

**Solutions to HWS-1  
HWS-2**

## Oxygen Containing Organic Compounds-III

### Preparation of Carboxylic Acids & Derivatives

#### Preparation of Carboxylic Acids

1. From Grignard Reagent
2. From Alkenes
  - (a) Oxidation
  - (b) Carbonylation
3. From Alkoxide ion
4. Oxidation Of
  - (a) Alcohols
  - (b) Aldehydes & Ketones
5. Hydrolysis Of
  - (a) Cyanides
  - (b) Cyanohydrins
  - (c) Tri-Halides
  - (d) Acid Derivatives
6. Malonic Ester Synthesis
7. Arndt-Eistert Reaction
8. Preparation of Formic Acid
9. Preparation of Acetic Acid
10. Preparation of Benzoic Acid

#### Preparation of Derivatives of Carboxylic Acids

1. Acid Chlorides & Bromides
2. Acid Anhydrides
3. Acid Amides
4. Esters

# Chemical Properties of Carboxylic Acids

1. Acidic Nature
2. With Diazomethane ( $\text{CH}_2\text{N}_2^+$ )
3. Reduction
4. Schmidt Reaction
5.  $\alpha$ -H Substitution (HVZ Reaction)
6. Reactions of Salts
  - (a) Decarboxylation
  - (b) Kolbe's Electrolysis
  - (c) Action of heat on calcium salts
  - (d) Action of heat on Ammonium salts
  - (e) Reaction of silver salts (Hunsdiecker Reaction)
7. Formation of Acid Derivatives
8. Action of heat on poly-functional Acids

## Reactions of Acid Chlorides:

1. With Acid Salts
2. With Alcohols in pyridine
3. (a) With Ammonia (b) With 1<sup>o</sup> Amines (c) With 2<sup>o</sup> Amines
4. Hydrolysis
5. Friedal Craft Acylation/Benzolation
6. With Grignard & Gillman Reagent
7. Rosenmond Reduction
8. Arndt Eistert Reaction
9. Reduction

## Reactions of Acid Anhydrides:

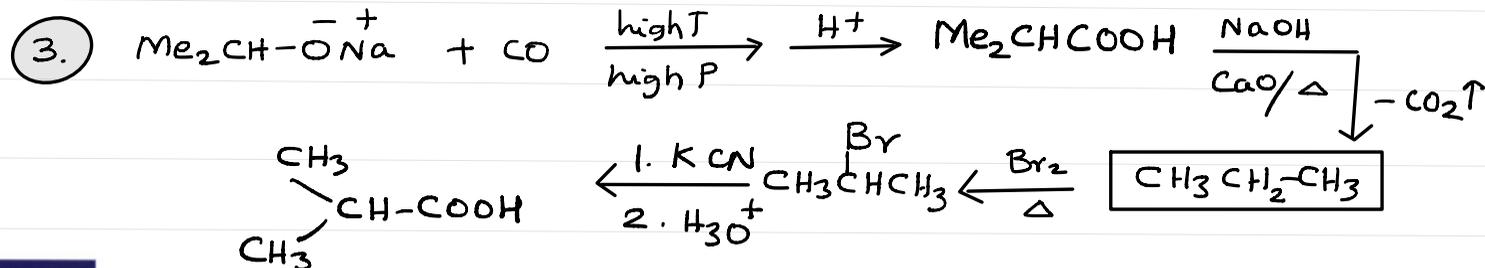
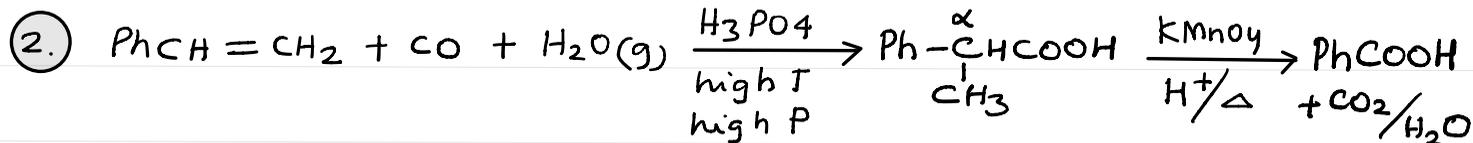
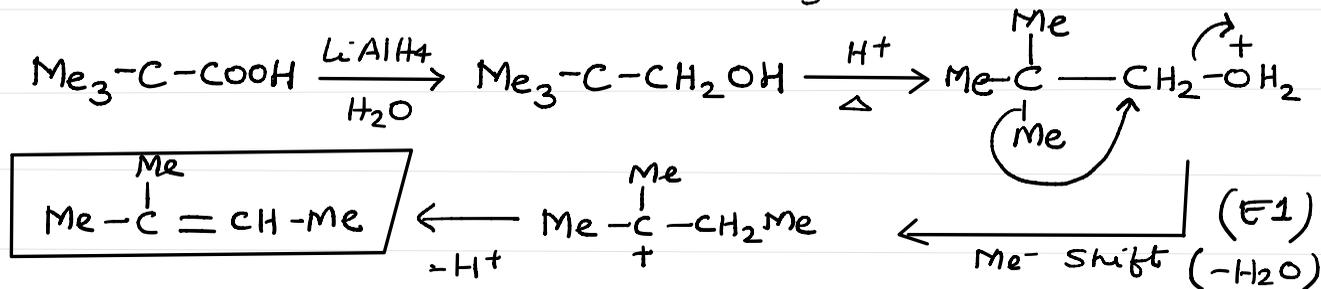
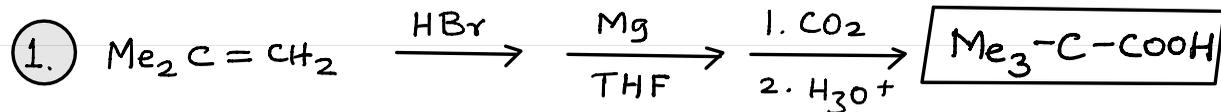
1. With Alcohols in Pyridine
2. With Reducing Agents
3. (a) With Ammonia      (b) With 1° Amines      (c) With 2° Amines
4. Hydrolysis
5. Perkin Reaction
6. With Grignard Reagent

## Reactions of Acid Amides:

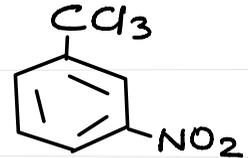
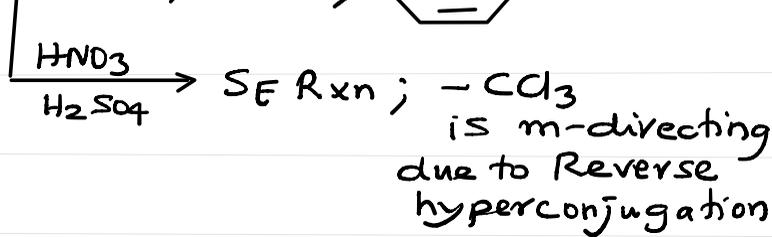
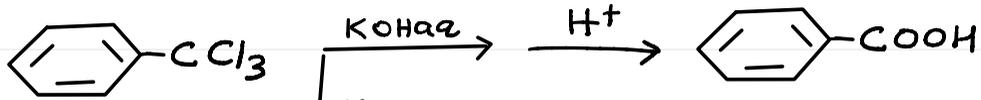
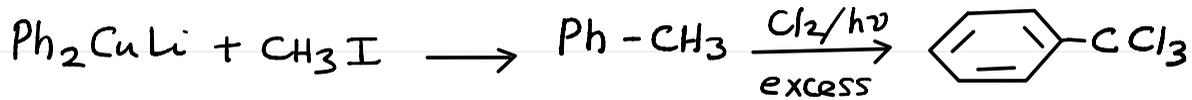
1. Dehydration
2. Reduction
3. Hoffmann's Degradation (Rearrangement) of Amides
4. Hydrolysis

## Reactions of Esters

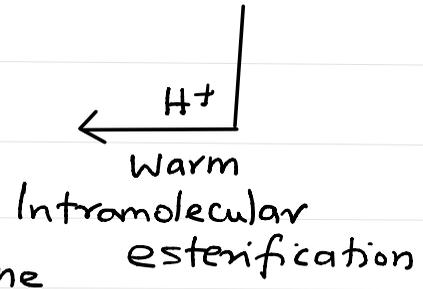
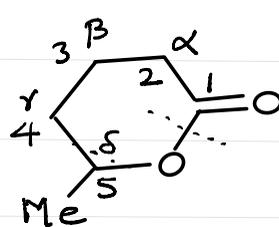
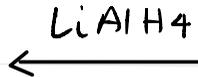
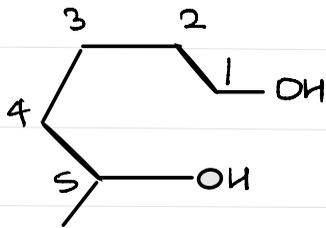
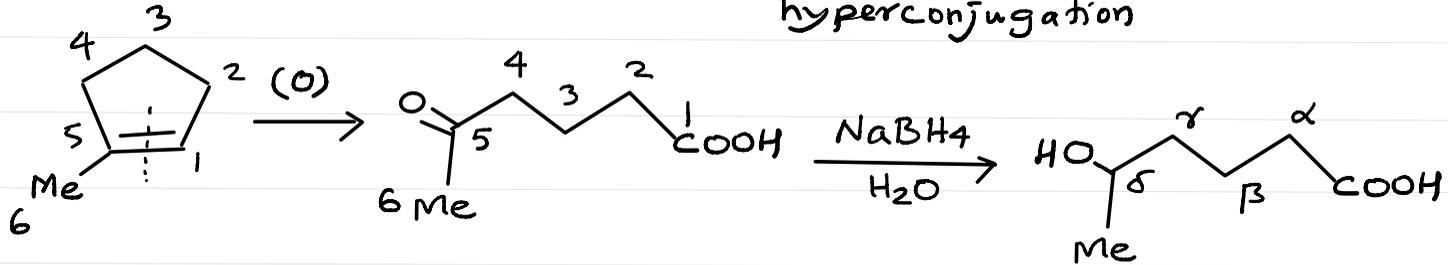
1. Hydrolysis      (a) Acid Catalysed
2. Trans-esterification
3. Saponification
4. Reduction
5. With Grignard Reagent
6. Formation of Amides
7. Claisen Condensation
  - (a) Self
  - (b) Cross
  - (c) Intramolecular (Dieckmann's Condensation)



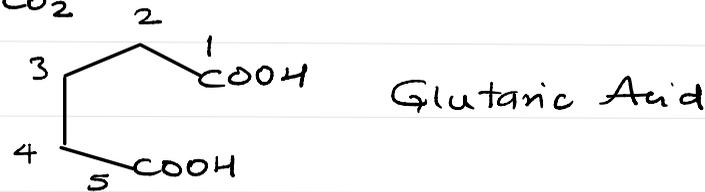
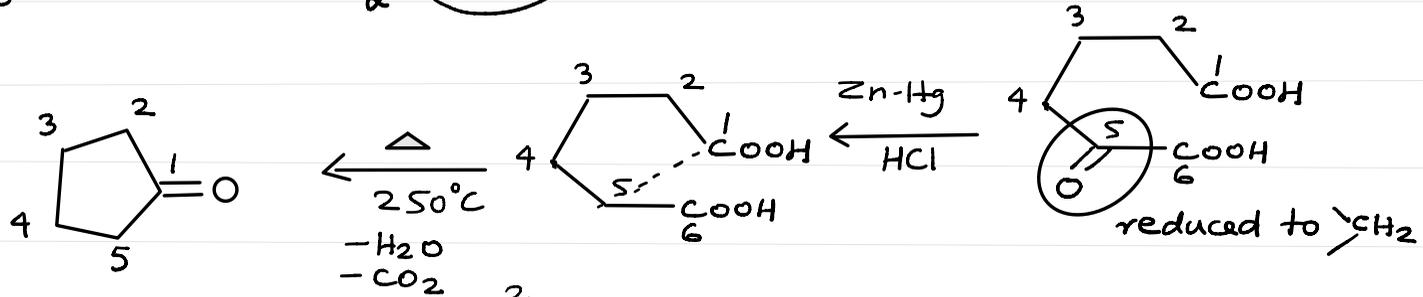
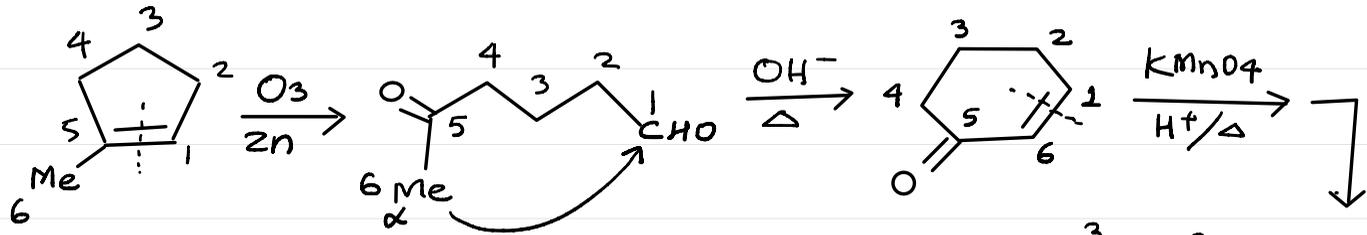
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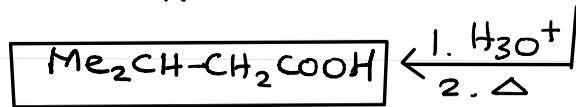
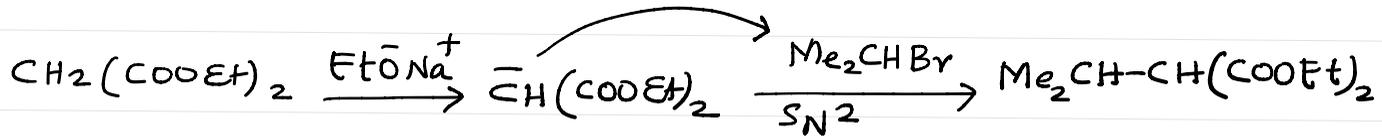
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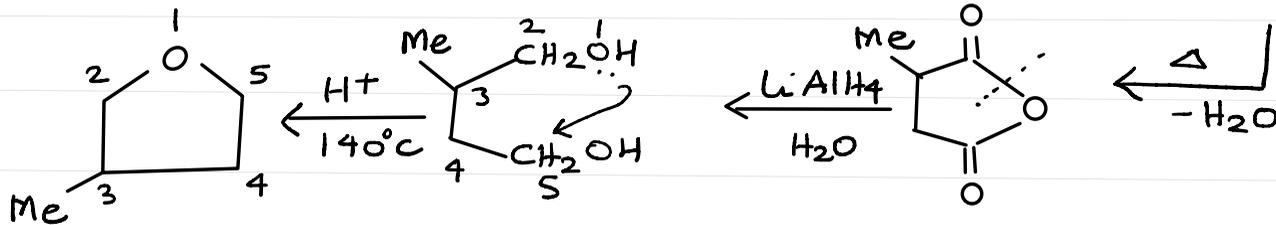
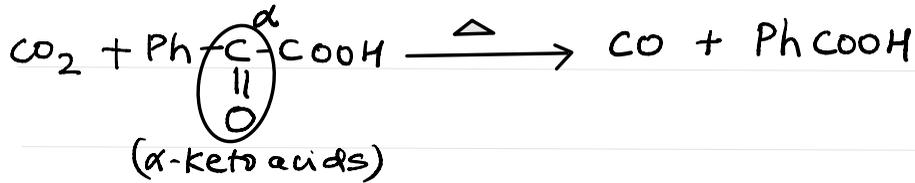
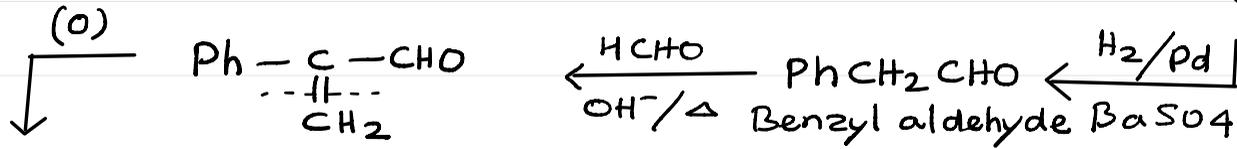
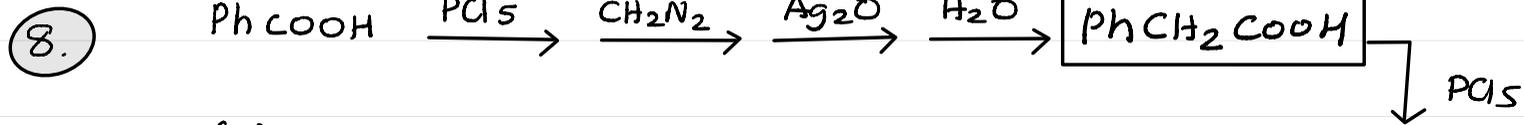


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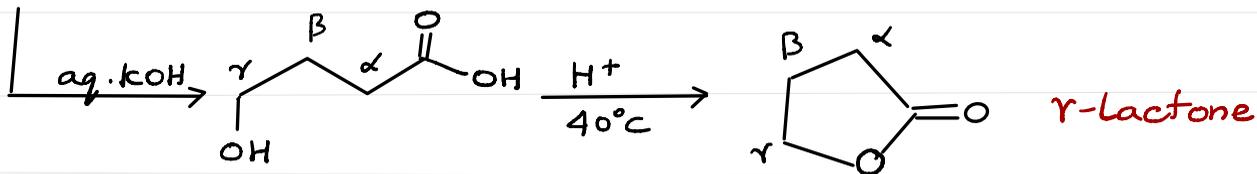
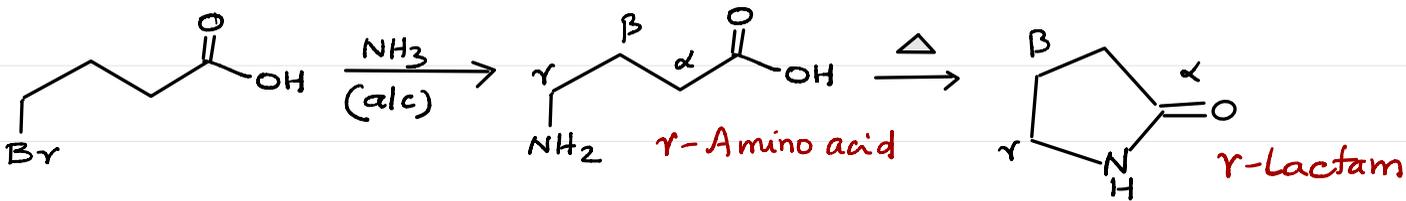


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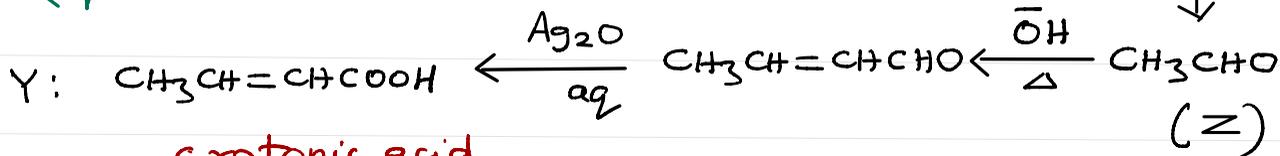
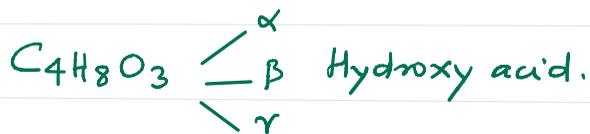
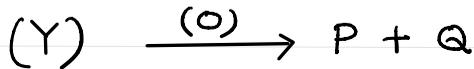
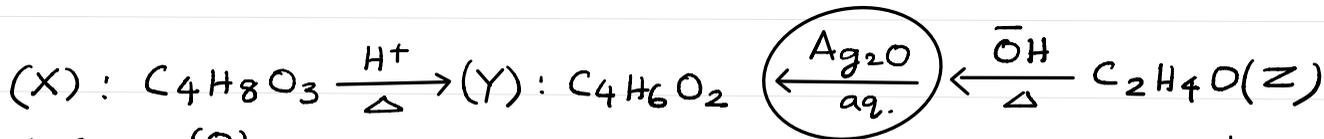




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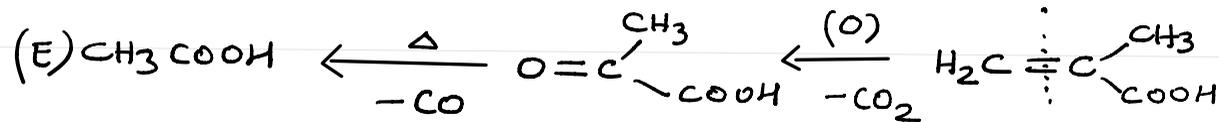
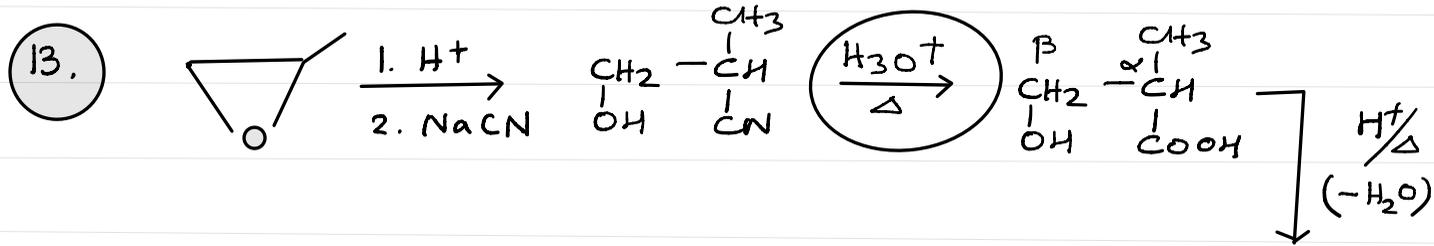
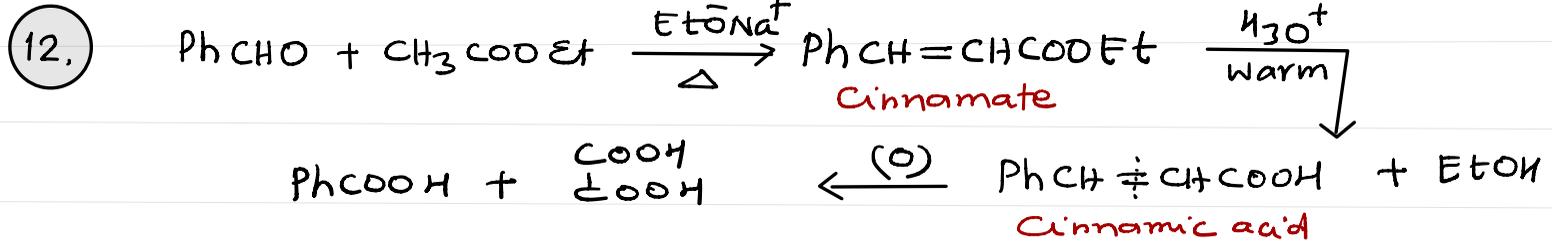


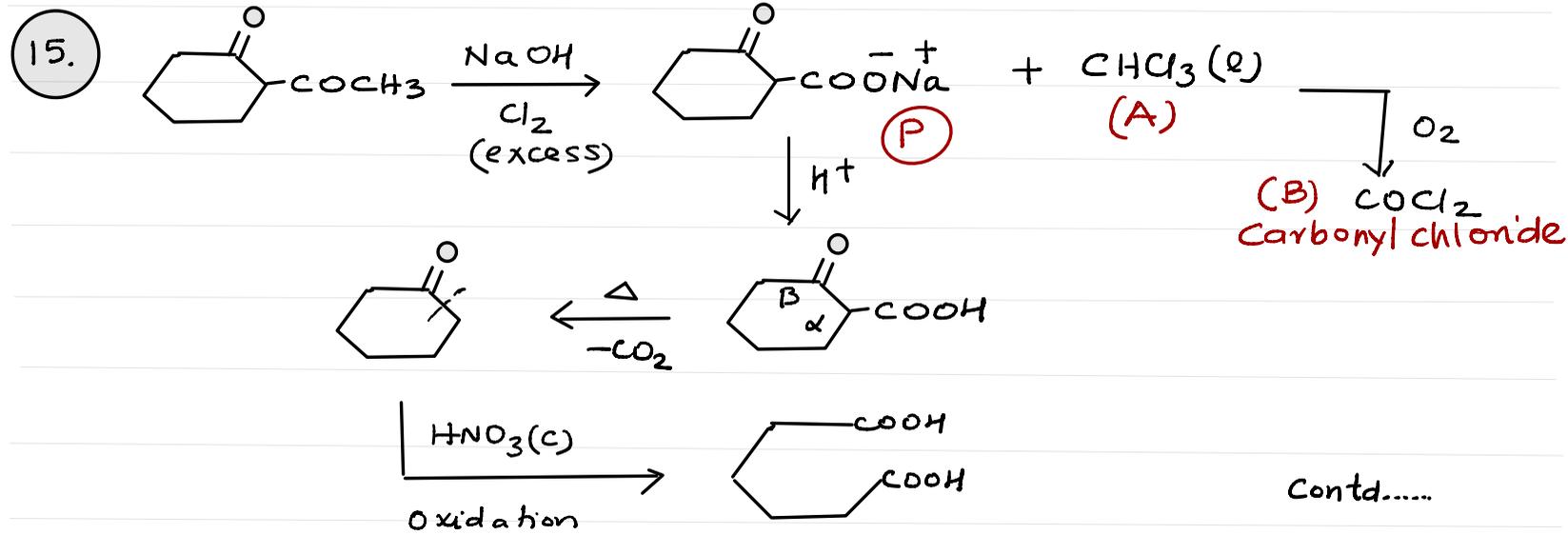
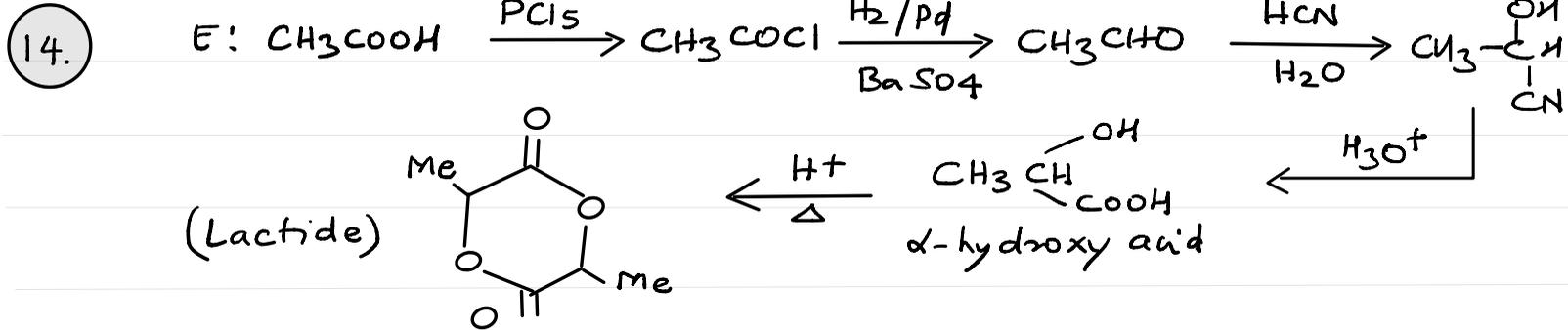
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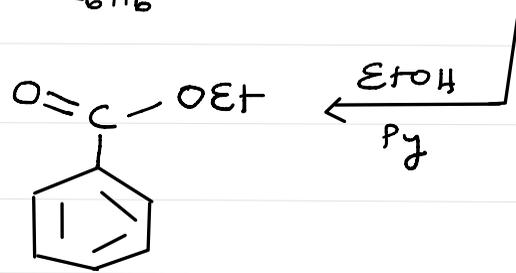
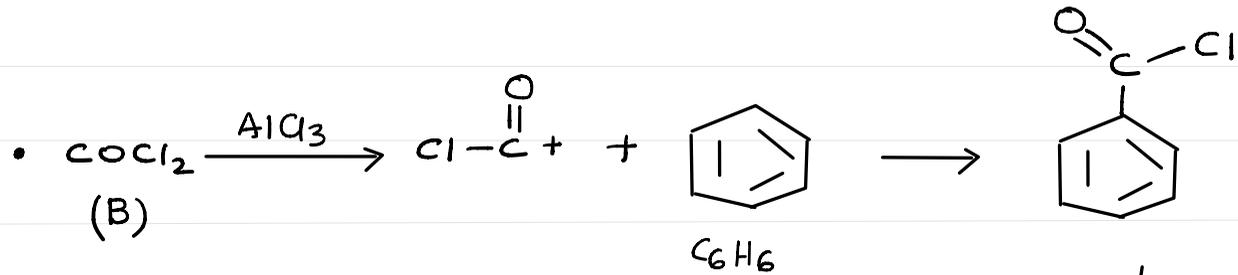


contd.....

contd.... (X) has to  $\beta$ -hydroxy acid.  $\equiv$   $\text{CH}_3 \overset{\beta}{\underset{\text{OH}}{\text{CH}}} \overset{\alpha}{\text{CH}_2} \text{COOH}$







Leave Q.6 &  
Q.50

Time: 120 min

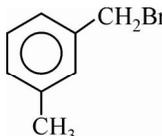
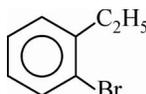
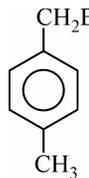
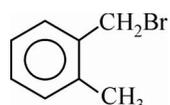
Chemistry

Carboxylic Acids

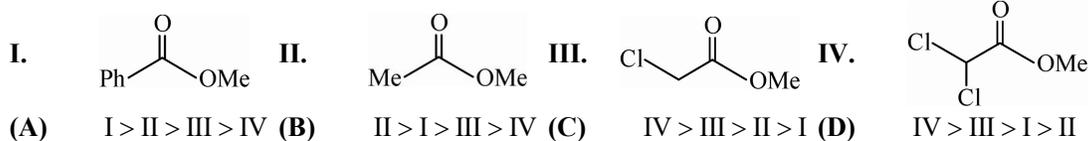
Class Test

Choose the correct Alternatives for each of the following questions. Each Question has ONE correct Alternative, however those marked with (\*) may have MORE THAN ONE correct Alternatives.

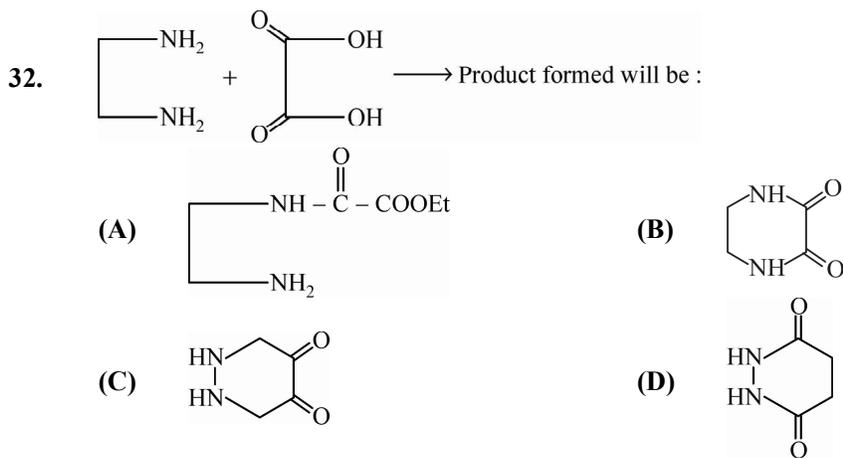
- The final product (B) in the given reaction setup will be :  $\text{CH}_3\text{Cl} \xrightarrow[2. \text{H}_3\text{O}^+]{1. \text{KCN}}$  Product  
(A)  $\text{CH}_3\text{COOC}_2\text{H}_5$  (B)  $\text{CH}_3\text{COOH}$  (C)  $\text{HCOOH}$  (D)  $\text{CH}_3\text{CONH}_2$
- In the given reaction setup :  $\text{CH}_3\text{OH} \xrightarrow[(ii) \text{Rh}; \Delta]{(i) \text{R}}$   $\text{CH}_3\text{COOH}$ , the reagent (R) is :  
(A)  $\text{CO}_2$  (B)  $\text{CO}$  (C)  $\text{MgO}$  (D)  $\text{C}$
- In vinegar the concentration of acetic acid is nearly :  
(A) 50% (B) 2% (C) 6-10% (D) 100%
- \*4. Which of the following statements is/are true about acetic acid ?  
(A) it is a polar molecule (B) it forms H-bonds  
(C) it is stronger than mineral acid  
(D) it has higher boiling point than corresponding alcohols
- In the given reaction, X and Y are respectively :  $\text{CH}_3\text{COOH} + \text{NH}_3 \longrightarrow (\text{X}) \xrightarrow{\Delta} (\text{Y}) + \text{H}_2\text{O}$   
(A)  $\text{CH}_3\text{CONH}_2, \text{CH}_4$  (B)  $\text{CH}_3\text{COONH}_4, \text{CH}_3\text{CONH}_2$   
(C)  $\text{CH}_3\text{CONH}_2, \text{CH}_3\text{COOH}$  (D)  $\text{CH}_3\text{NH}_2, \text{CH}_3\text{CONH}_2$
6.  $\text{CH}_3\text{CO}_2\text{C}_2\text{H}_5 \xrightarrow[(ii) \text{H}_3\text{O}^+]{(i) \text{C}_2\text{H}_5\text{O}^-\text{Na}^+/\text{H}^+}$  A. The structure of the compound A is :  
(A)  $\text{CH}_3\text{COCH}_2\text{CO}_2\text{H}$  (B)  $\text{CH}_3 - \text{CH} = \text{CH} - \text{CO}_2\text{H}$   
(C)  $\text{CH}_3\text{COCH}_3$  (D)  $\text{CH}_3\text{COCH}_2\text{CH}_2\text{CO}_2\text{H}$
- Lower carboxylic acids are soluble in water due to :  
(A) Low molecular weight (B) Hydrogen bonding  
(C) Dissociation into ions (D) Easy hydrolysis
- \*8. Which of the following statements is/are correct ?  
(A) the two carbon-oxygen bond lengths in molecular formic acid are different  
(B) the two carbon oxygen bond lengths in sodium formate are equal  
(C) partial resonance is there in formic acid  
(D) formate ion is more strongly resonance stabilized than formic acid
- The correct order of increasing acidic strengths is :  
(A) Phenol < Ethanol < Chloroacetic acid < Acetic acid  
(B) Ethanol < Phenol < Chloroacetic acid < Acetic acid  
(C) Ethanol < Phenol < Acetic acid < Chloroacetic acid  
(D) Chloroacetic acid < Acetic acid < Phenol < Ethanol
- The weakest acid among the following is :  
(A)  $\text{CH}_3\text{COOH}$  (B)  $\text{ClCH}_2\text{COOH}$  (C)  $\text{Cl}_3\text{CCOOH}$  (D)  $(\text{CH}_3)_2\text{CHCOOH}$

11. The correct order of decreasing acid strength of trichloroacetic acid (A), trifluoro acetic (B), acetic acid (C) and formic acid (D) is :  
 (A)  $A > B > C > D$  (B)  $A > C > B > D$  (C)  $B > A > D > C$  (D)  $B > D > C > A$
12. Which of the following has highest tendency to ionise in aqueous solution ?  
 (A) HCOOH (B) CH<sub>3</sub>COOH (C) FCH<sub>2</sub>COOH (D) BrCH<sub>2</sub>COOH
13. Which of the following reactions of acetic acid involves C – OH bond cleavage ?  
 I. Action with Na II. Formation of acid chloride  
 III. Action with NaHCO<sub>3</sub> IV. Formation of an ester  
 (A) I, II (B) II, III (C) III, IV (D) II, IV
14. Which of the following is the strongest acid ?  
 (A) HCOOH (pK<sub>a</sub> = 3.77) (B) C<sub>6</sub>H<sub>5</sub>COOH (pK<sub>a</sub> = 4.22)  
 (C) CH<sub>3</sub>COOH (pK<sub>a</sub> = 4.71) (D) CH<sub>3</sub>CH<sub>2</sub>COOH (pK<sub>a</sub> = 4.88)
- \*15. Which of the following will not undergo Hell Volhard Zelinsky reaction ?  
 (A) CH<sub>3</sub>COOH (B) CH<sub>3</sub>CH<sub>2</sub>COOH  
 (C) 2, 2-dimethyl propionic acid (D) C<sub>6</sub>H<sub>5</sub>COOH
16. The product 'C' in the following reaction is  $\text{RCOOH} \xrightarrow{\text{NH}_3} \text{(A)} \xrightarrow{\text{heat}} \text{(B)} \xrightarrow{\text{P}_2\text{O}_5, \text{heat}} \text{(C)}$  :  
 (A) RNH<sub>2</sub> (B) RCN (C) RNC (D) RCONH<sub>2</sub>
17. α-chloropropanoic acid on treatment with alcoholic KOH followed by acidification gives :  
 (A) CH<sub>3</sub> – CH(OH) – COOH (B) CH<sub>2</sub> = CH – COOH  
 (C) HO – CH<sub>2</sub> – CH<sub>2</sub> – COOH (D) CH<sub>3</sub> – CH<sub>2</sub> – COOH
18. Sodium ethoxide has reacted with ethanoyl chloride. The compound that is produced in the above reaction is :  
 (A) 2-Butanone (B) Ethyl chloride (C) Ethyl ethanoate (D) Diethyl ether
19. Compound (A), C<sub>8</sub>H<sub>9</sub>Br, gives a yellow precipitate when warmed with alcoholic AgNO<sub>3</sub>. Oxidation of (A) gives an acid (B), C<sub>8</sub>H<sub>6</sub>O<sub>4</sub>. (B) easily forms anhydride on heating. Identify the compound (A).  
 (A)  (B)  (C)  (D) 
20. Which of the following anion is a strongest base ?  
 (A) C<sub>6</sub>H<sub>5</sub>COO<sup>-</sup> (B) HCOO<sup>-</sup> (C) CH<sub>3</sub>COO<sup>-</sup> (D) (CH<sub>3</sub>)<sub>2</sub>CHCOO<sup>-</sup>
21. Compound  $\text{Ph} - \text{O} - \overset{\text{O}}{\parallel}{\text{C}} - \text{Ph}$  can be prepared by the reaction of \_\_\_\_\_.  
 (A) Phenol and benzoic acid in the presence of NaOH  
 (B) Phenol and benzoyl chloride in the presence of pyridine  
 (C) Phenol and benzoyl chloride in the presence of ZnCl<sub>2</sub>  
 (D) Phenol and benzaldehyde in the presence of palladium
22.  $\text{RCOOH} + \text{CH}_2\text{N}_2 \xrightarrow{\text{HBF}_4} \text{A} + \text{N}_2$ . Identify the compound (A).  
 (A) RCOCH<sub>3</sub> (B) RCH<sub>2</sub>NH<sub>2</sub> (C) RCOOCH<sub>3</sub> (D) None of these

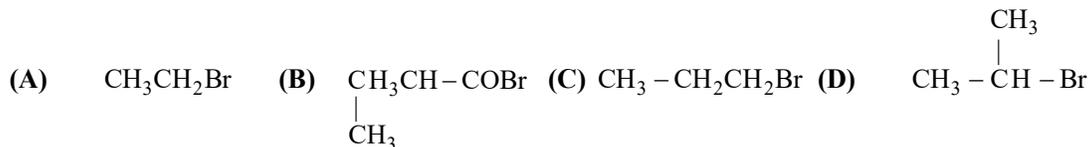
23. Acetic acid warming with hydrazoic acid in presence of conc.  $H_2SO_4$  gives :  
 (A)  $CH_3CONH_2$  (B)  $CH_3NH_2$  (C)  $CH_3COONH_4$  (D)  $CH_3CH_2NH_2$
24. When  $CH_2=CH-COOH$  is reduced with  $LiAlH_4$ , the compound obtained will be :  
 (A)  $CH_2=CH-CH_2OH$  (B)  $CH_3-CH_2-CH_2OH$   
 (C)  $CH_3-CH_2-CHO$  (D)  $CH_3-CH_2-COOH$
25. Both the organic compounds A and B release hydrogen with Na. Only compound A can form a salt with NaOH, whereas B cannot. When A reacts with B in presence of con.  $H_2SO_4$ , a pleasant smelling compounds is formed. The pair of compounds A and B can be respectively :  
 (A)  $C_2H_5OH$  and  $C_2H_2$  (B)  $CH_3COOH$  and  $C_2H_2$   
 (C)  $CH_3COOH$  and  $C_2H_5OH$  (D)  $C_2H_5OH$  and  $CH_3COOH$
26. Sodium adipate on electrolysis gives :  
 (A) but-2-ene (B) but-1-ene (C) cyclobutane (D) cyclobutene
27. The  $pK_a$  of acetylsalicylic acid (aspirin) is 3.5. The pH of gastric juice in human stomach is about 2-3 and pH in the small intestine is about 8. Aspirin will be :  
 (A) Unionized in the small intestine and in the stomach  
 (B) Completely ionized in the stomach and almost unionized in the small intestine  
 (C) Ionized in the stomach and almost unionized in the small intestine  
 (D) Ionized in the small intestine and almost unionized in the stomach
28. The reaction of formic acid with concentrated  $H_2SO_4$  gives :  
 (A)  $CH_3COOH$  (B)  $CO_2+H_2O$  (C)  $CO+H_2O$  (D) HCHO
29. Acetic acid in the vapour state has a molecular weight of 120 because :  
 (A) its molecule gets solidified  
 (B) its molecule gets stabilized by resonance  
 (C) it undergoes intermolecular H-bonding and exists as the dimer  
 (D) it forms anhydride in this condition
30. The order of reactivity of the following esters towards hydrolysis is :



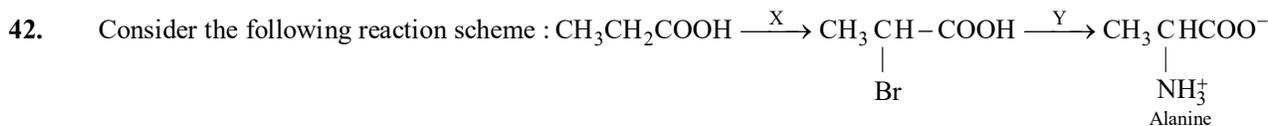
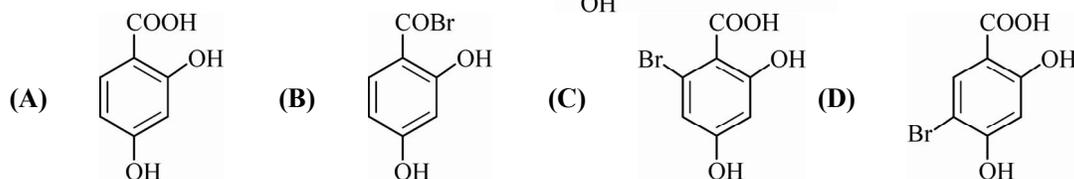
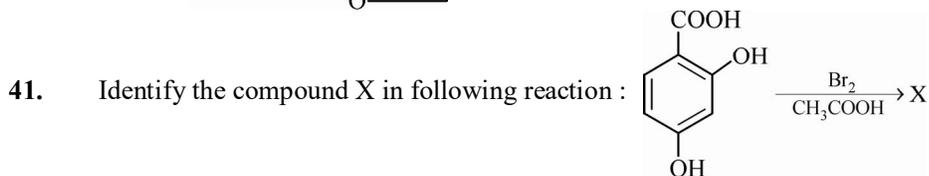
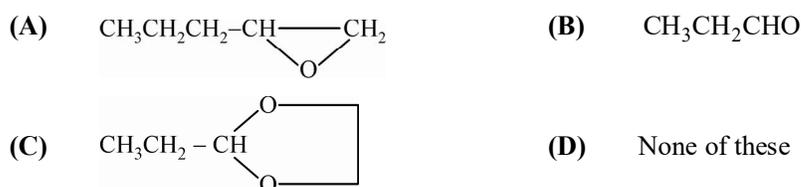
- \*31. Which of the following can form cyclic anhydride on simple heating ?  
 (A) Succinic acid (B) Malonic acid (C) Adipic acid (D) glutaric acid



33. Malonic acid and succinic acids are distinguished by :  
 (A) Heating (B)  $\text{NaHCO}_3$  (C) Both (A) & (B) (D) None of these
34. The hydrolysis of ethane nitrile with dilute sulphuric acid gives :  
 (A) Ethanoic acid (B) Propanoic acid (C) Methanoic acid (D) Ethanamide
35. Heating glycerol with ethanedioic acid (oxalic acid) at  $100-110^\circ\text{C}$  yields :  
 (A)  $\text{HCOOH}$  (B)  $\text{CH}_3\text{COOH}$  (C)  $\text{HOCH}_2\text{COOH}$  (D) Glycollic acid
36. Silver salt of 2-methyl propanoic acid on reaction with bromine gives :



37. Addition of hydrogen bromide to Prop-2-en-1-oic acid gives :  
 (A) Propenoyl bromide (B) 2-bromo propenoic acid  
 (C) 3-bromo propanoic acid (D) 3-bromo propenoic acid
38. A colourless water soluble organic liquid gives off  $\text{CO}_2$  with sodium carbonate and turns the lime water milky. It produces a red precipitate with Fehling's solution. The compound is :  
 (A) benzoic acid (B) ethanoic acid (C) methanal (D) methanoic acid
39. The missing product X in the given reaction is :  $\text{CH}_3\text{COOAg} + \text{I}_2 \rightarrow \text{X} + \text{AgI} + \text{CO}_2$   
 (A) Iodomethane (B) Ethyl Iodide (C) Methyl ethanoate (D) Ethanal



Identify X & Y.

- (A) X:  $\text{Br}_2$ , Y:  $\text{NaNH}_2$  (B) X:  $\text{Br}_2, \text{P}$ , Y:  $\text{NaOH}$   
 (C) X:  $\text{Br}_2, \text{P}$ , Y:  $\text{NH}_3 / \text{alc}$  (D) X:  $\text{HBr}$ , Y:  $\text{NH}_3 / \text{alc}$

43. Which of the following product is obtained when ethylene is heated with carbon monoxide and steam under pressure at 400°C in the presence of phosphoric acid ?

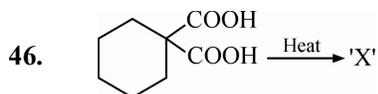
- (A)  $\text{CH}_3\text{CH}_2\text{CHO}$  (B)  $\text{CH}_3\text{COCH}_3$  (C)  $\text{CH}_3 - \text{COOH}$  (D)  $\text{CH}_3\text{CH}_2\text{CO}_2\text{H}$

44.  $\text{CH}_3\text{I} + \text{Na}^+ \bar{\text{C}}\text{H}(\text{CO}_2\text{C}_2\text{H}_5)_2 \longrightarrow \text{X} \xrightarrow[\Delta]{\text{H}_3\text{O}^+} \text{Y}$  ? The IUPAC name of the product Y is :

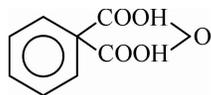
- (A) Ethyl methanoate (B) Propanoic acid  
(C) Ethyl propanoate (D) None of these

45.  $\text{PCl}_5 + \text{SO}_2 \rightarrow \text{X} + \text{Y}$ ;  $\text{CH}_3\text{COOH} + \text{X} \rightarrow \text{CH}_3\text{COCl}$ . The compound X is :

- (A)  $\text{POCl}_3$  (B)  $\text{SO}_2\text{Cl}_2$  (C)  $\text{SOCl}_2$  (D)  $\text{PCl}_3$



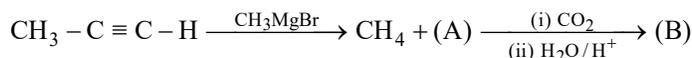
The compound 'X' is :

- (A) Benzoic acid (B) Cyclohexanoic acid  
(C) Cyclohexane carboxylic acid (D) 

\*47. Formic acid and formaldehyde can not be distinguished by treatment with :

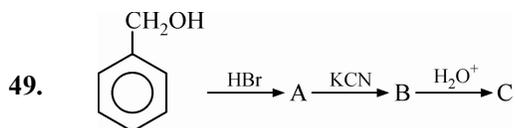
- (A) Benedict's solution (B) Tollen's reagent  
(C) Fehling solution (D)  $\text{NaHCO}_3$

48. In the reaction sequence :

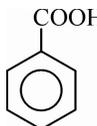
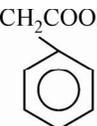
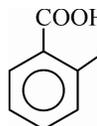
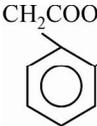


(B) will be :

- (A)  $\text{CH}_3 - \text{C} \equiv \text{C} - \text{CH}_3$  (B)  $\text{CH}_3 - \text{C} \equiv \text{C} - \text{MgBr}$   
(C)  $\text{CH}_3 - \text{C} \equiv \text{C} - \text{COOH}$  (D)  $\text{CH}_3 - \text{CH}_2 - \text{COOH}$

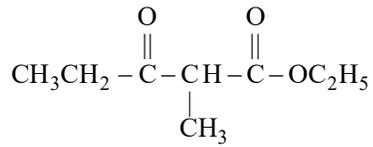
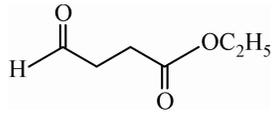
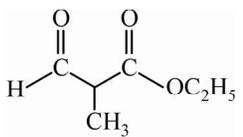
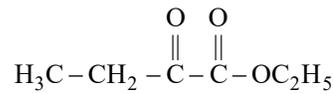


In the above sequence of reactions, C is :

- (A)  (B)  (C)  (D) 

50. Which of the following compound is formed as major product when ethyl propanoate and ethyl methanoate are reacted in the presence of sodium ethoxide in ethyl alcohol followed by acidification ?

The structure of the compound A is :

- (A)  (B)   
(C)  (D) 

**Answer Key for Class Test-1 | Carboxylic Acid**

<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>	<b>10</b>
B	B	C	ABD	B	A	B	ABCD	C	D
<b>11</b>	<b>12</b>	<b>13</b>	<b>14</b>	<b>15</b>	<b>16</b>	<b>17</b>	<b>18</b>	<b>19</b>	<b>20</b>
C	C	D	A	CD	B	B	C	D	D
<b>21</b>	<b>22</b>	<b>23</b>	<b>24</b>	<b>25</b>	<b>26</b>	<b>27</b>	<b>28</b>	<b>29</b>	<b>30</b>
B	C	B	A	C	C	D	C	C	C
<b>31</b>	<b>32</b>	<b>33</b>	<b>34</b>	<b>35</b>	<b>36</b>	<b>37</b>	<b>38</b>	<b>39</b>	<b>40</b>
AD	B	A	A	A	D	C	D	C	C
<b>41</b>	<b>42</b>	<b>43</b>	<b>44</b>	<b>45</b>	<b>46</b>	<b>47</b>	<b>48</b>	<b>49</b>	<b>50</b>
D	C	D	B	C	C	ABC	C	B	C

**Thank you !**