 89 (Ac) to 103 (Lr). They fill the 5f orbital.

The given atomic numbers:

- **(A) 59:** This is Praseodymium (Pr), which is in the**Lanthanide series** (4f block).**(Inner transition)**
- **(B) 95:** This is Americium (Am), which is in the**Actinide series** (5f block).**(Inner transition)**
- **(C) 102:** This is Nobelium (No), which is in the**Actinide series** (5f block).**(Inner transition)**
- **(D) 74:** This is Tungsten (W), which is a**d-block transition element**, not an inner transition element (it's in Group 6, Period 6).**(Not inner transition)**

Therefore, (A), (B), and (C) are atomic numbers of inner transition elements.

Question22

Match the properties given in list-I with the metals given in list-II

List-I	**List-II**
Property	**Metal**
(A) Element with highest second ionization enthalpy	(I) Co
(B) Element with highest heat of atomisation	(II) Cu
(C) M in $M(\mathrm{CO})_6$	(III) Zn
(D) Element with highest third ionization enthalpy	(IV) Cr

Choose the correct answer from the options given below:

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

Options:

A.

1

B.

2

C.

3

D.

4

Answer: B

Solution:

$$\textbf{A) Highest Second Ionization Enthalpy } (\mathrm{IE}_2) \rightarrow \text{Copper (Cu)}$$

$$\mathrm{IE}_2 \text{ is for removing an electron from } \mathrm{Cu}^+.$$

$$\mathrm{Cu}^+ \text{ has an exceptionally stable, completely filled } d^{10}\text{-orbital } ([\mathrm{Ar}]3d^{10}).$$

$$\text{Removing an electron from this stable configuration requires the most energy.}$$

$$\textbf{B) Highest Heat of Atomisation } \rightarrow \text{Cobalt (Co)}$$

$$\text{Heat of atomisation relates to the strength of metallic bonding.}$$

$$\text{It generally correlates with the number of unpaired } d\text{-electrons and effective nuclear charge.}$$

$$\text{Cobalt (Co) has the highest known experimental value (approx. 425 kJ/mol) among the options.}$$

$$\textbf{C) Stable } \mathrm{M(CO)_6} \text{ Carbonyl } \rightarrow \text{Chromium (Cr)}$$

$$\text{Stable metal carbonyls often follow the 18-electron rule.}$$

$$\mathrm{Cr(CO)_6} \text{ achieves the 18-electron count (6 from Cr} + 12 \text{ from 6 CO ligands } = 18).$$

$$\text{Chromium, a Group 6 element, forms this very stable neutral complex.}$$

$$\textbf{D) Highest Third Ionization Enthalpy } (\mathrm{IE}_3) \rightarrow \text{Zinc (Zn)}$$

$$\mathrm{IE}_3 \text{ is for removing an electron from } \mathrm{Zn}^{2+}.$$

$$\mathrm{Zn}^{2+} \text{ has an extremely stable, completely filled } d^{10}\text{-shell } ([\mathrm{Ar}]3d^{10}).$$

Removing an electron from this shell requires a significantly higher energy than Co, Cu, or Cr (which are removing electrons from partially filled d-orbitals

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Question23

Which of the following reactions are involved in preparation of aldehydes?

(A) Gatterman-Koch reaction

(B) Etard Reaction

(C) Stephen Reaction

(D) Rosenmund Reaction

Choose the correct answer from the options given below:

1. (A), (B) and (C) only
2. (B), (C) and (D) only

3. (A), (B), (C) and (D)
4. (A), (B) and (D) only

Options:

A.

1

B.

2

C.

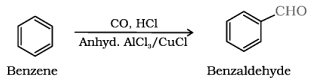
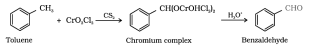
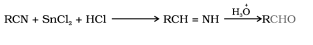
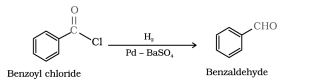
3

D.

4

Answer: C

Solution:

Name of reaction	Description	Reaction
Gatterman – Koch reaction	When benzene or its derivative is treated with carbon monoxide and hydrogen chloride in the presence of anhydrous aluminium chloride or cuprous chloride, it gives benzaldehyde or substituted benzaldehyde.	
Etard reaction	Chromyl chloride oxidises methyl group to a chromium complex, which on hydrolysis gives corresponding benzaldehyde.	
Stephen reaction	Nitriles are reduced to corresponding imine with stannous chloride in the presence of hydrochloric acid, which on hydrolysis give corresponding aldehyde.	
Rosenmund reduction	Acyl chloride (acid chloride) is hydrogenated over a catalyst, palladium on barium sulphate.	

Question24

The relative lowering of vapor pressure is equal to the

1. mole fraction of solute
2. boiling point of solvent
3. mole fraction of solvent
4. Vapor pressure of solute

Options:

A. 1

B. 2

C. 3

D. 4

Answer: A

Solution:

This is directly stated by Raoult's Law for relative lowering of vapor pressure:

$$\frac{P^0 - P_s}{P^0} = X_{\text{solute}}$$

Where:

$$P^0 = \text{vapor pressure of pure solvent}$$

$$P_s = \text{vapor pressure of solution}$$

$$X_{\text{solute}} = \text{mole fraction of solute}$$

Question25

Glucose reacts with Tollen's reagent (ammoniacal silver nitrate) due to the presence of

1. Ester
2. Aldehyde
3. Ketone
4. Alcoholic AgNO3

Options:

A. 1

B. 2

C. 3

D. 4

Answer: B

Solution:

- Tollen's reagent is a test for aldehydes. It's a mild oxidizing agent.
- Glucose, in its open-chain form, contains an aldehyde functional group (-CHO) at C1.
- This aldehyde group is oxidized by Tollen's reagent, reducing silver ions (Ag+) to metallic silver (Ag), which forms a "silver mirror."
- Though glucose exists primarily in cyclic forms, there's always an equilibrium with the open-chain aldehyde form, which reacts with Tollen's reagent.

Question26

Which of the following compound will undergo Cannizzaro reaction?

1. Methanal
2. Cyclohexanone
3. Propanal
4. Acetone

Options:

A. 1

B. 2

C. 3

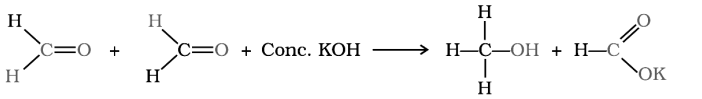
D. 4

Answer: A

Solution:

In Cannizzaro reaction, aldehydes which do not have an α hydrogen atom, undergo self oxidation and reduction (disproportionation) reaction on treatment with concentrated alkali. This reaction is given by methanal (formaldehyde) and benzaldehyde.

Cyclohexanone, acetone and propanal possess atleast one α hydrogen atom and gives Aldol condensation reaction.



Question27

75% of a first order reaction was completed in 16 minutes. When was it half completed?

(Given: log(0.75) = -0.125, log(0.25) = -0.602)

1.8 min
2. 12 min
3. 4 min
4. 32 min

Options:

A. 1

B. 2

C. 3

D. 4

Answer: A

Solution:

First-Order Rate Law (Integrated): $k = \frac{2.303}{t} \log\left(\frac{[A]_0}{[A]}\right)$

Where: k =rate constant, t =time, $[A]_0$ =initial concentration, $[A]$ =concentration at time t

Given: 75% completed in 16 minutes.

If $[A]_0 = 100$, then $[A] = 100 - 75 = 25$

$k = \frac{2.303}{16} \log\left(\frac{100}{25}\right) = \frac{2.303}{16} \log(4)$

Since $\log(4) = 2\log(2) \approx 2 \times 0.301 = 0.602$

$k = \frac{2.303 \times 0.602}{16}$

For Half-Life $(t_{1/2})$:

Half-life is the time when the reaction is 50% completed.

So, if $[A]_0 = 100$, then $[A] = 50$

$k = \frac{2.303}{t_{1/2}} \log\left(\frac{100}{50}\right) = \frac{2.303}{t_{1/2}} \log(2)$

$t_{1/2} = \frac{2.303 \log(2)}{k} = \frac{0.693}{k}$ (since $2.303 \times \log(2) \approx 0.693$)

Relate 75% Completion to Half-Life:

For a first-order reaction:

After one half-life, 50% remains. After two half-lives, 25% remains.

If 25% remains, then 75% is completed.

So, 16 minutes represents two half-lives: $2 \times t_{1/2} = 16$

$t_{1/2} = \frac{16}{2} = 8$ minutes.

Question28

Match List-I with List-II

List-I	List-II
(A) Gatterman-Koch reaction	(I) CrO2Cl2/CS2
(B) Rosenmund reduction	(II) Acyl chloride and anhyd. AlCl3
(C) Etard reaction	(III) CO, HCl, AlCl3/CuCl
(D) Friedel Craft acylation	(IV) H2/Pd-BaSO4

Choose the correct answer from the options given below:

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) - (III), (B) - (IV), (C) - (I), (D) - (II)

Options:

A.

1

B.

2

C.

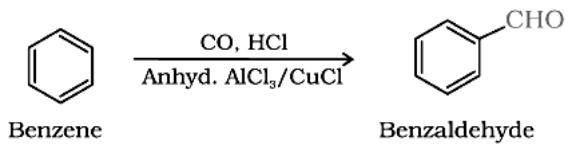
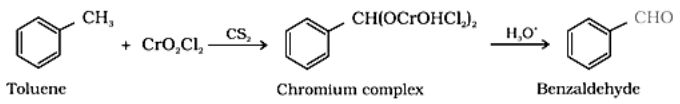
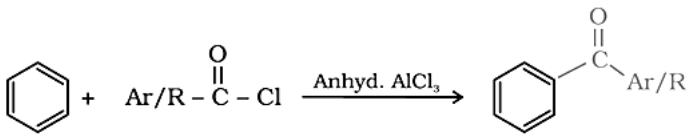
3

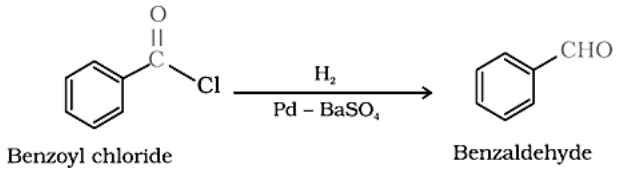
D.

4

Answer: D

Solution:

Name of reaction	Description	Reaction
Gatterman – Koch reaction	When benzene or its derivative is treated with carbon monoxide and hydrogen chloride in the presence of anhydrous aluminium chloride or cuprous chloride, it gives benzaldehyde or substituted benzaldehyde.	
Etard reaction	Chromyl chloride oxidises methyl group to a chromium complex, which on hydrolysis gives corresponding benzaldehyde.	
Friedel-Crafts acylation reaction	When benzene or substituted benzene is treated with acid chloride in the presence of anhydrous aluminium chloride, it affords the corresponding ketone.	

Rosenmund reduction	Acyl chloride (acid chloride) is hydrogenated over a catalyst, palladium on barium sulphate.	

Question29

Match List-I with List-II

List-I	**List-II**
Reaction	**Preparation**
(A) Kolbe's Reaction	(I) Salicylaldehyde
(B) Reimer-Tiemann Reaction	(II) Salicylic acid
(C) Williamson synthesis	(III) Ethyl methyl ether
(D) Cumene Process	(IV) Phenol

Choose the correct answer from the options given below:

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

Options:

A.

1

B.

2

C.

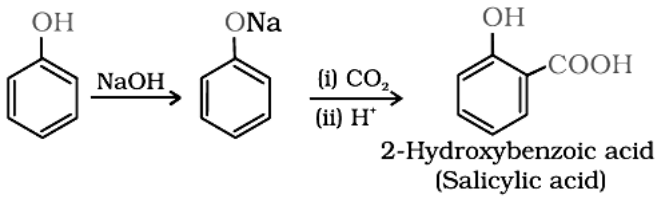
3

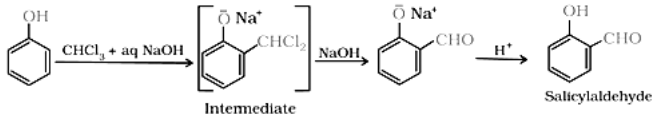
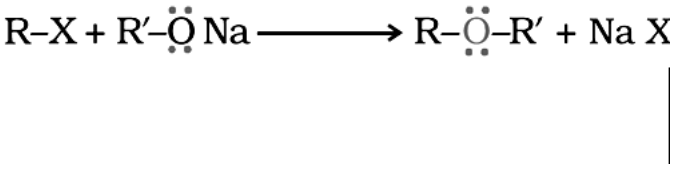
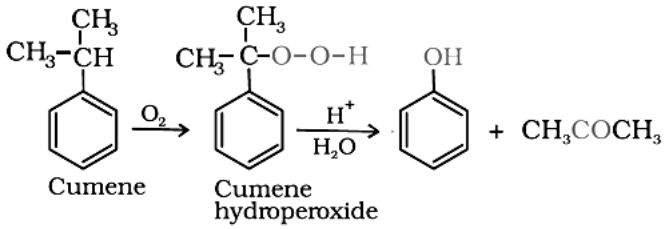
D.

4

Answer: B

Solution:

Name of reaction	Description	Reaction
Kolbe's reaction	Phenoxide ion generated by treating phenol with sodium hydroxide undergoes electrophilic substitution with carbon dioxide, a weak electrophile. Ortho hydroxybenzoic acid is formed as the main reaction product.	

Reimer - Tiemann reaction	On treating phenol with chloroform in the presence of sodium hydroxide, a –CHO group is introduced at the ortho position of the benzene ring.	
Williamson synthesis	It is an important laboratory method for the preparation of symmetrical and unsymmetrical ethers. In this method, an alkyl halide is allowed to react with sodium alkoxide.	
Cumene Process	Cumene (isopropylbenzene) is oxidised in the presence of air to cumene hydroperoxide. It is converted to phenol and acetone by treating it with dilute acid.	

Question30

Which structure of proteins gives rise to fibrous and globular proteins?

1. Primary Structure
2. Secondary Structure
3. Tertiary Structure
4. Quaternary Structure

Options:

A. 1

B. 2

C. 3

D. 4

Answer: C

Solution:

- **Tertiary structure** refers to the overall three-dimensional folding of a single polypeptide chain. This unique 3D shape, determined by various interactions (hydrogen bonding, disulfide bridges, hydrophobic interactions, ionic bonds), is what dictates whether a protein takes on a**fibrous** (elongated, insoluble) or**globular** (compact, soluble) form.
- **Primary structure** is just the amino acid sequence.
- **Secondary structure** refers to local folding patterns like alpha-helices and beta-sheets.
- **Quaternary structure** involves the arrangement of multiple polypeptide subunits, but the fundamental fibrous/globular nature is established at the tertiary level for each subunit.

Question31

If the solubility of the given gases in water decreases in the order of formaldehyde, methane, vinyl chloride, argon.
Match List-I with List-II.

List-I	List-II
Gas	$(K)_H$/k bar
(A) Formaldehyde	(I) 40.3
(B) Vinyl Chloride	(II) 0.413
(C) Argon	(III) 1.83 x 10^-5
(D) Methane	(IV) 0.611

Choose the correct answer from the options given below:

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) - (III), (B) - (IV), (C) - (I), (D) - (II)

Options:

A.

1

B.

2

C.

3

D.

4

Answer: D

Solution:

$$\text{Lower Solubility} \Rightarrow \text{Higher } K_H \text{ (Henry's Law Constant)}$$

$$\text{The problem states: Solubility decreases in the order: Formaldehyde} > \text{Methane} > \text{Vinyl chloride} > \text{Argon.}$$

$$\text{Therefore, the } K_H \text{ values should increase in the same order.}$$

$$\text{Order of increasing } K_H \text{ values: Formaldehyde} < \text{Methane} < \text{Vinyl chloride} < \text{Argon}$$

$$\text{Given } K_H \text{ values (in increasing order):}$$

$$1.\ 1.83 \times 10^{-5} \text{ (Smallest } K_H, \text{ so Highest Solubility)}$$

$$2.\ 0.413$$

$$3.\ 0.611$$

$$4.\ 40.3 \text{ (Largest } K_H, \text{ so Lowest Solubility)}$$

Question32

The function of the enzymes in various chemical reactions:

1. Increase activation energy
2. Biochemical enhancers
3. Decreases the rate of reaction
4. Act as biological catalysts

Options:

A. 1

B. 2

C. 3

D. 4

Answer: D

Solution:

Enzymes are biological catalysts. Their primary function is to**speed up (increase the rate of) biochemical reactions** by**lowering the activation energy** required for the reaction to proceed.

They do not increase activation energy (Option 1 is incorrect).
They do not decrease the rate of reaction (Option 3 is incorrect).

Question33

The units of rate constant of four reactions are given below. Arrange them in the increasing order of re

$$(\mathrm{A})\mathrm{s}^{-1}$$

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

$$(\mathrm{C})\mathrm{mol}^{1/2}\mathrm{L}^{-1/2}\mathrm{s}^{-1}$$

$$(\mathrm{D})\mathrm{L}^{1/2}\mathrm{mol}^{-1/2}\mathrm{s}^{-1}$$

Choose the correct answer from the options given below:

1. (A), (B), (C), (D)
2. (D), (A), (C), (B)
3. (B), (A), (D), (C)
4. (B), (C), (A), (D)

Options:

A. 1

B. 2

C. 3

D. 4

Answer: D

Solution:

The general unit for a rate constant (k) for an nth order reaction is:

$$\text{Units of } k = (\mathrm{mol\ L}^{-1})^{1-n}\,\mathrm{s}^{-1} \quad \text{or more commonly} \quad \mathrm{L}^{n-1}\,\mathrm{mol}^{1-n}\,\mathrm{s}^{-1}$$

Let's find the order (n) for each unit:

$$\textbf{(A)}\ \mathrm{s}^{-1}$$

Compare to $(\mathrm{mol\ L}^{-1})^{1-n}\mathrm{s}^{-1}$. For units of $\mathrm{mol\ L}^{-1}$ to disappear, $1-n=0$.

$$1 - n = 0 \Rightarrow n = 1$$

$$\text{Order} = 1 \text{ (First Order)}$$

$$\textbf{(B)}\ \text{mol L}^{-1}\text{s}^{-1}$$

$$\text{Compare to } (\text{mol L}^{-1})^{1-n}\text{s}^{-1}. \text{ For mol L}^{-1} \text{ to have a power of 1, } 1 - n = 1.$$

$$1 - n = 1 \Rightarrow n = 0$$

$$\text{Order} = 0 \text{ (Zero Order)}$$

$$\textbf{(C)}\ \text{mol}^{1/2}\text{L}^{-1/2}\text{s}^{-1}$$

$$\text{This is equivalent to } (\text{mol L}^{-1})^{1/2}\text{s}^{-1}.$$

$$1 - n = \tfrac{1}{2} \Rightarrow n = 1 - \tfrac{1}{2} = \tfrac{1}{2}$$

$$\text{Order} = \tfrac{1}{2} \text{ (Half Order)}$$

$$\textbf{(D)}\ \text{L}^{1/2}\text{mol}^{-1/2}\text{s}^{-1}$$

$$\text{This is equivalent to } (\text{mol L}^{-1})^{-1/2}\text{s}^{-1}.$$

$$1 - n = -\tfrac{1}{2} \Rightarrow n = 1 + \tfrac{1}{2} = \tfrac{3}{2}$$

$$\text{Order} = \tfrac{3}{2} \text{ (One and a half Order)}$$

Increasing Order of Reaction:

0<0.5<1<1.5. So, (B) < (C) < (A) < (D)

Question34

Ethanoic acid can be converted into ethanol using reagent

1. Sn + HCI
2. Na and C2H5OH
3. LiAIH4 in H2O
4. H2 and Pt

Options:

A. 1

B. 2

C. 3

D. 4

Answer: C

Solution:

LiAlH4 (Lithium Aluminium Hydride) is a strong reducing agent specifically used to convert carboxylic acids like ethanoic acid into primary alcohols like ethanol.

Question35

Calculate the molality of 25 g of ethanoic acid (CH_3COOH) in 250 g benzene

1. $16.64\ \text{mol kg}^{-1}$

2. $1.664\ \text{mol kg}^{-1}$

3. $166.4\ \text{mol kg}^{-1}$

4. $6.64\ \text{mol kg}^{-1}$

Options:

A. 1

B. 2

C. 3

D. 4

Answer: B

Solution:

$$\textbf{Formula for Molality (m):} \quad m = \frac{\text{moles of solute}}{\text{mass of solvent (in kg)}}$$

$$\textbf{Calculate Moles of Solute (Ethanoic Acid, CH}_3\text{COOH):}$$

$$\text{Molar mass of } CH_3COOH:$$

$$\text{C} = 12.01\,\text{g/mol},$$

$$\text{H} = 1.008\,\text{g/mol},$$

$$\text{O} = 16.00\,\text{g/mol}$$

$$\text{Molar mass} = 2(12.01) + 4(1.008) + 2(16.00) = 24.02 + 4.032 + 32.00 = 60.052\,\text{g/mol}$$

$$\textbf{Moles} = \frac{\text{mass}}{\text{molar mass}}$$

$$\text{Moles of } CH_3COOH = \frac{25\,\text{g}}{60.052\,\text{g/mol}} \approx 0.4163\,\text{mol}$$

$$\textbf{Convert Mass of Solvent to kg:}$$

$$\text{Mass of benzene} = 250\,\text{g} = 0.250\,\text{kg}$$

$$\textbf{Calculate Molality:} \quad m = \frac{0.4163\,\text{mol}}{0.250\,\text{kg}} = 1.6652\,\text{mol kg}^{-1}$$

Question36

_____ is the rate of a reaction at a particular moment of time.

1. Order of reaction
2. Average rate
3. Instantaneous rate
4. Rate constant

Options:

A. 1

B. 2

C. 3

D. 4

Answer: C

Solution:

- **Instantaneous rate** is defined as the rate of a chemical reaction at a specific moment in time. It's determined by finding the slope of the tangent to the concentration-time curve at that particular instant.
- **Average rate** is the rate over a measurable period of time.
- **Order of reaction** describes how the reaction rate depends on reactant concentrations.
- **Rate constant** is a proportionality constant in the rate law.

Question37

The order of increasing boiling point for the following compounds is

(A) CH3CH2CH2CH3

(B) CH3CH2CH2 CH2OH

(C) C2H5OC2H5

(D) CH3CH2CH2CHO

Choose the correct answer from the options given below:

1. (A), (B), (C), (D)
2. (A), (C), (B), (D)
3. (A), (C), (D), (B)
4. (C), (B), (D), (A)

Options:

A. 1

B. 2

C. 3

D. 4

Answer: C

Solution:

Boiling point increases with stronger intermolecular forces (IMFs).

(A) $CH_3CH_2CH_2CH_3$ (Alkane) : Only weak London Dispersion Forces (LDFs). (Lowest BP)

(C) $C_2H_5OC_2H_5$ (Ether) : LDFs and moderate dipole-dipole forces. No H-bonding.

(D) $CH_3CH_2CH_2CHO$ (Aldehyde) : LDFs and stronger dipole-dipole forces (due to polar C=O). No H-bonding.

(B) $CH_3CH_2CH_2CH_2OH$ (Alcohol) : Strongest forces due to hydrogen bonding, plus dipole-dipole and LDFs. (Highest BP)

Order: Alkane < Ether < Aldehyde < Alcohol

Question38

Write the IUPAC name for the coordination compound:

[Cr(NH3)3(H2O)3]Cl3

1. triamminetriaquachromium (III) chloride
2. triaquatriamminechromium (III) chloride
3. tris(amminetriaqua)chromium (III) chloride
4. triammine-tris(aqua)chromium (III) chloride

Options:

A. 1

B. 2

C. 3

D. 4

Answer: A

Solution:

1. **Ligands:** "ammine" (NH_3) and "aqua" (H_2O). Both are neutral.
2. **Count & Alphabetize:** 3 ammine, 3 aqua. "ammine" comes before "aqua". ⇒ triammine, triaqua.
3. **Metal:** Chromium (Cr).
4. **Oxidation State:** $NH_3(0)$ $+H_2O$ (0) $+Cr$ $(x) = +3$ (due to $3Cl^-$ counterions) $\Rightarrow x = +3$ (Chromium(III)).
5. **Counter-ion:** Chloride.

Final Name: triammine-triaqua-chromium(III) chloride.

Question39

50 g of ethylene glycol ($C_2H_6O_2$) is mixed with 900 g of water. The freezing point of the solution will b

1. 271.49 K

2. 270.15 K

3. 269.52 K

4. 273.15 K

Options:

A. 1

B. 2

C. 3

D. 4

Answer: A

Solution:

$$\textbf{1. Molar Mass of Ethylene Glycol } (\mathrm{C_2H_6O_2}) : 62.07 \text{ g/mol}$$

$$\textbf{2. Moles of Solute: } 50 \text{ g}/62.07 \text{ g/mol} \approx 0.8055 \text{ mol}$$

$$\textbf{3. Molality } (m) : 0.8055 \text{ mol}/0.900 \text{ kg} \approx 0.895 \text{ mol/kg}$$

$$\textbf{4. Freezing Point Depression } (\Delta T_f) :$$

$$\Delta T_f = i \times K_f \times m$$

$$i = 1 \text{ (non-electrolyte)}$$

$$\Delta T_f = 1 \times 1.86 \text{ K kg/mol} \times 0.895 \text{ mol/kg} \approx 1.665 \text{ K}$$

$$\textbf{5. Freezing Point of Solution } (T_f) :$$

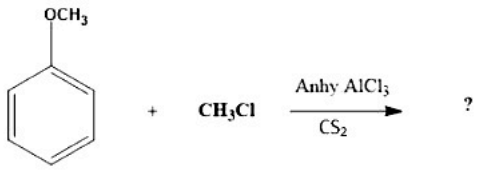
$$T_f^0(\text{water}) = 273.15 \text{ K}$$

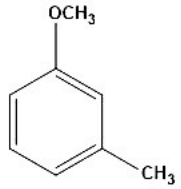
$$T_f = T_f^0 - \Delta T_f = 273.15 \text{ K} - 1.665 \text{ K} = 271.485 \text{ K}$$

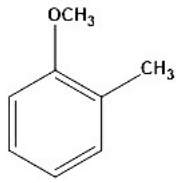
This value is approximately **271.49 K**.

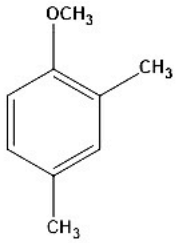
Question40

The major product of the following reaction is



1. 

2. 

3. 

4.

Options:

A. 1

B. 2

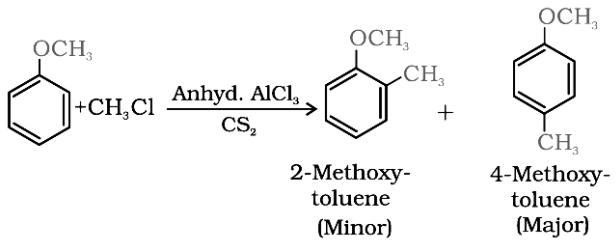
C. 3

D. 4

Answer: D

Solution:

Anisole undergoes Friedel-Crafts reaction, i.e., the alkyl and acyl groups are introduced at ortho and para positions by reaction with alkyl halide and acyl halide in the presence of anhydrous aluminium chloride (a Lewis acid) as catalyst.



Question41

Read the passage carefully and answer the questions

Amines are considered to be derivatives of ammonia obtained by replacement of hydrogen atoms with alkyl or aryl groups.
They are usually prepared from nitro compounds, halides, amides, imides etc. The presence of hydrogen bonding influences its
physical properties. In alkylamines, a combination of electron releasing steric and hydrogen bonding factors influences the
stability of substituted ammonium cations in protic polar solvents and thus affects the basic nature of amines. Alkyl amines are
found to be stronger bases than ammonia which is more basic than water. Primary and secondary amines are engaged in
intermolecular association due to hydrogen bonding. This intermolecular association is more in primary amines than in
secondary amines. Tertiary amines do not have intermoleulcar association due to the absence of hydrogen atom available for
hydrogen bonding. Thus, the boiling point of amines depends on hydrogen bonding. In aromatic amines, electron releasing
and withdrawing groups increase and decrease their basic character. Aryl diazonium salts usually obtained from arylamine
undergo replacement of the diazonium group with a variety of nucleophile. Their coupling reaction of aryl diazonium salts with
phenol or arylamine results in formation of dyes.

Complete the reaction by giving the final product:

Chloroethane+ethanolic (NaCN)+$LiAlH_4$ $\rightarrow$?

1. $CH_3CH_2NH_2$
2. $CH_3CH_2CH_2NH_2$
3. CH_3CH_2CN
4. $CH_3CH_2CH_2CN$

Options:

A. 1

B. 2

C. 3

D. 4

Answer: B

Solution:

The reaction sequence involves two steps:

1. Chloroethane (CH_3CH_2Cl) + Ethanolic NaCN:

This is a nucleophilic substitution reaction (S_N2). The cyanide ion (CN^-) displaces the chloride ion (Cl^-), extending the carbon chain by one carbon and forming a nitrile.

$CH_3CH_2Cl + NaCN \rightarrow CH_3CH_2CN + NaCl$

The product here is **Propanenitrile**.

2. Propanenitrile (CH_3CH_2CN) + $LiAlH_4$:

Lithium Aluminium Hydride ($LiAlH_4$) is a powerful reducing agent. It reduces nitriles (-CN) to primary amines ($-CH_2NH_2$).

$CH_3CH_2CN \xrightarrow{LiAlH_4} CH_3CH_2CH_2NH_2$

The final product is **Propan-1-amine**.

Question42

Read the passage carefully and answer the questions

Amines are considered to be derivatives of ammonia obtained by replacement of hydrogen atoms with alkyl or aryl groups.
They are usually prepared from nitro compounds, halides, amides, imides etc. The presence of hydrogen bonding influences its
physical properties. In alkylamines, a combination of electron releasing steric and hydrogen bonding factors influences the
stability of substituted ammonium cations in protic polar solvents and thus affects the basic nature of amines. Alkyl amines are
found to be stronger bases than ammonia which is more basic than water. Primary and secondary amines are engaged in
intermolecular association due to hydrogen bonding. This intermolecular association is more in primary amines than in
secondary amines. Tertiary amines do not have intermoleulcar association due to the absence of hydrogen atom available for
hydrogen bonding. Thus, the boiling point of amines depends on hydrogen bonding. In aromatic amines, electron releasing
and withdrawing groups increase and decrease their basic character. Aryl diazonium salts usually obtained from arylamine
undergo replacement of the diazonium group with a variety of nucleophile. Their coupling reaction of aryl diazonium salts with
phenol or arylamine results in formation of dyes.

The most basic species in the following is

1. NH_2^-
2. H_2O
3. OH^-
4. NH_3

Options:

A. 1

B. 2

C. 3

D. 4

Answer: A

Solution:

Basicity is the ability to accept a proton (H^+). Stronger bases have very weak conjugate acids.

Comparison of Conjugate Acids:

1. NH_2^-: Conjugate acid is NH_3 (ammonia). NH_3 is a weak base, so NH_2^- is extremely strong.
2. H_2O: Conjugate acid is H_3O^+. Water is a very weak base.
3. OH^-: Conjugate acid is H_2O. OH^- is a strong base, but weaker than NH_2^- .
4. NH_3: Conjugate acid is NH_4^+ . Ammonia is a weak base.

Order of Basicity (Strongest to Weakest): $NH_2^- > OH^- > NH_3 > H_2O$

The amide ion (NH_2^-) is derived from the very weak acid NH_3 ($pK_a \approx 38$), making it an exceptionally strong base.

Question43

Read the passage carefully and answer the questions

Amines are considered to be derivatives of ammonia obtained by replacement of hydrogen atoms with alkyl or aryl groups.
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physical properties. In alkylamines, a combination of electron releasing steric and hydrogen bonding factors influences the
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and withdrawing groups increase and decrease their basic character. Aryl diazonium salts usually obtained from arylamine
undergo replacement of the diazonium group with a variety of nucleophile. Their coupling reaction of aryl diazonium salts with
phenol or arylamine results in formation of dyes.

Carbylamine reaction is used as a test for

1. Primary aliphatic amine
2. Primary aliphatic and aromatic amine
3. Secondary aliphatic amine
4. Secondary aromatic amine

Options:

A. 1

B. 2

C. 3

D. 4

Answer: B

Solution:

$R\text{--}NH_2 + CHCl_3 + 3KOH \xrightarrow{Heat} R\text{--}NC + 3KCl + 3H_2O$

Explanation:

Aliphatic and aromatic primary amines on heating with chloroform and ethanolic potassium hydroxide form isocyanides (carbylamines), which are foul-smelling substa

Secondary and tertiary amines do not show this reaction. This reaction is known as the **carbylamine reaction** or **isocyanide test** and is used as a test for primary amin

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Question44

Read the passage carefully and answer the questions

Amines are considered to be derivatives of ammonia obtained by replacement of hydrogen atoms with alkyl or aryl groups.
They are usually prepared from nitro compounds, halides, amides, imides etc. The presence of hydrogen bonding influences its
physical properties. In alkylamines, a combination of electron releasing steric and hydrogen bonding factors influences the
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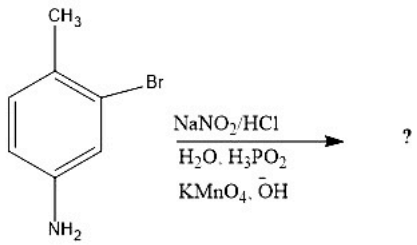
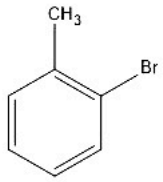
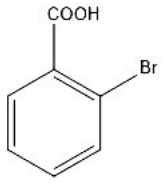
and withdrawing groups increase and decrease their basic character. Aryl diazonium salts usually obtained from arylamine
undergo replacement of the diazonium group with a variety of nucleophile. Their

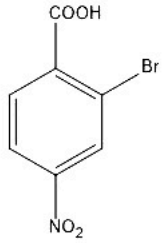
coupling reaction of aryl diazonium salts with phenol or arylamine results in formation of dyes.

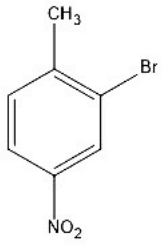
Complete the following reaction:



1. 

2. 

3. 

4. 

Options:

A. 1

B. 2

C. 3

D. 4

Answer: B

Solution:

1. Initial Reactant: 2-bromo-4-methylaniline

2. Step 1: Diazotization and Deamination

The **--NH_2** group is replaced by H.

Intermediate: 2-bromo-4-methylbenzene

3. Step 2: Oxidation

The **--CH_3** group is oxidized to **--COOH.**

Under harsh basic (OH^-) and oxidizing ($KMnO_4$) conditions, the Br atom is typically cleaved from the ring.

4. Final Product: 4-methylbenzoic acid (p-toluic acid)

Question45

Read the passage carefully and answer the questions

**Amines are considered to be derivatives of ammonia obtained by replacement of hydrogen atoms with alkyl or aryl groups.
They are usually prepared from nitro compounds, halides, amides, imides etc. The presence of hydrogen bonding influences its
physical properties. In alkylamines, a combination of electron releasing steric and hydrogen bonding factors influences the
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and withdrawing groups increase and decrease their basic character. Aryl diazonium salts usually obtained from arylamine
undergo replacement of the diazonium group with a variety of nucleophile. Their coupling reaction of aryl diazonium salts with
phenol or arylamine results in formation of dyes.**

Which of the following compounds will not undergo azo coupling with benzene diazonium chloride?

1. Anisole
2. Phenol
3. Aniline
4. Nitrobenzene

Options:

A. 1

B. 2

C. 3

D. 4

Answer: D

Solution:

Azo coupling is an electrophilic aromatic substitution reaction where the weakly electrophilic diazonium ion ($Ar\text{--}N_2^+$) attacks an activated aromatic ring

The aromatic ring must be highly activated by a strong electron-donating group (EDG), such as:

-OH (Phenol), **-NH_2** (Aniline), **-OCH_3** (Anisole)

Phenol, Aniline, and Anisole all contain strong EDGs that make their rings sufficiently nucleophilic to react with the diazonium ion,

typically resulting in coupling at the para position.

Nitrobenzene contains a strong electron-withdrawing group (EWG), the nitro group (-NO_2).

This group deactivates the benzene ring, making it too poor a nucleophile to react with the weakly electrophilic diazonium salt.

Question46

Read the passage carefully and answer the questions

Electrochemistry is the study involving two types of processes. One type involves the production of electricity from the energy released during a spontaneous chemical reaction. Galvanic cells like Daniel cells are used to produce electricity from the redox reaction. Nernst equation of a galvanic cell gives the relation between the standard cell potential and the concentration of the species involved in the redox reaction. The second type of study involves the cells in which electrical energy is used to bring about the chemical reactions in a non-spontaneous process. The conductance of electrolytic solution depends on many factors including the nature of the electrolyte and the dimensions of the electrolytic cell.

The conductivity of ionic electrolytic solutions does not depend on:

1. Concentration of electrolyte.
2. Viscosity of solvent.
3. Solvation of ion.
4. Pressure.

Options:

A. 1

B. 2

C. 3

D. 4

Answer: D

Solution:

The conductivity of an ionic electrolytic solution depends primarily on the**mobility** and**number** of ions in the solution.

- **Concentration**: Directly affects the number of ions available to carry the current.
- **Viscosity of solvent**: Affects the resistance to the movement of ions, thus affecting their mobility.
- **Solvation of ion**: Affects the effective size of the ion (hydrated radius), which in turn affects its mobility.
- **Pressure**: For liquid solutions, a change in external pressure (unless extreme) has a negligible effect on the concentration, viscosity, or ion mobility, and therefore**does not significantly affect conductivity**.

Question47

Read the passage carefully and answer the questions

Electrochemistry is the study involving two types of processes. One type involves the production of electricity from the energy released during a spontaneous chemical reaction. Galvanic cells like Daniel cells are used to produce electricity from the redox reaction. Nernst equation of a galvanic cell gives the relation between the standard cell potential and the concentration of the species involved in the redox reaction. The second type of study involves the cells in which electrical energy is used to bring about the chemical reactions in a non-spontaneous process. The conductance of electrolytic solution depends on many factors including the nature of the electrolyte and the dimensions of the electrolytic cell.

What is the SI unit of conductivity?

$1. \mathrm{S\ m^{-1}}$

$2. \Omega\ \mathrm{m}$

$3. \mathrm{S\ m}$

$4. \Omega\ \mathrm{m^{-1}}$

Options:

A. 1

B. 2

C. 3

D. 4

Answer: A

Solution:

$$\textbf{Conductivity } (\kappa) \text{ is the reciprocal of resistivity } (\rho): \quad \kappa = \frac{1}{\rho}$$

$$\text{The SI unit of resistance } (R) \text{ is the } \textbf{ohm } (\Omega).$$

$$\text{The SI unit of resistivity } (\rho) \text{ is the } \textbf{ohm-meter } (\Omega\,\mathrm{m}).$$

$$\text{The SI unit of conductance } (G) \text{ is the } \textbf{siemens } (\mathbf{S}), \text{ where } 1\,\mathrm{S} = 1\,\Omega^{-1}.$$

$$\textbf{Therefore, the SI unit of conductivity } (\kappa) \textbf{ is } \Omega^{-1}\mathrm{m}^{-1}, \text{ which is also written as } \mathbf{S\ m}^{-1} \text{ (Siemens per meter).}$$

Question48

Read the passage carefully and answer the questions

Electrochemistry is the study involving two types of processes. One type involves the production of electricity from the energy released during a spontaneous chemical reaction. Galvanic cells like Daniel cells are used to produce electricity from the redox reaction. Nernst equation of a galvanic cell gives the relation between the standard cell potential and the concentration of the species involved in the redox reaction. The second type of study involves the cells in which electrical energy is used to bring about the chemical reactions in a non-spontaneous process. The conductance of electrolytic solution depends on many factors including the nature of the electrolyte and the dimensions of the electrolytic cell.

Faraday's laws of electrolysis are related to:

1. Speed of cation
2. Equivalent mass of electrolyte
3. Atomic number of anion
4. Atomic number of cation

Options:

A.

1

B.

2

C.

3

D.

4

Answer: B

Solution:

Faraday's Laws of Electrolysis quantify the relationship between the amount of substance produced or consumed at an electrode and the electric char through the electrolyte.

Faraday's First Law: The mass (m) of substance liberated is directly proportional to the charge (Q) passed.

$$m \propto Q$$

Faraday's Second Law: The masses (m_1, m_2) of different substances produced by the same amount of charge are proportional to their equivalent masse

$$\frac{m_1}{m_2} = \frac{E_1}{E_2}$$

Thus, the laws are fundamentally related to the **equivalent mass** (or the **chemical equivalent**) of the substance undergoing deposition or liberation.

Question49

Read the passage carefully and answer the questions

Electrochemistry is the study involving two types of processes. One type involves the production of electricity from the energy released during a spontaneous chemical reaction. Galvanic cells like Daniel cells are used to produce electricity from the redox reaction. Nernst equation of a galvanic cell gives the relation between the standard cell potential and the concentration of the species involved in the redox reaction. The second type of study involves the cells in which electrical energy is used to bring about the chemical reactions in a non-spontaneous process. The conductance of electrolytic solution depends on many factors including the nature of the electrolyte and the dimensions of the electrolytic cell.

When KCI is dissolved in water, the Potassium ion is;

1. Oxidized
2. Reduced
3. Hydrated
4. Hydrolyzed

Options:

A.

1

B.

2

C.

3

D.

4

Answer: C

Solution:

When KCl (Potassium Chloride) dissolves in water, the solid ionic lattice dissociates into ions:

$$\mathrm{KCl(s)} \rightarrow \mathrm{K}^+(aq) + \mathrm{Cl}^-(aq)$$

The Potassium ion (K^+), being a cation, is surrounded by polar water molecules, which orient their

oxygen atoms (the negative end) towards the ion. This process is called hydration or solvation.

It is a salt of a strong acid (HCl) and a strong base (KOH), so neither the K^+ nor the Cl^- ions undergo hydrolysis (reaction with water to change pH).

K is in its most stable oxidation state (+1) and does not undergo oxidation or reduction upon dissolving.

Question50

Read the passage carefully and answer the questions

Electrochemistry is the study involving two types of processes. One type involves the production of electricity from the energy released during a spontaneous chemical reaction. Galvanic cells like Daniel cells are used to produce electricity from the redox reaction. Nernst equation of a galvanic cell gives the relation between the standard cell potential and the concentration of the species involved in the redox reaction. The second type of study involves the cells in which electrical energy is used to bring about the chemical reactions in a non-spontaneous process. The conductance of electrolytic solution depends on many factors including the nature of the electrolyte and the dimensions of the electrolytic cell.

The following equation represents the reaction taking place in a Galvanic cell:

$$\mathrm{Mg(s)} + 2\mathrm{Ag}^+(0.001\,\mathrm{M}) \rightarrow \mathrm{Mg}^{2+}(0.01\,\mathrm{M}) + 2\mathrm{Ag(s)}$$

Calculate its E_{cell} at $298\,\mathrm{K}$ if $E^\circ_{\text{cell}} = 2.91\,\mathrm{V}$.

1. 2.79 V
2. 2.96 V

3. 3.21 V

4. 1.52 V

Options:

A. 1

B. 2

C. 3

D. 4

Answer: A

Solution:

$$\textbf{Given:} \quad \mathrm{E}^\circ_{\text{cell}} = 2.91\,\mathrm{V}$$

$$\textbf{Overall Reaction:} \quad \mathrm{Mg(s)} + 2\mathrm{Ag}^+(0.001\,\mathrm{M}) \rightarrow \mathrm{Mg}^{2+}(0.01\,\mathrm{M}) + 2\mathrm{Ag(s)}$$

$$\textbf{Number of electrons transferred:} \quad n = 2$$

$$\textbf{Reaction Quotient:} \quad Q = \frac{[Mg^{2+}]}{[Ag^{+}]^2} = \frac{0.01}{(0.001)^2} = \frac{10^{-2}}{10^{-6}} = 10^4$$

$$\textbf{Nernst Equation:} \quad E_{\text{cell}} = E^{\circ}_{\text{cell}} - \frac{0.0592}{n}\log Q$$

$$E_{\text{cell}} = 2.91 - \frac{0.0592}{2}\log(10^4)$$

$$E_{\text{cell}} = 2.91 - (0.0296)(4)$$

$$E_{\text{cell}} = 2.91 - 0.1184 = 2.7916\,\text{V} \approx 2.79\,\text{V}$$