

Chemical Reactions JEE Main PYQ – 1

Total Time: 1 Hour

Total Marks: 100

Instructions

Instructions

1. Test will auto submit when the Time is up.
2. The Test comprises of multiple choice questions (MCQ) with one or more correct answers.
3. The clock in the top right corner will display the remaining time available for you to complete the examination.

Navigating & Answering a Question

1. The answer will be saved automatically upon clicking on an option amongst the given choices of answer.
2. To deselect your chosen answer, click on the clear response button.
3. The marking scheme will be displayed for each question on the top right corner of the test window.

Chemical Reactions

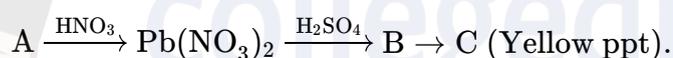
1. Given below are two statements: Statement (I): The boiling points of alcohols and phenols increase with increase in the number of C-atoms. (+4, -1)

Statement (II): The boiling points of alcohols and phenols are higher in comparison to other classes of compounds such as ethers and haloalkanes.

In the light of the above statements, choose the correct answer from the options given below:

- a. Both Statement I and Statement II are false
- b. Statement I is false but Statement II is true
- c. Statement I is true but Statement II is false
- d. Both Statement I and Statement II are true

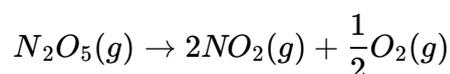
2. Identify A, B, and C in the given reaction sequence: (+4, -1)



- a. PbCl_2 , PbSO_4 , PbCrO_4
- b. PbS , PbSO_4 , PbCrO_4
- c. PbS , PbSO_4 , $\text{Pb}(\text{CH}_3\text{COO})_2$
- d. PbCl_2 , $\text{Pb}(\text{SO}_4)_2$, PbCrO_4

3. In Carius method for estimation of halogens, 180 mg of an organic compound produced 143.5 mg of AgCl . The percentage composition of chlorine in the compound is _____%. [Given: Molar mass in g mol^{-1} of $\text{Ag} = 108$, $\text{Cl} = 35.5$] (+4, -1)

4. For a reaction, (+4, -1)



in a constant volume container, no products were present initially. The final pressure of the system when 50% of the reaction gets completed is:

- $\frac{7}{2}$ times of initial pressure
- 5 times of initial pressure
- $\frac{5}{2}$ times of initial pressure
- $\frac{7}{4}$ times of initial pressure

5. The species which does not undergo disproportionation reaction is: (+4, -1)

- ClO_2^-
- ClO_4^-
- ClO_3^-
- ClO_2

6. Match List-I with the List-II (+4, -1)

List-I Reaction	List-II Type of redox reaction
(A) $\text{N}_2(\text{g}) + \text{O}_2(\text{g}) \rightarrow 2\text{NO}(\text{g})$	(I) Decomposition
(B) $2\text{Pb}(\text{NO}_3)_2(\text{s}) \rightarrow 2\text{PbO}(\text{s}) + 4\text{NO}_2(\text{g}) + \text{O}_2(\text{g})$	(II) Displacement
(C) $2\text{Na}(\text{s}) + 2\text{H}_2\text{O}(\text{l}) \rightarrow 2\text{NaOH}(\text{aq}) + \text{H}_2(\text{g})$	(III) Disproportionation
(D) $2\text{NO}_2(\text{g}) + 2\text{OH}^-(\text{aq}) \rightarrow \text{NO}_2^-(\text{aq}) + \text{NO}_3^-(\text{aq}) + \text{H}_2\text{O}(\text{l})$	(IV) Combination

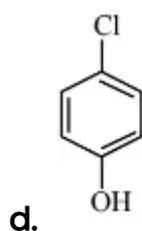
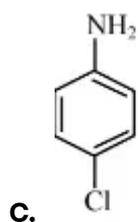
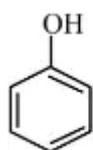
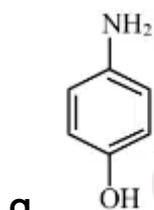
Choose the correct answer from the options given below:

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

- b. (A)-(III), (B)-(II), (C)-(I), (D)-(IV)
- c. (A)-(II), (B)-(III), (C)-(IV), (D)-(I)
- d. (A)-(IV), (B)-(I), (C)-(II), (D)-(III)

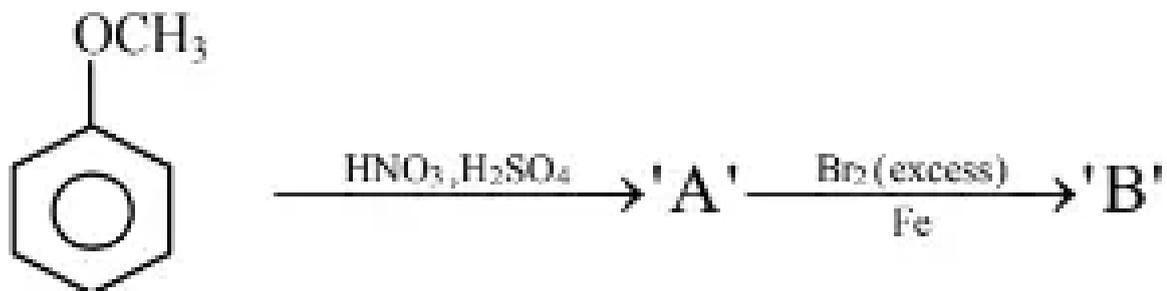
7. Identify the product A in the following reaction.

(+4, -1)

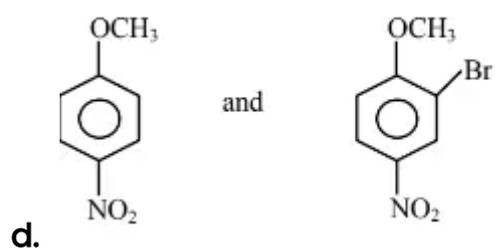
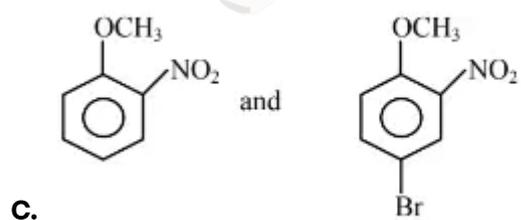
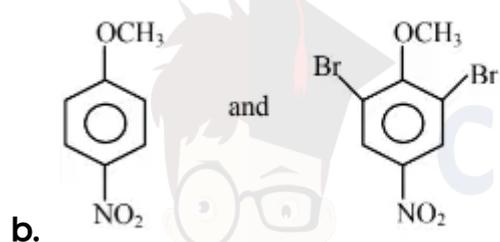
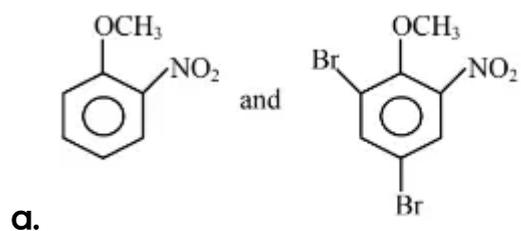


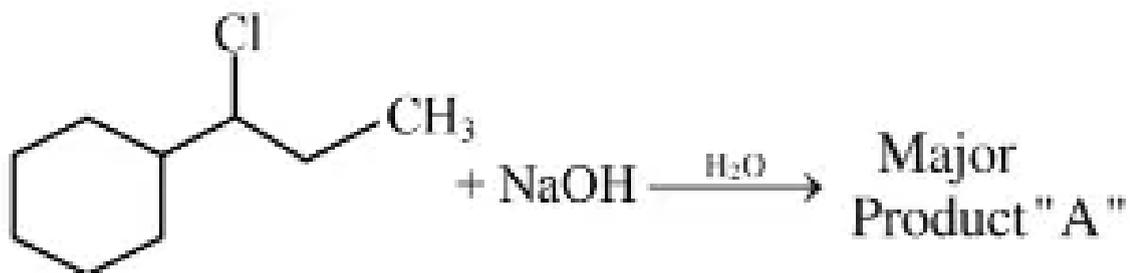
8. The major products formed:

(+4, -1)



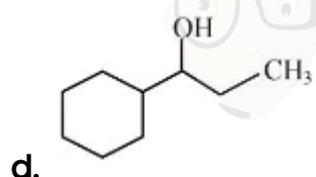
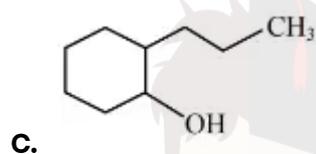
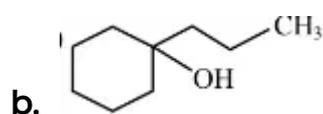
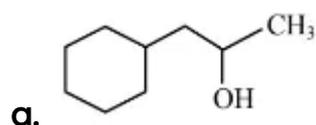
A and B respectively are:





9. (+4, -1)

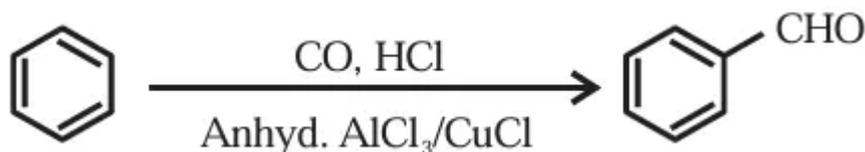
Consider the above chemical reaction. Product "A" is:



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10. Consider the following reaction: $MnO_2 + KOH + O_2 \rightarrow A + H_2O$. Product 'A' in neutral or acidic medium disproportionates to give products 'B' and 'C' along with water. The sum of spin-only magnetic moment values of B and C is _____ BM (nearest integer). (+4, -1)
 (Given atomic number of Mn is 25)

11. Identify the name reaction (+4, -1)

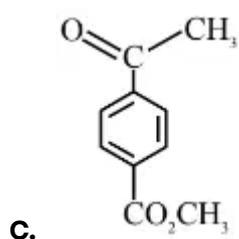
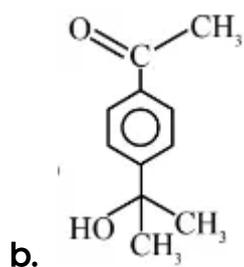
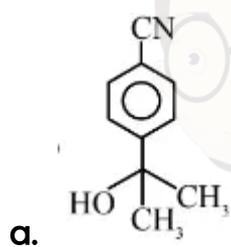
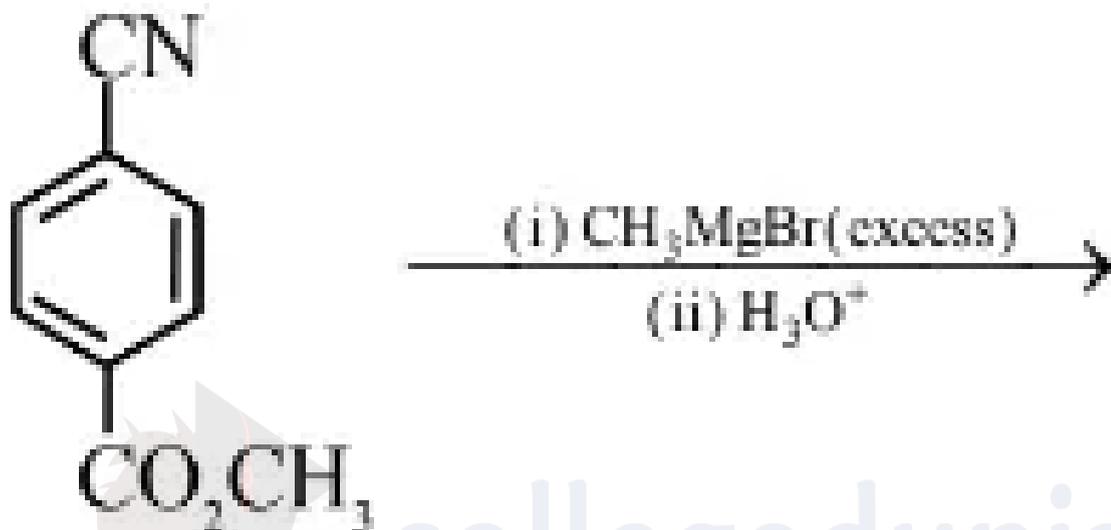


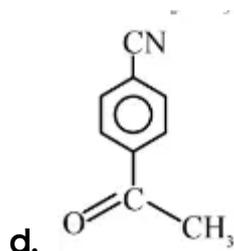
a. Stephen reaction

- b. Etard reaction
- c. Gatterman-koch reaction
- d. Rosenmund reduction

12. Major product of the following reaction is

(+4, -1)





13. Which of the following reactions are disproportionation reactions? (+4, -1)

- (A) $\text{Cu}^+ \rightarrow \text{Cu}^{2+} + \text{Cu}$
 (B) $3\text{MnO}_4^{2-} + 4\text{H}^+ \rightarrow 2\text{MnO}_4^- + \text{MnO}_2 + 2\text{H}_2\text{O}$
 (C) $2\text{KMnO}_4 \rightarrow \text{K}_2\text{MnO}_4 + \text{MnO}_2 + \text{O}_2$
 (D) $2\text{MnO}_4^- + 3\text{Mn}^{2+} + 2\text{H}_2\text{O} \rightarrow 5\text{MnO}_2 + 4\text{H}^+$

Choose the correct answer from the options given below.

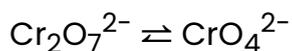
- a. (A), (B)
 b. (B), (C), (D)
 c. (A), (B), (C)
 d. (A), (D)

14. For a reversible reaction $\text{A} \rightleftharpoons \text{B}$, the $\Delta H_{\text{forward reaction}} = 20 \text{ kJ mol}^{-1}$. The activation energy of the uncatalysed forward reaction is 300 kJ mol^{-1} . When the reaction is catalysed keeping the reactant concentration same, the rate of the catalysed forward reaction at 27°C is found to be same as that of the uncatalysed reaction at 327°C . The activation energy of the catalysed backward reaction is _____ kJ mol^{-1} . (+4, -1)

15. What is the purpose of adding gypsum to cement? (+4, -1)

- a. To give a hard mass
 b. To facilitate the hydration of cement
 c. To slow down the process of setting
 d. To speed up the process of setting
-

16. Consider the given reaction:



Above reaction shifts in forward direction in

- a. Acidic Medium
- b. Basic Medium
- c. Neutral Medium
- d. Slightly acidic medium

(+4, -1)

17. $A(g) \rightleftharpoons 2B(g) + C(g)$

For the given reaction, if the initial pressure is 450 mm Hg and the pressure at time t is 720 mm Hg at a constant temperature T and constant volume V . The fraction of $A(g)$ decomposed under these conditions is $x \times 10^{-1}$. The value of x is _____ . (nearest integer)

(+4, -1)

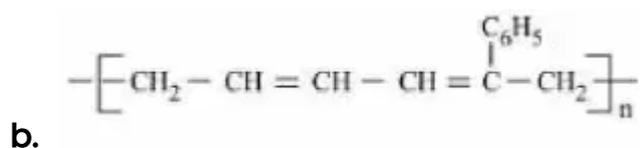
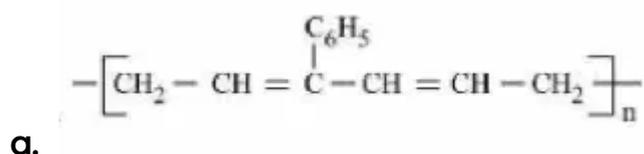
18. The reaction used for preparation of soap from fat is :

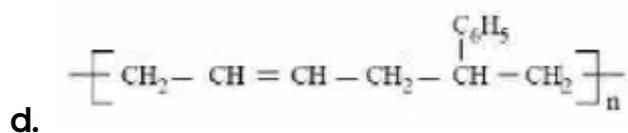
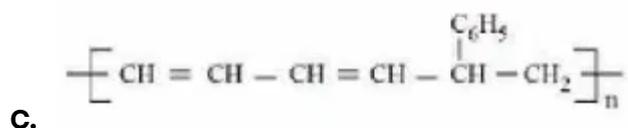
- a. reduction reaction
- b. an addition reaction
- c. alkaline hydrolysis reaction
- d. an oxidation reaction

(+4, -1)

19. Buna-S can be represented as:

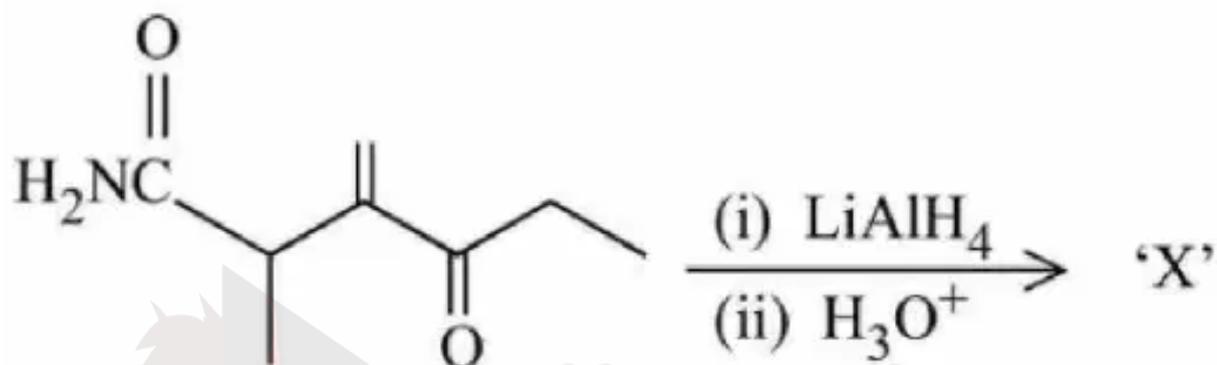
(+4, -1)



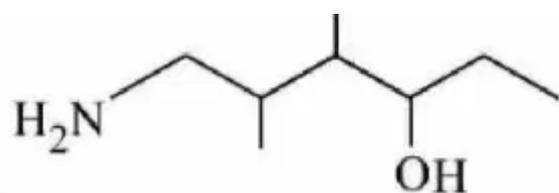
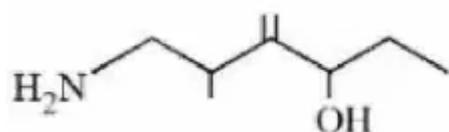
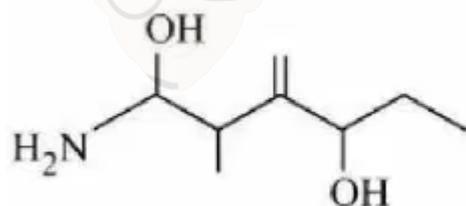


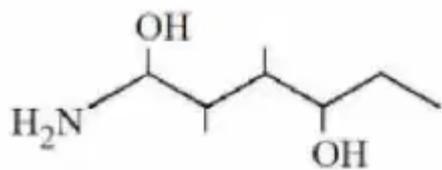
20. In the reaction given below :

(+4, -1)



The Product 'X' is:



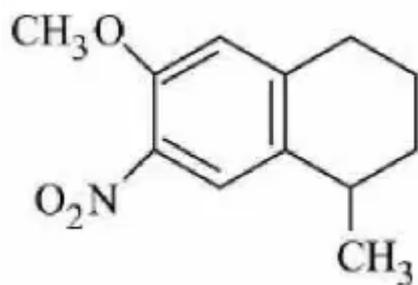
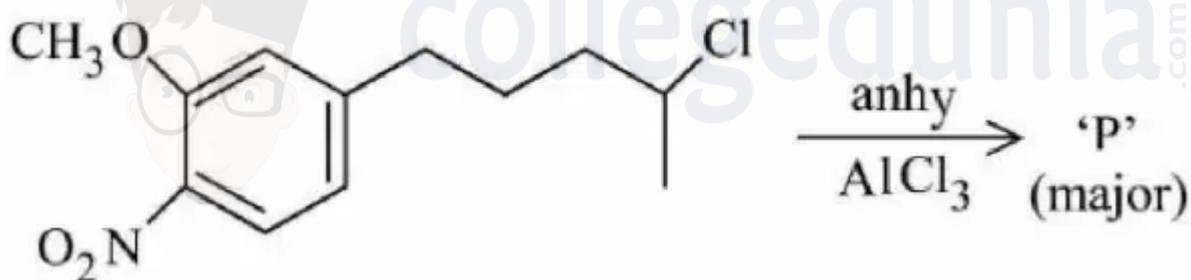


d.

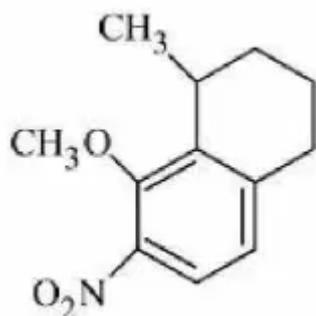
21. Incorrect method of preparation for alcohols from the following is: (+4, -1)

- Hydroboration-oxidation of alkene.
- Reaction of Ketone with RMgBr followed by hydrolysis.
- Reaction of alkyl halide with aqueous NaOH.
- Ozonolysis of alkene.

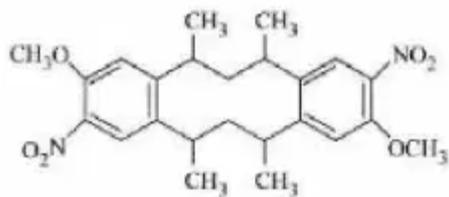
22. The major product P formed in the given reaction is: (+4, -1)



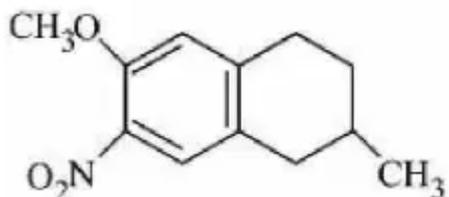
a.



b.

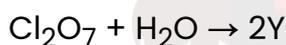
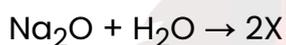


c.



d.

23. In the following reactions, the total number of oxygen atoms in X and Y is (+4, -1)



24. Coagulating value of the electrolytes AlCl_3 and NaCl for As_2S_3 are 0.09 and 50.04 respectively. The coagulating power of AlCl_3 is x times the coagulating power of NaCl . The value of x is _____ . (+4, -1)

25. The statement/s which are true about antagonists from the following is/are: (+4, -1)

- A. They bind to the receptor site.
- B. Get transferred inside the cell for their action.
- C. Inhibit the natural communication of the body.
- D. Mimic the natural messenger.

Choose the correct answer from the options given below:

- a. A and B
- b. A, C and D
- c. B only
- d. A and C

Answers

1. Answer: d

Explanation:

To determine the accuracy of each statement, let's examine them individually:

1. Statement (I): The boiling points of alcohols and phenols increase with an increase in the number of C-atoms.

- Alcohols and phenols are both characterized by the presence of hydroxyl groups ($-OH$).
- The boiling point of these compounds is generally influenced by two main factors:
 - Hydrogen bonding: The hydroxyl group can form hydrogen bonds, which significantly increases boiling points.
 - Molecular weight: As the number of carbon atoms increases, the molecular weight of the alcohol or phenol increases, leading to higher boiling points due to greater van der Waals forces (London Dispersion Forces).
- Thus, it is true that the boiling points increase with an increase in the number of carbon atoms.

2. Statement (II): The boiling points of alcohols and phenols are higher in comparison to other classes of compounds such as ethers and haloalkanes.

- This is primarily due to hydrogen bonding, which is much stronger than the van der Waals forces acting in ethers and haloalkanes.
- Ethers and haloalkanes have weaker intermolecular forces as they lack the hydrogen bonding present in alcohols and phenols.
- Therefore, alcohols and phenols generally have higher boiling points compared to ethers and haloalkanes of comparable molecular weight.

Based on the above analysis, we can conclude that **both Statement (I) and Statement (II) are true**. Therefore, the correct answer is:

- *Both Statement I and Statement II are true*

2. Answer: b

Explanation:

1. Analyze the given reaction sequences:

- The initial compound A reacts with nitric acid HNO_3 to form lead nitrate $\text{Pb}(\text{NO}_3)_2$.
- Lead nitrate $\text{Pb}(\text{NO}_3)_2$ further reacts with sulfuric acid H_2SO_4 to form B, which is lead sulfate PbSO_4 .
- Compound B undergoes another transformation to give a yellow precipitate, indicating the formation of lead chromate PbCrO_4 , labeled as C.

2. Determine the identity of A:

- To yield lead nitrate when treated with nitric acid, A could most likely be lead sulfide PbS . This is because $\text{PbS} \xrightarrow{\text{HNO}_3} \text{Pb}(\text{NO}_3)_2$ can be balanced to show the transformation.

3. Summarize the full reaction pathway:

- Step 1: $\text{PbS} \xrightarrow{\text{HNO}_3} \text{Pb}(\text{NO}_3)_2$
- Step 2: $\text{Pb}(\text{NO}_3)_2 \xrightarrow{\text{H}_2\text{SO}_4} \text{PbSO}_4$
- Step 3: $\text{PbSO}_4 \rightarrow \text{PbCrO}_4$ (yellow ppt)

4. Correct Option Evaluation:

- The sequence through which PbS turns into PbSO_4 and finally into the yellow precipitate PbCrO_4 matches the option: " $\text{PbS}, \text{PbSO}_4, \text{PbCrO}_4$ ".

5. Elimination of Other Options:

- Options involving PbCl_2 and $\text{Pb}(\text{SO}_4)_2$ do not fit the pathway as PbS directly leads to $\text{Pb}(\text{NO}_3)_2$ and PbSO_4 .

Thus, the correct sequence of reactions is captured by the option: $\text{PbS}, \text{PbSO}_4, \text{PbCrO}_4$.

3. Answer: 20 – 20

Explanation:

The moles of Cl in AgCl are:

$$n_{\text{Cl}} = n_{\text{AgCl}} = \frac{143.5 \times 10^{-3}}{143.5} = 10^{-3}$$

The percentage composition of Cl is:

$$\%Cl = \frac{10^{-3} \times 35.5}{180 \times 10^{-3}} \times 100 = 19.72\%$$

Thus, the percentage composition of chlorine is approximately 20%.

4. Answer: d

Explanation:

To determine the final pressure of the system when 50% of the reaction is completed, we start by analyzing the given reaction:



1. Initially, we have only N_2O_5 in the container with initial pressure P_0 .
2. Let's assume the initial moles of N_2O_5 are 1. No products are present initially.
3. When 50% of the reaction is completed, half of N_2O_5 is decomposed, so moles of $N_2O_5 = 0.5$.
4. From the stoichiometry of the reaction, when 0.5 moles of N_2O_5 decompose, the moles of products formed are:
 - o $NO_2 : 2 \times 0.5 = 1$
 - o $O_2 : \frac{1}{2} \times 0.5 = 0.25$
5. The total moles in the system when 50% reaction is completed:
 0.5 (remaining N_2O_5) + 1 (formed NO_2) + 0.25 (formed O_2) = 1.75
6. The change in total moles from initial (1 mole of N_2O_5) to the final state (1.75 moles) results in a pressure change because volume and temperature are constant.
7. The final pressure can be calculated as:
 - o $\frac{\text{Final Moles}}{\text{Initial Moles}} \times P_0 = \frac{1.75}{1} \times P_0 = 1.75 \times P_0$
8. This is equivalent to the final pressure being $\frac{7}{4}$ times the initial pressure, since $1.75 = \frac{7}{4}$.

Hence, the final pressure of the system is $\frac{7}{4}$ times the initial pressure, confirming that the correct answer is:

$\frac{7}{4}$ times of initial pressure

5. Answer: b

Explanation:

Disproportionation reactions involve a species being simultaneously oxidized and reduced to form two different products. Among the given species: - ClO_2^- and ClO_3^- can undergo disproportionation to form ClO_3^- and ClO_2 , respectively. - ClO_4^- does not undergo disproportionation because it is already in its most oxidized state as a chlorine(V) species, and there is no higher oxidation state to form. Thus, the correct answer is ClO_4^- , which does not undergo disproportionation.

6. Answer: d

Explanation:

To solve the given problem, we need to match each reaction in List-I with the corresponding type of redox reaction mentioned in List-II.

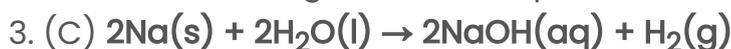
Step-by-step Explanation:



This is a **Combination Reaction**. In this reaction, nitrogen (N_2) and oxygen (O_2) combine to form nitrogen monoxide (NO). This type of reaction involves the combination of two or more substances to form a single product.



This is a **Decomposition Reaction**. In this reaction, lead nitrate decomposes to form lead oxide, nitrogen dioxide, and oxygen gas. A decomposition reaction involves breaking down a compound into two or more components.



This is a **Displacement Reaction**. In displacement reactions, one element displaces another in a compound. Here, sodium displaces hydrogen from water to form sodium hydroxide and hydrogen gas.



This is a **Disproportionation Reaction**. Disproportionation reactions involve the same element being simultaneously oxidized and reduced. In the given

reaction, nitrogen dioxide is both oxidized to nitrate (NO_3^-) and reduced to nitrite (NO_2^-).

Matching the reactions with the type:

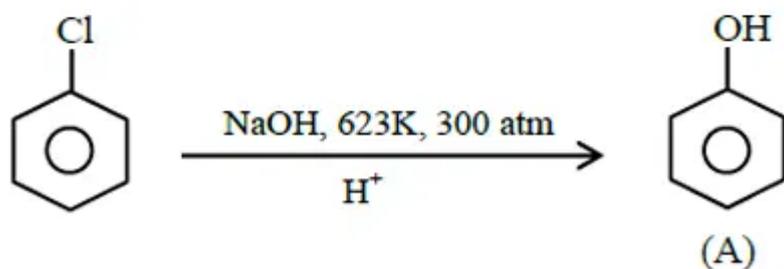
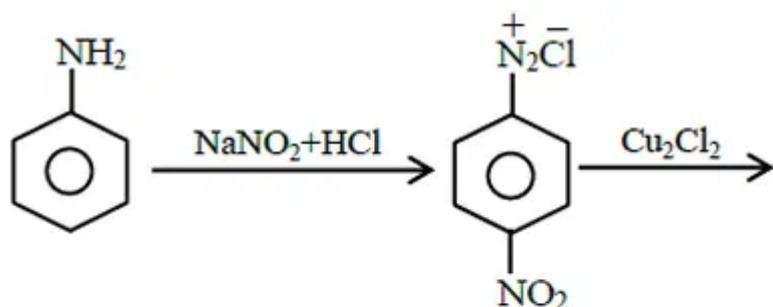
List-I Reaction	List-II Type of Redox Reaction
(A) $\text{N}_2(\text{g}) + \text{O}_2(\text{g}) \rightarrow 2\text{NO}(\text{g})$	(IV) Combination
(B) $2\text{Pb}(\text{NO}_3)_2(\text{s}) \rightarrow 2\text{PbO}(\text{s}) + 4\text{NO}_2(\text{g}) + \text{O}_2(\text{g})$	(I) Decomposition
(C) $2\text{Na}(\text{s}) + 2\text{H}_2\text{O}(\text{l}) \rightarrow 2\text{NaOH}(\text{aq}) + \text{H}_2(\text{g})$	(II) Displacement
(D) $2\text{NO}_2(\text{g}) + 2\text{OH}^-(\text{aq}) \rightarrow \text{NO}_2^-(\text{aq}) + \text{NO}_3^-(\text{aq}) + \text{H}_2\text{O}(\text{l})$	(III) Disproportionation

Therefore, the correct answer is (A)-(IV), (B)-(I), (C)-(II), (D)-(III).

7. Answer: b

Explanation:

The reaction sequence is as follows:

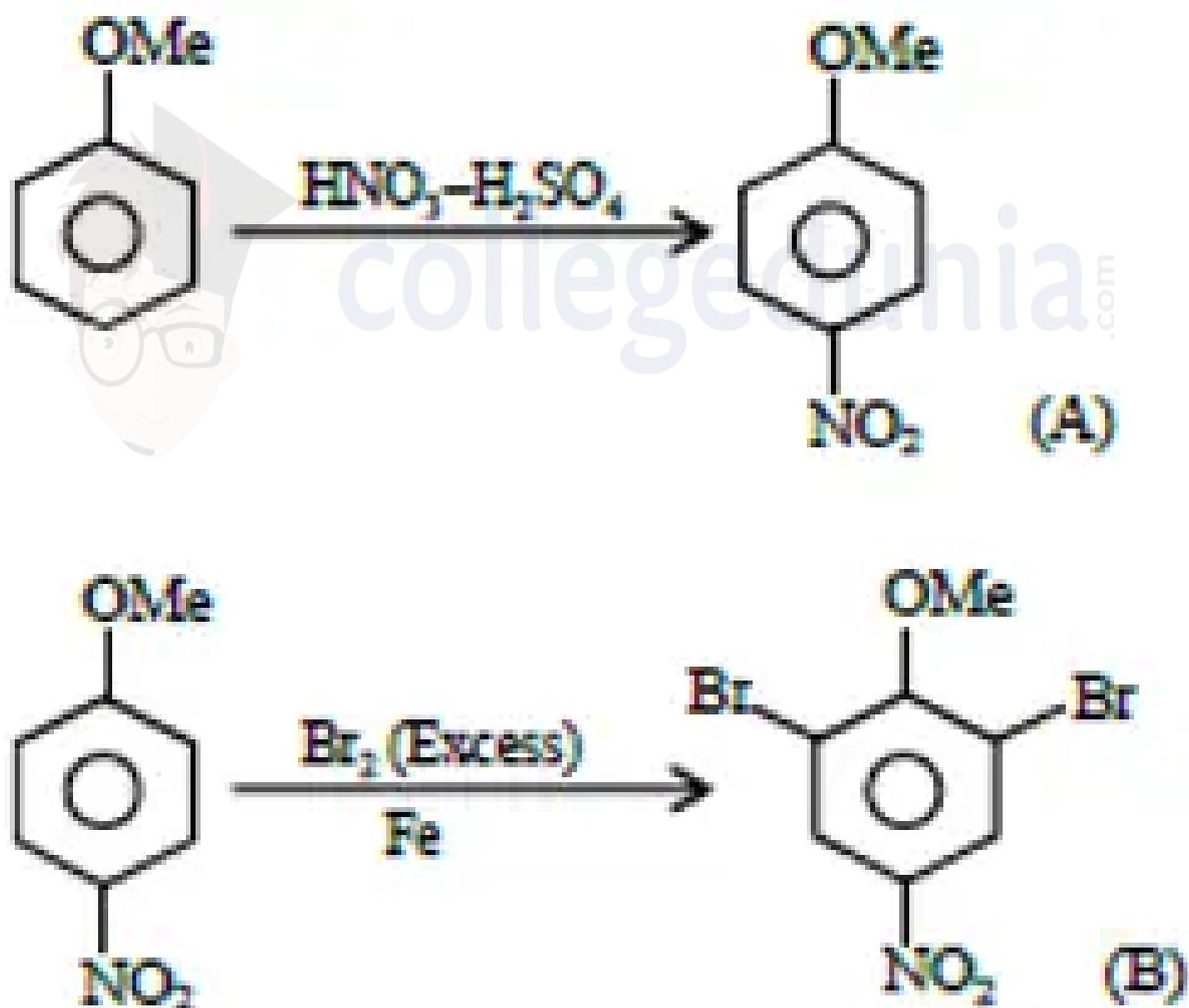


Thus the correct answer is option 2.

8. Answer: b

Explanation:

The reaction proceeds as follows: 1. The anisole (methoxybenzene) undergoes nitration with $\text{HNO}_3/\text{H}_2\text{SO}_4$ to form the product (A), which is 4-nitroanisole. 2. Subsequently, bromination with Br_2 (in the presence of excess iron) results in the brominated product (B), 4-bromo-2-nitroanisole.



Thus, the major products are (A) and (B) as represented in option (2).

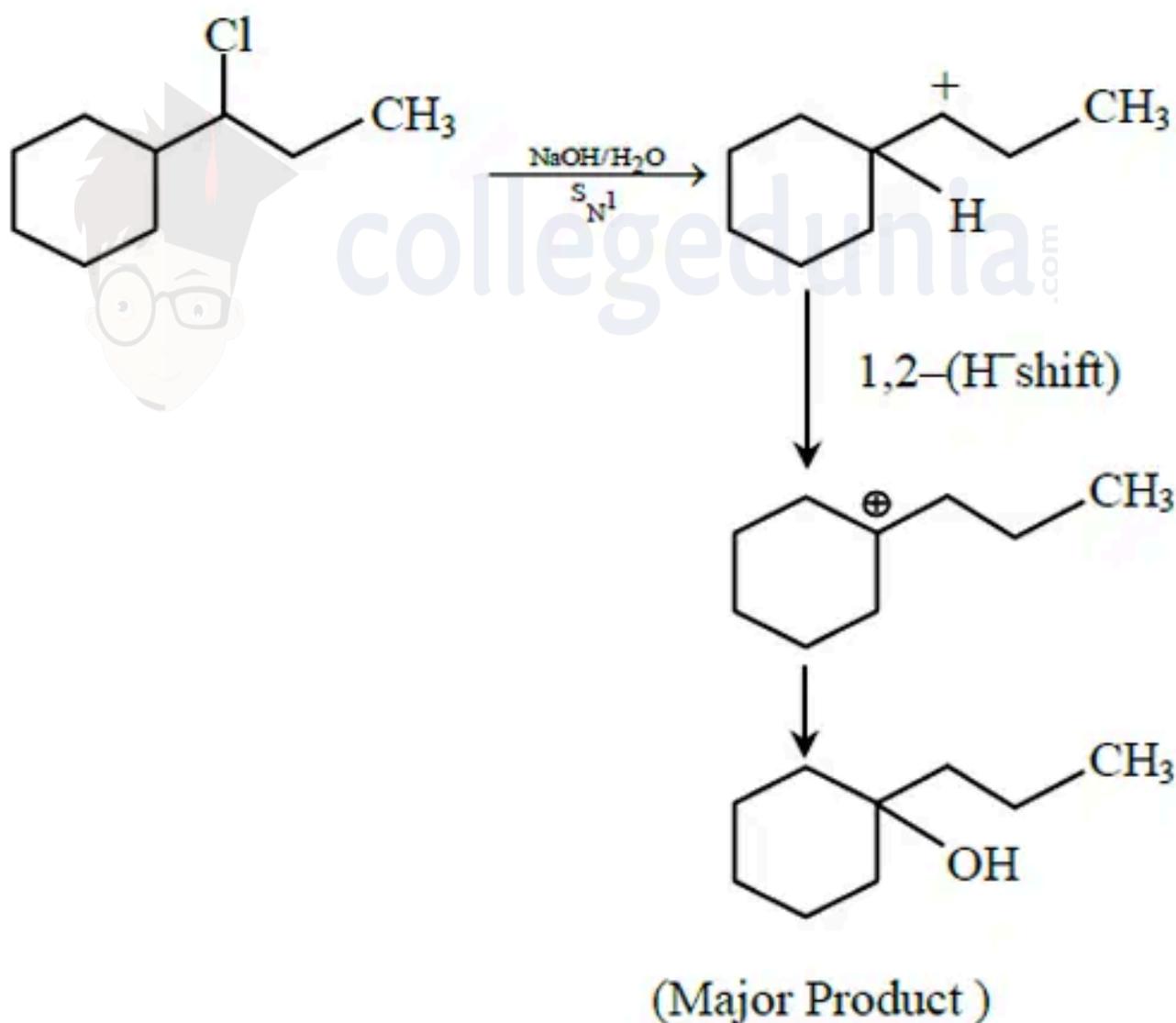
9. Answer: b

Explanation:

The reaction proceeds via an S_N1 mechanism where the chlorine group leaves, forming a carbocation.

After the formation of the carbocation, a 1,2-hydride shift occurs to stabilize the carbocation, resulting in a more stable tertiary carbocation.

Subsequent attack by hydroxide ion (OH^-) leads to the formation of the major product:



The major product is a tertiary alcohol.

10. Answer: 4 – 4

Explanation:

Reaction Analysis:

The reaction:



where product $A = \text{K}_2\text{MnO}_4$.

Disproportionation of K_2MnO_4 :

In a neutral or acidic medium, K_2MnO_4 disproportionates as follows:



where: Product ' B ' is KMnO_4 ,

Product ' C ' is MnO_2 .

Calculating Spin-Only Magnetic Moment:

For KMnO_4 : Manganese in KMnO_4 has an oxidation state of +7, which has no unpaired electrons. Therefore, the magnetic moment for KMnO_4 is 0 BM.

For MnO_2 : Manganese in MnO_2 has an oxidation state of +4, with a $3d^3$ electron configuration.

Number of unpaired electrons $n = 3$. The spin-only magnetic moment μ is calculated as:

$$\mu = \sqrt{n(n+2)} = \sqrt{3(3+2)} = \sqrt{15} \approx 3.87 \text{ BM}$$

Sum of Magnetic Moments of B and C:

$$\text{Magnetic moment of B (KMnO}_4) + \text{C (MnO}_2) = 0 + 3.87 \text{ BM (nearest integer)}$$

Conclusion:

The sum of the spin-only magnetic moment values of B and C is 4 BM.

11. Answer: c

Explanation:

The reaction depicted in the image is called the **Gatterman-Koch reaction**. This reaction involves the formylation of aromatic compounds like benzene to form benzaldehyde.

1. The reaction uses carbon monoxide (CO) and hydrogen chloride (HCl) in the presence of a Lewis acid catalyst such as anhydrous aluminum chloride (AlCl₃) or cuprous chloride (CuCl).
2. The main purpose of this reaction is to introduce an aldehyde group (-CHO) onto the aromatic ring.

Explanation:

The setup typically involves bubbling CO and HCl through a solution of an aromatic ring and the catalyst. When benzene is used, the Gatterman-Koch reaction results in the formation of benzaldehyde:



This method is particularly useful because it directly converts benzene into benzaldehyde in one step.

This is distinct from other reactions listed in the options:

- **Stephen reaction:** Used to convert nitriles to aldehydes.
- **Etard reaction:** Involves the oxidation of aromatic methyl groups to aldehydes using chromyl chloride.
- **Rosenmund reduction:** Reduces acyl chlorides to aldehydes using hydrogen and a palladium catalyst.

Thus, the correct answer is **Gatterman-Koch reaction**.

12. Answer: b

Explanation:

To determine the major product of the given chemical reaction, we need to consider the reagents and the functional groups involved in the reaction.

The given reactant is a benzene ring with a cyano group (CN) and a methoxy carbonyl group (CO₂CH₃). The given reagents are:

- (i) CH₃MgBr (excess) - This is a Grignard reagent.
- (ii) H₃O⁺ - This represents acidic hydrolysis.

Step-by-step Reaction Process:

1. The Grignard reagent, CH₃MgBr, will attack the electrophilic center of the carbonyl group (CO₂CH₃), leading to the formation of an alcohol post acidic work-up (hydrolysis).
2. Given that the Grignard reagent is in excess, it will also attack the cyano group (CN) twice, resulting in the conversion of the cyano group into a fully substituted tertiary alcohol after hydrolysis.
3. The product obtained after these transformations is a tertiary alcohol with the original benzene ring intact, and additional methyl (CH₃) groups attached due to the Grignard reagent's action.

Conclusion: The major product is a tertiary alcohol derived from both the cyano and ester groups being reacted with excess Grignard reagent and hydrolysis.

13. Answer: a

Explanation:

The problem asks to identify which of the given chemical reactions are disproportionation reactions. A disproportionation reaction is a specific type of redox reaction where a single element from a single reactant is simultaneously oxidized and reduced, forming at least two different products containing that element in different oxidation states.

Concept Used:

To identify a disproportionation reaction, we must perform the following checks for each reaction:

1. Identify an element in a reactant that appears in multiple products.

2. Determine the oxidation state of this element in the reactant and in each of the products.
3. Verify if the oxidation state of the element in the reactant is intermediate to its oxidation states in the products.
4. Confirm that the element is both oxidized (its oxidation state increases) and reduced (its oxidation state decreases) in the reaction.

The general form for disproportionation is: Element (Oxidation State N) \rightarrow Element (Oxidation State $> N$) + Element (Oxidation State $< N$)

Step-by-Step Solution:

Step 1: Analyze Reaction (A)

The reaction is: $\text{Cu}^+ \rightarrow \text{Cu}^{2+} + \text{Cu}$

We determine the oxidation states of copper (Cu) in the reactant and products:

- Oxidation state of Cu in reactant Cu^+ is +1.
- Oxidation state of Cu in product Cu^{2+} is +2.
- Oxidation state of Cu in product Cu (elemental form) is 0.

Here, Cu^+ is oxidized to Cu^{2+} (oxidation state increases from +1 to +2), and it is also reduced to Cu (oxidation state decreases from +1 to 0). Since the same species Cu^+ undergoes both oxidation and reduction, this is a disproportionation reaction.

Step 2: Analyze Reaction (B)

The reaction is: $3\text{MnO}_4^{2-} + 4\text{H}^+ \rightarrow 2\text{MnO}_4^- + \text{MnO}_2 + 2\text{H}_2\text{O}$

We determine the oxidation states of manganese (Mn):

- In reactant MnO_4^{2-} : Let oxidation state of Mn be x . Then $x + 4(-2) = -2 \Rightarrow x = +6$.
- In product MnO_4^- : Let oxidation state of Mn be y . Then $y + 4(-2) = -1 \Rightarrow y = +7$.
- In product MnO_2 : Let oxidation state of Mn be z . Then $z + 2(-2) = 0 \Rightarrow z = +4$.

Manganese in MnO_4^{2-} (oxidation state +6) is oxidized to MnO_4^- (+7) and is also reduced to MnO_2 (+4). Since the same reactant MnO_4^{2-} undergoes both oxidation and reduction, this is a disproportionation reaction.

Step 3: Analyze Reaction (C)

The reaction is: $2\text{KMnO}_4 \rightarrow \text{K}_2\text{MnO}_4 + \text{MnO}_2 + \text{O}_2$

We determine the oxidation states of the elements involved:

- In reactant KMnO_4 : Oxidation state of Mn is +7, and O is -2.
- In product K_2MnO_4 : Oxidation state of Mn is +6.
- In product MnO_2 : Oxidation state of Mn is +4.
- In product O_2 : Oxidation state of O is 0.

In this reaction, Manganese (Mn) is reduced from +7 to +6 and +4. Oxygen (O) is oxidized from -2 to 0. Since two different elements (Mn and O) from the same reactant are undergoing redox changes, this is an intramolecular redox reaction, but not a disproportionation reaction.

Step 4: Analyze Reaction (D)

The reaction is: $2\text{MnO}_4^- + 3\text{Mn}^{2+} + 2\text{H}_2\text{O} \rightarrow 5\text{MnO}_2 + 4\text{H}^+$

We determine the oxidation states of manganese (Mn):

- In reactant MnO_4^- : Oxidation state of Mn is +7.
- In reactant Mn^{2+} : Oxidation state of Mn is +2.
- In product MnO_2 : Oxidation state of Mn is +4.

Here, Mn from MnO_4^- (+7) is reduced to MnO_2 (+4), and Mn from Mn^{2+} (+2) is oxidized to MnO_2 (+4). Although the same element is involved, it comes from two different reactants. This type of reaction, where an element from two different oxidation states forms a product with an intermediate oxidation state, is called a comproportionation (or synproportionation) reaction, which is the reverse of disproportionation.

Final Result:

Based on the analysis, reactions (A) and (B) are disproportionation reactions.

Therefore, the correct options are **(A) and (B)**.

14. Answer: 130 – 130

Explanation:

Activation Energy Calculation

Step 1: Activation energy for the uncatalyzed backward reaction:

$$E_a(\text{backward}) = E_a(\text{forward}) - \Delta H$$

$$E_a(\text{backward}) = 300 - 20 = 280 \text{ kJ/mol}$$

Step 2: Using the given temperatures and equal rates, calculate $E_a(\text{forward, catalyzed})$:

$$\frac{E_a(\text{forward, catalyzed})}{E_a(\text{forward, uncatalyzed})} = \frac{T_c}{T_u}$$

$$\frac{E_a(\text{forward, catalyzed})}{300} = \frac{300}{600}$$

$$E_a(\text{forward, catalyzed}) = 150 \text{ kJ/mol}$$

Step 3: Calculate $E_a(\text{backward, catalyzed})$:

$$E_a(\text{backward, catalyzed}) = E_a(\text{forward, catalyzed}) - \Delta H$$

$$E_a(\text{backward, catalyzed}) = 150 - 20 = 130 \text{ kJ/mol}$$

Final Results:

- **Uncatalyzed Backward Reaction:** 280 kJ/mol
- **Catalyzed Forward Reaction:** 150 kJ/mol
- **Catalyzed Backward Reaction:** 130 kJ/mol

15. Answer: c

Explanation:

Gypsum ($\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$) is added to cement to regulate the setting time. Without gypsum, cement would set immediately upon mixing with water, leaving no time for concrete placement.

Gypsum reacts with tricalcium aluminate (C_3A) in cement to form insoluble calcium sulfoaluminates, which slows down the hydration reaction.

This delay ensures sufficient time for the mixing, transportation, and placement of concrete before it hardens.

16. Answer: b**Explanation:**

The Correct answer is option is (B) : Basic Medium

17. Answer: 3 – 3**Explanation:**

The reaction is given as:



At time $t = 0$, the pressure of A is 450 mmHg, and at time $t = t$, the total pressure is 720 mmHg.

Let the extent of decomposition at time t be $2x$, so that the pressures of A, B, and C at time t are:

$$\text{Pressure of A} = 450 - x$$

$$\text{Pressure of B} = 2x$$

$$\text{Pressure of C} = x$$

Thus, the total pressure at time t is:

$$P_t = P_A + P_B + P_C = (450 - x) + 2x + x = 720 \text{ mmHg}$$

Now, solving for x :

$$720 = 450 - x + 2x + x$$

$$720 = 450 + 2x$$

$$270 = 2x$$

$$x = 135$$

The fraction of A decomposed is:

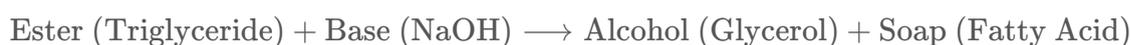
$$\text{Fraction of A decomposed} = \frac{x}{450} = \frac{135}{450} = 0.3 = 3 \times 10^{-1}$$

Thus, the value of x is 3.

18. Answer: c

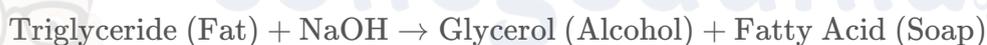
Explanation:

The process of preparing soap from fat is known as **saponification**, which is a type of alkaline hydrolysis reaction. During saponification, triglycerides (fats) react with a strong base like sodium hydroxide (NaOH), resulting in the formation of glycerol (glycerin) and fatty acids, the key components of soap. The general equation for saponification is:



In this process, triglycerides (which are esters) undergo hydrolysis when treated with NaOH. The ester bonds in the triglycerides are broken, yielding glycerol and fatty acids. The fatty acids then combine with the sodium ions from the sodium hydroxide to form soap (sodium salts of fatty acids).

This reaction is classified as alkaline hydrolysis because it involves breaking down ester bonds using a strong base (NaOH), leading to the formation of soap and alcohol. Thus, the correct classification is an alkaline hydrolysis reaction.



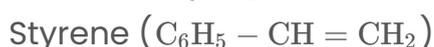
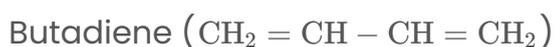
This reaction plays a key role in soap production.

19. Answer: d

Explanation:

Step 1: Understanding the structure of Buna-S

Buna-S is a copolymer, meaning it is formed by the polymerization of two distinct monomers: butadiene and styrene. The monomers involved in the copolymerization are as follows:



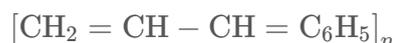
Step 2: Identifying the correct structure

The polymerization of butadiene and styrene occurs in a 3:1 ratio. This means that for every three units of butadiene, one unit of styrene is incorporated. In the polymerization process, the double bonds in the monomers break and connect,

forming the long polymer chain.

Option (1) is incorrect because it does not correctly represent the polymerization process involving styrene.

Option (2) is the correct representation as it shows the proper copolymerization between butadiene and styrene, with the following structure:



This structure correctly alternates between the butadiene and styrene units, forming the desired polymer chain.

Step 3: Finalizing the structure of Buna-S

In Buna-S, the repeating unit alternates between styrene and butadiene molecules. This arrangement is essential as it determines the material's properties, such as its elasticity, strength, and resistance to wear.

Thus, the correct structure of Buna-S is represented in option (4), and the polymerization of butadiene and styrene produces the copolymer known as Buna-S.

20. Answer: b

Explanation:

Step 1: Analyzing the given reaction.

The given reaction involves the reduction of a molecule containing a carbonyl group ($\text{C}=\text{O}$) and an amide group ($-\text{NH}_2$) using lithium aluminum hydride (LiAlH_4), followed by hydrolysis with H_3O^+ .

1. Step 1: Reduction with LiAlH_4

Lithium aluminum hydride (LiAlH_4) is a strong reducing agent. When it reacts with a carbonyl compound (such as a ketone or aldehyde), it reduces the carbonyl group to a primary or secondary alcohol. In this case, the carbonyl group ($\text{C}=\text{O}$) of the given compound will be reduced to a hydroxyl group ($-\text{OH}$), resulting in an intermediate amide being reduced to a primary amine group ($-\text{NH}_2$). The structure of the intermediate product will be:



where the ketone group is reduced to an alcohol group.

2. Step 2: Hydrolysis with H_3O^+

After reduction, the product is treated with an acidic solution (H_3O^+), which will hydrolyze the intermediate and result in a final product where the amide group has

been converted to an amine group ($-\text{NH}_2$) attached to a hydroxyl group ($-\text{OH}$). This confirms the product as:



This is the final product, and it is a primary amine with a hydroxyl group attached to the adjacent carbon. Thus, the product 'X' is $\text{H}_2\text{N} - \text{CH}_2\text{OH}$.

21. Answer: d

Explanation:

Step 1: Understanding the methods of alcohol preparation.

Let's evaluate each of the methods:

1. Ozonolysis of alkene:

Ozonolysis involves the cleavage of the double bond in an alkene using ozone (O_3) to form two carbonyl compounds, which could be either aldehydes or ketones.

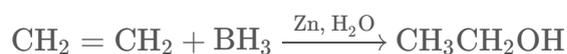
The reaction proceeds as:



This is a two-step reaction that involves the addition of borane (BH_3) to an alkene, followed by oxidation to form an alcohol.

2. Hydroboration-oxidation of alkene:
This is a two-step reaction that involves the addition of borane (BH_3) to an alkene, followed by oxidation to form an alcohol.

The reaction proceeds as:

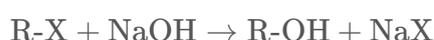


This method is correct for preparing alcohols from alkenes, and it follows the syn addition of boron and hydrogen across the double bond, followed by the formation of an alcohol after oxidation.

3. Reaction of alkyl halide with aqueous NaOH:

This is a nucleophilic substitution reaction, where an alkyl halide reacts with aqueous NaOH to form an alcohol.

The reaction proceeds as:



This is a correct method for alcohol preparation, as the hydroxide ion acts as a

nucleophile and displaces the halide ion to form an alcohol.

4. Reaction of Ketone with RMgBr followed by hydrolysis:

This is a reaction of a ketone with a Grignard reagent (RMgBr), which adds to the carbonyl carbon, followed by hydrolysis to form an alcohol.

The reaction proceeds as:



This is a correct method for preparing alcohols, specifically secondary alcohols, from ketones.

Thus, the only incorrect method for preparing alcohols is ozonolysis of alkene.

22. Answer: a

Explanation:

The given reaction is an electrophilic aromatic substitution. When the compound reacts with $AlCl_3$, a Friedel-Crafts alkylation or acylation typically takes place. The compound contains both a nitro group (NO_2) and a methoxy group (OCH_3) as substituents.

The nitro group is electron-withdrawing and deactivates the aromatic ring towards electrophilic substitution, while the methoxy group is electron-donating and activates the ring. Therefore, the reaction will predominantly occur at the position where the methoxy group is located, as it makes the ring more reactive.

As a result, the major product will be the structure shown in option (1), where substitution occurs at the position activated by the methoxy group.

23. Answer: 5 - 5

Explanation:

The reactions of sodium oxide and dichlorine heptoxide with water are as follows:



Adding the coefficients from both equations: $1 + 4 = 5$

24. Answer: 556 – 556

Explanation:

Coagulating Power of Electrolytes:

The coagulating power of an electrolyte is inversely proportional to its coagulating value:

$$\text{Coagulating power} \propto \frac{1}{\text{Coagulating value}}$$

For AlCl_3 and NaCl :

The ratio of their coagulating powers is given by:

$$\frac{\text{Coagulating power of AlCl}_3}{\text{Coagulating power of NaCl}} = \frac{\text{Coagulating value of NaCl}}{\text{Coagulating value of AlCl}_3}$$

Substitute the Given Values:

$$\frac{\text{Coagulating power of AlCl}_3}{\text{Coagulating power of NaCl}} = \frac{50.04}{0.09}$$

Simplify:

$$x = \frac{50.04}{0.09} = 556$$

Conclusion:

The coagulating power of AlCl_3 is **556 times** that of NaCl .

25. Answer: d

Explanation:

Antagonists are substances that bind to receptor sites to block the effects of natural messengers. They do not get transferred into the cell but inhibit the natural

communication of the body.

Analysis of Options :

1. **Option A** : Correct. Antagonists bind to receptor sites.
2. **Option B** : Incorrect. Antagonists act at the receptor site and are not transferred inside the cell.
3. **Option C** : Correct. They inhibit the natural communication of the body.
4. **Option D** : Incorrect. Antagonists do not mimic natural messengers; they block them.

Conclusion: The correct answer is **(4) A and C.**

