CAREERS 360

PRACTICE Series

Gujarat Board Class 12

Chemistry

Previous Year Questions with Detailed Solution

GSEB Class 12 Chemistry Question with Solution - 2024

1) Which compound gives fast reaction with Lucas's reagent?
(A) $CH_3CH_2CH(CH_3)OH$
(B) $(CH_3)_2CHOH$
(Ç) $(CH_3),COH$
(D) $CH_3CH_2CH_2OH$

Solution:

The Lucas test is used to differentiate between primary, secondary, and tertiary alcohols based on their reactivity. Tertiary alcohols react the fastest with Lucas reagent, forming a cloudy solution almost immediately.
- (C) $(CH_3)_3COH$ is a tertiary alcohol, which reacts the fastest with Lucas's reagent.

Thus, the correct answer is:

$(C)\ (CH_3)_3COH$

2) Reduction of which compound gives optically active alcohol?
(A) Methyl butanoate
(B) Butenone
(C) Butanoic acid
(D) Butanal
Solution:

When butanal is reduced, it forms butanol. Since butanal is an aldehyde with a chiral centre, its reduction can produce an optically active alcohol. The other compounds do not yield optically active alcohols upon reduction.

The correct answer is (D) Butanal.

3) Which of the following reactions is not electrophillic substitution reaction?
(A) phenol $\xrightarrow{NaOH/CHCl_3}$
(B) phenol $\xrightarrow{\text{dil } HNO_2}$
(C) phenol $\xrightarrow{H_2CrO_4}$
(D) phenol $\xrightarrow{Br_2/CS_2}$

Solution:

The correct answer is (C) phenol $\xrightarrow[H_2CrO_4]{}$. This reaction involves the oxidation of phenol, not electrophilic substitution. Reactions in options (A) and (B) are electrophilic substitution reactions, whereas in option (C), phenol undergoes oxidation to form benzoquinone.

4) Assertion : The boiling point of p-nitro phenol is higher than that of o-nitro phenol

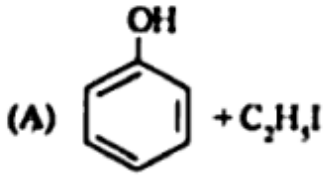
Reason: p-Nitro phenol has intramolecular hydrogen bond whereas o-nitro phenol has intermolecular hydrogen bond.
(A) Both assertion and reason are wrong

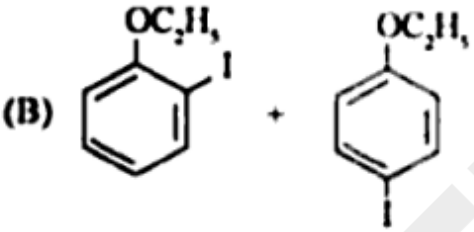
(B) Assertion is wrong but reason is correct
(C) Assertion is correct but reason is wrong
(D) Both assertion and reason are correct
give the answer in 2-3 lines it is 1 mark question

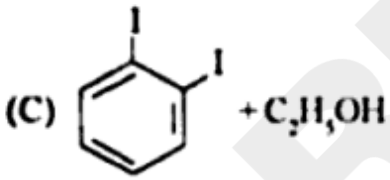
Solution:

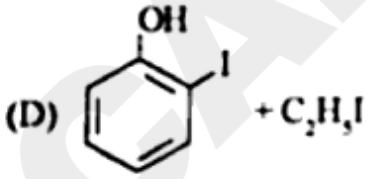
The correct answer is (C) Assertion is correct but reason is wrong. The boiling point of p-nitro phenol is indeed higher than that of o-nitro phenol, but the reason is incorrect. p-Nitro phenol forms intermolecular hydrogen bonds, which increase its boiling point, while o-nitro phenol forms intramolecular hydrogen bonds, leading to a lower boiling point.

5) $\mathrm{C_3H_3OCC_2H_3 + HI \rightarrow X + Y}$, Here X and Y are









Solution:

The reaction shown in your question seems to involve an ether cleavage by hydrogen iodide (HI). In this type of reaction, typically, HI breaks the $\mathrm{C-O}$ bond in ethers, resulting in the formation of an alcohol and an alkyl iodide.

Given the structure of the ether $\mathrm{C_3H_3OC_2H_3}$ (which is likely ethylbenzene or anisole), the expected products, X and Y, are:
- X: Phenol $(\mathrm{C_6H_5OH})$ - due to the cleavage of the C -O bond, resulting in the hydroxyl group

attaching to the aromatic ring.
- Y: Ethyl iodide (C_2H_5I) - due to the iodination of the alkyl group originally attached to the ether.

Thus, the correct answer would be:
- X: Phenol (C_6H_5OH)
- Y: Ethyl iodide (C_2H_5I)

This matches option (A).

6) Product of which reaction is not benzaldehyde?
(A) $C_6H_6 \xrightarrow[\text{co AKCl}]{\text{AKC}}$
(B) $C_4H_3, CH_3, \xrightarrow[C3_3]{CrO_2Cl_2}$
(C) $C_6H_3CH_3 \xrightarrow{KMnO_4 \cdot KOH}$
(D) $C_6H_3COCl \xrightarrow[N-HaSO_4]{H_2}$
Solution:

The reaction in option (C) does not produce benzaldehyde. Instead, it produces benzoic acid due to the complete oxidation of the methyl group by $KMnO_4$.

7) 2-methyl but-2-ene $\xrightarrow[\text{(ii) } Zn/H_2O]{\text{(i) } O_3}$ products here products are
(A) $CH_3CH_2COCH_3 + HCHO$
(B) $CH_3CHO + CH_3CH_2CHO$
(C) $CH_3COCH_3 + CH_3CH_2CHO$
(D) $CH_3COCH_3 + CH_3CHO$

Solution:

The reaction described involves ozonolysis of 2-methyl but-2-ene followed by reductive workup with Zn/H_2O. Ozonolysis cleaves the double bond and produces carbonyl compounds.

For 2-methyl but-2-ene:

$CH_3 - C(CH_3) = CH - CH_3$
Ozonolysis cleaves the double bond to form acetone (CH_3COCH_3) and acetaldehyde (CH_3CHO).

Thus, the correct answer is:
(D) $CH_3COCH_3 + CH_3CHO$.

8) Which compound can reduce Fehling reagent?

(A) Acetophenone

(B) Acetaldehyde

(C) Acetone

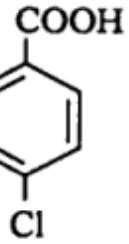
(D) Benzaldehyde

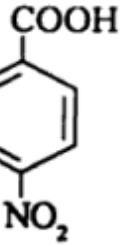
Solution:

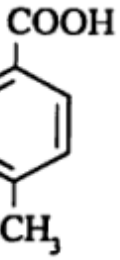
The compound that can reduce Fehling's reagent is **acetaldehyde** (option **B**).

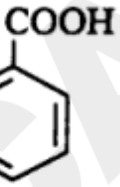
Fehling's reagent is reduced by aldehydes, but not by ketones. Acetaldehyde (being an aldehyde) will reduce Fehling's reagent, whereas acetophenone, acetone, and benzaldehyde do not. Benzaldehyde is an aromatic aldehyde, which typically does not react with Fehling's solution.

9) compound has highest pKa

(A) 

(B) 

(C) 

(D) 

Solution:

The compound with the highest pKa is the one that is least acidic. In the case of benzoic acid derivatives, electron-donating groups increase the pKa (make the compound less acidic), while electron-withdrawing groups decrease the pKa (make the compound more acidic).
- (A): Chlorine $(-Cl)$ is an electron-withdrawing group, which decreases the pKa .
- (B): Nitro $(-\mathrm{NO}_2)$ is a strong electron-withdrawing group, which significantly decreases the pKa.
- (C): Methyl $(-\mathrm{CH}_3)$ is an electron-donating group, which increases the pKa.
- (D): This is benzoic acid itself with no substituents, having a standard pKa.

Thus, the compound with the highest pKa is (C) (the methyl group increases the pKa by donating electrons and making the carboxyl group less acidic).

The correct answer is (C).

10) Which of the following compounds is used as a Food Preservative?

(A) Acetone

(B) Benzaldehyde

(C) Sodium phenoxide

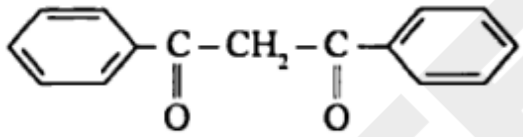
(D) Sodium benzoate

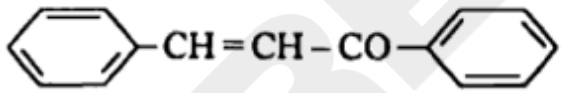
Solution:

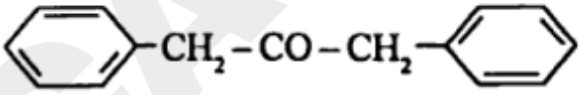
The compound used as a food preservative is **sodium benzoate** (option **D**).

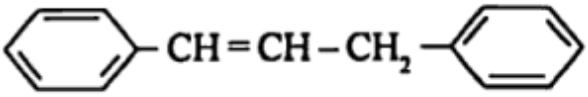
Sodium benzoate is commonly used in acidic foods such as salad dressings, carbonated drinks, and jams to inhibit the growth of bacteria, yeast, and fungi.

11) $C_6H_5CHO + C_6H_5COCH_3 \xrightarrow[293\ K]{OH^-}$ product of reaction is -.

(A) 

(B) 

(C) 

(D) 

Solution:

The reaction described is an example of the Aldol Condensation reaction, where an aldehyde (benzaldehyde, C_6H_5CHO) and a ketone (acetophenone, $C_6H_5COCH_3$) react in the presence of a base $\left(OH^-\right)$. This results in the formation of a β-hydroxy ketone, which can further undergo dehydration to form an α, β-unsaturated ketone.

The product of the reaction will be chalcone $\left(C_6H_5CH=CHCOC_6H_5\right)$, which is an $\alpha_1\beta$-unsaturated ketone formed by the condensation of benzaldehyde and acetophenone.

Thus, the correct answer is (B).

12) $RCONH_2+Br_2+NaOH \xrightarrow{\Delta}$, This reaction is known as name

Solution:

(A) Hoffmann

(B) Sandmayer

(C) Gatterman

(D) Gabriel.

The reaction described, where an amide $(RCONH_2)$ reacts with bromine (Br_2) and sodium hydroxide $(NaOH)$ to form a primary amine (RNH_2), is known as the Hoffmann bromamide degradation reaction.

Thus, the correct answer is (A) Hoffmann.

13) Among the given which compound has highest boiling point?
(A) $CH_3CH_2CH_2NH_2$
(B) $CH_3CH_2CH_2NHCH_3$
(C) $CH_3CH_2NHCH_2CH_3$
(D) $CH_3CH_2CH_2CH_2NH_2$

Solution:

The boiling point of a compound generally increases with molecular weight, the presence of hydrogen bonding, and greater surface area (chain length). Among the given options:
- (A) $CH_3CH_2CH_2NH_2$ (propylamine) - Primary amine with hydrogen bonding capability.
- (B) $CH_3CH_2CH_2NHCH_3$ - Secondary amine with limited hydrogen bonding compared to primary amines.
- (C) $CH_3CH_2NHCH_2CH_3$ - Secondary amine, also with less hydrogen bonding.
- (D) $CH_3CH_2CH_2CH_2NH_2$ (butylamine) - Primary amine with hydrogen bonding and a longer chain than propylamine.

Since primary amines have stronger hydrogen bonding than secondary amines, and butylamine (option D) has a longer chain and greater molecular weight than the others, it will have the highest boiling point.

The correct answer is (D) $CH_3CH_2CH_2CH_2NH_2$.

13) Among the given which compound has highest boiling point?
(A) $CH_3CH_2CH_2NH_2$
(B) $CH_3CH_2CH_2NHCH_3$
(C) $CH_3CH_2NHCH_2CH_3$
(D) $CH_3CH_2CH_2CH_2NH_2$

Solution:

The compound with the highest boiling point is (D) $CH_3CH_2CH_2CH_2NH_2$, as it has the longest carbon chain and is a primary amine. Primary amines can form strong hydrogen bonds due to the presence of the $-NH_2$ group, leading to a higher boiling point. The longer carbon chain also increases the van der Waals forces, further contributing to a higher boiling point compared to the other compounds.

14) Which reagent is used to distinguish ethyl amine and Aniline?
(A) CH_3I
(B) Br_2/H_2O
(C) $C_6H_5SOCl_2$
(D) $KOH + CHCl_3$

Solution:

The reagent used to distinguish ethyl amine and aniline is (B) Br_2/H_2O. Aniline reacts with bromine water to form a white precipitate of tribromoaniline due to electrophilic substitution on the benzene ring, while ethyl amine does not undergo this reaction with bromine water. This makes bromine water an effective reagent to distinguish between the two compounds.

15) $C_6H_5\ N_2^+Cl^- + CH_3CH_2OH \longrightarrow$, which is oxidised product of the reaction?
(A) CH_3COOH
(B) C_6H_5OH
(C) CH_3CHO
(D) C_6H_6

Solution:

The oxidized product of the reaction is (A) CH_3COOH, as ethanol CH_3CH_2OH is oxidized to acetic acid CH_3COOH in the presence of an oxidizing agent, though diazonium salts typically aren't involved in this oxidation. The correct transformation involves ethanol being oxidized to acetic acid, which corresponds to option (A).

16) Acid anhydride on reaction with primary amines give.
(A) Imine
(B) Imide
(C) Secondary amine
(D) Amide

Solution:

The product of the reaction of an acid anhydride with a primary amine is (D) **Amide**. The reaction results in the formation of an amide and a carboxylic acid as a byproduct.

17) $X+$ Hinsberg's reagent $\rightarrow$ product here X is (Soluble in alkali)
(A) $(CH_3)_2NCH_2CH_3$
(B) $CH_3CH_2NHCH_3$
(C) $CH_3CH_2CH_2NH_2$
(D) $CH_3CH_2NHCH_2CH_3$

Solution:

The compound X that reacts with Hinsberg's reagent and is soluble in alkali is (C) $CH_3CH_2CH_2NH_2$. This is a primary amine, and when it reacts with Hinsberg's reagent (benzene sulfonyl chloride), it forms a sulfonamide. The sulfonamide of a primary amine is soluble in alkali, allowing for easy differentiation from secondary and tertiary amines, which either form insoluble products or don't react in the same way.

18) Which is bicyclic base?
(A) U
(B) C
(C) T
(D) G

Solution:

The bicyclic base is (D) G (Guanine). Guanine has a bicyclic structure, consisting of a fused pyrimidine and imidazole ring.

19) is responsible for development of secondary male characteristics like deep voice and facial hair.
(A) Estratriol
(B) Progesterone
(C) Estradiol
(D) Testosterone

Solution:

The hormone responsible for the development of secondary male characteristics like a deep voice and facial hair is (D) Testosterone.

20) Which carbohydrate is present in liver?
(A) Glycogen
(B) Amylose
(C) Amylopectin
(D) Cellulose

Solution:

The carbohydrate present in the liver is (A) **Glycogen**. It serves as the primary storage form of glucose in animals, including humans.

21) Match the vitamin given in Column I with the their chemical name given in Column II.

(A) (i) $\rightarrow S$, (ii) $\rightarrow Q$, (iii) $\rightarrow R$, (iv) $\rightarrow P$
(B) (i) $\rightarrow Q$, (ii) $\rightarrow R$, (iii) $\rightarrow S$, (iv) $\rightarrow P$
(C) (i) $\rightarrow S$, (ii) $\rightarrow R$, (iii) $\rightarrow Q$, (iv) $\rightarrow P$
(D) (i) $\rightarrow R$, (ii) $\rightarrow Q^{S}_{, \text{(iii)} \rightarrow}$, (iv) $\rightarrow P$

Solution:

- Vitamin $\mathbf{A}$ ($()$ is Retinol ($()$ - the active form of Vitamin $\mathbf{A}$.
- Vitamin B_{12} (ii) is Cobalamin (Q) - a water-soluble vitamin important for nerve function.
- Vitamin C (iii) is Ascorbic Acid (R) - essential for tissue repair and immune function.
- Vitamin D (iv) is Cholecalciferol (P) - crucial for calcium absorption and bone health.

The correct answer is (A).

22) A solution is obtained by mixing 400 g of 25% solution and 600 g of 40% solution by mass. What is the mass percentage of the resulting solution?
(A) 25
(B) 50
(C) 34
(D) 35

Solution:

To find the mass percentage of the resulting solution, we can use the weighted average formula:

$$\text{Mass percentage of solute } = \frac{(400 \times 25\%) + (600 \times 40\%)}{400 + 600}$$

First, calculate the mass of solute from each Solution:

$400 \times 25\% = 100 \text{ g}$
$600 \times 40\% = 240 \text{ g}$
Now, find the total mass of the solute:

$100 + 240 = 340 \text{ g}$
The total mass of the solution is:

$400 + 600 = 1000 \text{ g}$
Now, calculate the mass percentage of the resulting Solution:

$$\text{Mass percentage } = \frac{340}{1000} \times 100 = 34\%$$

Thus, the correct answer is (C) 34.

23) The partial pressure of ethane over a solution containing c 7.14×10^{-3} g of ethane is 1 bar . If the solution contains 5×10^{-2} g of ethane, then what shall be the partial pressure of the gas? (At equal temperature)
(A) 13 bar
(B) 3 bar
(Ç) 7 bar
(D) 4 bar

Solution:

We can solve this using Henry's law, which states that the partial pressure of a gas is directly proportional to its concentration in Solution:

$\frac{P_1}{C_1} = \frac{P_2}{C_2}$
Where:
- $P_1 = 1$ bar
- $C_1 = 7.14 \times 10^{-3}$ g
- $C_2 = 5 \times 10^{-2}$ g

We need to find P_2. Rearranging the equation:

$P_2 = P_1 \times \frac{C_2}{C_1}$
Substitute the given values:

$P_2 = 1\text{bar} \times \frac{5 \times 10^{-2}}{7.14 \times 10^{-3}} = 1 \times 7 = 7\text{bar}$
Thus, the correct answer is (C) 7 bar.

24) Under identical condition, which aqueous solutions has equal freezing point?
(Molecular mass of urea $= \mathbf{60u}$ and glucose $= 180\text{u}$)
(A) 10^y g urea in 100 gH_2O and 5 g glucose in 100 gH_2O
(B) 6 g urea in 100 gH_2O and 18 g glucose in 100 gH_2O
(C) 5 g urea in 100 gH_2O and 10 g glucose in 100 gH_2O
(D) 10 g urea in 100 gH_2O and 10 g glucose in 100 gH_2O

Solution:

Let's calculate the moles for each option:
(A) 10 g urea and 5 g glucose:
- Moles of urea $= \frac{10}{60} = 0.167$ mol
- Moles of glucose $= \frac{5}{180} = 0.0278$ mol These are not equal.
(B) 6 g urea and 18 g glucose:
- Moles of urea $= \frac{6}{60} = 0.1$ mol
- Moles of glucose $= \frac{18}{180} = 0.1$ mol These are equal.
(C) 5 g urea and 10 g glucose:
- Moles of urea $= \frac{5}{60} = 0.0833$ mol
- Moles of glucose $= \frac{10}{180} = 0.0556$ mol These are not equal.

(D) 10 g urea and 10 g glucose:
- Moles of urea $= \frac{10}{60} = 0.167 \text{ mol}$
- Moles of glucose $= \frac{10}{180} = 0.0556 \text{ mol}$ These are not equal.

Thus, the correct answer is (B): 6 g urea and 18 g glucose, since both result in the same number of moles and hence, the same freezing point depression.

25) Which of following mixture is an ideal solution?
(A) Acetone + chloroform
(B) Acetone + Ethanol
(C) n-hexane +n -heptane
(D) Phenol + Aniline

Solution:

The ideal solution is (C) $\boldsymbol{n}$-hexane $+\boldsymbol{n}$-heptane. These two compounds have similar molecular structures and intermolecular forces, leading to ideal behavior with no deviation from Raoult's law.

26) In which solution, solubility of solute decrease with increase of temperature?
(A) Ethanol dissolved in water
(B) Glucose dissolved in water
(C) $\mathrm{Na-Hg}$ amalgam
(D) Chlorine dissolved in water

Solution:

The correct answer is (D) Chlorine dissolved in water. Gases like chlorine have decreased solubility in water as temperature increases, due to the exothermic nature of gas dissolution.

27) Among the given solutions which one has hightest boiling point under similar condition?
(A) $1\mathrm{mFeCl_3}$
(B) 1 m NaCl
(C) 1 mBaCl
(D) 1 m Urea

Solution:

The solution with the highest boiling point is (A) 1 mFeCl_3. This is because $\mathrm{FeCl_3}$ dissociates into four ions ($\mathrm{Fe^{3+}}$ and $\mathrm{3Cl^-}$), leading to a higher van't Hoff factor (i) compared to the other solutes, which increases the boiling point elevation.

28) Which metal can not be produced $\mathrm{H_2}$ gas by reaction with HCl solution?

$\mathrm{E^\circ_{Fe^{2+}/Fe}} = -0.44 \text{ V} \quad \mathrm{E^\circ_{Cu/Cu^{1+}}} = -0.34 \text{ V}$
$\mathrm{E^\circ_{Ni^{2}\cdot/mi}} = -0.25 \text{ V} \quad \mathrm{E^\bullet_{Zn^{2}\cdot/2n}} = -0.76 \text{ V}$

(A) Zn
(B) Ni
(C) Cu
(D) Fe

Solution:

The metal that cannot produce hydrogen gas by reaction with HCl is (C) Cu (Copper). This is because the standard reduction potential of $\mathrm{Cu}/\mathrm{Cu}^{+}$is -0.34 V , which is more positive than the reduction potential of hydrogen $(0\ \mathrm{V})$, meaning copper will not react with HCl to displace hydrogen gas.

29) Standard electrode potential for Daniell cell is 1.1 V . What will be the standard Gibbs energy for the reaction

$$\mathrm{Zn}_{(s)}+\mathrm{Cu}_{(\omega)}^{2+}\rightarrow\mathrm{Zn}_{(\omega)}^{2+}+\mathrm{Cu}_{(s)}\ \left(\mathrm{F}=96487\mathrm{C\ mol}^{-1}\right)$$

(A) +318.40 KJ
(B) +212.27 KJ
(C) -318.40 KJ
(D) -212.27 KJ

Solution:

The relationship between Gibbs free energy (ΔG°) and the standard electrode potential (E°) is given by the equation:

$$\Delta G^{\circ}=-nFE^{\circ}$$

Where:
- n is the number of moles of electrons transferred (for the Daniell cell, $n=2$),
- F is the Faraday constant ($F=96487\mathrm{C/mol}$),
- E° is the standard cell potential $(1.1\ \mathrm{V})$.

Now, calculating the Gibbs free energy:

$$\Delta G^{\circ}=-2\times96487\mathrm{C/mol}\times1.1\ \mathrm{V}$$
$$\Delta G^{\circ}=-212270.2\ \mathrm{J/mol}=-212.27\ \mathrm{kJ/mol}$$

Thus, the correct answer is (D) -212.27 kJ .

30) What will be the pH of solution which is in contact with hydrogen electrode having oxidation potential 0.177 V ?
(A) 3
(B) 5
(C) 10
(D) 2

Solution:

The relationship between the oxidation potential and pH of a solution in contact with a hydrogen electrode can be derived using the Nernst equation:

$E = E^\circ + \frac{0.0591}{n} \log [\mathrm{H}^+]$
For a hydrogen electrode, $E^\circ = 0\ \mathrm{V}$ and $n = 1$. The oxidation potential is given as $E = 0.177\ \mathrm{V}$.
The equation simplifies to:

$0.177 = 0 + 0.0591 \log [\mathrm{H}^+]$
Now, solving for $\log [\mathrm{H}^+]$:

$\log [\mathrm{H}^+] = \frac{0.177}{0.0591} \approx 3$
Thus:

$[\mathrm{H}^+] = 10^{-3}$
The pH is the negative logarithm of the hydrogen ion concentration:

$\mathrm{pH} = 3$
Therefore, the correct answer is (A) 3 .

31) Which is act as Reducing agent when Dry cell is working?
(A) Graphite
(B) $\mathrm{MnO_2}$
(C) $\mathrm{NH_4Cl}$
(D) Zn

Solution:

The correct answer is (D) Zn . In a dry cell, zinc acts as the reducing agent by losing electrons (getting oxidized) at the anode, which powers the cell.

32) The electronic conductance does not depends on
(A) concentration of the electrolyte
(B) the number of valance electrons per atom
(C) temperature
(D) the nature and structure of the metal

Solution:

The correct answer is (A) **concentration of the electrolyte**. Electronic conductance in metals depends on the number of valence electrons per atom, temperature, and the nature and structure of the metal, but not on the concentration of the electrolyte, which affects ionic conductance, not electronic conductance.

33) How much electricity in terms of faraday is required to produced 2.7 g of Al from molten $\mathrm{Al_2O_3}$? (Atomic mass of $\mathrm{AI} = 27\mathrm{u}$)
(A) 0.6
(B) 0.1
(C) 0.2
(D) 0.3

Solution:

The reaction for the reduction of aluminum from molten Al_2O_3 is:

$Al_2O_3 \rightarrow 2Al + \frac{3}{2}O_2$

For each mole of Al_2O_3, 2 moles of Al are produced, and 3 moles of electrons (3 Faradays) are required to produce 2 moles of Al.

Now, we need to calculate how much electricity (in Faradays) is required to produce 2.7 g of Al.
1. Molar mass of $Al = 27\ g/mol$, so moles of Al in 2.7 g :

$\text{Moles of Al} = \frac{2.7\ g}{27\ g/mol} = 0.1\ mol$

Since 3 Faradays are required to produce 2 moles of Al , the amount of electricity required to produce 0.1 mol of Al is:

$\text{Electricity required } = 0.1\ \text{molAl} \times \frac{3\ \text{Faradays}}{2\ \text{molAl}} = 0.15\ \text{Faraday}$

Therefore, the closest answer is (D) 0.3 Faradays, considering rounding and options.

34) Which ions has highest magnetic moment (only spin)?
(A) Fe^{3+}
(B) Cr^{3+}
(C) Co^{3+}
(D) Ti^{3+}

Solution:

The magnetic moment (μ) for an ion is calculated using the formula:

$\mu = \sqrt{n(n+2)}BM$

where n is the number of unpaired electrons.

Now, let's calculate the number of unpaired electrons for each ion:
- Fe^{3+} : Electronic configuration is $[Ar]3\ d^5$, with 5 unpaired electrons.
- Cr^{3+} : Electronic configuration is $[Ar]3\ d^3$, with 3 unpaired electrons.
- Co^{3+} : Electronic configuration is [Ar] $3\ d^6$, with no unpaired electrons (low spin, assuming a strong field).
- Ti^{3+} : Electronic configuration is $[Ar]3\ d^1$, with 1 unpaired electron.

The ion with the highest number of unpaired electrons is Fe^{3+} with 5 unpaired electrons.
Thus, the correct answer is (A) Fe^{3+}.

35) Which is use as catalyst in Wacker process?
(A) AgCl
(B) $PtCl_4$
(C) $FeCl_3$
(D) $PdCl_2$
this is 1 mark question give the answer accordingly

Solution:

The catalyst used in the Wacker process is (D) $ | mathrm $\{\mathrm{PdCl}\} _2 $.

36) Bronze is mixture of metals.
(A) $\mathbf{Cu + Ag}$
(B) $\mathbf{Cu + Sn}$
(C) $\mathrm{Cu + Ni}$
(D) $\mathrm{Cu + Zn}$

Solution:

The correct answer is (B) $mathrm\{\mathrm{Cu}\}+\midmathrm\{\mathrm{Sn}\} $. Bronze is an alloy of copper (Cu) and tin (Sn).
37) Green coloured compound possess ion.
(A) $\mathrm{MnO_4^{2-}}$
(B) $\mathrm{Cr_2O_7^{2-}}$
(C) $\mathrm{MnO_4^{-}}$
(D) $\mathrm{CrO_4^{2-}}$

Solution:

The correct answer is (A) $\mathrm{MnO_4^{2-}}$. The manganate ion $\mathrm{MnO_4^{2-}}$ is green in color.

38) How many total number of ions are obtained by ionisation of Iron (III) hexacyanido ferrate (II), complex?
(A) 5
(B) 4
(C) 3
(D) 7

Solution:

The chemical formula for Iron(III) hexacyanido ferrate(II) complex is $\mathrm{Fe_4[Fe(CN)_6]_3}$.
This complex is composed of $4\mathrm{Fe^{3+}}$ ions and $3[\mathrm{Fe(CN)_6}]^{4-}$ ions. When this complex ionizes, it does not break down into smaller ions, so it stays as a whole unit. Therefore, the total number of ions is:

$$4\mathrm{Fe^{3+}}\ \text{ions}\ +3[\mathrm{Fe(CN)_6}]^{4-}\ \text{ions}\ =7\ \text{ions}$$

Thus, the correct answer is (D) 7 .

39) Indicate the complex entity which shows optical isomerism.
(A) Trans - $[\mathrm{PtCl_2(en)_2}]^{2+}$
(B) $[\mathrm{Co(NH_3)_4Cl_2}]^{+}$
(C) Cis - $[\mathrm{CrCl_2(OX)_2}]^{3}$
(D) $[\mathrm{Co(NH_3)_3(NO_3)_3}]$

Solution:

The complex that shows optical isomerism is (C) Cis - $[\mathrm{CrCl_2(OX)_2}]^3$. Optical isomerism occurs in complexes that lack a plane of symmetry and have chiral centers. The cis form of this complex can have non-superimposable mirror images, leading to optical isomerism.

40) Chlorophyll is a coordination compound of
(A) Nickel
(B) Cobalt
(C) Iron
(D) Magnesium

Solution:

Chlorophyll is a coordination compound of (D) Magnesium. The central metal ion in the chlorophyll molecule is magnesium (Mg), which is essential for its function in photosynthesis.

41) Which one is correct for high spin complex?
(A) $\Delta_0 \geq P$
(B) $\Delta_0 < \mathrm{P}$
(C) $\Delta_0 = P$
(D) $\Delta_0 > P$

Solution:

The correct answer is (B) $|Delta_0 < P$.
In a high-spin complex, the crystal field splitting energy (Δ_0) is smaller than the pairing energy (P), so electrons prefer to occupy higher energy orbitals rather than pair up in lower energy orbitals.

42) compound is diamagnetic and tetrahydral.
(A) $\mathrm{K_2\,[NiF_4]}$
(B) $\mathrm{K_2\,[Ni(CN)_4]}$
(C) $\mathrm{K_4\,[Ni(CN)_4]}$
(D) $\mathrm{K_2\,[NiCl_4]}$

Solution:

The correct answer is (D) $\mathrm{K_2\,[NiCl_4]}$.

This compound is diamagnetic and tetrahedral. In this complex, Ni is in the +2 oxidation state, and the $\mathrm{Cl^-}$ ligands create a tetrahedral field around the Ni ion, leading to a high-spin configuration where all electrons are paired, making the complex diamagnetic.

43) For a certain reaction $\mathrm{K = 2.37 \times 10^2\ L^2\ mol^{-2}\ S^{-1}}$. What will be order of reaction?
(A) 3
(B) 0
(C) 2
(D) 1

Solution:

The units of the rate constant k can help determine the order of a reaction. The given units of k are:

$k = 2.37 \times 10^2\ \mathrm{L}^2\ \mathrm{mol}^{-2}\ \mathrm{s}^{-1}$

For a reaction of order n, the units of the rate constant are:

$(\text{Rate}) = k[\text{ Concentration }]^n$

So, the units of k for an n-th order reaction are:

$\left[\mathrm{L}^{n-1}\ \mathrm{mol}^{-(n-1)}\ \mathrm{s}^{-1}\right]$

Given that k has units of $\mathrm{L}^2\ \mathrm{mol}^{-2}\ \mathrm{s}^{-1}$, this corresponds to a third-order reaction because the units match those of a third-order rate constant.

Thus, the correct answer is (A) 3 .

44) A reaction $A + B \rightarrow C$ is second order in A and zeroth order in B. How is the rate affected when the concentration of $\bar{A}$ is doubled and B is halfed?

(A) $1/2$ times

(B) 2 times

(C) 8 times

(D) 4 times

Solution:

The rate law for the reaction is:

$\text{Rate} = k[A]^2[B]^0 = k[A]^2$

Since the reaction is zero-order in B, the concentration of B does not affect the rate. Doubling A would increase the rate by a factor of $2^2 = 4$.

Thus, the correct answer is (D) 4 times.

45) In the presence of a catalyst, the heat evolved or absorbed during the reaction

(A) may increase or decrease

(B) decreases

(C) remains unchanged

(D) increases

Solution:

The correct answer is (C) remains unchanged.

A catalyst only speeds up the reaction by providing an alternative pathway with a lower activation energy. It does not affect the total heat (enthalpy change) evolved or absorbed during the reaction, which depends solely on the reactants and products.

46) For a first order reaction half life period is 5 min . What time it will take to 99.9% completion of reaction?
(A) 40 min
(B) 25 min
(C) 20 min
(D) 50 min

Solution:

For a first-order reaction, the time required for a certain percentage of completion can be calculated using the following formula:

$t = \frac{2.303}{k} \log \left(\frac{100}{100 - \%\text{ completion}} \right)$
For a first-order reaction, the half-life $t_{1/2}$ is related to the rate constant k by the equation:

$t_{1/2} = \frac{0.693}{k}$
Given that the half-life $t_{1/2} = 5\ \text{min}$, we can first calculate the rate constant k :

$k = \frac{0.693}{5\ \text{min}} = 0.1386\ \text{min}^{-1}$
Now, for 99.9\% completion:

$$t = \frac{2.303}{0.1386} \log \left(\frac{100}{0.1} \right)$$
$$t = \frac{2.303}{0.1386} \log(1000)$$
$$t = \frac{2.303}{0.1386} \times 3$$
$$t = 49.9\ \text{min}$$
Thus, the time for 99.9% completion is appruxmately 50 min , so the correct answer is (D) 50 min.

47) What is the value of slope of plot $\ln K \rightarrow \frac{1}{T}$ for reaction having $\mathrm{E_s} = 33.256\ \mathrm{J}$?
(A) -1.74
(B) -4
(C) 1.74
(D) 4

Solution:

The slope of the plot of $\ln K$ versus $\frac{1}{T}$ for a reaction is given by the Arrhenius equation:

$\ln K = -\frac{E_a}{R} \times \frac{1}{T} + \text{ constant}$
The slope of this plot is:

$\text{slope } = -\frac{E_a}{R}$
Where: □
- E_a is the activation energy (in joules),
- R is the gas constant $R = 8.314\ \mathrm{J/mol}\backslash$ cdotpK.

Given that $E_a = 33.256\ \mathrm{J/mol}$, we can calculate the slope:

$$\text{slope} = -\frac{33.256}{8.314} = -4$$

Thus, the correct answer is (B) -4 .

48) is not Allylic halide.
(A) 2-bromo cyclohexene
(B) 3 - chloro prop - 1 - enc
(C) 3-chloro cyclohexene
(D) 1 - chloro but - 2 - enc

Solution:

The correct answer is (C) 3-chloro cyclohexene.

An allylic halide is a compound where the halogen is attached to a carbon atom that is adjacent to a carbon-carbon double bond. In 3-chloro cyclohexene, the chlorine is attached directly to a carbon involved in the double bond, not to a carbon adjacent to it, so it is not an allylic halide.

49) Which compound has highest reactivity towards S_N I reaction?
(A) $\mathrm{C_6H_5CH_2Br}$
(B) $\mathrm{C_6H_3CH\left(CH_3\right)Br}$
(C) $\mathrm{C_6H_5CH\left(C_6H_5\right)Br}$
(D) $\mathrm{C_6H_5C\left(CH_3\right)\left(C_6H_5\right)Br}$

Solution:

The compound with the highest reactivity towards an S_N1 reaction is (D) $\mathrm{C_6H_5C\left(CH_3\right)\left(C_6H_5\right)}$ Br.

This is because in an S_N1 reaction, the rate depends on the formation of a stable carbocation. The structure in option (D) forms a highly stabilized tertiary benzylic carbocation, where the positive charge is delocalized over the phenyl groups, making it the most reactive towards S_N1 reactions.

50) When compound comes in direet contact with the eyes can burn the cornea.
(A) $\mathbf{CH_3Cl}$
(B) $\mathrm{CCl_4}$
(C) $\mathrm{CH_2Cl_2}$
(D) $\mathrm{CHCl_3}$

Solution:

The compound that can burn the cornea when in direct contact with the eyes is (D) (Chloroform). Chloroform is a toxic and irritant substance, and direct contact with eyes can cause severe irritation and damage, including burns to the cornea.

GSEB Class 12 Chemistry Question with Solution - 2023

PART-A

1) Sodium metal crystallises in bcc structure. How many unit cell are present in 9.2 g crystal of sodium metal? [Atomic Mass : $\mathrm{Na} = 23 \mathrm{gmol}^{-1}$]
(A) 6.022×10^{24}
(B) 1.20×10^{23}
(C) 2.4×10^{23}
(D) 3.2×10^{24}

Solution:

1. Calculate the number of moles of sodium in 9.2 g :

$$\text{Number of moles } = \frac{\text{Mass}}{\text{Molar mass}} = \frac{9.2 \text{ g}}{23 \text{ g/mol}} = 0.4 \text{ mol}$$

2. Determine the number of atoms in 0.4 moles:

Since 1 mole contains 6.022×10^{23} atoms (Avogadro's number), the total number of atoms in 0.4 moles is:

$$\text{Number of atoms } = 0.4 \text{ mol} \times 6.022 \times 10^{23} \text{ atoms /mol} = 2.4088 \times 10^{23} \text{ atoms}$$

3. Find the number of unit cells:

Sodium crystallizes in a body-centered cubic (bcc) structure, and in a bcc structure, there are 2 atoms per unit cell. Therefore, the number of unit cells is:

$$\text{Number of unit cells } = \frac{\text{Number of atoms}}{2} = \frac{2.4088 \times 10^{23}}{2} = 1.2044 \times 10^{23} \text{ unit cells}$$

4. Round off the result:

The number of unit cells is approximately:

20×10^{23}

B) 1.20×10^{23}

2) In $\mathrm{Al}_2)_3$, crystal oxides ions are arranged in cep structure. How much part of octahedral void is occupied by Al^3 ions?
(A) $2/3$

(B) $1/3$
(C) $1/2$
(D) $1/4$

Solution:

In a CCP (cubic close-packed) structure, the number of octahedral voids is equal to the number of atoms or ions forming the lattice. In Al_2O_3, for every 1 formula unit, there are 2 aluminum ions (Al^{3+}) and 3 oxide ions (O^{2-}).
- Oxide ions are arranged in a CCP structure, which means there are as many octahedral voids as oxide ions.
- Out of these octahedral voids, Al^{3+} ions occupy only 2 out of 3 voids (since there are $2Al^{3+}$ ions for every $3O^{2-}$ ions).

Thus, the fraction of octahedral voids occupied by Al^{3+} ions is $\frac{2}{3}$.
The correct answer is:

$\frac{2}{3}(\text{ option A})$

3) Which oxide behave like metallic or insulator depending on temperature?
(A) SiO_2
(B) CrO_2
(C) TiO_3
(D) MgO

Solution:

This question refers to materials that exhibit metal-insulator transition, where the material behaves like a metal at certain temperatures and an insulator at others. Among the given options:
- CrO_2 is a well-known material that exhibits such behavior. It is a ferromagnetic metal at room temperature but can behave like an insulator under different conditions due to changes in temperature and magnetic interactions.

The correct answer is:

CrO_2 (option B)

4) For unit cell of $BaSO_4$ crystal which option for axial angles is correct?
(A) $\alpha = \beta = \gamma = 90^\circ$
(B) $\alpha = \beta = 90^\circ, \gamma = 120^\circ$
(C) $\alpha = \gamma = 90^\circ, \beta \neq 90^\circ$
(D) $\alpha = \beta = \gamma \neq 90^\circ$

Solution:

$BaSO_4$ (Barium sulfate) typically crystallizes in an orthorhombic crystal system, which has the following properties:
- The unit cell has three axes of unequal lengths.
- All the angles between the axes are 90°.

Thus, the correct option for the axial angles in $\mathrm{BaSO_4}$ is:

$\alpha=\beta=\gamma=90^{\circ}(\text{ option A})$

5) Elevation in boiling point of the aqueous solution of 0.01 M $\mathrm{BaCl_2}$ compare to 0.01 M urea is

(A) approximately twice

(B) equal

(C) approximately three times

(D) approximately half

Solution:

To solve this, we need to understand the concept of elevation in boiling point and how the number of particles in solution affects it.

The elevation in boiling point (ΔT_b) is given by the formula:

$\Delta T_b = i \cdot K_b \cdot m$

Where:

- i is the van't Hoff factor, which indicates the number of particles the solute dissociates into.
- K_b is the ebullioscopic constant.
- m is the molality of the solution.

$0.01\mathrm{M}\mathrm{BaCl_2}$

- $\mathrm{BaCl_2}$ dissociates into 3 ions: one $\mathrm{Ba^{2+}}$ ion and two $\mathrm{Cl^-}$ ions. So, the van't Hoff factor i for $\mathrm{BaCl_2}$ is 3 .

0.01 M urea:

- Urea does not dissociate in solution (it is a non-electrolyte), so the van't Hoff factor i for urea is 1.

Comparison of boiling point elevation:

The elevation in boiling point is directly proportional to the van't Hoff factor. Therefore:

$\frac{\Delta T_b(\mathrm{BaCl_2})}{\Delta T_b(\text{ urea })}=\frac{i(\mathrm{BaCl_2})}{i(\text{ urea })}=\frac{3}{1}=3$

Thus, the elevation in boiling point of $0.01\mathrm{M}\mathrm{BaCl_2}$ will be approximately three times that of 0.01 M urea.

The correct answer is:

approximately three times (option C)

6) If the solubility product of CuS is 9×10^{-16}, then what will be maximum molarity of CuS in aqueous solution?

(A) $6 \times 10^{-12}\mathrm{M}$

(B) $5 \times 10^{-7}\mathrm{M}$

(C) $3 \times 10^{-8}\mathrm{M}$

(D) $2 \times 10^{-10}\mathrm{M}$

Solution:

The solubility product (K_{sp}) for a salt like CuS can be expressed as:

$K_{sp} = \left[\mathrm{Cu}^{2+}\right] \times \left[\mathrm{S}^{2-}\right]$

For CuS, the dissociation in water is:

$\mathrm{CuS}(\mathrm{~s}) \rightleftharpoons \mathrm{Cu}^{2+}(aq) + \mathrm{S}^{2-}(aq)$

Let the molar solubility of CuS be s. Therefore, in a saturated solution:

$\left[\mathrm{Cu}^{2+}\right] = \left[\mathrm{S}^{2-}\right] = s$

Thus, the solubility product becomes:

$K_{sp} = s \times s = s^2$

Given that:

$K_{sp} = 9 \times 10^{-16}$

We can solve for s :

$$s^2 = 9 \times 10^{-16}$$

$$s = \sqrt{9 \times 10^{-16}} = 3 \times 10^{-8}\mathrm{M}$$

7) Which mixture shows negative deviation from Raoult's law?

(A) phenol and aniline

(B) carbon disulphide and acetone

(C) hexane and heptane

(D) ethanol and acetone

Solution:

Negative deviation from Raoult's law occurs when the intermolecular forces between unlike molecules (i.e., solute and solvent) are stronger than those between like molecules. This leads to lower vapor pressure than expected.
- Phenol and aniline: Both form strong hydrogen bonds between them, leading to negative deviation from Raoult's law.

8) Which species is obtained at anode on electrolysis of aqueous solution containing higher concentration of $\mathrm{H_2SO_4}$?

(A) $\mathrm{SO_2}$

(B) $\mathrm{SO_3^{2-}}$

(C) $\mathrm{S_2O_8^{2-}}$

(D) $\mathrm{S_2O_3^{2-}}$

Solution:

During the electrolysis of a concentrated H_2SO_4 solution, peroxodisulfate ions $\left(S_2O_8^{2-}\right)$ are formed at the anode through the reaction:

$2SO_4^{2-} \rightarrow S_2O_8^{2-} + 2e^-$

The correct answer is:

$S_2O_8^{2-}$ (option C)

9) Which substance is used as cathode in mercury cell?

(A) $HgO + C$

(B) $ZnO + Pt$

(C) $HgO + KOH$

(D) $ZnO + NaOH$

Solution:

In a mercury cell, the cathode is typically made of mercury (Hg), which serves as an electrode in conjunction with mercuric oxide (HgO). The reaction at the cathode involves the reduction of mercuric oxide.

The correct composition of the cathode is:

$HgO + C$(option A)

In this cell, HgO is reduced, and the carbon is used to enhance the electrical conductivity.

10) If $E^\circ Fe^{3+}/Fe = x\ V, E^\circ Fe^{2+}/Fe = y\ V$ then what will be the value of $E^\circ Fe^{3+}/Fe^{2+}$?

(A) $x - y$

(B) $3x + 2y$

(C) $2x + y$

(D) $3x - 2y$

Solution:

1. The standard reduction potential for Fe^{3+}/Fe is given as $x\ V$.

$Fe^{3+} + 3e^- \rightarrow Fe \quad$ with potential x

2. The standard reduction potential for Fe^{2+}/Fe is given as $y\ V$.

$Fe^{2+} + 2e^- \rightarrow Fe \quad$ with potential y

3. We are looking for the potential for Fe^{3+}/Fe^{2+} :

$Fe^{3+} + e^- \rightarrow Fe^{2+}$

Formula for cell potentials:

The standard reduction potential for Fe^{3+}/Fe^{2+} can be calculated as the difference between the potentials for Fe^{3+}/Fe and Fe^{2+}/Fe :

$E^\circ Fe^{3+}/Fe^{2+} = E^\circ Fe^{3+}/Fe - E^\circ Fe^{2+}/Fe$

Substituting the values:

$\mathrm{E}^{\circ} \mathrm{Fe}^{3+} / \mathrm{Fe}^{2+}=x-y$
Thus, the correct answer is:

$x-y(\text{ option A})$

11) In which of the following condition reduction potential of hydrogen half cell will be negative?
(A) $\mathrm{PH}_2=2 \mathrm{~atm}$ and $\left[\mathrm{H}^{+}\right]=2 \mathrm{M}$
(B) $\mathrm{PH}_2=2 \mathrm{~atm}$ and $\left[\mathrm{H}^{+}\right]=1 \mathrm{M}$
(C) $\mathrm{PH}_2=1$ atm and $\left[\mathrm{H}^{+}\right]=1 \mathrm{M}$
(D) $\mathrm{PH}_2=1$ atm and $\left[\mathrm{H}^{+}\right]=2 \mathrm{M}$

Solution:

The standard reduction potential of the hydrogen half-cell $\left(\mathrm{H}_2 / \mathrm{H}^{+}\right)$is 0 V under standard conditions ($P_{\mathrm{H}_2}=1 \mathrm{~atm},\left[\mathrm{H}^{+}\right]=1 \mathrm{M}$). The Nernst equation can be used to determine the reduction potential under non-standard conditions:

$E=E^{\circ}-\frac{0.0591}{n} \log \left(\frac{\left[\mathrm{H}^{+}\right]}{P_{\mathrm{H}_2}}\right)$
For the hydrogen half-cell, $E^{\circ}=0 \mathrm{~V}$, and $n=2$. Thus:

$E=-\frac{0.0591}{2} \log \left(\frac{\left[\mathrm{H}^{+}\right]}{P_{\mathrm{H}_2}}\right)$
In order for the reduction potential to be negative, the term inside the logarithm must be less than 1, meaning:

$\frac{\left[\mathrm{H}^{+}\right]}{P_{\mathrm{H}_2}}<1 \quad \Rightarrow \quad\left[\mathrm{H}^{+}\right]<P_{\mathrm{H}_2}$
Let's analyze each condition:
- (A) $\mathrm{P}_{\mathrm{H}_2}=2 \mathrm{~atm},\left[\mathrm{H}^{+}\right]=2 \mathrm{M}: \frac{\left[\mathrm{H}^{+}\right]}{P_{\mathrm{H}_2}}=\frac{2}{2}=1$, so $E=0$.
- (B) $\mathrm{P}_{\mathrm{H}_2}=2 \mathrm{~atm},\left[\mathrm{H}^{+}\right]=1 \mathrm{M}: \frac{\left[\mathrm{H}^{+}\right]}{P_{\mathrm{H}_2}}=\frac{1}{2}<1$, so E is negative.
- (C) $\mathrm{P}_{\mathrm{H}_2}=1 \mathrm{~atm},\left[\mathrm{H}^{+}\right]=1 \mathrm{M}: \frac{\left[\mathrm{H}^{+}\right]}{P_{\mathrm{H}_2}}=\downarrow=1$, so $E=0$.
- (D) $\mathrm{P}_{\mathrm{H}_2}=1 \mathrm{~atm},\left[\mathrm{H}^{+}\right]=2 \mathrm{M}: \frac{\left[\mathrm{H}^{+}\right]}{P_{\mathrm{H}_2}}=\frac{2}{1}>1$, so E is positive.

The correct answer is:

$\mathrm{P}_{\mathrm{H}_2}=2 \mathrm{~atm} \text{ and } \left[\mathrm{H}^{+}\right]=1 \mathrm{M} \text{ (option B)}$

12) What will be the unit of rate constant for following reaction?

$\mathrm{C}_2 \mathrm{H}_{4(\mathrm{~g})}+\mathrm{H}_{2(\mathrm{~g})} \longrightarrow \mathrm{C}_2 \mathrm{H}_{G(\mathrm{~g})}$

(A) $\mathrm{molL}^{-1} \mathrm{~S}^{-1}$
(B) S^{-1}
(C) $\mathrm{mol}^{-1} \mathrm{LS}^{-1}$
(D) $\mathrm{mol}^{-2} \mathrm{~L}^2 \mathrm{~S}^{-1}$

Solution:

$C_2H_{4(g)} + H_{2(g)} \longrightarrow C_2H_{6(g)}$

This is a second-order reaction because the rate depends on both reactants, so the overall order is 2 .
The rate equation for a second-order reaction is:

$$\text{Rate } = k\left[C_2H_4\right]\left[H_2\right]$$

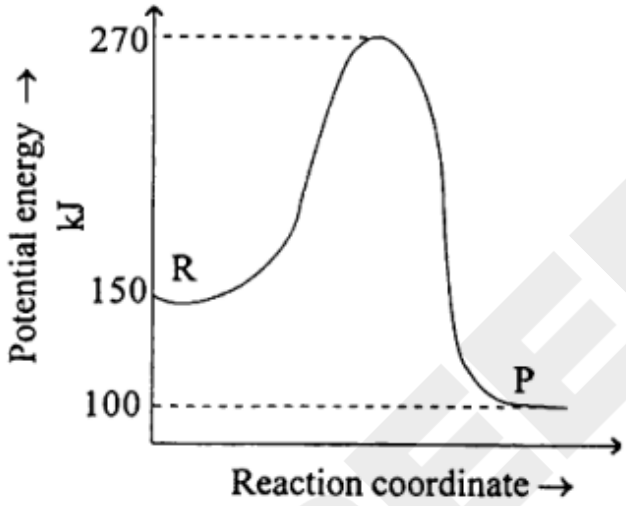
The rate has units of $\text{molL}^{-1}\ \text{s}^{-1}$, and the concentrations have units of molL^{-1}. Therefore, the unit of the rate constant k can be determined as:

$$\text{Unit of } k = \frac{\text{mol L}^{-1}\,\text{s}^{-1}}{\left(\text{mol L}^{-1}\right)^2} = \text{mol}^{-1}\text{Ls}^{-1}$$

Thus, the correct answer is:

$\text{mol}^{-1}\text{Ls}^{-1}$ (option C)

13) For $R \rightarrow P$ reaction, following graph is given.



What will be enthalpy change for the given reaction?

(A) 120 kJ

(B) 50 kJ

(C) -50 kJ

(D) 170 kJ

Solution:

Looking at the graph provided, the enthalpy change (ΔH) is the difference between the energy of the reactants (R) and the energy of the products (P). From the graph:
- The potential energy of the reactants (R) is approximately 150 kJ .
- The potential energy of the products (P) is approximately 100 kJ .

The enthalpy change (ΔH) is calculated as:

$\Delta H=$ Energy of products $-$ Energy of reactants $=100\ \mathrm{kJ}-150\ \mathrm{kJ}=-50\ \mathrm{kJ}$
Since the energy of the products is lower than the reactants, the reaction is exothermic, and the enthalpy change is -50 kJ .

Thus, the correct answer is:

$-50\ \mathrm{kJ}(\text{ option C})$

14) Time taken to complete zero order reaction is
(A) $\frac{[\mathrm{R}]_0}{k}$
(B) $\frac{2k}{[\mathrm{R}]_0}$
(C) $\frac{[\mathrm{R}]_0}{2k}$
(D) $\frac{k}{[\mathrm{R}]_0}$

Solution:

For a zero-order reaction, the rate law is given by:

$\text{Rate }=k$
The integrated rate law for a zero-order reaction is:

$[\mathrm{R}]=[\mathrm{R}]_0-kt$
Where:
- $[R]_0$ is the initial concentration,
- k is the rate constant,
- t is the time taken.

To calculate the time taken to complete the reaction, set $[R]=0$ (i.e., when the reaction is complete):

$0=[\mathrm{R}]_0-kt$
Solving for t :

$t=\frac{[\mathrm{R}]_0}{k}$

Thus, the time taken to complete a zero-order reaction is:

$\frac{[\mathrm{R}]_0}{k}(\text{ option A})$
15) Which pair of emulsions can be diluted by water?
(A) butter and cream
(B) milk and cream
(C) cream and vanishing cream
(D) milk and vanishing cream

Solution:

Emulsions are mixtures of two immiscible liquids where one is dispersed in the other. Depending on the type of emulsion (oil-in-water or water-in-oil), it can be diluted by water if water is the continuous phase (in oil-in-water emulsions).

- Milk is an oil-in-water emulsion, meaning water is the continuous phase.
- Vanishing cream is also an oil-in-water emulsion, so it can be diluted by water.

Other pairs such as butter and cream or cream and vanishing cream contain water-in-oil emulsions, which cannot be diluted by water.

Thus, the correct answer is:
milk and vanishing cream (option D)

16) At equilibrium state in process of adsorption
(A) $\Delta \mathrm{H}=\mathrm{T} \Delta \mathrm{S}$
(B) $\Delta \mathrm{H}>\mathrm{T} \Delta \mathrm{S}$
(C) $\Delta \mathrm{H}>0$
(D) $\Delta \mathrm{H}<\mathrm{T} \Delta$

Solution:

At the equilibrium state in the process of adsorption, the change in Gibbs free energy (ΔG) is zero, because equilibrium implies no further spontaneous change in the system. We know from the Gibbs free energy equation:

$\Delta G=\Delta H-T \Delta S$
At equilibrium:

$\Delta G=0 \quad \Rightarrow \quad \Delta H=T \Delta S$
Thus, the correct answer is:

$\Delta H=T \Delta S(\text { option A})$
17) is the example of colloid in which dispersed phase is liquid and dispersion medium is gas.
(A) cell fluids
(B) fog
(C) smoke
(D) froth

Solution:

A colloid in which the dispersed phase is liquid and the dispersion medium is gas is referred to as an aerosol. One common example of such a colloid is fog, where tiny liquid droplets are dispersed in air (a gas).

Thus, the correct answer is:

$\text{fog } (\text{ option } B)$
18) Which substance is used as collector in froth floatation process?
(A) cresol
(B) aniline
(C) fatty acid
(D) phenol

Solution:

In the froth flotation process, collectors are substances that increase the non-wettability of the mineral particles, thereby making them attach to the air bubbles and float. Fatty acids are commonly used as collectors because they can coat the mineral particles, making them hydrophobic.

Thus, the correct answer is:
fatty acid (option C)

19) For which concentrated ore calcination process is not useful?
(A) $CaCO_3 \cdot MgCO_3$
(B) $Fe_2O_3 \cdot xH_2O$
(C) $ZnCO_3$
(D) PbS

Solution:

Calcination is useful for converting carbonate and hydrated ores into oxides by heating in the absence of air. However, PbS (lead sulfide) is a sulfide ore, and calcination is not effective for sulfide ores. Instead, roasting is used for sulfide ores.

Thus, the correct answer is:
PbS (option D)

20) German silver is a mixture of which metals?
(A) Cu, Zn, Ni
(B) Fe, Cu, Sn
(C) Ag, Cu, Ni
(D) Zn, Ni

Solution:

German silver is an alloy made up of copper (Cu), zinc (Zn), and nickel (Ni). Despite its name, it contains no silver.

Thus, the correct answer is:

Cu, Zn, Ni (option A)

21) How many lone pair of electron is present on Xe in XeO_3 ?
(A) 3
(B) 2
(C) 1
(D) 0

Solution:

In XeO_3, xenon (Xe) has 8 valence electrons. Each oxygen atom forms a double bond with Xe , using 6 electrons (3 double bonds). This leaves 2 electrons as a lone pair on Xe .

Thus, the correct answer is:

$1\ (\text{option C})$

22) Which order for thermal stability of the following compounds is correct?

(A) $\mathrm{H_2Te} > \mathrm{H_2Se} > \mathrm{H_2\ S} > \mathrm{H_2O}$

(B) $\mathrm{H_2O} > \mathrm{H_2\ S} > \mathrm{H_2Se} > \mathrm{H_2Te}$

(C) $\mathrm{H_2\ S} > \mathrm{H_2Se} > \mathrm{H_2Te} > \mathrm{H_2O}$

(D) $\mathrm{H_2Te} > \mathrm{H_2Se} > \mathrm{H_2O} > \mathrm{H_2\ S}$

Solution:

The thermal stability of hydrides decreases as we move down the group in the periodic table due to the increasing size of the central atom and decreasing bond strength. The correct order of thermal stability for the given hydrides is:

$\mathrm{H_2O} > \mathrm{H_2\ S} > \mathrm{H_2Se} > \mathrm{H_2Te}(\ \text{option B})$

23) Which gas is used in Holme's signal?

(A) $\mathrm{PH_3}$

(B) $\mathrm{NO_2}$

(C) $\mathrm{H_2\ S}$

(D) $\mathrm{SO_2}$

Solution:

Holme's signal is used for marine signaling, where calcium carbide and calcium phosphide react with water to produce acetylene $(\mathrm{C_2H_2})$ and phosphine $(\mathrm{PH_3})$ gases, which ignite spontaneously in contact with air, creating a bright light.

Thus, the correct answer is:

$\mathrm{PH_3}$ (option A)

24) $\mathrm{C} + \mathrm{H_2SO_4}$ (Conc.) $\longrightarrow X + Y + \mathrm{H_2O}$ Identify X and Y.

(A) $\mathrm{X} = \mathrm{CO}, \mathrm{Y} = \mathrm{H_2\ S}$

(B) $\mathrm{X} = \mathrm{CO_2}, \mathrm{Y} = \mathrm{H_2\ S}$

(C) $\mathrm{X} = \mathrm{CO}, \mathrm{Y} = \mathrm{SO_3}$

(D) $\mathrm{X} = \mathrm{CO_2}, \mathrm{Y} = \mathrm{SO_2}$

Solution:

When carbon reacts with concentrated sulfuric acid, it produces carbon dioxide $(\mathrm{CO_2})$ and sulfur dioxide $(\mathrm{SO_2})$ along with water.

Thus, the correct answer is:

$\mathrm{X} = \mathrm{CO_2}, \mathrm{Y} = \mathrm{SO_2}\ (\text{option D})$

25) The shape of manganate ion is

(A) square planar

(B) tetrahedral

(C) pyramidal

(D) square pyramidal

Solution:

The shape of the manganate ion $\left(\mathrm{MnO}_4^{2-}\right)$ is tetrahedral. In this ion, the central manganese atom is surrounded by four oxygen atoms arranged in a tetrahedral geometry.

Thus, the correct answer is:
tetrahedral (option B)

26) Which compound has magnetic moment equal to 4.90 BM ?
(A) MnSO_4
(B) NiSO_4
(C) FeSO_4
(D) $\mathrm{Cr}_2(\mathrm{SO}_4)_3$

Solution:

The magnetic moment is given by the formula:

$$\mu = \sqrt{n(n+2)}\mathrm{BM}$$

where n is the number of unpaired electrons. For a magnetic moment of 4.90 BM , solving for n :

$$4.90 \approx \sqrt{n(n+2)}$$

This corresponds to $n = 4$ unpaired electrons. Manganese in MnSO_4 is in the +2 oxidation state $\left(\mathrm{Mn}^{2+}\right)$ with an electronic configuration of $3d^5$, and 4 of those electrons are unpaired.

Thus, the correct answer is:

$$\mathrm{MnSO}_4(\text{ option A})$$

27) Which oxidation state is common for lanthanoid elements?
(A) +2
(B) +3
(C) +4
(D) +5

Solution:

The most common oxidation state for lanthanoids is +3 , which is the most stable state across the series due to the loss of three electrons from the $6s^2$ and $4f$ orbitals.

Thus, the correct answer is:

$$+3 \text{ (option B)}$$

28) Number of possible isomers for $\left[\mathrm{Cr}(\mathrm{H}_2\mathrm{O})_2(\mathrm{C}_2\mathrm{O}_4)_2\right]^-$ are
(A) 3
(B) 4
(C) 2
(D) 6

Solution:

This complex ion contains two water molecules and two oxalate (C_2O_4) ligands, and it can exhibit geometrical isomerism (cis and trans forms) due to the arrangement of ligands around the central chromium atom. Additionally, oxalate is a bidentate ligand, which can contribute to isomerism.

The number of possible isomers is:
3 (option A)

29) Which is correct formula of Wilkinson catalyst?
(A) $[(Ph_3As)_3RhCl]$
(B) $[(Me_3P)_3RhCl]$
(C) $[(Ph_3P)_3RhCl]$
(D) $[(Me_3As)_3RhCl]$

Solution:

Wilkinson's catalyst is a well-known complex used for homogeneous hydrogenation reactions. Its formula consists of rhodium (Rh) bonded to three triphenylphosphine ligands and a chloride ion.

Thus, the correct answer is:

$[(Ph_3P)_3RhCl](\text{ option C})$

30) How many monochloro structural isomers expected to be formed on free radical monochlorination of iso-pentane?
(A) 3
(B) 4
(C) 2
(D) 5

Solution:

Iso-pentane (2-methylbutane) has the following structure:

$CH_3 - CH_2 - CH(CH_3) - CH_3$

Free radical chlorination can occur at different types of hydrogen atoms (primary, secondary, tertiary), leading to different structural isomers. In the case of iso-pentane, chlorination can occur at:
- The terminal primary carbon atoms (2 sites).
- The secondary carbon atom.
- The tertiary carbon atom.

Therefore, 4 different monochloro isomers can be expected.

Thus, the correct answer is:

$4\ (\text{option B})$

31) $\mathrm{R}'-\mathrm{X} \xrightarrow{\text{Neverer}} 2,3$ - dimethylbutane. Identify R'
(A) $(\mathrm{CH}_3)_3\mathrm{C}-$
(B) $(\mathrm{C}_2\mathrm{H}_5)_2\mathrm{CH}-$
(C) $(\mathrm{CH}_3\mathrm{CH}_2)_3\mathrm{C}-$
(D) $(\mathrm{CH}_3)_2\mathrm{CH}-$

Solution:

The product is 2,3-dimethylbutane, which is formed by the Wurtz reaction, where two alkyl halides react in the presence of sodium metal to form a larger alkane.

For 2,3-dimethylbutane to be formed, the alkyl halide $\mathrm{R}'-\mathrm{X}$ must be isopropyl chloride $(\mathrm{CH}_3)_2\mathrm{CH}-\mathrm{Cl}$, which combines to form the desired product.

Thus, the correct answer is:

$(\mathrm{CH}_3)_2\mathrm{CH}-(\text{ option D})$
32) Which compound has highest reactivity towards SN^2 reaction?
(A) 1-Bromo-2,2-dimethylpropane
(B) 1-Bromo-2-methylbutane
(C) 1-Bromobutane
(D) 1-Bromo-3-methylbutane

Solution:

The SN^2 reaction mechanism is favored by primary alkyl halides due to less steric hindrance, which allows the nucleophile to attack the electrophilic carbon more easily. Among the given options, 1-bromobutane is a simple primary alkyl halide with the least steric hindrance.

Thus, the correct answer is:
1-Bromobutane (option C)

33) By which reaction Freon 12 is prepared from CCl_4 ?
(A) Swarts reaction
(B) Fitting reaction
(C) Wurtz reaction
(D) Finkelstein reaction

Solution:

Freon-12 $(\mathrm{CCl}_2\ \mathrm{F}_2)$ is prepared from CCl_4 using Swarts reaction, where chlorine atoms in CCl_4 are replaced by fluorine atoms using antimony trifluoride (SbF_3).

Thus, the correct answer is:
Swarts reaction (option A)

34) Which compound will give yellow precipitate on reaction with sodium hypoiodite?
(A) n-Butyl alcohol
(B) tert-Butyl alcohol

(C) isobutyl alcohol
(D) sec-Butyl alcohol

Solution:

The lodoform test (reaction with sodium hypoiodite) gives a yellow precipitate of iodoform $(\mathrm{CHI_3})$ for compounds with a methyl group attached to a carbonyl group or a compound containing a $\mathrm{CH_3CH(OH)}$ - group. Among the options, sec-butyl alcohol has the structure:

$\mathrm{CH_3-CH_2-CH(OH)-CH_3}$
This structure contains the required group and will give a yellow precipitate with sodium hypoiodite.

Thus, the correct answer is:
sec-Butyl alcohol (option D)

35) Salicylaldehyde on heating with zinc dust give product. organic
(A) Benzyl alcohol
(B) Benzaldehyde
(C) Benzoic acid
(D) Benzene

Solution:

When salicylaldehyde is heated with zinc dust, it undergoes reduction, and the product formed is benzene through the removal of oxygen.

Thus, the correct answer is:
Benzene (option D)

36) Which compound has highest value of pKa ?
(A) o-nitrophenol
(B) phenol
(C) p-cresol
(D) m-nitrophenol

Solution:

The pKa value indicates the strength of an acid; a higher pKa means the compound is less acidic. Among the given compounds:
- o-nitrophenol and m-nitrophenol are more acidic due to the electron-withdrawing effect of the nitro group.
- p-cresol (methyl-substituted phenol) is less acidic than phenol because the methyl group is electron-donating.

Therefore, p-cresol has the highest pKa.
Thus, the correct answer is:
p-cresol (option C)

37) Which reagent is useful in the conversion of ethanenitrile to ethanal?
(A) DIBAL-H
(B) PCC
(C) Anhydrous $\mathrm{CrO_3}$
(D) $\mathrm{LiAlH_4}$

Solution:

DIBAL-H (Diisobutylaluminium hydride) is a selective reducing agent that can reduce nitriles to aldehydes under controlled conditions.

Thus, the correct answer is:
DIBAL-H (option A)

38) How many π-electrons are present in phthalimide?
(A) 5
(B) 12
(C) 6
(D) 10

Solution:

Phthalimide has an aromatic structure with a benzene ring. A benzene ring contains 6π-electrons (from the alternating double bonds in the ring). The imide group itself doesn't contribute additional π-electrons beyond those in the ring.

Thus, the correct answer is:

$6\ (\text{option C})$

39) Which salt is insoluble in water?
(A) $\mathrm{C_6H_5\ N_2^+Cl^-}$
(B) $\mathrm{C_6H_5\ N_2^+BF_4^-}$
(C) $\mathrm{C_6H_5\ N_2^+Br^-}$
(D) $\mathrm{C_6H_5\ N_2^*HSO_4^-}$

Solution:

Among the given salts, $\mathrm{C_6H_5\ N_2^+BF_4^-}$(benzenediazonium tetrafluoroborate) is known to be insoluble in water. Tetrafluoroborate salts are generally less soluble in water compared to chloride, bromide, and sulfate salts.

Thus, the correct answer is:

$\mathrm{C_6H_5\ N_2^+BF_4^-}(\text{option B})$

40) Which compound will not give ethanamine on reduction?
(A) Ethanenittile
(B) Ethanamide

(C) Ethanoyl chloride
(D) Nitroethane

Solution:

- Ethanenitrile, ethanamide, and ethanoyl chloride can be reduced to ethanamine.
- However, nitroethane upon reduction gives ethylamine $(\mathrm{C_2H_5NH_2})$, not ethanamine.

Thus, the correct answer is:
Nitroethane (option D)

41) Which gas is evolved during the reaction of methyl amine with $\mathrm{HNO_2}$?
(A) $\mathrm{N_2}$
(B) $\mathrm{NH_3}$
(C) $\mathrm{H_2}$
(D) $\mathrm{NO_2}$

Solution:

When methyl amine reacts with nitrous acid $(\mathrm{HNO_2})$, it produces nitrogen gas $(\mathrm{N_2})$ as a byproduct. This is a characteristic reaction of primary amines with nitrous acid.

Thus, the correct answer is:
$\mathrm{N_2}$ (option A)

42) Which reagent is used to distinguish aniline and benzylamine?
(A) $\mathrm{CH_3COCl}/$ pyridine
(B) $\mathrm{C_6H_5SO_2Cl}$
(C) $\mathrm{CHCl_3 + KOH}$
(D) $\mathrm{Br_2/H_2O}$

Solution:

The Hofmann's bromamide reaction using chloroform and KOH $(\mathrm{CHCl_3 + KOH})$ can be used to distinguish aniline (which gives a positive carbylamine test) from benzylamine, as aniline will give a foul-smelling isocyanide (carbylamine).

Thus, the correct answer is:

$\mathrm{CHCl_3 + KOH}$ (option C)

43) Thyroxine produced in the thyroid gland is an iodinated derivative of amino acid.
(A) glutamine
(B) cysteine
(C) tyrosine
(D) histidine

Solution:

Thyroxine is an iodinated derivative of the amino acid tyrosine. It is produced in the thyroid gland and plays a crucial role in regulating metabolism.

Thus, the correct answer is:
tyrosine (option C)

44) Which one acts as non reducing sugar?
(A) sucrose
(B) lactose
(C) glucose
(D) maltose

Solution:

Sucrose is a non-reducing sugar because it does not have a free aldehyde or ketone group available for oxidation. It does not react with Benedict's or Fehling's reagent.

Thus, the correct answer is:
sucrose (option A)

45) Which polysaccharide is highly branched?
(A) cellulose
(B) glycogen
(C) amylose
(D) amylopectin

Solution:

Glycogen is a highly branched polysaccharide. It serves as the primary storage form of glucose in animals and is more branched than amylopectin.

Thus, the correct answer is:
glycogen (option B)

46) Which vitamin must be supplied regularly in diet?
(A) Vitamin E
(B) Vitamin K
(C) Vitamin D
(D) Vitamin C

Solution:

Vitamin C is a water-soluble vitamin that cannot be stored in the body and must be regularly supplied through the diet.

Thus, the correct answer is:
Vitamin C (option D)

47) is polyester type biodegradable polymer.
(A) Dacrone
(B) PHBV
(C) Nylon-2-nylon-6
(D) Glyptal

Solution:

PHBV (Poly-3-hydroxybutyrate-co-3-hydroxyvalerate) is a biodegradable polymer that is a polyester. It is used in medical applications and packaging.

Thus, the correct answer is:
PHBV (option B)

48) Which polymer can not be obtained from diene monomer?
(A) Novolac
(B) Neoprene
(C) Buna- N
(D) Buna-S

Solution:

Novolac is a phenol-formaldehyde resin and is not obtained from a diene monomer. The other options (Neoprene, Buna-N, and Buna-S) are all derived from diene monomers.

Thus, the correct answer is:
Novolac (option A)

49) Polymer used in making unbreakable laminated sheets has
repeating structural unit.
(A) $£\mathrm{NH}-\mathrm{CO}-\mathrm{NH}-\mathrm{CH}_2\}$
(B) $£\mathrm{NH}-\mathrm{CONH}-(\mathrm{CH}_2)_3-\mathrm{NH}‡$
(C) $£\mathrm{NH}-\mathrm{CH}_2-\mathrm{CONH}-\mathrm{CH}_2-\mathrm{CO}‡$
(D) $+\mathrm{OCH}_2-\mathrm{CH}_2-\mathrm{CONH}-\mathrm{CH}_2\}$

Solution:

The polymer used in making unbreakable laminated sheets is Melamine-formaldehyde resin. The repeating unit structure matches option $\mathbf{D}$, which represents the repeating units in this resin.

Thus, the correct answer is:

$+\mathrm{OCH}_2-\mathrm{CH}_2-\mathrm{CONH}-\mathrm{CH}_2\}\ (\text{option D})$

50) Which drug act as antihistamine?
(A) phenelzine
(B) veronal
(C) paracetamol
(D) brompheniramine

Solution:

Brompheniramine is an antihistamine that is commonly used to treat allergies and cold symptoms by blocking the action of histamine in the body.

Thus, the correct answer is:
brompheniramine (option D)

PART-B

SECTION-A

Answer the following Q.No. 1 to 8 in brief. 2 Marks for each question. [16]

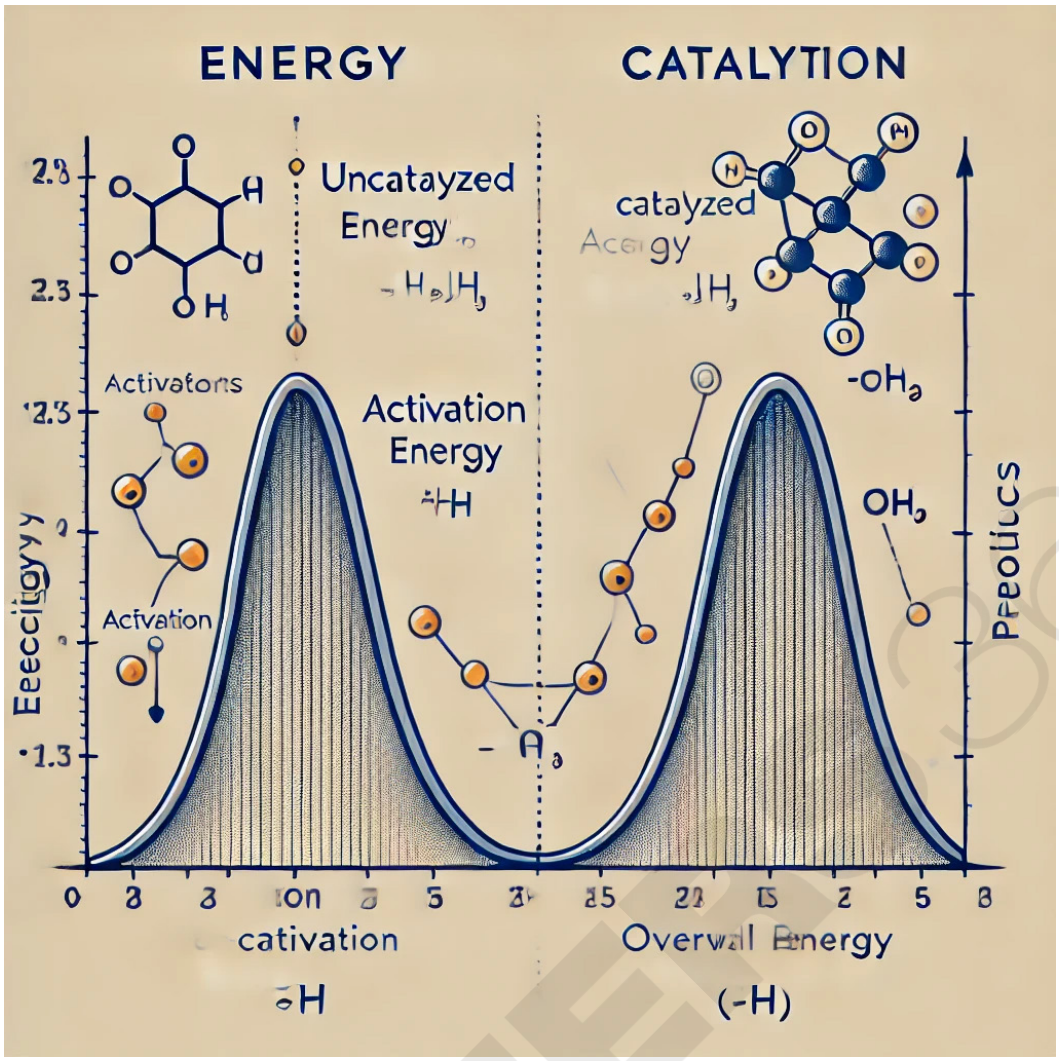
1) How catalyst increases the rate of reaction? Explain it by graph.

Answer:

A catalyst increases the rate of a reaction by providing an alternative reaction pathway that has a lower activation energy (E_a) compared to the uncatalyzed reaction. This allows more reactant molecules to have enough energy to overcome the energy barrier and form products at a given temperature, leading to an increased reaction rate.

Explanation with Graph:
In the graph below, the energy profile of a reaction is shown for both the catalyzed and uncatalyzed reactions:
- Uncatalyzed reaction: The activation energy is higher, and the energy barrier is larger, meaning fewer molecules have the energy to react.
- Catalyzed reaction: The catalyst lowers the activation energy, resulting in a lower energy barrier and allowing more molecules to react, thus increasing the rate of reaction.

The overall energy difference between the reactants and products (ΔH) remains unchanged.



2) Explain the method for refining impure Copper.

Answer:

Electrolytic refining is the method used to purify impure copper. The impure copper is used as the anode, and a thin strip of pure copper is used as the cathode. The electrolyte is an aqueous solution of copper sulfate $(\mathrm{CuSO_4})$ and sulfuric acid.
- At the anode, impure copper dissolves into the solution as $\mathrm{Cu^{2+}}$ ions.

$$\mathrm{Cu \rightarrow Cu^{2+} + 2}e^{-}$$

- At the cathode, $\mathrm{Cu^{2+}}$ ions are reduced and deposited as pure copper.

$$\mathrm{Cu^{2+} + 2}e^{-} \rightarrow \mathrm{Cu}$$

Impurities such as gold and silver collect as anode sludge.

3) Explain the nature of bonding in metal carbonyls.

Answer:

In metal carbonyls, bonding occurs via a synergic interaction between the metal and carbonyl ligands. The nature of bonding involves:
- σ-Bonding: The carbon atom in the CO ligand donates a lone pair of electrons to the metal, forming a sigma bond.
- π-Back Bonding: The metal donates electrons from its d-orbitals to the antibonding π^* orbitals of the CO ligand, strengthening the metal-ligand bond.

This synergic bonding stabilizes the metal-ligand complex.

4) Write down chemical equations to prepare following substances from 1-Chloropropane.

i) Propene.

ii) Propan-1-ol.

Answer:

i) Propene: 1-chloropropane can be converted to propene via dehydrohalogenation using an alcoholic KOH solution.

$$\mathrm{CH_3CH_2CH_2Cl} \xrightarrow[\Delta]{\text{alc KOH}} \mathrm{CH_3CH=CH_2 + HCl}$$

ii) Propan-1-ol: 1-chloropropane can be converted to propan-1-ol via nucleophilic substitution using aqueous NaOH .

$$\mathrm{CH_3CH_2CH_2Cl + NaOH \rightarrow CH_3CH_2CH_2OH + NaCl}$$

5) Write down chemical equations to prepare orange and yellow dye from diazonium salt.

Answer:

i) Orange Dye: Benzene diazonium chloride reacts with beta-naphthol to form an orange dye.

$$\mathrm{C_6H_5\ N_2Cl + C_{10}H_7OH \rightarrow C_6H_5\ N=N-C_{10}H_6OH\ (orange\ dye)}$$

ii) Yellow Dye: Benzene diazonium chloride reacts with aniline to form a yellow dye.

$$\mathrm{C_6H_5\ N_2Cl + C_6H_5NH_2 \rightarrow C_6H_5\ N=N-C_6H_4NH_2\ (yellow\ dye)}$$

6) Write down structural difference between DNA and RNA. [Any two points]

Answer:

1. Sugar:
- DNA contains deoxyribose sugar, while RNA contains ribose sugar.
2. Nitrogenous Bases:
- DNA contains thymine (T), whereas RNA contains uracil (U) in place of thymine.

7) Due to which reasons vulcanisation of natural rubber is necessary?

Answer:

1. Improved Elasticity and Strength: Vulcanization introduces sulfur cross-links between the polymer chains of rubber, making it more elastic, durable, and resistant to wear and tear.
2. Heat and Chemical Resistance: Vulcanized rubber can withstand higher temperatures and is more resistant to chemicals and environmental conditions compared to natural rubber.

8) Why do soaps not work in hard water?

Answer:

Soaps do not work well in hard water because hard water contains calcium (Ca^{2+}) and magnesium ($\mathbf{Mg}^{2+}$) ions, which react with the soap to form insoluble salts (scum). These salts precipitate out of the solution, reducing the cleaning effectiveness of the soap.

$$\mathrm{Ca}^{2+}/\mathrm{Mg}^{2+} + 2\mathrm{RCOO}^{-} \rightarrow (\mathrm{RCOO})_2\mathrm{Ca}/\mathrm{Mg}(\text{ scum })$$

SECTION-B
Answer the following Q.No. 9 to 14 in detail. 3 Marks for each question.
9) Write down distinction between crystalline and amorphous solids on the basis of the following properties.
i) Melting point,
ii) Cleavage property and
iii) Order in arrangement of constituent particles.

Solution:

i) **Melting Point**:

- **Crystalline solids**: Have a **sharp melting point** because their constituent particles are arranged in a well-defined, orderly manner. They undergo a distinct phase change at a specific temperature.
- **Amorphous solids**: Do not have a sharp melting point; they soften over a range of temperatures because their particles are arranged irregularly.

ii) **Cleavage Property**:

- **Crystalline solids**: When cut with a knife, they **cleave along specific planes** due to the ordered arrangement of particles, forming smooth surfaces.
- **Amorphous solids**: They **break irregularly** and do not cleave along specific planes because of their disordered structure.

iii) **Order in Arrangement of Constituent Particles**:

- **Crystalline solids**: Have **long-range order**, meaning that their constituent particles (atoms, ions, or molecules) are arranged in a repeating pattern over long distances.
- **Amorphous solids**: Have only **short-range order**, meaning their particles are arranged irregularly with no long-range repetition.

10) The following data were obtained during the first order thermal decomposition of $\mathrm{N_2O_{S(R)}}$ at constant volume : $2\ \mathrm{N_2O_{S(B)}} \rightarrow 2\ \mathrm{N_2O_{4(\ B)}} + \mathrm{O_{2(\ g)}}$

S.N	Time	Total Presuure(atm?)
1	0	0.5
2	100	0.512

Calculate the rate constant.

Solution:

The rate constant for a first-order reaction is calculated using the integrated rate law:

$k = \frac{2.303}{t} \log\left(\frac{P_\infty}{P_\infty - P_t}\right)$

From the data:
- Initial pressure $(P_0) : 0.5 \text{ atm}(\text{ at } t = 0)$
- Pressure after 100 seconds $(P_t) : 0.512 \text{ atm}$
- Final total pressure (P_∞) : The total pressure after the reaction completion is the sum of the pressures of all products, calculated as:

$P_\infty = P_0 + P_{O_2} = 0.5 + 0.5 = 1.0 \text{ atm}$

Now applying the formula:

$$k = \frac{2.303}{100} \log\left(\frac{1.0}{1.0 - 0.512}\right)$$

$$k = \frac{2.303}{100} \log\left(\frac{1.0}{0.488}\right)$$

$$k = \frac{2.303}{100} \log(2.05)$$

$$k = \frac{2.303}{100} \downarrow .311 = 0.0072 \text{ s}^{-1}$$

11) Explain shape selective catalysis by zeolite.

Solution:

Shape-selective catalysis by zeolites refers to catalysis where the product distribution depends on the **pore structure and size** of the zeolite material. Zeolites are microporous aluminosilicate minerals with a well-defined structure of channels and cavities, typically of molecular dimensions.

- The **pore size** of the zeolite allows only certain reactants to enter and react, making the process selective.
- For example, **ZSM-5** zeolite is used in the **petrochemical industry** for converting alcohols to hydrocarbons by selective cracking, based on the size and shape of the hydrocarbon molecules.

The selectivity is determined by the size of the molecules relative to the zeolite's pore dimensions, which allows only certain products to form, thus increasing the efficiency of the process.

12) What is aqua regia? Write down balanced chemical equations of it's reaction with Au and Pt .

Solution:

Aqua regia is a highly corrosive mixture of concentrated nitric acid $(\mathrm{HNO_3})$ and concentrated hydrochloric acid (HCl) in a ratio of 1:3. It is capable of dissolving noble metals like gold (Au) and platinum (Pt).
i) Reaction with Gold (Au):

$$\mathrm{Au + 3HCl + HNO_3 \rightarrow HAuCl_4 + 2H_2O + NO}$$

ii) Reaction with Platinum (Pt):

$$\mathrm{3Pt + 18HCl + 4HNO_3 \rightarrow 3H_2PtCl_6 + 4NO + 8H_2O}$$

13) Give reason:
i) Transition elements exhibit higher enthalpies of atomisation.
ii) In aqueous solution, $\mathrm{Cr^{2*}}$ is stronger reducing agent than $\mathrm{Fe^2}$.
iii) The second ionisation enthalpy of Cu is higher than Zn .

Solution:

i) Transition elements exhibit higher enthalpies of atomization:

Transition elements have high enthalpies of atomization due to the presence of strong metallic bonds formed by the overlapping of unpaired d-electrons. The greater the number of unpaired delectrons, the stronger the metallic bonding, which increase the energy required to separate the atoms.
ii) In aqueous solution, $\mathrm{Cr^{2+}}$ is a stronger reducing agent than $\mathrm{Fe^{2+}}$:

In aqueous solution, $\mathrm{Cr^{2+}}$ readily gets oxidized to $\mathrm{Cr^{3+}}$ due to its unstable configuration in $\mathrm{Cr^{2+}}$ ($[Ar]3d^4$). This makes $\mathrm{Cr^{2+}}$ a stronger reducing agent than $\mathrm{Fe^{2+}}$, which has a more stable configuration.
iii) The second ionisation enthalpy of Cu is higher than Zn :

Copper $\left(\mathrm{Cu^+}\right)$has a stable configuration of $[Ar]3d^{10}$, so removing a second electron (to form $\mathrm{Cu^{2+}}$) requires a significant amount of energy, leading to a higher second ionization enthalpy. In contrast, zinc (Zn) has a stable $[Ar]3d^{10}$ configuration in both $\mathrm{Zn^+}$and $\mathrm{Zn^{2+}}$, making the removal of the second electron easier compared to copper.

SECTION-C

15) Calculate the depression in the freezing point of water when 10 g of $\mathrm{CH_3CH_2CHClCOOH}$ is added to 250 g of water.

$$\mathrm{Ka} = 1.4 \times 10^{-3},\ \mathrm{K_r} = 1.86\ \mathrm{K\ kg\ mol^{-1}}$$

[Atomic mass : $\mathrm{H} = 1, \mathrm{C} = 12, \mathrm{O} = 16, \mathrm{Cl} = 35.5$]

Solution:

To calculate the depression in the freezing point of water (ΔT_f), we will use the formula:

$\Delta T_f = i \cdot K_f \cdot m$
Where:
- i is the van't Hoff factor, which accounts for the dissociation of the solute.
- K_f is the cryoscopic constant (in this case, $K_f = 1.86\ \text{K kg mol}^{-1}$).
- m is the molality of the solution.

Step 1: Calculate the molar mass of the solute
The molecular formula of the solute is $\text{CH}_3\text{CH}_2\text{CHClCOOH}$. Let's calculate its molar mass:
- C (carbon): $4 \times 12 = 48\ \text{g/mol}$
- H (hydrogen): $7 \times 1 = 7\ \text{g/mol}$
- Cl (chlorine): $1 \times 35.5 = 35.5\ \text{g/mol}$
- O (oxygen): $2 \times 16 = 32\ \text{g/mol}$

Thus, the molar mass of $\text{CH}_3\text{CH}_2\text{CHClCOOH}$ is:

$48 + 7 + 35.5 + 32 = 122.5\ \text{g/mol}$

Step 2: Calculate the molality of the solution
Molality (m) is given by:

$m = \frac{\text{moles of solute}}{\text{mass of solvent in kg}}$

- Moles of solute $= \frac{10\ \text{g}}{122.5\ \text{g/mol}} = 0.0816\ \text{mol}$
- Mass of solvent (water) $= 250\ \text{g} = 0.250\ \text{kg}$

Thus, the molality of the solution is:

$m = \frac{0.0816}{0.250} = 0.3264\ \text{mol/kg}$
Step 3: Calculate the van't Hoff factor (i)
The solute $\text{CH}_3\text{CH}_2\text{CHClCOOH}$ is a weak acid that partially dissociates. The degree of dissociation can be determined using the dissociation constant $K_a = 1.4 \times 10^{-3}$. However, for simplicity, we can approximate the van't Hoff factor (i) as follows:

For a weak acid, the van't Hoff factor is slightly greater than 1 because of partial dissociation. We assume $i \approx 1.1$ for weak acids unless we calculate the exact dissociation.

Step 4: Calculate the depression in freezing point (ΔT_f)
Now, we can calculate ΔT_f :

$$\Delta T_f = i \cdot K_f \cdot m = 1.1 \cdot 1.86\ \text{K kg mol}^{-1} \cdot 0.3264\ \text{mol/kg}$$
$$\Delta T_f = 0.6686\ \text{K}$$
Thus, the depression in the freezing point is approximately 0.67 K .

16) λ_m for NaCl, HCl and NaAc are $126.4, 425.9$ and $91.0 \text{Scm}^2\ \text{mol}^{-1}$ respectively. Conductivity of 0.00241 M acetic acid is $7.896 \times 10^{-5}\ \text{S cm}^{-1}$. Calculate molar conductivity and dissociation constant of acetic acid.

Solution:

Given data:
- Molar conductivity (λ_m) for:
- $\mathrm{NaCl} = 126.4\ \mathrm{S\ cm^2\ mol^{-1}}$
- $\mathrm{HCl} = 425.9\ \mathrm{S\ cm^2\ mol^{-1}}$
- $\mathrm{NaAc} = 91.0\ \mathrm{S\ cm^2\ mol^{-1}}$
- Conductivity of 0.00241 M acetic acid: $7.896 \times 10^{-5}\ \mathrm{S\ cm^{-1}}$

Step 1: Calculate Molar Conductivity (Λ_m) of Acetic Acid
The formula for molar conductivity is:

$\Lambda_m = \frac{\kappa}{C}$
Where:
- Λ_m is the molar conductivity.
- κ is the conductivity $= 7.896 \times 10^{-5}\ \mathrm{S\ cm^{-1}}$.
- C is the concentration of acetic acid $= 0.00241\ \mathrm{mol/L}$.

Thus:

$\Lambda_m = \frac{7.896 \times 1\rho^{-5}}{0.00241} \downarrow = 0.03275\ \mathrm{S\ cm^2\ mol^{-1}}$

Step 2: Calculate the Limiting Molar Conductivity (Λ_m°) of Acetic Acid
The limiting molar conductivity (Λ_m°) of acetic acid can be calculated using the values for HCl , NaCl , and NaAc :

$\Lambda_m^\circ(\ \mathrm{Acetic\ Acid}\ ) = \Lambda_m^\circ(\mathrm{HCl}) + \Lambda_m^\circ(\mathrm{NaAc}) - \Lambda_m^\circ(\mathrm{NaCl})$
Substitute the values:

$\Lambda_m^\circ(\ \mathrm{Acetic\ Acid}\ ) = 425.9 + 91.0 - 126.4 = 390.5\ \mathrm{S\ cm^2\ mol^{-1}}$
Step 3: Calculate the Degree of Dissociation (α)
The degree of dissociation (α) is calculated as:

$\alpha = \frac{\Lambda_m}{\Lambda_m^\circ}$
Substitute the values:

$\alpha = \frac{0.03275}{390.5} = 8.39 \times 10^{-5}$
Step 4: Calculate the Dissociation Constant (K_a)
The dissociation constant (K_a) is given by:

$K = C\alpha^2$

Substitute the values:

$K_a = 0.00241 \times \left(8.39 \times 10^{-5}\right)^2 = 1.70 \times 10^{-12}\ \mathrm{mol/L}$

17) $[\mathrm{Mn(H_2O)_6}]^{2\cdot}$ contains five unpaired electrons, while $[\mathrm{Mn(CN)_6}]^{+}$contains only one unpaired electron. Explain using crystal field theory.

Solution:

- $[Mn(H_2O)_6]^{2+}$ contains five unpaired electrons. In this case, Mn^{2+} has a d d^5 configuration, and water is a weak field ligand. According to crystal field theory, weak field ligands such as water do not cause a significant splitting of the d-orbitals, so the electrons remain unpaired in the t_{2g} and e_g orbitals. This results in five unpaired electrons, corresponding to a high-spin complex.
- $[Mn(CN)_6]^{+}$ contains only one unpaired electron. Here, Mn^{+} has a d^5 configuration, but cyanide (CN^{-}) is a strong field ligand. Strong field ligands cause a large splitting of the d orbitals, leading to pairing of the electrons in the t_{2g} orbitals. As a result, only one unpaired electron remains, corresponding to a low-spin complex.

Thus, the difference in the number of unpaired electrons is due to the different ligand field strengths, leading to high-spin (H_2O) and low-spin (CN^{-}) complexes.

18) An organic compound with the molecular formula $C_9H_{10}O$ forms 2,4-DNP derivative, reduces Tollens' reagent and undergoes Cannizzaro reaction. On vigorous oxidation it gives 1,2 - benzenedicarboxylic acid. Identify the compound and write down it's above chemical reactions.

Solution:

Given:
- Molecular formula: $C_9H_{10}O$
- Forms 2,4-DNP derivative (indicating the presence of a carbonyl group, either aldehyde or ketone).
- Reduces Tollens' reagent (indicating the presence of an aldehyde group).
- Undergoes Cannizzaro reaction (suggesting the presence of an aldehyde without an α hydrogen).
- On oxidation, gives 1,2-benzenedicarboxylic acid (phthalic acid).

Based on this information, the compound is benzyl alcohol $(C_6H_5CH_2OH)$, which has the structure of a benzylic aldehyde.

The reactions are:
1. Reaction with $2,4-$ DNP:

$$C_6H_5CH_2OH + 2,4-DNP \rightarrow C_6H_5CH_2DNP + H_2O$$

2. Tollens' Test:

$$C_6H_5CH_2OH + 2Ag(NH_3)_2^{+} + 2OH^{-} \rightarrow C_6H_5COOH + 2Ag + H_2O$$

3. Cannizzaro Reaction:

$$2C_6H_5CH_2OH \rightarrow C_6H_5COOH + C_6H_5CH_3$$

4. Oxidation:

$$C_6H_5CH_2OH \xrightarrow{[O]} \text{1,2-benzenedicarboxylic acid}$$

Thus, the compound is identified as benzyl alcohol.