4. CARBOXYLIC ACIDS AND ITS DERIVATIVES

SYNOPSIS

Carboxylic acids are the compounds having –COOH as the functional group. They are classified as mono, di- and tricarboxylic acids as they contain one, two and three –COOH groups respectively. Aliphatic monocarboxylic acids are called fatty acids since their higher members were first produced by hydrolysis of fats. With the exception of C_3 and C_5 acids, the fatty acids usually present in oils and fats contain an even number of carbon atoms.

Monocarboxylic acids have the general formula R – COOH where R = H or any alkyl (i.e., $C_nH_{2n+1}COOH$; where n = 0, 1, 2……etc, or aryl group.

NOMENCLATURE

a) **Common or trivial Name:** The common names are derived from the Greek or Latin name of the sources from which they were first isolated.

b) **IUPAC names:** The IUPAC name of the saturated monocarboxylic acid is **alkanoic acid** which is derived by replacing the terminal **'e'** from the name of the corresponding **alkane** chain by the suffix **'oic acid'**.

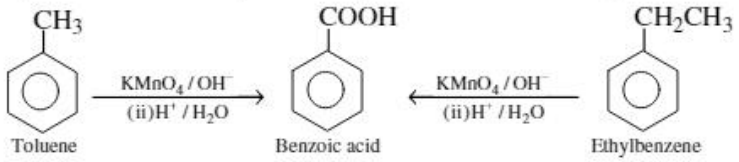
i.e., Alkane $\xrightarrow[+\text{oic acid}]{-e}$ Alkanoic acid

METHODS OF PREPARATION

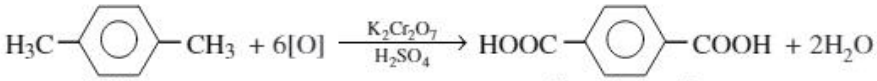
i) Oxidation of primary alcohols with acid or alkaline $KMnO_4$ or acidic $K_2Cr_2O_7$.

$$R - CH_2OH + 2[O] \xrightarrow{K_2Cr_2O_7/H_2SO_4} R - COOH + H_2O$$

ii) By oxidation of alkylbenzene, aromatic acids are produced



Toluene — Benzoic acid — Ethylbenzene



P-Xylene — Terephthalic acid

iii) By acid or alkaline hydrolysis of nitriles

$$\underset{\text{Ethenenitrile}}{CH_3 - C \equiv N} + 2H_2O + HCl \longrightarrow \underset{\text{Ethanoic acid}}{CH_3COOH} + NH_4Cl$$

$$\underset{\text{Benzenenitrile}}{C_6H_5 - C \equiv N} + 2H_2O + HCl \longrightarrow \underset{\text{Benzoic acid}}{C_6H_5COOH} + NH_4Cl$$

iv) By reaction of Grignard reagents with dry ice

$$RMgX + O = C = O \xrightarrow{\text{Dry ether}} R - \overset{\overset{O}{\|}}{C} - OMgX \xrightarrow[-Mg(OH)X]{H^+/H_2O} R - \overset{\overset{O}{\|}}{C} - OH$$

v) By hydrolysis of acid derivatives, i.e..

$$\underset{\text{Ester}}{RCOOR} + H_2O \xrightarrow{H^+ \text{or} OH^-} RCOOH + ROH \; ; \; \underset{\text{Acid chloride}}{RCOOCl} + H_2O \xrightarrow{H^+ \text{or} OH^-} RCOOH + HCl$$

$$\underset{\text{Acid amide}}{RCONH_2} + H_2O \xrightarrow{H^+ \text{or} OH^-} RCOOH + NH_3$$

vi) Byhydrolysisof1,1,1-trihalides

$$\underset{\text{Benzotrichloride}}{C_6H_5CCl_3} + 3KOH \xrightarrow{-3KCl} \underset{\text{Unstable}}{C_6H_5C(OH)_3} \xrightarrow{-H_2O} \underset{\text{Benzoic acid}}{C_6H_5COOH}$$

vii) By oxidation of methyl ketones – Haloform reaction

$$\underset{\text{pentan-2-one}}{CH_3CH_2CH_2COCH_3} \xrightarrow[(ii)H^+/H_2O]{(i)\ I_2/NaOH} \underset{\text{Butanoic acid}}{CH_3CH_2CH_2COOH} + CHI_3$$

viii) From olefins $\underset{\text{Ethylene}}{CH_2=CH_2} + CO + \underset{\text{(steam)}}{H_2O} \xrightarrow[\text{under pressure}]{H_3PO_4,\ 573-673K} \underset{\text{Propionic acid}}{CH_3CH_2COOH}$

This acid-catalysed hydrocarboxylation of olefins is called **Koch reaction**.

ix) From sodium alkoxides and carbon monoxide

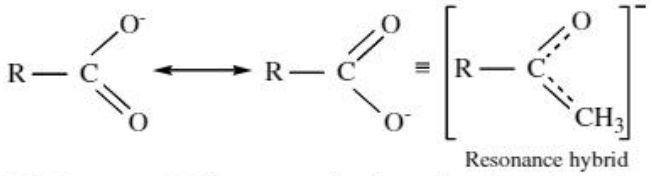
$$RO-Na + CO \xrightarrow[\text{under pressure}]{\Delta} RCOO^-Na \xrightarrow[-NaCl]{H^+/H_2O} RCOOH$$

HCOOH is, however, prepared by the reaction of NaOH and CO.

$$CO + NaOH \xrightarrow[473K]{8-10\ atm} HCOONa \xrightarrow[-NaCl]{HCl} HCOOH$$

CHEMICAL PROPERTIES

i) **Acidic strength:** Carboxylic acids are much stronger acids than alcohols and phenols since the carboxylate ion after the removal of a proton is stabilized by two equivalent structures.



Resonance hybrid

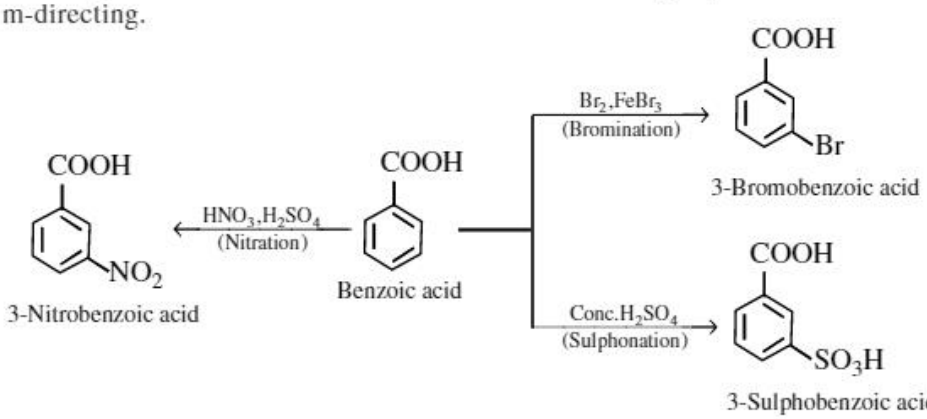
it is because of this reason that in carboxylate ions, the two C–O bond lengths are equal ($1.27A^0$ in sodium formate). Carboxylic acids, on the other hand, have two carbon-oxygen bond length (in formic acid C = O is 1.23^0 long while C–OH bond is $1.36A^0$ long).

The acidic strength of carboxylic acids is measured either in terms of Ka (dissociation constant) or pKa (pKa = – logKa) values. Higher the Ka or lower the pKa value, stronger is the acid.

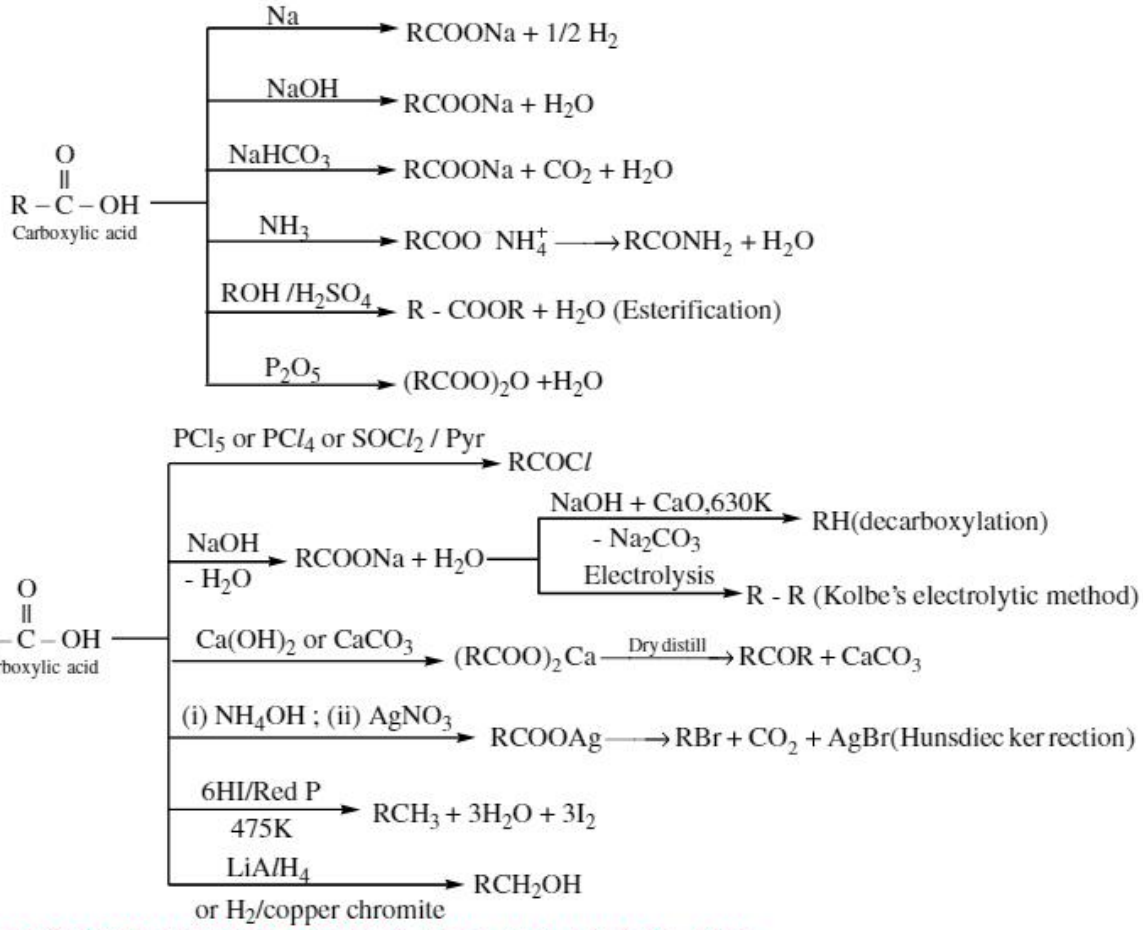
ii) **Hell-Vohlard-Zelinsky (H.V.Z.) reaction :** Carboxylic acids (except formic acid which does not contain an alkyl group) react with chlorine or bromine in presence of red phosphorus to give exclusively α-chloro and α-bromo acids. This reaction is called H.V.Z. Reaction.

$$\underset{\text{Propionic acid}}{\overset{\beta}{CH_3}\overset{\alpha}{CH_2}COOH} \xrightarrow[-HBr]{Br_2,P} CH_3CHBrCOOH \xrightarrow[-HBr]{Br_2,P} \underset{\alpha\text{-}\alpha\text{-Dibromopropionic acid}}{CH_3CBr_2COOH}$$

iii) **Electrophilic substitution reactions :** The –COOH group is electron withdrawing and hence m-directing.



Some other important reactions of –COOH group are summarized below:



DISTINCTION BETWEEN FORMIC ACID AND ACETIC ACID

Formic acid behaves both as an aldehyde as well as an acid whereas acetic acid behaves only as an acid. The main points of difference are

(i) Formic acid reduces Tollen's reagent, Fehling's solution, acidified $KMnO_4$ solution and mercuric chloride.

$$HCOO^- + 2[Ag(NH_3)_2]^+ + 3OH^- \longrightarrow \underset{\text{silver mirror}}{2Ag\downarrow} + CO_3^{2-} + 2H_2O + 4NH_3$$

$$HCOO^- + 2[Cu(NH_3)_4]^{2+} + 5OH^- \longrightarrow \underset{\text{Red ppt}}{Cu_2O\downarrow} + CO_3^{2-} + 3H_2O + 8NH_3$$

$$2KMnO_4 + 5HCOOH + 3H_2SO_4 \longrightarrow K_2SO_4 + 2MnSO_4 + 5CO_2 + 8H_2O$$

$$\underset{\text{Mercuric chloride}}{2HgCl_2} + HCOOH \longrightarrow \underset{\substack{\text{Mercurous chloride}\\ \text{(White ppt.)}}}{Hg_2Cl_2} + CO_2 + 2HCl$$

(ii) With PCl_5, formic acid first gives formyl chloride which being unstable and decomposes to give $CO + HCl$ while acetic acid gives acetyl chloride.

$$HCOOH + PCl_5 \xrightarrow{-POCl_3,\ -HCl} \underset{\text{(Unstable)}}{HCOCl} \longrightarrow HCl + CO$$

$$CH_3COOH + PCl_5 \longrightarrow CH_3COCl + POCl_3 + HCl$$

(iii) Sod. Formate on heating gives sodium oxalate

$$2\underset{\text{Sod.formate}}{HCOONa} \xrightarrow{663K} \underset{\text{Sod.oxalate}}{\begin{matrix}COONa\\|\\COONa\end{matrix}} + H_2$$

(iv) With conc. H_2SO_4, HCOOH gives CO; $HCOOH \xrightarrow{H_2SO_4} CO + H_2O$

(v) When heated with soda-lime, sodium formate gives H_2 while sodium acetate gives CH_4.

(vi) Dry distillation of calcium formate gives formaldehyde while that of calcium acetate gives acetone.

Manufacture of formic acid

$$NaOH + CO \xrightarrow[473K]{6-10atm} \underset{\text{Sod.formate}}{HCOONa} \xrightarrow[-NaCl]{Dil.HCl} \underset{\text{Formic acid}}{HCOOH}$$

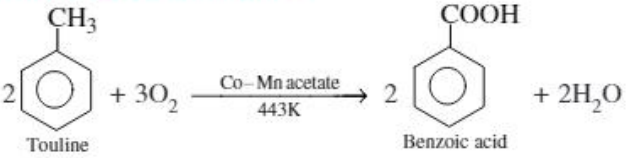
Manufacture of acetic acid

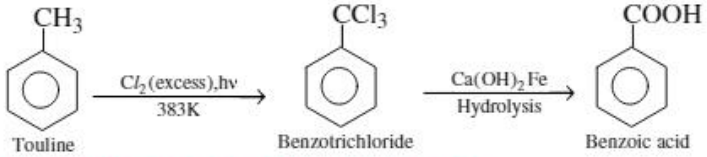
i) $\underset{\text{Acetylene}}{HC\equiv CH} + H_2O \xrightarrow[333K]{Dil.HgSO_4,H^+} \underset{\text{Acetaldehyde}}{CH_3CHO} \xrightarrow{O_2,(CH_3COO)_2Mn} \underset{\text{Acetic acid}}{CH_3COOH}$

ii) $CH_3OH + CO \xrightarrow{Rh\ catalyst} CH_3COOH$

iii) $CH_3CH_2OH \xrightarrow{Cu,573K} CH_3CHO \xrightarrow{O_2,(CH_3COO)_2Mn} CH_3COOH$

Manufacture of benzoic acid

i) 

ii) 

DERIVATIVES OF CARBOXYLIC ACIDS

Acid halides (acyl halides), acid anhydrides, esters by acid amides which are obtained by replacement of **–OH** part of the COOH group of acids –X(halogen), –OCOR, OR and $–NH_2$ respectively are collectively called functional derivatives or simply derivatives of acids. These are

(X = Cl, Br)

Reactivity : All these derivatives on treatment with nucleophiles (H_2O, NH_3, ROH etc) readily undergo nucleophilic substitution reactions. To differentiate these reactions from nucleophilic substitution reactions of alkyl halides, these are called acyl substitution reactions. The order of reactivity of these derivatives towards acyl substitution reactions decreases in the order.

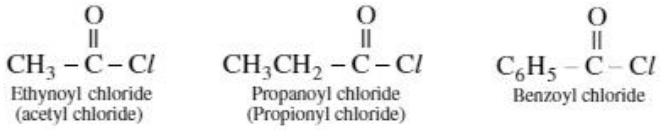
$RCOCl > (RCO)_2O > RCOOR' > RCONH_2$

In other words, the reactivity decreases as the basicity of the leaving groups increases i.e.,

$Cl^- < RCOO^- < RO^- < NH_2^-$

ACID CHLORIDES

Acid chlorides have the general formula, $(RCO)_2O$ where R may be any alkyl or anyl group. The name of acid chloride are obtained replacing the terminal **'ic acid'** from the common or IUPAC name of the parent acid by the suffix **'yl chloride'**. The common (in parenthesis) and IUPAC names of some acid chlorides are:



METHODS OF PREPARATION

i) By the action of PCl_5, PCl_3 or $SOCl_2$ on an acid.

$$RCOOH + PCl_5 \longrightarrow RCOCl + POCl_3 + HCl$$

$$3RCOOH + PCl_3 \longrightarrow 3RCOCl + H_3PO_3$$

$$RCOOH + SOCl_2 \xrightarrow{\text{Pyridine}} RCOCl + SO_2 = HCl$$

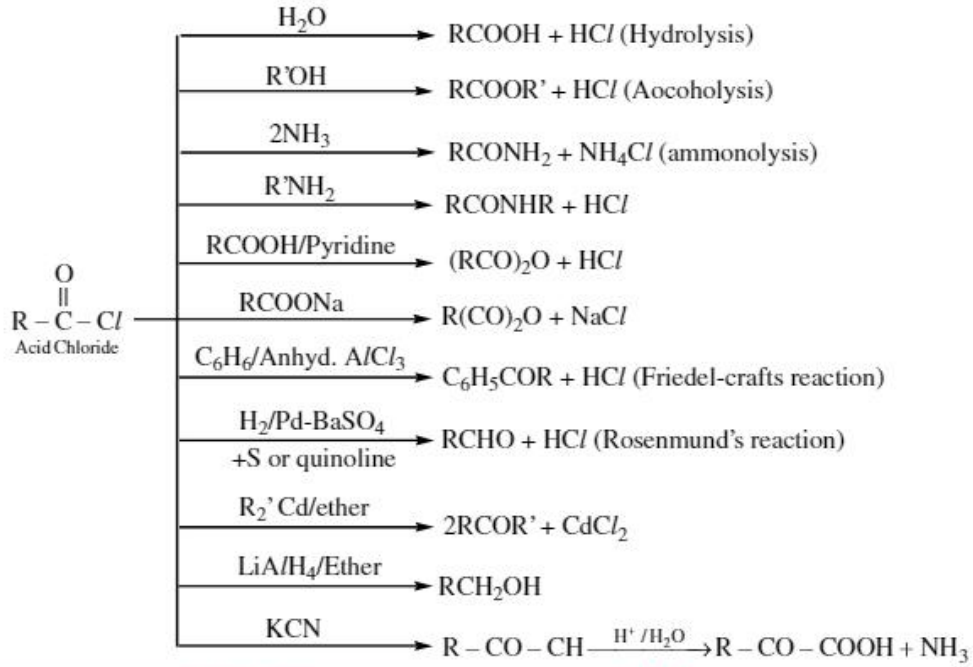
ii) Action of PCl_3 on sodium salt of an acid

$$\underset{\text{Sod.acetate}}{3CH_3COONa} + PCl_3 \xrightarrow{\text{Distill}} \underset{\text{Acetyl chloride}}{3CH_3COCl} + Na_3PO_3$$

$$\underset{\text{Sod.benzoate}}{2C_6H_5COONa} + POCl_3 \xrightarrow{\text{Distill}} \underset{\text{Benzoyl chloride}}{3C_6H_5COCl} + NaCl + NaPO_3$$

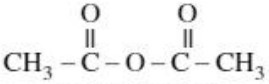
Properties : The boiling points of acid chlorides are lower than those of their parent acids due to absence of H-bonding.

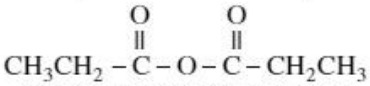
Some important chemical reactions of acid chlorides are summarized below:

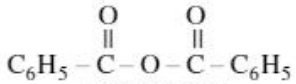


ACID ANHYDRIDES

Acid anhydrides have the general formula $(RCO)_2O$ where R is any alkyl group. Acid anhydrides are named by replacing the word **acid** from common or IUPAC name of the parent carboxylic acid by the word **'anhydride'**. In case of mixed anhydrides, the names of two parent acids are written in 'alphabetical order and the word anhydride is added only once. Some important anhydrides are


Ethanoic anhydride (Acetic anhydride)


Propanoic anhydride(Propionoic anhydride)


Benzoic anhydride

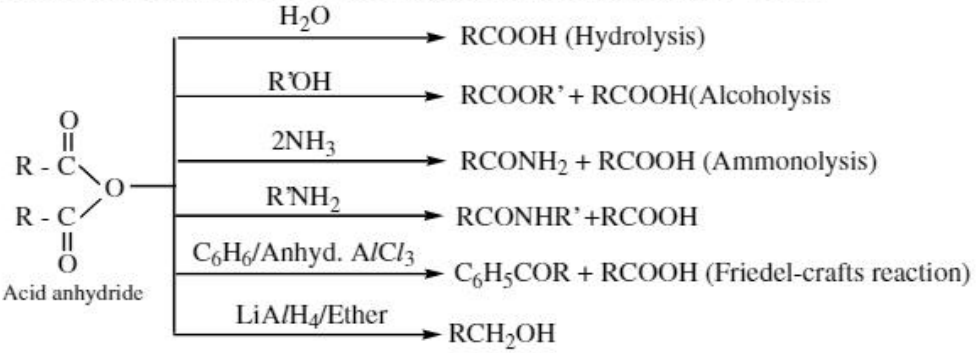
Methods of preparation:

i) $CH_3COOH + HCOOCH_3 \xrightarrow{P_2O_5,\Delta} CH_3CO.O.CO.CH_3 + H_2O$
(Acetic acid → acetic anhydride)

ii) $CH_3COOH + CH_3COCl \xrightarrow{\text{Pyridine}} CH_3CO.O.COCH_3 + HCl$

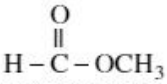
iii) $CH_3COCl + CH_3COONa \xrightarrow{\Delta} CH_3CO.O.COCH_3 + NaCl$

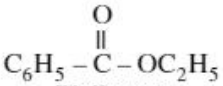
Properties: The boiling points of the acid anhydrides are higher than those of the acids from which they are derived mainly due to higher vander Waals forces of attraction due to larger size of the molecule. Some important chemical properties of acid anhydrides are summarized below.

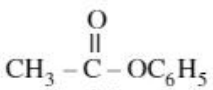


ESTERS

Esters are widely distributed in nature in plants, fruits and flowers. For example, the smell of bananas is due to isoamyl acetate. Their general formula is RCOOR' where R = H or any alkyl group and R' is any alkyl group but not hydrogen. Esters are named by writing the name of the alkyl or the aryl group before the common or IUPAC name of the parent acid with its terminal **ic acid** replaced by **ate**. The names of some esters are


Methyl methanoate (Methyl formate)


Ethyl benzoate


Phenyl ethanoate

Methods of preparation

i) $CH_3COOH + C_2H_5OH \xrightarrow{H^+} CH_3COOC_2H_5 + H_2O$ (Direct esterification)
(Acetic acid → Ethyl acetate)

$C_6H_5COOH + CH_3OH \xrightarrow{H^+} C_6H_5COOCH_3 + H_2O$
(Benzoic acid → Methyl benzoate)

ii) $CH_3COCl + C_2H_5OH \xrightarrow{\text{Pyridine}} CH_3COOC_2H_5 + HCl$

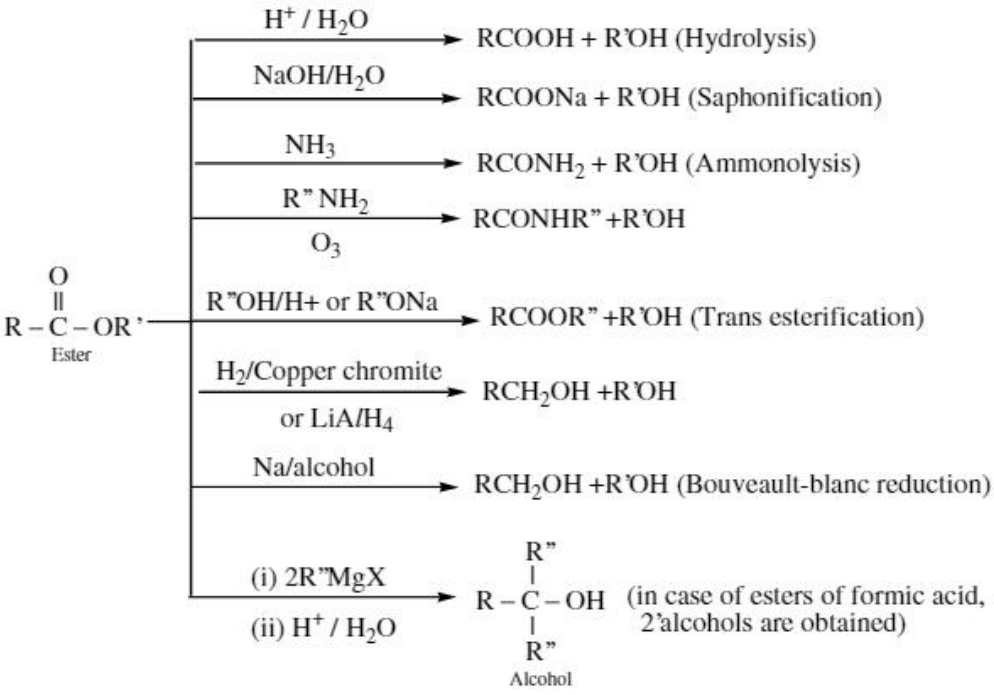
$(CH_3CO)_2O + C_2H_5OH \xrightarrow{H^+} CH_3COOC_2H_5 + CH_3COOH$

$C_6H_5COCl + CH_3CH_2OH \xrightarrow{NaOH} C_6H_5COOCH_2CH_3 + HCl$

iii) $RCOOH + \overline{C}H_2 - \overset{+}{N} \equiv N \longrightarrow RCOOCH_3 + N_2$
Diazomethane — Methylester

iv) $2RCH_2CHO \xrightarrow{Al(OC_2H_5)_3} RCH_2COOCH_2R$ (Tischenko reaction)
Aldehyde — Ester

Properties : Some important chemical properties of esters are summarized below:



ACID AMIDES

Acid amides are derivatives of acids in which –OH group of –COOH is replaced NH_2, NHR' or NR_2' and are classified as 1^0, 2^0 or 3^0 according as the –OH group is replaced by NH_2, NHR' and NR_2' respectively.

$R-\overset{O}{\overset{\|}{C}}-NH_2$ (1^0 Amide) $\qquad R-\overset{O}{\overset{\|}{C}}-NHR'$ (2^0 Amide) $\qquad R-\overset{O}{\overset{\|}{C}}-NR_2'$ (3^0 Amide)

Primary amides are name by replacing the suffix **ic acid** from the common name or **oic acid** from the IUPAC name of the parent acid by the suffix **amide**.

The IUPAC and common names (in parenthesis) of some amides are

$H-\overset{O}{\overset{\|}{C}}-\overset{CH_3}{\overset{|}{N}}-CH_3$; $CH_3-\overset{O}{\overset{\|}{C}}-NH-CH_3$; $C_6H_5-\overset{O}{\overset{\|}{C}}-NHCH_3$; $C_6H_5-NH-\overset{O}{\overset{\|}{C}}-CH_3$

N, N-dimethylmethanamide (N,N-Dimethylformamide) — N-Methylethanamide (N-Methylacetanide) — N-Methylbenzamide (N-Methylbenzamide) — N-Phenylethanamide (N- Phenylacetamide or Acetanilide)

Methods of preparation

i) By ammonolysis of acid derivatives

$RCOCl + 2NH_3 \longrightarrow RCONH_2 + NH_4Cl$

$(RCO)_2O + 2NH_3 \longrightarrow RCONH_2 + RCOONH_4$

$RCOOR' + NH_3 \longrightarrow RCONH_2 + R'OH$

ii) By thermal decomposition of ammonium salts

$$RCOONH_4 + 2NH_3 \xrightarrow{\Delta} RCONH_2 + H_2O \;;\; \underset{\text{Amm. Acetate}}{CH_3COONH_4} \xrightarrow{\Delta} \underset{\text{Acetamide}}{CH_3CONH_2} + H_2O$$

iii) By partial hydrolysis of cyanides

$$R - C \equiv N + H_2O \xrightarrow[\text{or } H_2O_2 - NaOH]{\text{conc.}HCl} R - CONH_2 \;;\; \underset{\text{Acetonitrile}}{CH_3C \equiv N} + H_2O \xrightarrow{\text{Conc.}H_2SO_4} \underset{\text{Acetamide}}{CH_3 - CONH_2}$$

Properties: Amides have high melting and boiling points (even higher than those of acids from which they are derived) due to strong intermolecular H-bonding. Lower amides are also soluble in water due to formation of H-bonds with water.

Some important chemical properties of amides are summarized below.

$$\underset{\text{Acidamides}}{R-\overset{\overset{O}{\|}}{C}-NH_2} \longrightarrow$$

- $\xrightarrow{H^+ / H_2O}$ $RCONHNa + 1/2\ H_2$ (Acidic hydrolysis)
- $\xrightarrow{NaOH}$ $RCOONa + NH_3$ (Basic hydrolysis)
- $\xrightarrow{Con.HCl}$ $RCONH_2.HCl$ (Basic nature)
- $\xrightarrow{2Na}$ $RCONHNa + 1/_2H_2$ (Acidic nature)
- $\xrightarrow{P_2O_5}$ $3RC \equiv N + 2H_3PO_4$
- $\xrightarrow{SOCl_2}$ $RC \equiv N + SO_2 + HCl$
- $\xrightarrow{HONO}$ $RCOOH + N_2 + H_2O$
- $\xrightarrow{Br_2 + 4KOH}$ $RNH_2 + K_2CrO_3 + 2KBr + H_2O$ (Hofmann bromamide reaction)
- $\xrightarrow{LiAlH_4/\text{dry ether}}$ $\underset{1^0\text{amine}}{RCH_2NH_2}$

LECTURE SHEET

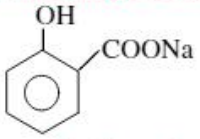
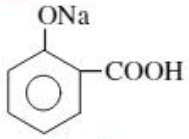
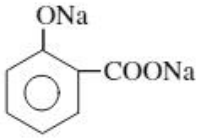
EXERCISE-I

(Preparation methods of carboxylic acids, Physical & Chemical Properties)

LEVEL-I (MAIN)

Straight Objective Type Questions

1. Sodium bicarbocate reacts with salicylic acid to form:

1) C_6H_5ONa 2)  3)  4) 

2. Which one of the following on heating gives unsaturated acid:

1) α-Hydroxy acid 2) β-Hydroxy acid 3) γ-Hyroxy acid 4) δ-Hydroxy acid

3. Which will form lactone on treatment with NaOH?

1) α-Bromo acid 2) β-Bromo acid 3) γ-Hydroxy acid 4) δ-Bromo acid

4. Which one of the following will go decarboxylation on heating?

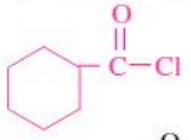
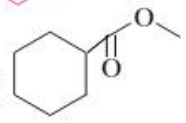
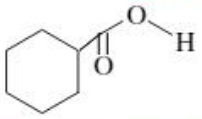
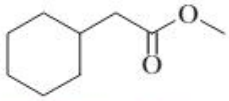
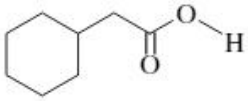
1) Succinic acid 2) Phthalic acid 3) Malonic acid 4) Adipic acid

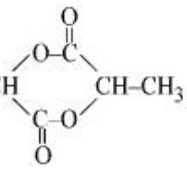
5. Which acid can be oxidised be Fehling solution:
1) Malonic acid 2) Acetic acid 3) Oxalic acid 4) formic acid

6. Reducing property of formic acid is due to the presence of :
1) – OH 2) $-\overset{O}{\overset{\|}{C}}-H$ 3) $-\overset{O}{\overset{\|}{C}}-OH$ 4) All of these

7. Which of the following will not undergo Hell-Volhard Zellinsky (HVZ) reaction?
1) HCOOH 2) CH_3COOH 3) CH_3CH_2COOH 4) $CH_3CHBrCOOH$

8. $CH_3CH_2CH_2CONH_2$ is boiled with aqueous NaOH, then the reaction mixture is acidified with HCl. Products obtained are
1) $CH_3CH_2CH_2COO^- + NH_3$ 2) $CH_3CH_2CH_2COONa + NH_3$
3) $CH_3CH_2CH_2COOH + NH_4Cl$ 4) $CH_3CH_2CH_2COO^- + NH_4Cl$

9.  $\xrightarrow[]{CH_2N_2(2\,mole)}$ $\xrightarrow[MeOH]{Ag_2O,\Delta}$ (X). Product (X) of above reaction is
1)  2)  3)  4) 

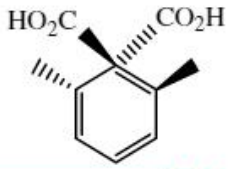
10. In the reaction sequence: $CH_3-\underset{OH}{\underset{|}{CH}}-COOH \xrightarrow{\Delta}$ [Y]. [Y] will be:
1) $CH_3-\underset{O}{\underset{\diagdown\,/}{CH}}-C=O$ 3) $CH_2=CH-COOH$ 4) $\overset{OH}{\overset{|}{CH_2}}-CH_2-COOH$ 4) 

11. In the given reaction : [X] + Acetic anhydride → Aspirin. [X] will be:
1) Benzoic acid 2) o-methoxybenzoic acid
3) o-Hydroxybenzoic acid 4) p-Hydroxybenzoic acid

12. In the reaction sequence: $CH_3-\overset{O}{\overset{\|}{C}}-H \xrightarrow[\underset{OH}{\overset{H}{|}}]{HCN} (A) \xrightarrow[\Delta]{H_2O/H^{\oplus}}$ Product. Product will be:
1) $CH_3-\overset{OH}{\overset{|}{\underset{H}{\underset{|}{C}}}}-COOH$ 2) $HOOC-\overset{OH}{\overset{|}{\underset{H}{\underset{|}{C}}}}-CH_3$
3) Mixture of $CH_3-\overset{OH}{\overset{|}{\underset{H}{\underset{|}{C}}}}-COOH$ and $HOOC-\overset{OH}{\overset{|}{\underset{H}{\underset{|}{C}}}}-CH_3$ 4) $CH_3-\overset{OH}{\overset{|}{CH}}-CONH_2$

13. In the given reaction : $CH_3CHO \xrightarrow[(ii)\ H_2O/H^{\oplus}/\Delta]{(i)\ NaCN/HCl} (A) \xrightarrow[reagent]{Fenton} (B)$. (B) will be :
1) Acetic acid 2) Oxalic acid 3) Pyruvic acid 4) Citric acid

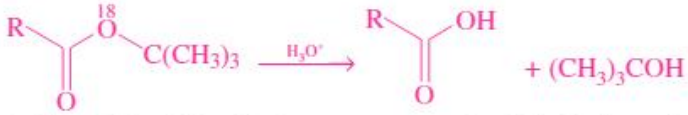
Numerical ValueType Questions

14. How many product will be formed, when below compound undergoes decarboxylation.


LEVEL-II (ADVANCED)

Straight Objective Type Questions

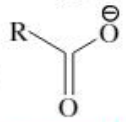
1. Following equilibrium is favoured in the forward side because of:

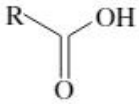


+ $(CH_3)_3COH$

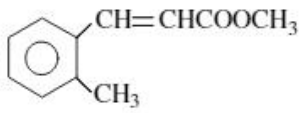
a) $(CH_3)_3CO^-$ (alkoxide) – a strong nucleophile is formed

b) $(CH_3)_3C^{\oplus}$ (carbocation) is formed

c)  formed is stabilised by resonance

d)  (a weak acid) is formed

2. A compound [X] discharges bromine water in CCl_4. The compound neither gives a any colour with $FeCl_3$ nor effervescences with aq. $NaHCO_3$ solution. However, its hydrolysate with conc. KOH followed by acidification gives another compound Y which gives colour with $FeCl_3$ solution as well as effervescences of CO_2 with $NaHCO_3$ solution. Compounds X and Y respectively are

a) 

b) 

c) 

d) 

3. Hydrolysis of an ester gives a carboxylic acid which on Kolbe's electrolysis yields ethane. The ester is

a) ethyl methanoate b) methyl ethanoate c) methyl methanoate d) methyl propanoate

4. Intermediates formed during reaction of $R-\overset{\overset{O}{\|}}{C}-NH_2$ with Br_2 and KOH are :

a) RCONHBr and RNCO b) RNHCOBr and RNCO

c) RNHBr and RcONHBr d) $RCONBr_2$

5. Which of the following acids on heating loses a molecule of to form an α,β – unsaturated acid?

a) $CH_3CHOHCOOH$ b) $HOCH_2COOH$

c) $CH_2CHOHCH_2COOH$ d) $HOCH_2CH_2CH_2COOH$

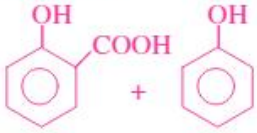
6. Which of the following would be expected to be the most highly ionized in water?

a) $ClCH_2CH_2CH_2COOH$ b) $CH_3CCl_2CH_2COOH$

c) $CH_3CH_2CCl_2COOH$ d) $CH_3CH_2CHClCOOH$

7. $Ph_3C-\overset{\overset{O}{\|}}{C}-OH \xrightarrow[MeOH]{Conc\,H_2SO_4}$ (A). A is:

a) $Ph_3C-\overset{\overset{O}{\|}}{C}-OMe$ b) $Ph_3C-\ddot{O}Me$ c) $Ph_3C-\ddot{O}H$ d) $Ph-\overset{\overset{O}{\|}}{C}-Ph$

8. In the given reaction :  , [X] will be:

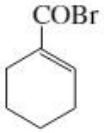
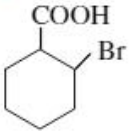
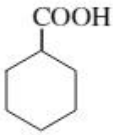
a) Phenyl salicylate b) Aspirin c) Phenol d) Benzoic acid

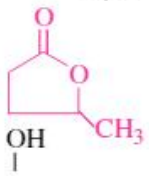
9. Which optically active compound on reduction with $LiAlH_4$ will give optically inactive compound?

a) $CH_3-\underset{\underset{OCH_3}{|}}{CH}-COOH$ b) $CH_3-CH_2-\underset{\underset{OH}{|}}{CH}-COOH$

c) $CH_3-CH_2-\underset{\underset{CH_2OH}{|}}{CH}-COOH$ d) $CH_3-\underset{\underset{OH}{|}}{CH}-CH_2-COOH$

10. In the given reaction:  [X]. [X] will be:

a)  b)  c)  d) 

11. In the given reaction:  [X]. [X] will be:

a) $HOOC-CH_2-CH_2-\underset{\underset{OH}{|}}{CH}-CH_3$ b) $CH_3-CH_2-CH_2-CH_2-COOH$

c) $HO-CH_2-CH_2-CH_2-COOH$ d) $CH_3-CH_2-\underset{\underset{OH}{|}}{CH}-CH_2-COOH$

12. In which reaction product is hydrocarbon?

a) $RCOOK \xrightarrow{\text{Electrolysis}}$ b) $RCOOAg \xrightarrow{I_2/\Delta}$ c) $CH_3-CH_3 \xrightarrow{Cl_2/h\nu}$ d) $CH_3-\underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}}-Cl \xrightarrow{C_2H_5OH}$

13. In the reaction sequence : $CH_3-C\equiv C-H \xrightarrow{CH_3MgBr} CH_4 + (A) \xrightarrow[(ii)\ H_2O/H^{\oplus}]{(i)\ CO_2} (B)$. (B) will be:

a) $CH_3-C\equiv C-CH_3$ b) $CH_3-C\equiv C-MgBr$ c) $CH_3-C\equiv C-COOH$ d) $CH_3-CH=CH-COOH$

14. Rochelle salt is dimetal salt of :

a) Tartaric acid b) Citric acid c) Oxalic acid d) Salicylic acid

More than One correct answer Type Questions

15.  $\xrightarrow[CCl_4]{Br_2}$ $HOOC-\underset{\underset{Br}{|}}{CH}-\underset{\underset{Br}{|}}{CH}-COOH$ (X)

 $\xrightarrow[CCl_4]{Br_2}$ $HOOC-\underset{\underset{Br}{|}}{CH}-\underset{\underset{Br}{|}}{CH}-COOH$ (Y)

The correct statement with respect to above reactions are

a) The reaction is stereospecific
b) (X) is erythro and (Y) is threo isomer
c) (X) is threo and (Y) is erythro isomer
d) each gives mixture of (X) and (Y)

16. Which of the following compounds will give acetic acid with $KMnO_4/H^{\oplus}/D$:

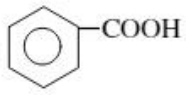
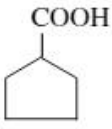
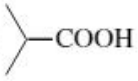
a) CH_3–CHO b) CH_3–CH=CH–CH_3 c) CH_3–C≡C–CH_3 d) CH_3CH_2OH

17 Consider the following reaction: $CH_3-\overset{\overset{O}{\|}}{C}-OH + CH_3-OH \xrightarrow{H^{\oplus}} CH_3-\overset{\overset{O}{\|}}{C}-O-CH_3 + HOH$

True about the above reaction is:

a) Product is having smell like fruits
b) Nucleophilic addition followed by elimination reaction
c) follows acid catalysed acyl-oxygen cleavage mechanism
d) it is irriversible reaction

18. Which one of the following compounds will give HVZ reaction?

a) 
b) 
c) 
d) 

19. In the given reaction: $R-\overset{\overset{O}{\|}}{C}-OH \xrightarrow{[X]} R-\overset{\overset{O}{\|}}{C}-O-CH_3$ [X] will be:

a) CH_2N_2 b) $CH_3OH/H^{\oplus}$ c) MeCOOH d) Me_2SO_4

Linked Comprehension Type Questions

Passage-I :

An organic compound (A) has the moecular formula $C_3H_6O_3$. it undergoes acetylation and evolves CO_2 on treatment with $NaHCO_3$ solution. On treatment with HI. (A) gave another product (B), $C_3H_6O_2$, which can be obtained by the hydrolysis of propane nitrile. (A) on heating eliminates water to give (C), $C_3H_4O_2$, which adds Br_2 and evolves CO_2 with aq. $NaHCO_3$.

20. What is the organic compound (A)

a) $CH_2-\underset{OH}{\underset{|}{CH}}-COOH$ b) $CH_3-\underset{OH}{\underset{|}{CH}}-COOH$ c) a or b d) CH_3CH_2COOH

21. What is the organic compound (B)

a) $CH_2=CH-COOH$ b) CH_3CH_2COOH c) $CH_2-\underset{OH}{\underset{|}{CH}}-COOH$ d) $CH_3-\underset{OH}{\underset{|}{CH}}-COOH$

22. What is the organic compound (C)

a) $CH_2-\underset{OH}{\underset{|}{CH}}-COOH$ b) $CH_3-\underset{OH}{\underset{|}{CH}}-COOH$ c) $CH_2=CH-COOH$ d) CH_3CH_2COOH

Matrix Matching Type Questions

23.

Column-I (organic compounds oxidised by HIO_4)	**Column-II (products of HIO_4 oxidation)**
A) CH_3COCHO	p) PhCH = O + HCOOH
B) 1,2-cyclohexane dione	q) $CH_3CH_2CHO + HOOCCH_3$
C) PhCH (OH) CHO	r) $HOOC(CH_2)_4COOH$
D) $CH_3CH_2CH(OH)COCH_3$	s) $CH_3COOH + HCOOH$

24.

Column-I	Column-II
A) Methanoic acid	p) Lactone on heating
B) Ethanoic acid	q) Unsaturated acid on heating
C) 2-Hydroxy propanoic acid	r) Cyclic anhydride on heating
D) Ethane dioic acid	s) Gives red colour with $FeCl_3$
E) Butane-1,4-dioic acid	t) Gives white ppt with $CaCl_2$
F) 3-Hydroxy butanoic acid	u) Gives iodoform on heating with I_2 and alkali
G) 4-Hydroxy butanoic acid	v) Reduces Tollen's reagent

EXERCISE-II

(Preparation methods of Physical & Chemical Properties of acid derivatives)

LEVEL-I (MAIN)

Straight Objective Type Questions

1. The compound which forms the strongest hydrogen bond is
   1) CH_3CH_2OH 2) C_6H_5OH 3) $C_2H_5NH_2$ 4) CH_3COOH

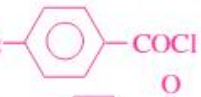
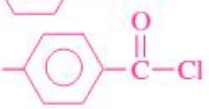
2. The order of increasing boiling points of
   i) CH_3COCl ii) $(CH_3CO_2)O$ iii) CH_3CONH_2 and iv) CH_3COOH is
   1) (i) > (iv) > (ii) > (iii) 2) (ii) < (i) < (iii) < (iv) 3) (iv) > (i) > (ii) > (iii) 4) (i) < (iv) < (ii) < (iii)

3. Which of the following is hydrolysed to give secondary amine:
   1) Alkyl cyanide 2) $H-\overset{\overset{O}{\|}}{C}-N<^{CH_3}_{CH_3}$ 3) Nitro paraffins 4) Acid amide

4. The reactivity of acyl compounds is in the order :
   1) acid chloride > amide > anhydride > ester 2) acid chloride > anhydride > ester > amide
   3) ester > acid chloride > anhydride > amide 4) ester > anhydride > acid chloride > amide

5. Acetamide is amphoteric in character because it can react with
   1) conc. HCl 2) HgO 3) conc. HCl and HgO 4) NaOH

6. Acetamide and ethyl acetate can be desinguished by reacting with
   1) Aqueous HCl and heat 2) Aqueous NaOH and heat
   3) acidified $KMnO_4$ 4) Bromine water

7. Arrange following compounds in decreasing order of reactivity for hydrolysis reaction :
   I) C_6H_5COCl II) 
   III)  IV) 
   1) II > IV > I > III 2) II > IV > III > I 3) I > II > III > IV 4) IV > III > II > I

8. Sodium benzoate on heating with sodalime gives:
   1) Benzene 2) Benzophenone 3) Methane 4) Calcium benzoate

9. Which compound will liberate CO_2 from $NaHCO_3$ solution:
   1) $CH_3CO\,NH_2$ 2) CH_3NH_2 3) $(CH_3)_4N^+OH^-$ 4) $CH_3N^+H_3Cl^-$

10. Acetamide reacts with NaOBr in alkaline medium to form :
1) NH_3 2) CH_3NH_2 3) CH_3CN 4) $C_2H_5NH_2$

11. Among the following which one does not act as an intermediate in Hofmann rearrangement ?
1) RNCO 2) RNC 3) $RCO\ddot{N}HBr$ 4) $RCO\ddot{N}$

12. Acetic anhydride reacts with PCl_5 to give :
1) $CH_3Cl + H_3PO_3$ 2) $CH_3COCl + POCl_3$ 3) $CH_3COOC_2H_5 + PCl_3$ 4) $CH_3COCH_3 + POCl_3$

13. Self condensation of two moles of ethyl acetate in presence of sodium ethoxide after acidification yields
1) acetoacetic ester 2) Acetic acid 3) Ethyl propionate 4) ethyl butyrate

14. An ester on catalytic hydrogenation in the presence of cupric oxide and copper chromate gives
1) RCH_2OH and R'OH 2) ROH and $R'CO_2H$ 3) RCO_2H and R'OH 4) RCH_2OR'

15. An alkyl cyanide froms an amide when it is treated with
1) $H_2O + HCl$ 2) $NaOH + H_2O$ 3) $H_2O_2 + NaOH$ 4) $H_2SO_4 + H_2O$

16. Alkaline hydrolysis of urea with dilute sodium hydroxide gives
1) Biuret and ammonia 2) Ammonia and sodium carbonate
3) Nitrogen and sodium carbonate 4) Ammonia and cyanuric acid

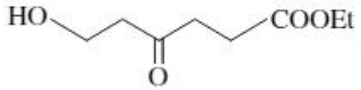
17. $C_6H_5COOCH_3 \xrightarrow{LiAlH_4} X$ Will be
1) $C_6H_5COOH + CH_3OH$ 2) $C_6H_5CH_2OH + CH_3OH$
3) $C_6H_5CHO + CH_3COOH$ 4) All of the above

18. A colourless liquid, at room temperature, reacts with soda-lime to form sodium salt of a carboxylic acid and ammonia gas. The liquid is
1) Propanoic acid 2) Formamide 3) Propanamide 4) Methyl ethanoate

19. Benzoyl chloride is prepared from benzoic acid by
1) Cl_2, hv 2) SO_2Cl_2 3) $SOCl_2$ 4) Cl_2, H_2O

Numerical Value Type Questions

20. The number of moles of grignard reagent consumed per mole of the compound



is:

LEVEL-II (ADVANCED)

Straight Objective Type Questions

1. $C_2H_5O-\overset{\overset{O}{\|}}{C}-OC_2H_5 \xrightarrow{2CH_3MgBr}$ A. Product A formed
a) is ethyl acetate b) further react with CH_3MgBr/H_2O^+ to give acetone
c) further react with CH_3MgBr/H_2O^+ to give t-butyl alcohol
d) a & b are correct

2. The compound that gives a lactone on heating is
a) pentaedioic acid b) 4-hydroxypentanoic acid
c) 4-aminopentanoic acid d) 2-hydroxypentanoic acid

3. Guess the product $CH_3CH_2CONH_2 \xrightarrow[\Delta]{PCl_5}$?
a) CH_3CH_2–CN b) CH_3CH_2COCl c) $CH_3CCl_2CONH_2$ d) $CH_3CH_2CONHCl$

4. Acetylation reaction with acetyl chloride is carried out in the presence of which solvent?
   a) HOH b) CH_3OH c) Pyridine d) NaOH

5. Hofmann degradation is given by:
   a) Imide b) Acid chloride c) Acid anhydride d) None of these

6. The reduction of benzoyl chloride with Pd and $BaSO_4/CaCO_3$ produces:
   a) Benzyl chloride b) Benzoic acid c) Benzaldehyde d) All of these

7. N-Ethyl pthalimide on hydrolysis gives:
   a) Methyl alcohol b) Ethyl amine c) Dimethyl amine d) Diethyl amine

8. Cyanides exists in:
   a) Tautomeric form b) Geometrical form c) In both form d) None

9. Hydrolysis of alkyl isocyanide yields:
   a) Primary amine b) Tert. amine c) Alcohol d) Aldehyde

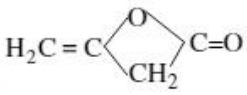
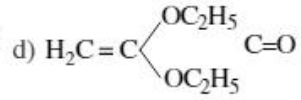
10. Which of the following compound gives the smell of mustard oil?
    a) Alkyl isocyanate b) Alkyl isothiocyanate c) Alkyl isocyanide d) Alkyl isonitrile

11. When propionamide reacts with Br_2 in the presence of alkali the product is:
    a) $CH_3CH_2CH_2NH_2$ b) $CH_3CH_2NH_2$ c) C_3H_7CN d) C_2H_5CN

12. A reaction of ethyl amine & acetic anhydride leads to the formation of:
    a) $CH_3NHCOCH_3$ b) $C_2H_5CONHCH_3$ c) $CH_3CONHC_2H_5$ d) $CH_3–CH=NOC_2H_5$

13. Acetic anhydride and ammonia gives the product:
    a) CH_3CONH_2 b) $CH_3CONHCH_3$ c) CH_3CN d) CH_3COONH_4

14. Reagent which can change CH_3COOH to CH_3COCl
    a) HCl b) $AlCl_3$ c) PCl_5 d) all of these

15. $CH_3CO_2C_2H_5$ on reaction with sodium ethoxide in ethanol gives, which on heating in the presence of acid gives (B). Compound (B) is
    a) CH_3COCH_2COOH b) CH_3COCH_3 c)  d) 

16. The reagent used to convert RCOOH to RCH_2OH
    a) $NaBH_4$ b) Na/Alcohol c) Zn/Hg–HCl d) $LiAlH_4$

17. $CH_3CH_2COOH \xrightarrow[\text{Red P}]{Br_2} X \xrightarrow{NH_3(alc)} Y$. Y in the above reaction is
    a) Lactic acid b) Ethylamine c) Propylamine d) Alanine

18. An aromatic compound (X) of molecular formula C_7H_7NO liberates ammonia on heating with alkali. When (X) is treated with bromine and alkali, the product will be
    a) Benzonitrile b) Benzamide c) Aniline d) benzoic acid

19 Amides may be converted into amines by a reaction named after :
    a) Kekule b) Perkin c) Hofmann d) Claisen

20. The treatment of an ester with $LiAlH_4$ followed by acid hydrolysis produces :
    a) Two aldehyde b) One carboxylic acid and one alcohol
    c) Two alcohols d) Two acids

More than One correct answer Type Questions

21. Which of the following reagent(s) can be used to dehydrate amides to cyanides?
a) Conc. H_2SO_4 b) $KHSO_4$ c) P_2O_5 d) $SOCl_2$

22. Which of the following reagent(s) can be used to convert amide into a primary amine with one carbon atom less than amide?
a) Br_2 + NaOH b) $Ca(OCl)_2$ c) NaOBr d) $FeSO_4$

23. Which of the following reaction(s) yield amide?
a) $R-C\equiv N+H_2O \xrightarrow[H_2SO_4]{Conc.}$ b) $2R-C\equiv N+2H_2O_2 \xrightarrow[H_2O]{NaOH}$
c) $R-C\equiv N+H_2O \xrightarrow{Dil.HCl}$ d) $R-C\equiv N+H_2O \xrightarrow{Dil.NaOH}$

24. Which of the following reaction(s) yield substituted amides?
a) Hofmann reaction b) Schmidt reaction
c) Ritter reaction d) Beckmann rearrangement

Linked Comprehension Type Questions

Passage-I :

The reaction between ethyl magnesium bromide (1mole) and carbonyl chloride produced (X), C_3H_5OCl. When (X) was treated with strong ammonia produced another compound (Y), C_3H_7NO, which was free from chlorine. Compound (Y) reacted with bromine and caustic soda produced a basic compound (Z), C_2H_7N (a mono acid base), which produced a bad smell on heating with chloroform and KOH solution to gave (W), C_3H_5N, which on hydrolysis produced basic compound (Z) and formic acid (the only monocarboxylic acid having reducing character). Compound (Z) reacted with $HNO_2(NaNO_2 + HCl)$ to give ethanol (a p-alcohol).

25. Compound 'X' is:
a) $Cl.CH_2CH_2-\overset{\overset{O}{\|}}{C}-OH$ b) $CH_3CH_2\overset{\overset{O}{\|}}{C}-Cl$ c) $CH_3-\underset{\underset{Cl}{|}}{CH}-\overset{\overset{O}{\|}}{C}-OH$ d) none of these

26. The compound 'Y' is:
a) $CH_3CH_2-\overset{\overset{O}{\|}}{C}-NH_2$ b) $CH_3-\underset{\underset{NH_2}{|}}{CH}-\overset{\overset{O}{\|}}{C}-OH$ c) $H_2N.CH_2CH_2-\overset{\overset{O}{\|}}{C}-OH$ d) none of these

27. Compound 'Z' is:
a) $CH_3CH_2NH_2$ b) $CH_3.NHCH_3$ c) both (a) and (b) d) none of these

28. Compound 'W' is:
a) $C_2H_5C\equiv N$ b) $C_2H_5N\doteqdot C$ c) both (a) and (b) d) none of these

Passage-II :

When two moles of ethanal are refluxed with aluminium ehtoxide a compound (A), $C_4H_8O_2$, is formed. Two moles of (A) on refluxing in the presence of sodium ethoxide (C_2H_5ONa) a compound (B), $C_6H_{10}O_3$, is produced. Compound(B) exhibits keto-enol tautomerism, and on boiling with dilute aq. KOH followed by acidification produced (C) $C_4H_6O_3$, Which forms an oxime with H_2NOH and liberates CO_2 from $NaHCO_3$ solution.(C) on decarboxylation gives (D), C_3H_6O, which on warming with iodine and NaOH solution producted a yellow precipitate and an acid (E), $C_2H_4O_2$ (E) on reaction with ethanol in the presence fo conc. H_2SO_4 produced compound(A).

29. The result of condensation of ethanol gave (A), which is:

a) $HCOOCH_2CH_2CH_3$ b) $HCOOCH(CH_3)_2$

c) $CH_3COOC_2H_5$ d) $CH_3CH_2COOCH_3$

30. The reaction forming (A) is known as:

a) Schmidt reaction b) Wurtz reaction

c) Tischenko reaction d) Cannizzaro reaction

31. The compound (B) of molecular formula $C_6H_{10}O_3$ is:

a) ethyl propionate b) ethyl acetoacetate

c) methyl ethyl ester d) a hydroxy acid

32. The hydrolysis and acidification product of (B) is (C). It is:

a) $CH_3-\overset{\overset{O}{\|}}{C}-CH_2COOH$ b) $CH_3CH_2-\overset{\overset{O}{\|}}{C}-COOH$

c) $HCOOCH_2-\overset{\overset{O}{\|}}{C}-CH_3$ d) none of these

33. The ecarboxylation product of (C) is:

a) CH_3CH_2CHO b) $CH_3-\underset{\diagdown\,O\,\diagup}{CH}-CH_2$ c) CH_3COCH_3 d) none of these

34. Compound(E) is:

a) formic acid b) acetic acid

c) propionic acid d) none of these

Matrix Matching Type Questions

35.

Column-I (Reagents reacting with $PhCH_2COOH$)	Column-II (Product formed)
A) CH_3MgBr	p) $PhCH_2COCl$
B) PCl_5	q) $PhCH_2COOCH_3$
C) NH_3, followed by heating	r) CH_4
D) CH_3OH in the presence of conc. H_2SO_4	s) $PhCH_2CONH_2$

36.

Column-I	Column-II
A) $RCN \xrightarrow{\text{reduction}}$	p) 1° Amine
B) $RCN \xrightarrow[(ii)\ H_2O]{(i)CH_3MgBr}$	q) Alcohol
C) $RNC \xrightarrow{\text{hydrolysis}}$	r) Ketone
D) $RNH_2 \xrightarrow{HNO_2}$	s) Acid

KEY SHEET (LECTURE SHEET)

EXERCISE-I

LEVEL-I

1) **2** 2) **2** 3) **4** 4) **3** 5) **4** 6) **2** 7) **1** 8) **3**
9) **3** 10) **4** 11) **3** 12) **3** 13) **3** 14) **1**

LEVEL-II

1) **b** 2) **b** 3) **b** 4) **a** 5) **c** 6) **c** 7) **b** 8) **a**
9) **c** 10) **b** 11) **a** 12) **a** 13) **c** 14) **a** 15) **ab** 16) **abcd**
17) **ab** 18) **bc** 19) **ab** 20) **c** 21) **b** 22) **c**
23) **A-s; B-r; C-p; D-q** 24) **A-v; B-s; C-u; D-s; E-r; F-q; G-p**

EXERCISE-II

LEVEL-I

1) **4** 2) 4 3) **2** 4) **2** 5) **3** 6) **2** 7) **1** 8) **1**
9) **4** 10) **2** 11) **2** 12) **2** 13) **1** 14) **1** 15) **3** 16) **2**
17) **2** 18) **2** 19) **3** 20) **4**

LEVEL-II

1) **c** 2) **b** 3) **a** 4) **c** 5) **a** 6) **c** 7) **b** 8) **a**
9) **a** 10) **b** 11) **b** 12) **c** 13) **a** 14) **c** 15) **c** 16) **d**
17) **d** 18) **b** 19) **c** 20) **c** 21) **cd** 22) **ac** 23) **ab** 24) **d**
25) **b** 26) **a** 27) **a** 28) **b** 29) **c** 30) **c** 31) **b** 32) **a**
33) **c** 34) **b** 35) **A-r, B-p, C-s, D-q** 36) **A-p, B-r, C-p,s; D-q**

PRACTICE SHEET

EXERCISE-I

(Preparation methods of carboxylic acids, Physical & Chemical Properties)

LEVEL-I (MAIN)

Straight Objective Type Questions

1. The molecular weight of benzoic acid in benzene as determined by depression in freezing point method corresponds to
   1) Ionization of benzoic acid
   2) Dimerization of benzoic acid
   3) Trimerization of bezoic acid
   4) Solution of benzoic acid

2. Glacial acetic acid is
   1) Pure acetic acid at 100°C
   2) Pure acetic acid at 0°C
   3) Acetic acid mixed with methanol
   4) Pure acetic acid at 16.6°C

3. Which of the following acids has the smallest dissociation constant?
   1) $CH_3CHFCOOH$ 2) FCH_2CH_2COOH 3) $BrCH_2CH_2COOH$ 4) $CH_3CHBrCOOH$

4. Identify the correct order of boiling points of the following compounds
(a) $CH_3CH_2CH_2CH_2OH$ (b) $CH_3CH_2CH_2CHO$ (c) $CH_3CH_2CH_2COOH$
1) a > b > c 2) c > a > b 3) a > c > b 4) c > b > a

5. In the anion, the two carbon-oxygen bonds are found to be of equal length. What is the reason for it ?
1) The anion is obtained by removal of a proton from the acid molecule.
2) Electronic orbitals of carbon atom are hybridized
3) The C = O bond is weaker than the C – O bond
4) The anion has two resonating structures.

6. Phenols is a weaker acid than acetic acid because
1) Phenoxide ion is better stabilized by resonance than acetate ion
2) Acetate ion is better stabilized by resonance than phenoxide ion
3) Phenol is less soluble in water than acetic acid
4) Both phenoxide ion and acetate

7. Rewrite the following in the increasing order of acidity?
i) Benzoic acid ii) p-Methoxybenzoic aicd iii) o-Chlorobenzoic acid
1) (i) < (ii) < (iii) 2) (iii) < (ii) <(i) 3) (ii) < (i) < (iii) 4) (iii) < (ii) < (i)

8. Increasing pKa of o, m and p-nitrobenzoic acid is
1) p < m < o 2) o < m < p 3) o < p < m 4) m < p < o

9. Phenol can be distinguished from acetic acid by
1) Blue litmus test 2) Sodium bisulphate test
3) With $FeCl_3$ solution 4) tollen's reagent test

10. Formic acid can be distinguished from acetic acid by reaction with
1) $NaHCO_3$ 2) Dil. Acidified $KMnO_4$ solution
3) 2, 4-Dinitrophenylhydrazine 4) Na metal

11. Which of the following alcohols will be esterified least readily by acetic acid in presence of a trace of con. H_2SO_4?
1) $CH_3CH_2CH_2CH_2OH$ 2) $(CH_3)_2CHCH_2OH$
3) $CH_3CHOHCH_2CH_3$ 4) $(CH_3)_3COH$

12. Which of the following is the correct decreasing order of acidic strength of
(i) methanoic acid (ii) ethanoic acid
(iii) propanoic acid (iv) butanoic acid
1) (i) > (ii) > (iii) > (iv) 2) (i) > (iv) > (iii) > (ii)
3) (i) > (iv) > (iii) > (ii) 4) (iv) > (i) > (ii) > (iii)

13. 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. Asprin will be
1) Unionized in the small intestine and in the stomach
2) Completely ionized in the stomach and almost unionized in the small intestine
3) Ionised the stomach and almost unionized in the small intestine
4) Ionized in the small intestine and almost unionized in the stomach.

14. The correct order of decreasing acid strength of trichloroacetic acid (A), trifluoroacetic acid (B), acetic acid (C) and formic acid (D) is

1) A > B > C > D 2) A > C > B > D 3) B > A > D > C 4) B > D > C > A

15. Arrange these esters in decreasing order of ease of esterfication with $CH_3OH/H^{\oplus}$:

(I) $CH_3-\underset{\displaystyle CH_3}{\underset{|}{CH}}-COOH$ (II) $CH_3-\underset{\displaystyle CH_3}{\underset{|}{CH}}-CH_2-COOH$

(III) $CH_3-\underset{\displaystyle CH_3}{\overset{\displaystyle CH_3}{\overset{|}{\underset{|}{C}}}}-COOH$ (IV) $(CH_3-CH_2)_3C-COOH$

a) II > I > III > IV b) I > II > III > IV c) III >IV > II > I d) IV > III > II > I

Numerical Value Type Questions

16. The number of possible isomeric hydroxy acids with the molecular formula $C_4H_8O_3$.

LEVEL-II (ADVANCED)

Straight Objective Type Questions

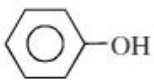
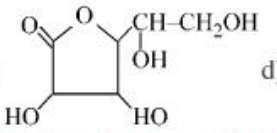
1. Which of the following compounds gives carbondioxide with $NaHCO_3$?

a) Acetic acid b) Hexanol c) Phenol d) Acetylene

2. When propanoic acid is treated with aqueous sodium bicarbonate, carbon dioxide is liberated. The carbon of the CO_2 comes from :

a) Methyl group b) Carboxylic group c) Methylene group d) Bicarbonate

3. Which of the following will liberate CO_2 on reaction with $NaHCO_3$

a)  b) CH_3COOH c)  d) $\underset{\displaystyle CH_2OH}{\overset{\displaystyle CH_2OH}{\overset{|}{\underset{|}{}}}}$

4. Which one of the following reacts with Grignard reagent to form an addition product which can be hydrolysed to a carboxylic acid?

a) O_2 b) CO_2 c) SO_2 d) None

5. A halogen compound 'A' on hydrolysis with dilute alkali followed by acidification gives acetic acid. The compound x is

a) $ClCH_2CH_2Cl$ b) CH_3CHCl_2 c) $ClCH_2CHCl_2$ d) CH_3CCl_3

6. Acetic acid exists as dimmer in due to

a) Condensation reaction b) Hydrogen bonding

c) Presence of a carboxyl group d) Presence of hydrogen at α -carbon.

7. The Hell-volthard Zelinsky reaction is used for preparing a/an

a) β-Haloacid b) γ-Haloacid c) Acid halide d) α-Haloacid

8. The compound which does not form an alkane when subjected to electrolysis is

a) Sodium acetate b) Sodium formate c) Sodium propanoate d) Sodium butanoate

9. Which one of the following reagents does not react with acetic acid to form acetyl chloride?
   a) $CHCl_3$ b) $SOCl_2$ c) PCl_3 d) PCl_5

10. The acid which does not form an anhydride when treated with P_2O_5 is
   a) formic acid b) acetic acid c) propionic acid d) Benzoic acid

11. Synthesis of an ester involves the reaction of alcohols with
   a) A ketone b) An amide c) CH_3MgBr d) RCOCl

12. The major product of nitration of benzoic acid is
   a) 3-Nitrobenzoic acid b) 4-Nitrobenzoic acid
   c) 2-Nitrobenzoic acid d) 2, 4-Dimitrobenzoic acid

13. Reaction of ethyl formate with excess of CH_3MgI followed by hydrolysis gives
   a) n-Propyl alcohol b) Ethanal c) Propanal d) Isopropyl alcohol

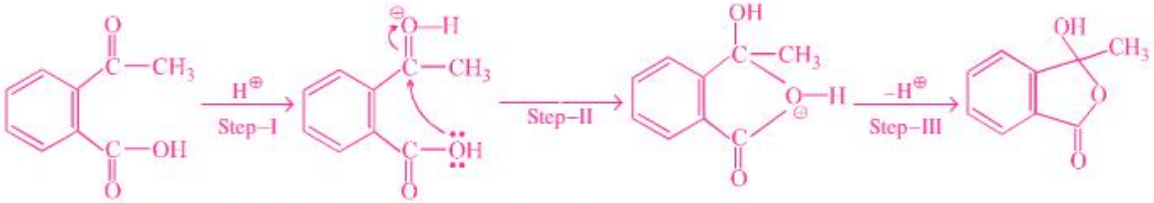
14. In presence of acid, hydrolysis of methyl cyanide gives
   a) Acetic acid b) Methylamine c) Methyl alcohol d) Formic acid

15. Benzoic acid on treatment with hydrazoic acid in the presence of concentrated sulphuric acid gives:
   a) Benzamide b) Sodium benzoate c) Aniline d) $C_6H_5CON_3$

16. Which one of the following compounds gives carboxylic acid with HNO_2?
   a) $C_6H_5-\overset{\overset{O}{\|}}{C}-Cl$ b) $C_6H_5CONH_2$ c) $CH_3-\overset{\overset{O}{\|}}{C}-O-\overset{\overset{O}{\|}}{C}-CH_3$ d) $CH_3COOC_2H_5$

More than One correct answer Type Questions

17. Decarboxylation will take place on heating
   a) methyl malonic acid b) succinic acid
   c) 2,2-dimethyl acetoacetic acid d) in all cases

18. 

Which of the following statements are correct?
   a) First step is protonation reaction which is reversible
   b) Second step is RDS
   c) Second step is Nu^r addition reaction d) Product of reaction is ester

19. Consider the following statements regarding the following reaction:
$$C_6H_5CHO \xrightarrow[CH_3COONa\ \Delta]{(CH_3CO)_2O} \xrightarrow{H_2O} C_6H_5-CH=CH-COOH + CH_3COOH$$
   a) Acetate ion acts as base in this reaction
   b) The anhydride having atleast one a-hydrogen, provides an enolate for the reaction
   c) The acetate deprotonates the anhydride to form the nucleophile needed for the reaction
   d) EtONa can also be use as base

20. Acetic acid can be used for the preparation of :
a) Ethane b) Methane c) Acetone d) ethanol

21. Which one of the following acids will form acetyl chloride with PCl_5?
a) MeCOOH b) MeCOOMe c) MeCOOCOMe d) Me–$CONH_2$

22. Sodium salt of which one of the monobasic acids on electrolysis does not give hydrocarbon:
a) C_6H_5COOH b) HCOOH c) Me_3C–COOH d)COOH–CH=CH–COOH

23. Which one of the following acids undergoes decarboxylation on strong heating:
a) Pyruvic acid b) 3-butenoic acid c) Formic acid d) Salicylic acid

24. Acetic anhydride is used as:
a) Solvent b) Dehydrating agent c) Acetylating agent d) Anticeptic

25. Which of the following gives silver mirror test?
a) HCOOH b) $CH_3COCHOHCH_3$ c) Tartaric acid d) Glucose

Linked Comprehension Type Questions

Passage-I :

A dibasic acid (X) has the molecular formula $C_4H_6O_4$(X) when heated with $KHSO_4$ gives a monobasic acid (A) with the elimination of CO_2 and water. ACid (A) has the molecular formula $C_3H_4O_3$. (A) on reduction gives another monobasic acid (C), $C_3H_6O_3$, which on heating gives a cyclic diester.

26. What is the compound (A)?
a) $\begin{matrix}CH(OH)COOH\\|\\CH(OH)COOH\end{matrix}$ b) $\begin{matrix}CH_2COOH\\|\\CH(OH)_2COOH\end{matrix}$ c) CH_3CH_2COOH d) $CH_3-CH(OH)-COOH$

27. What is the compound (B)?
a) $\begin{matrix}CH(OH)COOH\\|\\CH(OH)COOH\end{matrix}$ b) $\begin{matrix}CH_2COOH\\|\\CH(OH)_2COOH\end{matrix}$ c) $CH_3COCOOH$ d) CH_3CH_2COOH

28. What is the compound (C)?
a) CH_3CH_2COOH b) $\begin{matrix}CH(OH)COOH\\|\\CH(OH)COOH\end{matrix}$
c) $CH_3CH_2CH_2COOH$ d) $CH_3-CH(OH)-COOH$

EXERCISE-II

(Preparation methods of Physical & Chemical Properties of acid derivatives)

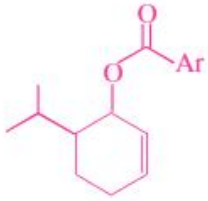
LEVEL-I (MAIN)

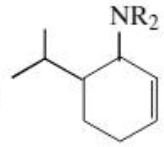
Straight Objective Type Questions

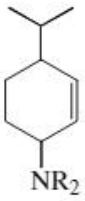
1. Rate of the reaction. $R-C(=O)-Z + Nu^- \rightarrow R-C(=O)-Nu + Z^-$. Is fastest when Z is :
1) Cl 2) NH_2 3) OC_2H_5 4) $OCOCH_3$

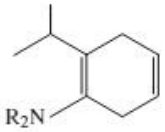
2. Self condensation of two moles of ethyl acetate in presence of sodium ethoxide yields :

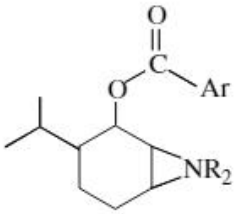
1) methyl acetoacetate 2) ethyl propionate 3) ethyl butyrate 4) acetoacetic ester

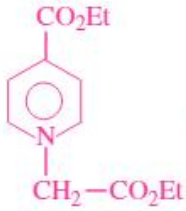
3.  $\xrightarrow[DMF]{R_2NH}$ Q (major); Q would be:

1) 

2) 

3) 

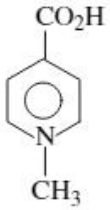
4) 

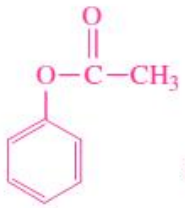
4.  $\xrightarrow{EtO^{\ominus}}$ $\xrightarrow[\Delta]{H_3O^{\oplus}}$ $\xrightarrow[HCl]{Zn(Hg)}$ (X). Product (X) of above reaction is:

1) 

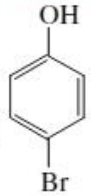
2) 

3) 

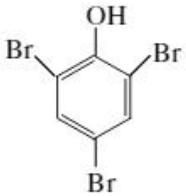
4) 

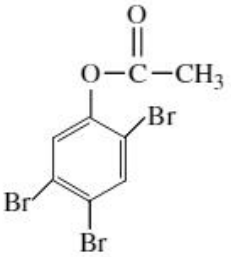
5.  ; $\xrightarrow[AlCl_3]{}$ A $\xrightarrow[(ii)\ H_3O^+]{(i)\ I_2 + \bar{O}H}$ B $\xrightarrow{excess\ Br_2 + H_2O}$ C

'C' form white precipitate compound 'C' is:

1) 

2) 

3) 

4) 

6. In the reaction: $C_6H_5 - H \xrightarrow[AlCl_3]{[X]} C_6H_5 - \overset{O}{\overset{\|}{C}} - CH_2 - C_6H_5$; [X] will be:

1) $C_6H_5CH_2COCl$ 2) $(C_6H_5 - CH_2CO)_2O$ 3) Both (1) and (2) 4) $C_6H_5 - CHCl_2$

7. In the given reaction: $C_6H_5 - \overset{O}{\overset{\|}{C}} - N\begin{matrix}CH_3\\CH_3\end{matrix} \xrightarrow{LiAlH_4}$; [X] will be:

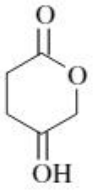
1) $C_6H_5–CH_2OH$ 2) C_6H_5COOH 3) $C_6H_5CONH_2$ 4) $C_6H_5–CH_2–N\begin{matrix}CH_3\\CH_3\end{matrix}$

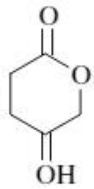
8. In the given reaction: $CH_3-\underset{Cl}{\underset{|}{CH}}-COOH \xrightarrow[1\,mole]{(i)NH_3\ (ii)H_2O}$ [X] ; Product [X] will be:

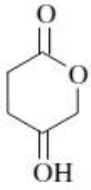
1) α -Amino acid 2) α -Aminoamide 3) β -Amino acid 4) β -Aminoamide

9. In the given reaction:  [A] . [A] and [B] respectively be:

[B]

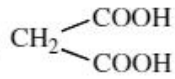
1) $CH_2OH-CH_2-CH_2-\underset{OH}{\underset{|}{CH}}-CH_2OH$ and 

2)  and $CH_2OH-CH_2-CH_2-\underset{OH}{\underset{|}{CH}}-CH_2OH$

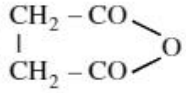
3) Both are 

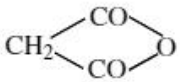
4) Both are $CH_2OH-CH_2-CH_2-\overset{OH}{\overset{|}{CH}}-CH_2OH$

10. In the given reaction : $CH_3-COOH \xrightarrow[1\,mole]{(i)NH_3\ (ii)H_2O}$ [X] ; [X] will be:

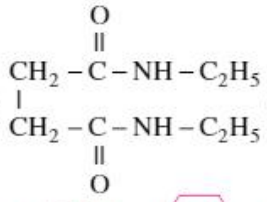
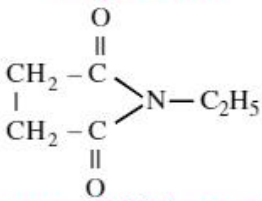
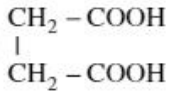
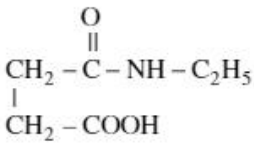
1) 

2) $COOH-CH_2-CH_2-COOH$

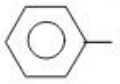
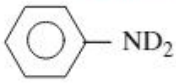
3) 

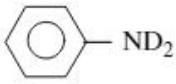
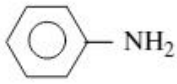
4) 

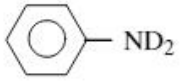
11. In the given reaction sequence: $\underset{CH_2-COOH}{\overset{CH_2-COOH}{|}} \xrightarrow{\Delta}$ (A) $\xrightarrow{CH_3-CH_2NH_2/\Delta}$ (B). (B) will be:

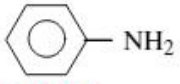
1)  2)  3)  4) 

12. Y $\xleftarrow[(ii)\ KOD,Br_2\Delta]{(i)\ NH_3,\Delta}$  $\xrightarrow[(ii)\ KOH,Br_2\Delta]{(i)\ ND_3,\Delta}$ X, What are X and Y:

1) X is  ; Y is 

2) X is  ; Y is  ;

3) both 

4) both 

Numerical Value Type Questions

13. The number of possible isomeric dicarboxylic acids of molecular formula $C_6H_{10}O_4$.

LEVEL-II (ADVANCED)

Straight Objective Type Questions

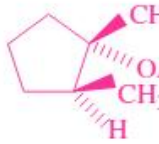
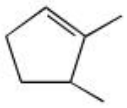
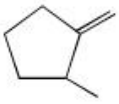
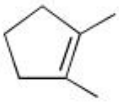
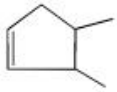
1. When propionic acid is treated with Br_2 in the presence of red phosphorus, the product obtained is
   a) CH_3CH_2COBr b) $CH_3CHBrCOOH$ c) $BrCH_2BrCOOH$ d) $BrCH_2CH_2COOH$

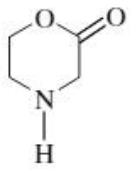
2. Acetic anhydride is employed for the detection and estimation of
   a) –OH group b) –COOH group c) –CHO group d) $-CONH_2$ group

3. The reaction is called $RCOOR' + R''OH \xrightarrow{H^+ \text{ or } OH^-} RCOOR'' + R'OH$
   a) Esterification b) Trans-esterification c) Saponification d) Hydrolysis

4. Carbonation of methylmagnesium bromide gives an organic compound. This compound is also obtained by
   a) Hydrolysis of acetonitrile by a mineral acid
   b) Oxidation of methyl alcohol
   c) Hydrolysis of methyl isocyanide with a mineral acid
   d) Hydrolysis of methyl formate with dilute mineral acid

5. $C_2H_5O-\overset{\overset{O}{\|}}{C}-OC_2H_5 \xrightarrow{2CH_3MgBr}$ A. Product A formed
   a) is ethyl acetate
   b) further react with CH_3MgBr/H_2O^+ to give acetone
   c) further react with CH_3MgBr/H_2O^+ to give t-butyl alcohol
   d) a & b are correct

6.  Which of the following product cannot be obtained by this reaction.
   a)  b)  c)  d) 

7. $Me-\overset{\overset{O}{\|}}{C}-O-CH_2-CH_2-\overset{\oplus}{N}H_3 \xrightarrow{NaOH}$ Q . Q is:
   a) $Me-\overset{\overset{O}{\|}}{C}-O-CH_2-CH_2-NH_2$ b) $Me-\overset{\overset{O}{\|}}{C}-NH-CH_2-CH_2-OH$
   c)  d) $MeCOONa + HOCH_2CH_2NH_2$

8. Guess the product $CH_3CH_2CONH_2 \xrightarrow[\Delta]{PCl_5}$?
   a) CH_3CH_2-CN b) CH_3CH_2COCl c) $CH_3CCl_2CONH_2$ d) $CH_3CH_2CONHCl$

9. The given reaction $CH_3-\underset{\underset{C_3H_7}{|}}{\overset{\overset{C_2H_5}{|}}{C}}-COOH \xrightarrow{N_3H/\text{Conc. } H_2SO_4} CH_3-\underset{\underset{C_3H_7}{|}}{\overset{\overset{C_2H_5}{|}}{C}}-NH_2$ is called :

a) Schmidt reaction
b) Cirtius reaction
c) Hofmann rearrangement
d) Lossen rearrangement

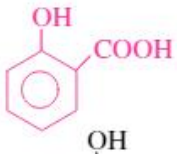
10. The given reaction is : $C_6H_5-CHO + C_6H_5CHO \xrightarrow{Na_2[Fe(CO)_4]} C_6H_5-\overset{\overset{O}{\|}}{C}-O-CH_2C_6H_5$

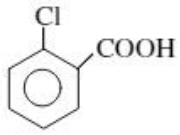
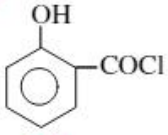
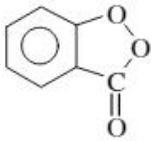
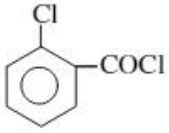
a) Claissen reaction b) Tischenko reaction c) Perkin reaction d) Cannizzaro reaction

11. Number of cross products in the given reaction:

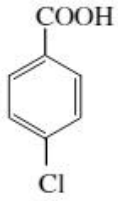
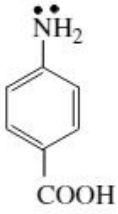
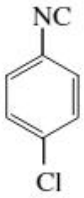
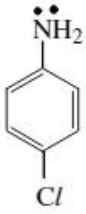
$CH_3COOC_2H_5 + C_6H_5-CH_2-COOC_2H_5 \xrightarrow[C_2H_5OH]{C_2H_5ONa}$

a) One b) Three c) Two d) four

12. In the given reaction :  $\xrightarrow{PCl_3}$ [X]. [X] will be :

a) 
b) 
c) 
d) 

13. Identify X in the reaction  $\xrightarrow[\text{heat}]{CHCl_3/KOH}$ Intermediate $\xrightarrow[300\text{ K}]{HCl}$ X

a) 
b) 
c) 
d) 

14. $\begin{matrix}C_6H_5-NH\\C_6H_5-NH\end{matrix}\!\!>C=S \xrightarrow[\text{Heat}]{\text{conc. HCl/ HgO}}$ A+B. The unknown compounds A and B in the above reaction are:

a) Phenyl mercaptan and aniline
b) Thiophenol and aniline hydrochloride
c) $C_6H_5-N=C=S$ and $C_6H_5\overset{\oplus}{N}H_3\overline{Cl}$
d) $C_6H_5CH_2SH$ and $C_6H_5\overset{\oplus}{N}H_3\overline{Cl}$

15. Major end product of the following sequence of reaction is:

$CH_3CH_2CH_2CONH_2 \xrightarrow[\Delta]{Ca(OH)_2,Cl_2} X \xrightarrow{HNO_2} Z$

a) $CH_3CH_2CH_2NH_2$ b) $CH_3CH_2CH_2OH$ c) $\underset{\underset{OH}{|}}{CH_3CHCH_3}$ d) CH_3CH_2COOH

16. In the given reaction sequence:

$CH_3–CH_2–OH \xrightarrow[(ii)\ H^{\oplus}]{(i)\ KMnO_4/\overset{\ominus}{O}H/\Delta} (A) \xrightarrow[(ii)\ NH_3/\Delta]{(i)\ SOCl_2} (B) \xrightarrow{Br_2/KOH} (C)$. (C) will be :

a) Methylamine b) Eltylamine c) Propylamine d) Acetamide

More than One correct answer Type Questions

17. Urea may be identified by which of the following test

a) with $CHCl_3$/KOH, it gives very offensive odour

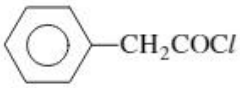
b) with HNO_2, it evolves H_2 & CO_2

c) with NaOH and a drop of $CuSO_4$, it gives violet colour

d) with NaOH on heating, it gives smell of NH_3 gas

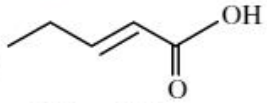
18. In the given reaction, 

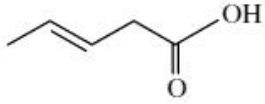
, [A] will be:

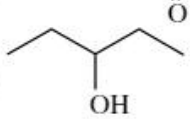
a) 

b) $(C_6H_5.CH_2)_2O$ c) $C_6H_5CHCl_2$ d) none of these

19. What products are obtained by heating the following? 

a) 

b) 

c) 

d) None of these

Linked Comprehension Type Questions

Passage-I :

Ethanoyl chloride reacts with diazomethane (CH_2N_2) to form a compound (A), $C_3H_4N_2O$, with the liberation of one mole of HCl. (A) on treatment with silver oxide rearragens to compound (B), C_3H_4O, with the release of one mole of nitrogen gas. Compound (B) adds one mole of water to form (C), $C_3H_6O_2$, which evolves CO_2 from bicarbonate (HCO_3^-) and on decarboxylation yields ethane. Compound (C) on treatment with PBr_5 and Br_2 and red phosphorous yields(D), $C_3H_4OBr_2$, which reacts with cold water to form (E), $C_3H_5O_2Br$.(E) is hydrolyzed by AgOH to give (F), $C_3H_6O_3$, which contains both –OH and –COOH. (F) when heated alone gave one mole of a cyclic dester.

20. Which of the following is compound (A) ($C_3H_4N_2O$)?

a) CH_3COCHN_2 b)  c) both (a) and (b) d) none of these

21. Compound (B), C_3H_4O, is:

a) CH_3CH_2CHO b) CH_3COCH_3 c) $CH_3CH = C = O$ d) none of these

22. The formation of (B) from (A) in presence of silver oxide is known as:

a) Wolff rearrangement b) Curtius rearrangement

c) Beckmann rearrangement d) none of these

23. Compound (C) is:

a) $HCOOCH_2CH_3$ b) CH_3COOCH_3 c) CH_3CH_2COOH d) none of these

24. Compound (D) is:

a) $CH_3-\underset{\displaystyle Br}{\underset{|}{CH}}.COBr$ b) $BrCH_2CH_2COBr$ c) $BrCH.CH_2CHO$ d) none of these

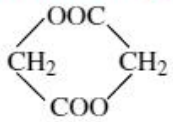
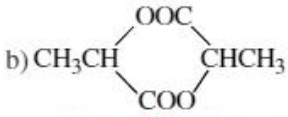
25. Compound (E) is:

a) $CH_3-\underset{\displaystyle Br}{\underset{|}{CH}}.COOH$ b) $BrCH_2CH_2COOH$ c) $HOCH_2CH_2COBr$ d) none of these

26. The compound (F) is:

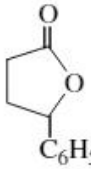
a) $HOCH_2CH_2OH$ b) $CH_3-\underset{\displaystyle OH}{\underset{|}{CH}}.COOH$ c) both (a) and (b) d) none of these

27. The formula of cyclic diester is:

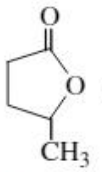
a)  b)  c) both (a) and (b) d) none of these

Matrix Matching Type Questions

28.

Column-I	Column-II
A) $PhCONH_2 \rightarrow PhCH_2OH$	p) B_2H_6 AcOH H_2O
B)  $\rightarrow CH_2OH-(CH_2)_2-CHOH-C_6H_5$	q) $LiAlH_4$
C) $C_6H_5CH=CH-COOH \rightarrow C_6H_5-CH=CH_2OH$	r) $H_2Pd\ BaSO_4$
D) $CH_3COCl \rightarrow CH_3-CHO$	s) None

29.

Column-I	Column-II
A) $C_6H_5-\underset{\displaystyle O}{\underset{\|\|}{C}}-OC_2H_5 + H_3C-\underset{\displaystyle O}{\underset{\|\|}{C}}-O-C_2H_5 \rightarrow C_6H_5-\underset{\displaystyle O}{\underset{\|\|}{C}}-CH_2-\underset{\displaystyle O}{\underset{\|\|}{C}}-OC_2H_5 + C_2H_5OH$	p) Anhydrous $ZnCl_2$
B) $H_3C-\underset{\displaystyle O}{\underset{\|\|}{C}}-OH + Cl_2 \rightarrow ClCH_2-\underset{\displaystyle O}{\underset{\|\|}{C}}-OH$	q) $C_2H_5O^r$
C) $C_6H_6+(H_3C-C=O)_2O \rightarrow C_6H_5-\underset{\displaystyle O}{\underset{\|\|}{C}}-CH_3$	r) Red P
D)  $\rightarrow CH_3CH(OH)CH_2CH_2CH_2OH$	s) LiA/H_4

KEY SHEET (PRACTICE SHEET)

EXERCISE-I

LEVEL-I

1) **2** 2) **4** 3) **3** 4) **2** 5) **4** 6) **2** 7) **3** 8) **3**
9) **3** 10) **3** 11) **4** 12) **1** 13) **4** 14) **3** 15) **1** 16) **8**

LEVEL-II

1) **a** 2) **d** 3) **b** 4) **b** 5) **d** 6) **b** 7) **d** 8) **b**
9) **a** 10) **a** 11) **d** 12) **a** 13) **d** 14) **a** 15) **c** 16) **b**
17) **ac** 18) **abcd** 19) **abc** 20) **abcd** 21) **abc** 22) **bc** 23) **abcd**
24) **abc** 25) **abcd** 26) **a** 27) **c** 28) **d**

EXERCISE-II

LEVEL-I

1) **1** 2) **4** 3) **2** 4) **2** 5) **3** 6) **3** 7) **4** 8) **1**
9) **1** 10) **1** 11) **2** 12) **1** 13) **9**

LEVEL-II

1) **b** 2) **a** 3) **b** 4) **a** 5) **c** 6) **d** 7) **b** 8) **a**
9) **a** 10) **b** 11) **c** 12) **b** 13) **d** 14) **c** 15) **c** 16) **a**
17) **ad** 18) **ab** 19) **a** 20) **a** 21) **c** 22) **a** 23) **c** 24) **a**
25) **a** 26) **b** 27) **b** 28) **A-s; B-q; C-s; D-r**
29) **A-q; B-r; C-p; D-s**

ADDITIONAL PRACTICE EXERCISE

LEVEL-I (MAIN)

Straight Objective Type Questions

1. Amides can be concerted into 1^0 amine by reaction name after :
   1) Cannizzaro 2) Williamson 3) Hofmann bromamide 4) Wurtz
2. Acetamide is treated separately with the following reagents. Which one of these would give methyl amine?
   1) PCl_5 2) NaOH + Br 3) Soda lime 4) Hot conc. H_2SO_4
3. Alkaline hydrolysis of an ester is called:
   1) neutralization 2) esterification 3) polymerisation 4) saponification
4. Reaction between ketene and RCOOH gives:
   1) an ester 2) an anhydride 3) a ketone 4) an aldehyde
5. $CH_3-\overset{\overset{O}{\|}}{C}-CH_3 \xrightarrow[[O]]{H_2SO_5} X$, the product X is:
   1) ester 2) anhydride 3) acid 4) amide
6. Which of the following compounds on treatment with acid yields ethanoic acid?
   1) CH_3CO_2MgX 2) $CH_3C \equiv N$ 3) $CH_3COOCOCH_3$ 4) all three

7. Which of the following intermediates is formed in Hofmann bromamide reaction?
1) RCONHBr 2) $[RCONBr]^{\ominus} K^{\oplus}$ 3) RNCO 4) all of these

8. Which of the following compounds will not give Hofmann bromamide reaction?
1) $C_6H_5CONH_2$ 2) $CH_3NHCOCH_3$ 3) $CH_3-\underset{\underset{NH_2}{|}}{C}=O$ 4) $(CH_3)_2CHCONH_2$

9. Acetamide on heating with PCl_5 gives:
1) acetyl chloride 2) acetic anhydride 3) methyl cyanide 4) N-chloro acetamide

10. Which of the following compounds would react with bromine and concentrated alkali ?
1) $CH_3\overset{O}{\overset{||}{C}}-NHCH_3$ 2) $CH_3-\overset{O}{\overset{||}{C}}-\overset{\ominus\oplus}{O}NH_3$ 3) $C_6H_5CONH_2$ 4) $CH_3-\overset{O}{\overset{||}{C}}-NHOH$

LEVEL-II

LECTURE SHEET (ADVANCED)

1. Which of the following esters cannot undergo Claisen self condensation?
a) $CH_3CH_2CH_2CH_2COOC_2H_5$ b) $C_6H_5COOC_2H_5$ c) $C_6H_5CH_2COOC_2H_5$ d) $C_6H_{11}CH_2COOC_2H_5$

2. CH_3CONH_2 is dehydrated by P_2O_5 to give:
a) CH_3NH_2 b) CH_3CN c) CH_3CHO d) $CH_3CH_3 + CO + NH_3$

3. The reaction, $ArCHO \xrightarrow[\text{Nickel peroxide}-20^0C]{NH_3}$ gives:
a) $ArCH_2NH_2$ b) $ArCONH_2$ c) ArCOOH d) $ArNHCH_3$

4. The reaction $CH_2=CH-CHO+NH_3 \xrightarrow[-20^0C]{\text{Nickel peroxide}}$ gives:
a) $CH_2=CHCH_2CONH_2$ b) $CH_2=CH-CH_2NH_2$
c) $CH_2=CH-CH_2COOH$ d) all of the above

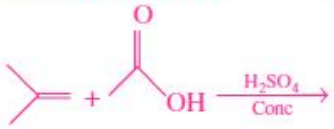
5. The reaction $C_3O_2+2C_2H_5OH \rightarrow$ gives:
a) $CH_2\begin{cases}COOC_2H_5\\COOC_2H_5\end{cases}$ b) $\begin{matrix}CH_2-COOC_2H_4\\|\\CH_2-COOC_2H_4\end{matrix}$ c) $CH_2\begin{cases}OC_2H_5\\OC_2H_5\end{cases}$ d) none of these

6. CH_2CO reacts with C_4H_5OH give:
a) $C_2H_5COOCH_3$ b) $CH_3COOC_2H_5$ c) $CH_3CH_2CH_2COOH$ d) $CH_3CH_2CH_2CHO$

7. The addition of CH_3COOH to ethylene gives:
a) an ester b) an anhydride c) an aldehyde d) a ketone

8. Which is the end product of following reaction?
$R-\overset{O}{\overset{||}{C}}-Cl+CH_2N_2 \rightarrow R-\overset{O}{\overset{||}{C}}-CHN_2 \xrightarrow[Ag_2O]{H_2O} X$:
a) an ester b) a carboxylic acid c) an anhydride d) an amide

9. Which one of the following reactions gives methanoic anhydride?
a) $2HCOOH \xrightarrow[\Delta]{P_2O_5}$ b) $2HCOOH+(CH_3CO)_2O \xrightarrow{\Delta}$
c) $HCOONa+HCOCl \rightarrow$ d) none of the above

10. The reaction  gives;

a) t-butyl ethanoate
b) t-butanoic anhydride
c) methyl t-butanoate
d) none of these

11. The product 'A' in the following reaction is: $R-C\equiv N+2H_2O_2 \xrightarrow{OH} A+O_2+H_2O$

a) $R-\overset{\overset{O}{\|}}{C}-NH_2$ b) $R-\overset{\overset{O}{\|}}{C}-OH$ c) $R-\overset{\overset{O}{\|}}{C}-NHOH$ d) RCOOR

12.  $\xrightarrow[\text{Heat}]{P_2O_5}$ A $\xrightarrow{\text{Dil.}H_2SO_4}$ B. The name of compound B is:

a) p-bromo aniline
b) p-bromo benzonitrile
c) p-bromo phenol
d) p-bromo benzoic acid

13. The correct order of increasing boiling points of the following compounds is:

CH_3CONH_2	CH_3COCl	CH_3COOCH_3	$CH_3COOCOCH_3$
(I)	(II)	(III)	(IV)

a) I < II < III < IV b) II < III < IV < I c) II < IV < III < I d) II < III < I < IV

14. CH_3CONH_2 is treated separately with the following reagents. Which of these would give methyl amine?

a) Na + C_2H_5OH b) Na + liquid NH_3 c) Br_2KOH d) Soda lime

PRACTICE SHEET (ADVANCED)

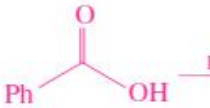
More than One correct answer Type Questions

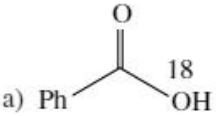
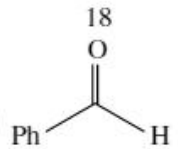
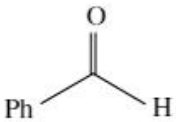
1. One can distinguish between HCOOH and CH_3COOH with:

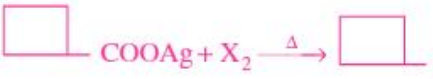
a) $FeCl_3$ b) H_2SO_4 c) Tollen's reagent d) Fehling's solution

2. Which of the following decarboxylate readily in the temperature range 100–150^{0}C ?

a) $CH_2=CH.CH_2COOH$
b) O_2NCH_2COOH
c) $NC-CH_2COOH$
d) CH_3COCH_2COOH

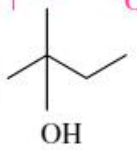
3. In the given reaction  $\xrightarrow{H_2O^{18}}$ Product, The product(s) is/are:

a)  b) c)  d) 

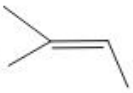
4. In the given reaction;  $+CO_2+AgX;X_2$ is:

a) Cl_2 b) Br_2 c) I_2 d) F_2

5. Which of the following reactants on reaction with CO in sulphuric acid solution gives the following product?

a) 

b) 

c) 

d) 

6. Which of the following would be most and least readily hydrolysed with NaOH ?

a) CH_3COOCH_3 b) $CH_3-\underset{\displaystyle CH_3}{\underset{|}{CH}}COOCH_3$ c) $CH_3COO-\overset{\displaystyle CH_3}{\overset{|}{\underset{|}{\overset{O}{\overset{||}{C}}}}}-CH_3$ d) none of these

Linked Comprehension Type Questions

Passage :

Ethanoic acid on treatment with thionyl chloride gives acetyl chloride which on treatment with KCN followed by hydrolysis produced compound (A), $C_3H_4O_3$. Compound (A) evolves CO_2 from $NaHCO_3$ solution as well forms oxime and hydrazone, respectively. (A) also reduces ammonical $AgNO_3$ to ethanoic acid with liberation of CO_2. Compound (A)mild reduction gives (B), $C_3H_6O_3$, which contained an asymetric carbon atom and gives the reactions of alcoholic OH group and –COOH group. Two moles of (B) on heating produced a cyclic diester. Compound (A) when treated with warm dil. H_2SO_4 produced ethanol and with conc. H_2SO_4 produced ethanoic acid.

7. The reaction product (A) is:

a) CH_3CH_2COOH b) $CH_3COCOOH$ c) $HCOOCH_2CH_3$ d) CH_3COOCH_3

8. Compound contain the functional groups:

a) $>C=O$ and –COOHb) $-COOC_2H_5$ c) –CO–O–CO d) none of these

9. Compound(B) is:

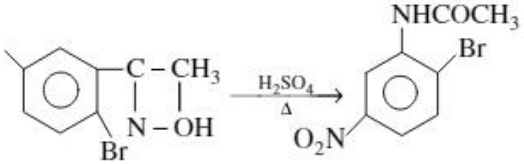
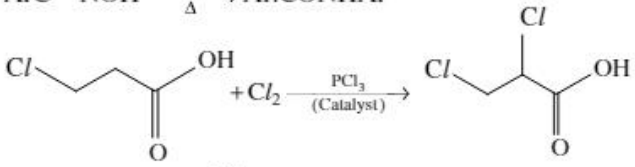
a) $CH_3-CH(OH)COOH$ b) $HOCH_2CH_2COOH$ c) both (a) and (b) d) none of these

10. (B) on heating yields a cyclic diester hence it is a/an:

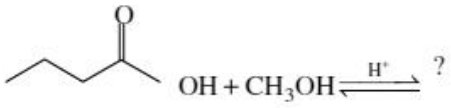
a) α – hydroxy acid b) β – hydroxy acid c) γ – hydroxy acid d) none of these

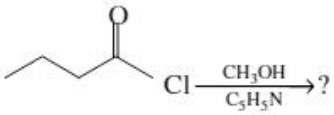
Matrix Matching/Integer Type Questions

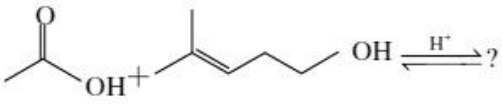
11.

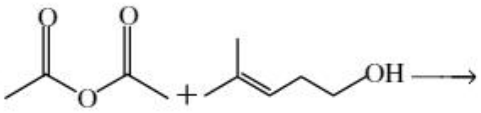
Column-I	**Column-II**
A) 	p) Arndt-Eistert synthesis
B) $ArC=NOH \xrightarrow[\Delta]{PCl_5} Ar.CONHAr$	q) Beckmann rearrangement
C) 	r) Claisen condensation
D) $CH_3COCHN_2 \xrightarrow[Ag_2O\ Catalyst]{NH_3} CH_3CH_2CONH_2 + N_2$	s) HVZ reaction

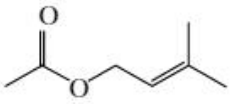
12. **Column-I** **Column-II**

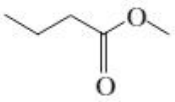
A) 

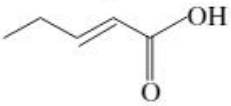
B) 

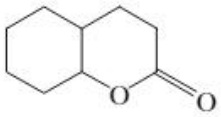
C) 

D) 

p) 

q) 

r) 

s) 

KEY SHEET (ADDITIONAL PRACTICE EXERCISE)

LEVEL-I (MAIN)

1) **3** 2) **2** 3) **4** 4) **2** 5) **1** 6) **4** 7) **4** 8) **2** 9) **3** 10) **3**

LEVEL-II

LECTURE SHEET (ADVANCED)

1) **b** 2) **b** 3) **b** 4) **a** 5) **a** 6) **b** 7) **a** 8) **a** 9) **d** 10) **a**

11) **a** 12) **d** 13) **b** 14) **c**

PRACTICE SHEET (ADVANCED)

1) **acd** 2) **ad** 3) **ab** 4) **ab** 5) **abc** 6) **ab** 7) **b** 8) **a** 9) **a** 10) **a**

11) **A-q; B-q; C-s; D-p** 12) **A-q; B-q; C-p; D-p**