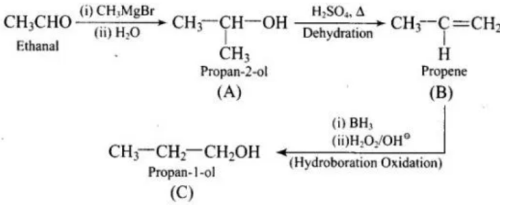
Solution

ALDEHYDES, KETONES, CARBOXYLIC ACID

Class 12 - Chemistry

1. **(a)** positional isomers

Explanation:



Thus, $CH_3\ \underset{CH_3}{\overset{}{C}}\ H-OH$ and CH_3-CH_2-CH_2OH are positional isomers(differs in position of functional group).

2.

(b) Oxalic acid

Explanation:

Structural formula of Ethan-1, 2-dioic acid is

$\begin{array}{l} COOH \\ | \\ COOH \end{array}$

∴ It is oxalic acid.

3.

(b) higher aldehydes

Explanation:

Higher aldehydes like aldehyde C-10 etc. are used in floral blends like rose, jasmine, etc.

4.

(c) Acetone

Explanation:

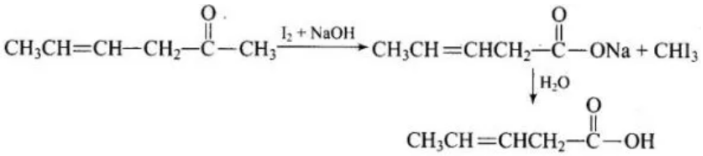
The dry distillation of calcium acetate primarily produces acetone. During the process, calcium acetate decomposes when heated, leading to the formation of acetone as the main product. Other options like acetaldehyde, ethane, and propanal are not the primary products of this reaction, making acetone the correct answer.

5.

(b) I_2 and NaOH solution

Explanation:

The reaction involved is-



6.

(c) 1-aminoethane

Explanation: 1-aminoethane

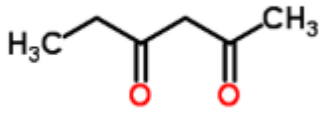
7.

(c) 2, 4 – Hexanedione

Explanation:

2,4-hexanedione will have active methylene group.

The structure of 2,4-hexanedione is



-CH_2 group present between the two carbonyl group is active methylene group, these hydrogens are highly acidic as their conjugate base is highly stable.

8.

(b) I_2 and NaOH

Explanation:

I_2 and NaOH

9.

(c) Pentan-2-one

Explanation:

Pentan-2-one

10.

(b) saponification

Explanation:

Base hydrolysis of ester produces the salt of carboxylic acid and alcohols as the product, and soaps are salts of carboxylic acids. Therefore, this reaction is called a saponification reaction.

11.

(b) Fehling's solution

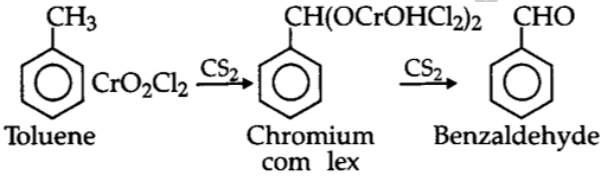
Explanation:

Fehling's solution oxidises aliphatic aldehydes very easily but does not react with acetone and aromatic aldehyde; benzaldehyde.

12.

(d) Etard reaction

Explanation:



This reaction is known as Etard reaction.

13.

(d) $(CH_3)_2Cd$

Explanation:

$(CH_3)_2Cd$

14.

(b) CH_3CHO

Explanation:

Acetaldehyde (CH_3CHO) have alpha hydrogen hence will undergo aldol reaction in presence of base rather than cannizaro reaction. Cannizaro reaction is given when there is no alpha hydrogen present on carbonyl group.

15.

(d) size and solubility of the aldehyde and ketone molecule.

Explanation:

Size and solubility of aldehyde and ketone determine fragrance. For example, aldehyde C-10 is used in floral blends like rose, jasmine, etc. While aldehyde C-11 has a strong citrus smell and aldehyde C-16 has a strong strawberry smell.

16.

(d) Adipic acid

Explanation:

Conc. $KMnO_4$ will cause oxidative ozonolysis and ring-opening forming adipic acid.

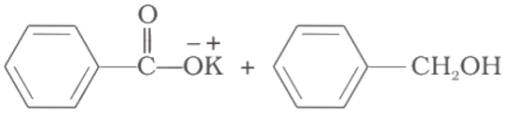
Cyclohexene + conc. $KMnO_4 \rightarrow HOOC(CH_2)_4COOH$

17. **(a)** $(CH_3)_2C = CHCHOHCH_3$

Explanation:

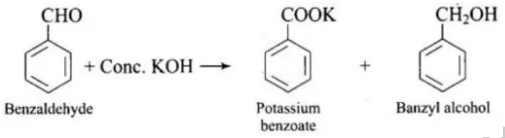
The solution identifies the final product (B) as option $(CH_3)_2C = CHCHOHCH_3$ based on the sequence of reactions provided. The reactions likely involve the formation of a double bond and the introduction of a hydroxyl group, which is characteristic of the product. In this case, the structure in option shows a double bond between the carbon atoms and a hydroxyl group attached, aligning with the expected transformations from the starting material through the reactions. The other options do not match the expected functional groups or structural features resulting from the reactions.

18. **(a)**



Explanation:

Benzaldehyde has no hydrogen. So, on reaction with aqueous KOH solution, it undergoes Cannizzaro's reaction. One molecule of aldehyde is reduced and other is oxidized to carboxylic acid salt.



19. **(a)** Acetic acid

Explanation:

Acetic acid is the strongest acid because it loses H^+ ion to form carboxylic ion (CH_3COO^-)which gets stabilised by resonance.

20.

(b) All of these

Explanation:

Tollen's reagent is used to differentiate between aldehydes and ketones, as well as to identify certain carboxylic acids. In option, Tollen's reagent can distinguish between acetic acid (a carboxylic acid) and benzaldehyde (an aldehyde) because aldehydes reduce Tollen's reagent while carboxylic acids do not. In option, Tollen's reagent can differentiate between acetaldehyde (an aldehyde) and acetic acid (a carboxylic acid) for the same reason. In option , Tollen's reagent can also differentiate between acetic acid and formic acid (HCOOH), as formic acid can reduce Tollen's reagent due to its aldehyde-like properties. Since Tollen's reagent can differentiate all the pairs in the options provided, the correct answer is that all of these compounds can be differentiated using Tollen's reagent.

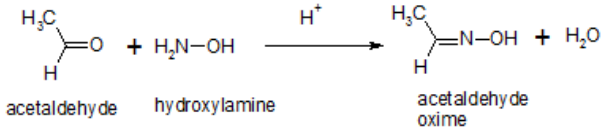
21.

(c) Etard reaction

Explanation:

Etard reaction

22. Oximes are produced *via* a condensation reaction between aldehydes or ketones with hydroxylamine (H_2N-OH) in weakly acidic medium. It belongs to the family of imines, with the general formula R^1R^2C=NOH. Here R^1 is the organic side chain, and R^2 may be hydrogen, forming an aldoxime, or another organic group, forming a ketoxime. A typical reaction for formation of oxime is depicted as:



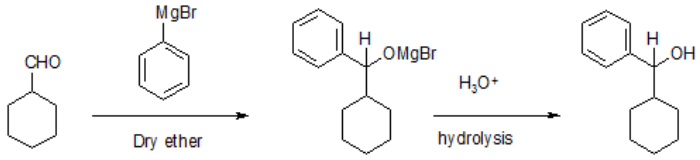
23. a. 2-Methylbutan-2-ol / $(CH_3)_2C(OH)CH_2CH_3$ is formed / $CH_3COCH_2CH_3 \xrightarrow[ii)\ H_2O]{i)\ CH_3MgBr} (CH_3)_2C(OH)CH_2CH_3$

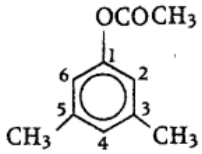
    b. Benzene / C_6H_6 is formed

$$C_6H_5COONa \xrightarrow{NaOH + CaO,\ \Delta} C_6H_6$$

24. a. Because acetate ion is less stable than formate ion due to +I effect of -CH_3 group.

    b. Because of the resonance stabilisation of conjugate base.

25. 

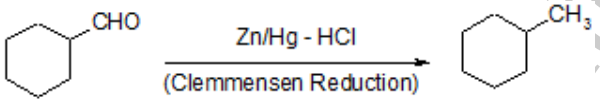
26. 

IUPAC Name: 3, 5-dimethyl phenyl ethanoate

27. The carboxyl group of aldehydes and ketones is reduced to CH_2 group on treatment with zinc-amalgam and concentrated hydrochloric acid (Clemmensen reduction)

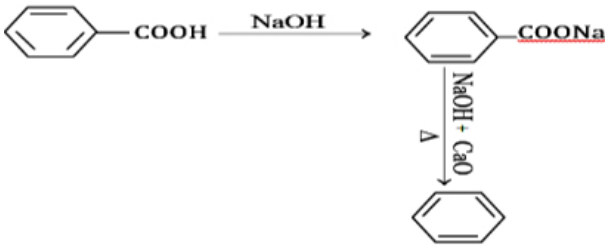
$$H_3C - CH_2 - CHO \xrightarrow[HCl]{Zn-Hg} CH_3 - CH_2CH_3 + H_2O$$

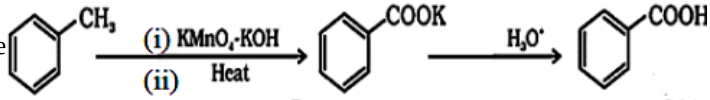
28. CH_3 - O - CH_3 < CH_3CHO < CH_3CH_2OH

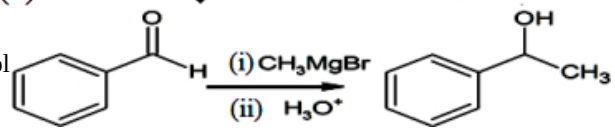
29. 

30. a. $CH_3CN \xrightarrow[Dry\ ether]{CH_3MgBr} CH_3 - \underset{CH_3}{\overset{}{C}} = NMgBr \xrightarrow[H^+]{H_2O} CH_3 - \underset{CH_3}{\overset{}{C}} = O$

    b.



31. i. Toluene to benzene 

    ii. Benzaldehyde to 1-phenylethanol 

32.

    (d) A is false but R is true.

    Explanation:

    Benedict's solution (Cu^{2+} + citric acid + base) and Fehling solution (Cu^{2+} + tartaric acid + base) are weaker oxidising agents than Tollen's reagent $[Ag(NH_3)_2{}^+]$; they oxidise aliphatic aldehydes but are not capable of oxidising aromatic aldehydes.

33.

(c) Assertion (A) is true, but Reason (R) is false.

Explanation:

C – Cl bond is more ionic than C – I bond because of the greater difference in the electronegativities of C and Cl as compared to that of carbon and iodine. Therefore, C – Cl bond is stronger than the C – I bond.

34.

(b) Both A and R are true but R is not the correct explanation of A.

Explanation:

Formic acid (HCOOH) is not true acid, it contains both aldehyde (-CHO) as well as a carboxyl group (-COOH), and it behaves as a reducing agent because it can be easily oxidized to CO_2 and H_2O and hence reduces Tollens reagent.

35.

(c) A is true but R is false.

Explanation:

Addition of KCN solution to carbonyl compounds increases the pH of solution. KCN hydrolysis to give HCN and KOH as shown below

$$KCN + H_2O \rightleftharpoons KOH + HCN$$

HCN formed attacks carbonyl group, to form cyanohydrins and thus to maintain hydrolysis constant, the hydrolysis of KCN increases to give more KOH and thus solution becomes more alkaline.

36.

(b) Both A and R are true but R is not the correct explanation of A.

Explanation:

SO_3^{--} is a large ion. Its addition is possible only under the condition that $\rangle C=O$ grouping is not sterically hindered as is the case for RCHO, $RCOCH_3$ and cyclic ketones.

37.

(d) A is false but R is true.

Explanation:

HCN is a weak acid and have low degree of dissociation but in presence of a base (even H_2O), the dissociation increases appreciably to provide appreciable CN^- to attack C=O bond.

38.

(b) Both A and R are true but R is not the correct explanation of A.

Explanation:

Both A and R are true but R is not the correct explanation of A.

39.

(c) A is true but R is false.

Explanation:

A is true but R is false.

40. **(a)** Both A and R are true and R is the correct explanation of A.

Explanation:

$$CH_3CHO + 2Cu^{2+} + 5OH^- \rightarrow CH_3COO^- + \underset{\text{red ppt.}}{Cu_2O} + 3H_2O$$

The overall effect of -I and +R effect of phenyl group.

41.

(c) A is true but R is false.

Explanation:

The boiling points of carbonyl compounds are higher than corresponding alkanes due to dipole-dipole attraction between polar carbonyl groups.

42. **(a)** (a) - (ii), (b) - (iii), (c) - (iv), (d) - (i)

Explanation:

(a) - (ii), (b) - (iii), (c) - (iv), (d) - (i)

43. **(a)** (a) - (ii), (b) - (i), (c) - (iv), (d) - (iii)

Explanation:

(a) - (ii), (b) - (i), (c) - (iv), (d) - (iii)

44.

(b) (a) - (iv), (b) - (iii), (c) - (ii), (d) - (i)

Explanation:

(a) - (iv), (b) - (iii), (c) - (ii), (d) - (i)

45.

(c) n – Butane, ethoxyethane, pentanal and pentan – 1 – ol

Explanation:

- Alcohols are involved in hydrogen bonding with each other i.e. intermolecular hydrogen bonding and thus have a higher boiling point compared to aldehydes or ketones and ethers.
- Aldehydes and ketones due to their polar CO bond have higher boiling point compared to ethers.
- Alkanes being non-polar have the least boiling point.

46. **(a)** I > II > III

Explanation:

I > II > III

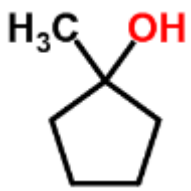
47.

(c)

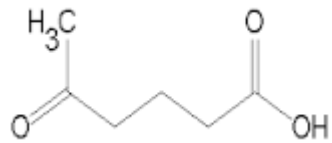
1. H_2SO_4 and heat
2. Conc. $KMnO_4$

Explanation:

5 – oxohexanoic acid starting with 1 – methylcyclopentan – 1 – ol can be synthesized using conc H_2SO_4 which will cause dehydration forming alkene which with $KMnO_4$ opens the ring and forms 1 – methylcyclopentan – 1 – ol.



this 1-methylcyclopentan-1-ol reacts with conc H_2SO_4 to form 1-methylcyclopent-1-ene which on reaction with conc $KMnO_4$ cause oxidative ozonolysis of alkene and forms 5 – oxohexanoic acid.



48. **(a)** Aldehydes and ketones undergo electrophilic substitution.

Explanation:

Aldehydes and ketones have polar C=O group therefore they undergo nucleophilic addition reactions. The oxygen being electronegative have a delta (small) negative charge and thus C attached to oxygen bears a positive charge. Thus this electrophilic C attracts a nucleophile to add to its double bond. Thus aldehydes and ketones undergo nucleophilic addition reactions.

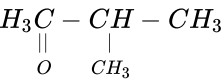
49. **(a)** C_2H_5OH, iodine with NaOH gives iodoform.

Explanation:

I_2 in the presence of NaOH act as a weak oxidizing agent and thus C_2H_5OH gets oxidizes to CH_3CHO and $COCH_3$ group is important for iodoform.

$CH_3CHO + I_2 + OH^- \rightarrow CHI_3 + HCOO^-$

CHI_3 is a yellow ppt known as iodoform.

50. **(a)** 

2 - Methyl - 3 - butanone

Explanation:

Numbering is done in such a way that CO gets the lower number as CO is the functional group and should get the first priority. The correct IUPAC name of the compound should be 3-methylbut-2-one.

51. Fill in the blanks:

(i) 1. Primary

(ii) 1. Baeyer-villiger oxidation

(iii) 1. Aldehydes, ketones

(iv) 1. Formalin

(v) 1. Acetic anhydride

(vi) 1. Pentane-2, 4-dione

(vii) 1. $CH_3COCH_2CH_3$

(viii) 1. High

(ix) 1. Pentan-2-one

(x) 1. Tollen's reagent