

CHAPTER
13

CARBOXYLIC ACID

MULTIPLE CHOICE QUESTIONS

- Ninhydrin reacts with amino acid to form product which has colour:**
(a) Blue (b) Violet
(c) Bluish violet (d) Red
- Slight oxidation of primary alcohol gives:**
(a) Ketone (b) Organic acid
(c) Aldehyde (d) An ester
- Which of the following is the strongest acid:**
(a) HCOOH (b) CH_3COOH
(c) $\text{CH}_3 - \text{CH}_2 - \text{COOH}$ (d) $\text{Cl} - \text{CH}_2 - \text{COOH}$
- Which of the following esters shows the flavour of orange:**
(a) Benzyl acetate (b) Iso-butyl formate
(c) Octyl acetate (d) Ethyl butyrate
- Which acid is used in the manufacture of synthetic fibre:**
(a) Formic acid (b) Acetic acid
(c) Carbonic acid (d) Benzoic acid
- Some amino acids are most important because they are the final product of hydrolysis of peptide and protein and they are:**
(a) α -amino acid (b) β -amino acid
(c) γ -amino acid (d) All of the above
- In amino acid proton is transferred from one point to the other point and this dipolar ion is called:**
(a) Oxonium ion (b) Carbonium ion
(c) Zwitter ion (d) Carbanion

8. Which of the following is neutral amino acid:
- (a) Glycine (b) Histidine
(c) Lysine (d) Aspartic acid
9. The amino acid which body can synthesize are called:
- (a) Essential (b) Non-essential
(c) Acidic (d) Basic
10. Amino acids are classified into following types:
- (a) Acidic (b) Basic
(c) Neutral (d) All
11. By convention a peptide having molecular mass upto 10,000 is called:
- (a) Peptide (b) Polypeptide
(c) Protein (d) Dipeptide
12. Acetic acid is manufactured commercially by:
- (a) Distillation (b) Fermentation
(c) Ozonolysis (d) Esterification
13. Which of the following derivative can't be prepared directly from acetic acid:
- (a) Acetic anhydride (b) Acetyl chloride
(c) Acetamide (d) Ethyl ethanoate
14. Which reagent is used to reduce a carboxylic group to an alcohol:
- (a) H_2/Ni (b) HI/P
(c) $NaBH_4$ (d) $LiAlH_4$
15. The solution of which acid is used for seasoning of food:
- (a) Formic acid (b) Acetic acid
(c) Benzoic acid (d) Butanoic acid
16. Which one of the following element is not present in all proteins:
- (a) Carbon (b) Hydrogen
(c) Nitrogen (d) Sulphur

17. The IUPAC name of $\begin{array}{c} \text{CH}_2 - \text{COOH} \\ | \\ \text{CH}_2 - \text{COOH} \end{array}$ is:
- (a) Succinic acid (b) Butanoic acid
(c) Dibutanoic acid (d) But-1, 4-dioic acid
18. $\text{C}_2\text{H}_5\text{Br} \xrightarrow{\text{KCN}} \text{A} \xrightarrow{\text{H}_2\text{O}/\text{H}^+} \text{B}$
The compound 'B' is:
- (a) Acetic acid (b) Propanoic acid
(c) Ethyl alcohol (d) Propionaldehyde
19. Which of the following will react with both ethanol and ethanoic acid at room temperature:
- (a) CaCO_3 (b) CuO
(c) Na-metal (d) CH_3OH
20. Which one of the following is not an amino acid:
- (a) Alanine (b) Glycine
(c) Aspartic acid (d) Aniline
21. Which one of the following metal can evolve hydrogen from acetic acid:
- (a) Na (b) Fe
(c) Al (d) Cu
22. Which one of the following is not a dicarboxylic acid:
- (a) Malonic acid (b) Valeric acid
(c) Maleic acid (d) Succinic acid
23. The compound $\begin{array}{c} \text{HO} - \text{CH} - \text{COOH} \\ | \\ \text{HO} - \text{CH} - \text{COOH} \end{array}$ is commonly called:
- (a) Lactic acid (b) Citric acid
(c) Tartaric acid (d) Succinic acid
24. Reverse of esterification is known as:
- (a) Trans esterification (b) Dehydration
(c) Hydrolysis (d) Decarboxylation

25. The general formula of monocarboxylic acid:
- (a) C_nH_nCOOH (b) $C_nH_{2n+1}COOH$
 (c) $C_nH_{2n}COOH$ (d) $C_nH_{2n-2}COOH$
26. The simplest of all amino acid:
- (a) Lysine (b) Glycine
 (c) Alanine (d) Aspartic acid
27. Carboxylic acid can be changed to acid chloride by the treatment with:
- (a) S_2Cl_2 (b) $SOCl_2$
 (c) HCl (d) $HOCl$
28. Which product is not formed when acetic acid reacts with $SOCl_2$ (Thionyl chloride):
- (a) CH_3Cl (b) CH_3COCl
 (c) HCl (d) SO_2
29. Which one of the following reagent is used to convert acetic acid to ethane?
- (a) $LiAlH_4$ (b) HI and Red P
 (c) P_2O_5 (d) $SOCl_2$ and pyridine
30. The weakest carboxylic acid:
- (a) $HCOOH$ (b) CH_3CH_2COOH
 (c) CH_3COOH (d) $ClCH_2COOH$

answers

1.	(c)	2.	(c)	3.	(a)	4.	(c)	5.	(b)
6.	(a)	7.	(c)	8.	(a)	9.	(b)	10.	(d)
11.	(b)	12.	(b)	13.	(c)	14.	(d)	15.	(b)
16.	(d)	17.	(d)	18.	(b)	19.	(c)	20.	(d)
21.	(a)	22.	(b)	23.	(c)	24.	(c)	25.	(b)
26.	(b)	27.	(b)	28.	(a)	29.	(b)	30.	(b)



SOLVED EXERCISE

Q.1 Fill in the blanks:

- (i) Formula of malonic acid is _____.
- (ii) Methyl nitrile upon acidic hydrolysis produces _____.
- (iii) Melting points of carboxylic acids containing even number of carbon atoms are _____ than the next lower and higher members containing odd number of carbon atoms.
- (iv) Acetic acid on heating with _____ produces acetic anhydride.
- (v) Acid chloride and acid anhydride are called _____ of acid.
- (vi) Pure acetic acid is called _____.
- (vii) Formula of alanine is _____.
- (viii) Proline is a _____ amino acid.
- (ix) A peptide having a molecular mass more than 10,000 is called _____.

answers

(i)	HOOC-CH ₂ -COOH	(ii)	acetic acid	(iii)	higher
(iv)	P ₂ O ₅	(v)	derivative	(vi)	glacial acetic acid
(vii)	$\begin{array}{c} \text{CH}_3\text{-CH-COOH} \\ \\ \text{NH}_2 \end{array}$	(viii)	neutral	(ix)	protein

Q.2 Indicate True or False:

- (i) Acetic acid exists as a dimer in benzene.
- (ii) First three aliphatic acids have fruity smells.
- (iii) Carboxylic acids on reduction with LiAlH₄ produce alkenes.
- (iv) Acetic acid on dehydration produces CO and H₂.

- (v) Sodium formate on heating with soda lime produces NaHCO_3 and hydrogen.
- (vi) Amino acids exist as Zwitter ion.
- (vii) Histidine is an acidic amino acid.
- (viii) A peptide having molecular mass upto 10000 is called protein.
- (ix) Phthalic acid is a monocarboxylic acid.
- (x) Formula of glycine is CH_2COOH .

answers

(i)	True	(ii)	False	(iii)	False	(iv)	False	(v)	False
(vi)	True	(vii)	False	(viii)	False	(ix)	False	(x)	False

Q.3 Multiple choice questions. Encircle the correct answer:

- (i) Acetic acid is manufactured by:
- (a) Distillation (b) Fermentation
(c) Ozonolysis (d) Esterification
- (ii) A carboxylic acid contains:
- (a) A hydroxyl group (b) A carboxyl group
(c) A hydroxyl and carboxyl group (d) A carboxyl and an aldehydic group
- (iii) Which acid is used in the manufacture of synthetic fibre:
- (a) Formic acid (b) Oxalic acid
(c) Carbonic acid (d) Acetic acid
- (iv) Which of the following derivative cannot be prepared directly from acetic acid:
- (a) Acetamide (b) Acetyl chloride
(c) Carbonic acid (d) Acetic acid
- (v) Which reagent is used to reduce a carboxylic group to an alcohol:
- (a) H_2/Ni (b) H_2/Pt
(c) NaBH_4 (d) LiAlH_4
- (vi) The solution of which acid is used for seasoning of food:
- (a) Formic acid (b) Acetic acid

- (c) Benzoic acid (d) Butanoic acid
- (vii) Organic compounds X and Y react together to form organic compound Z. What type of compounds can X, Y and Z be:
- | | | |
|-------------|---------|---------|
| X | Y | Z |
| (a) alcohol | ester | acid |
| (b) acid | ester | alcohol |
| (c) ester | alcohol | acid |
| (d) alcohol | acid | ester |
- (viii) An aqueous solution of an organic compound reacts with sodium carbonate to produce carbon dioxide gas. Which one of the following could be the organic compound:
- (a) $\text{CH}_2 = \text{CH} - \text{CH}_3$ (b) $\text{CH}_3 - \text{CHO}$
 (c) $\text{CH}_3\text{COOC}_2\text{H}_5$ (d) $\text{CH}_3 - \text{CH}_2 - \text{COOH}$
- (ix) Which of the following is not a fatty acid:
- (a) Propanoic acid (b) Acetic acid
 (c) Phthalic acid (d) Butanoic acid
- (x) Acetamide is prepared by:
- (a) Heating ammonium acetate (b) Heating methyl cyanide
 (c) Heating ethyl acetate (d) The hydrolysis of methyl cyanide

answers

(i)	(b)	(ii)	(b)	(iii)	(d)	(iv)	(a)	(v)	(d)
(vi)	(b)	(vii)	(d)	(viii)	(d)	(ix)	(c)	(x)	(a)

Q.4 Write down the structural formulae of the following:

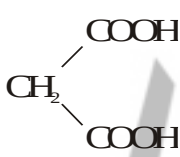
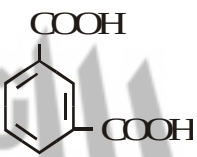
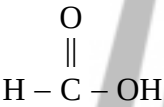
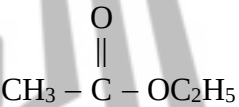
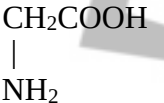
- (i) Valeric acid (ii) Propionic acid (iii) Oxalic acid
 (iv) Benzoic acid (v) Acetic anhydride (vi) Acetyl chloride

Ans.

Name	Structural Formula
Valeric acid	$\text{H}_3\text{C} - \text{CH}_2 - \text{CH}_2 - \text{CH}_2 - \text{COOH}$

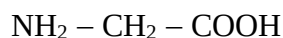
Propionic acid	$\begin{array}{c} \text{O} \\ \\ \text{H}_3\text{C}-\text{CH}_2-\text{C}-\text{OH} \end{array}$
Oxalic acid	$\begin{array}{c} \text{COOH} \\ \\ \text{COOH} \end{array}$
Benzoic acid	$\begin{array}{c} \text{O} \\ \\ \text{C}_6\text{H}_5-\text{C}-\text{OH} \end{array}$
Acetic anhydride	$\begin{array}{c} \text{O} \quad \text{O} \\ \quad \\ \text{H}_3\text{C}-\text{C}-\text{O}-\text{C}-\text{CH}_3 \end{array}$
Acetyl chloride	$\begin{array}{c} \text{O} \\ \\ \text{H}_3\text{C}-\text{C}-\text{Cl} \end{array}$

Q.5 Write down the names of the following compounds by IUPAC system:

- (i) 
- (ii) 
- (iii) 
- (iv) 
- (v) 
- (vi) 

Ans.

Structure	IUPAC Name
$\text{HOOC}-\text{CH}_2-\text{COOH}$	1, 3-propane dioic acid.
	1, 3-benzene dicarboxylic acid
$\begin{array}{c} \text{O} \\ \\ \text{H}-\text{C}-\text{OH} \end{array}$	Methanoic acid
$\text{CH}_3-\text{COOC}_2\text{H}_5$	Ethyl acetate



α -aminoethanoic acid

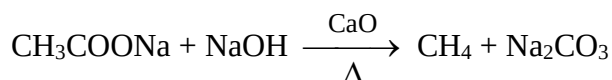
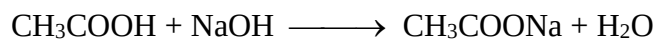


n-propyl formate

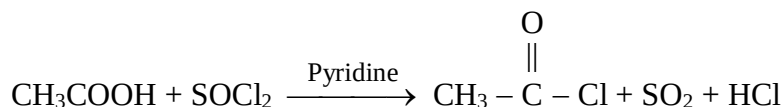
Q.6 How would you convert acetic acid into?

Ans.

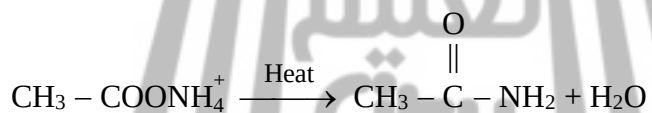
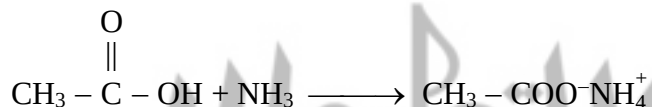
(a) Methane:



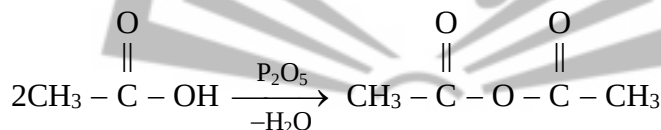
(b) Acetyl chloride:



(c) Acetamide:



(d) Acetic anhydride:



Q.7 (a) What are fatty acids?

(b) What is vinegar? Describe how is vinegar prepared from ethanol?

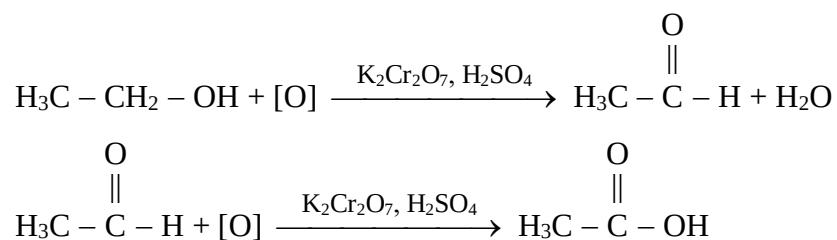
Ans.

(a) Fatty Acids: Long chain aliphatic carboxylic acids are called fatty acids especially the higher members of carboxylic acids which are obtained by the hydrolysis of fats and oils are called fatty acids. e.g.,

(i) Palmitic acid ($\text{C}_{15}\text{H}_{31}\text{COOH}$)

(ii) Stearic acid ($\text{C}_{17}\text{H}_{35}\text{COOH}$) etc.

- (b) **Vinegar:** A liquid containing 3-6% acetic acid is called vinegar. It is prepared from ethanol which is obtained by the fermentation of sugar, starch etc. Ethanol is oxidized to vinegar by bacteria. It may also be oxidized by using $K_2Cr_2O_7$ + conc. H_2SO_4 as follow:

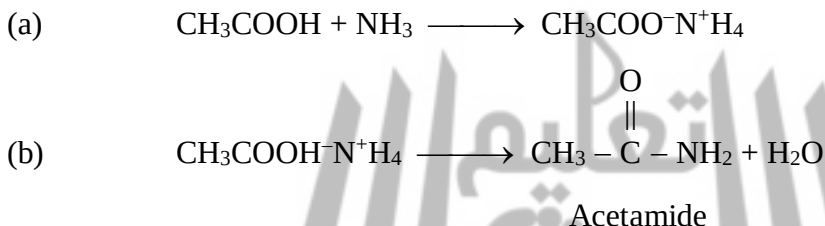


Q.8 How would you carry out the following conversions:

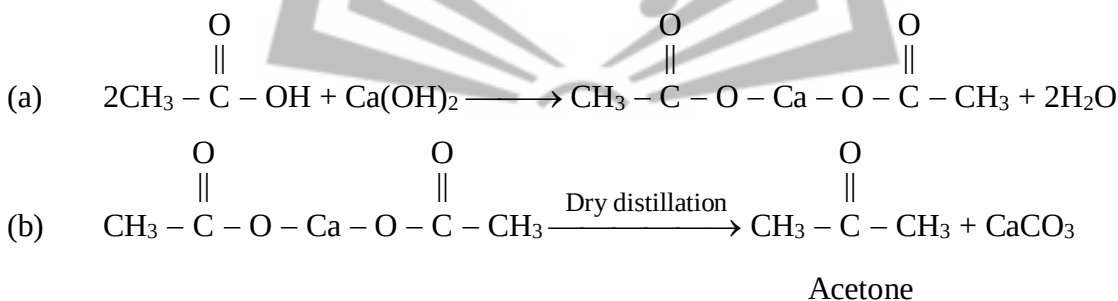
- (i) Acetic acid into acetamide (ii) Acetic acid into acetone

Ans.

(i) **Steps Involved:**



(ii) **Steps Involved:**

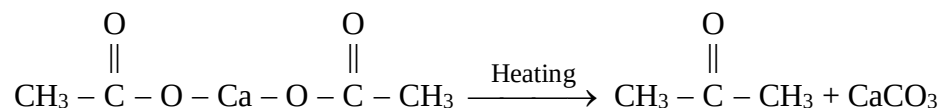


Q.10 What happens when the following compounds are heated:

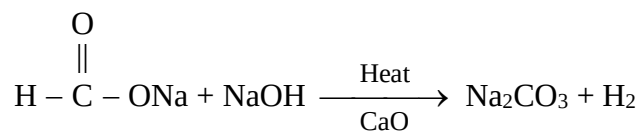
- (i) Calcium acetate (ii) Sodium formate and soda lime
- (iii) Ammonium acetate

Ans.

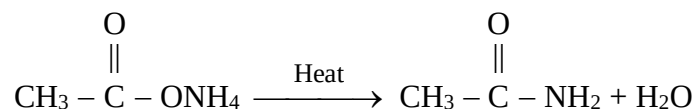
- (i) Calcium acetate on heating produce acetone. The reaction is:



- (ii) Sodium formate on heating with soda lime produces sodium carbonate and hydrogen. The reaction is:



- (iii) Ammonium acetate on heating produces acetamide. As following:



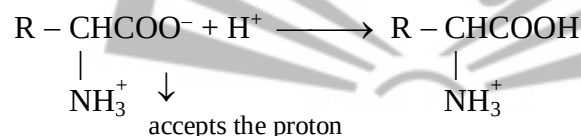
Q.11 What are amino acids? Explain their different types with one example in each case.

Ans. Descriptive question. Consult text book for details.

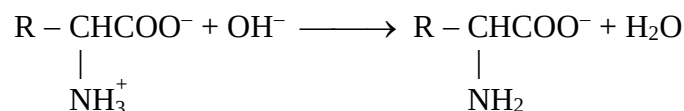
Q.12 Write a short note on acidic and basic characters of an amino acid.

Ans. On the basis of dipolar ion structure, the acidic and basic reactions of amino acids may be represented as:

- (i) **Basic Character:** When an acid is added to an amino acid the carboxylate ion accepts the proton, the basic character is due to this group.

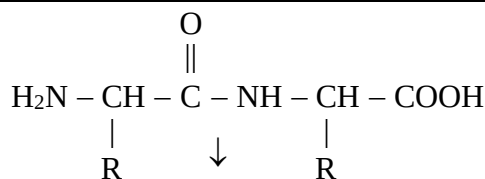


- (ii) **Acidic Character:** When an alkali is added to an amino acid, $-\text{NH}_3^+$ group releases the proton and therefore the acidic character is due to this group.



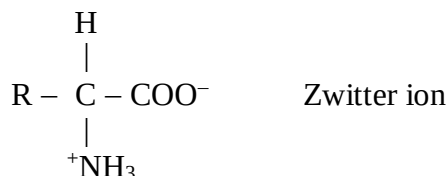
Q.13 What is a peptide bond? Write down the formula of a dipeptide.

Ans. **Peptide Bond:** A bond formed by the condensation of $-\text{NH}_2$ group of one amino acid and carboxylic group of another amino acid is called peptide bond. The peptide bond or linkage is represented as $-\text{NH}-\text{CO}-$ e.g.,



Q.14 What are Zwitterions?

Ans. **Zwitter Ion:** The dipolar ion is called Zwitter ion. It has positive as well as negative ends within the same molecule. Amino acids exist as Zwitter ion.

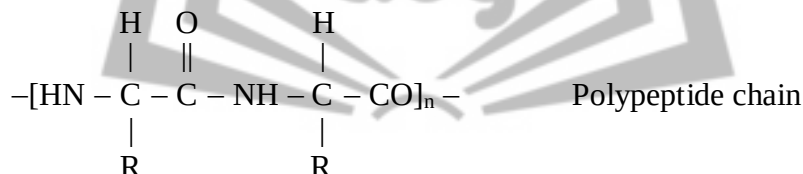


Q.15 What are α -amino acids, proteins and peptides? How are they related?

Ans. **α -amino Acids:** The acids in which amino group are attached to α -carbon are called α -amino acids. e.g.,



When amino acids link with each other by peptide bonds a long chain are called polypeptide.



Proteins: If molecular mass of polypeptide chain is more than 10000 then it is called proteins.

Peptide: If molecular mass of polypeptide chain is upto 10000 then it is called peptide.

Q.16 Study the facts given in (a), (b) and (c) below and then answer questions which follow:

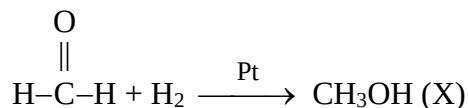
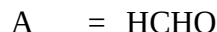
- (a) A is an organic compound made up of C, H and O. It has a vapour density 15. [Hint: Molecular mass = $2 \times$ Vapour density].
- (b) On reduction A gives a compound 'X' which has the following properties:

- (i) X is a colourless liquid miscible with water.
- (ii) X is neutral to litmus.
- (iii) When X is warmed with a few drops of conc. H_2SO_4 followed by a little salicylic acid a characteristic smell is produced.
- (c) When X is subjected to strong oxidation, it gives compound B, which has the following properties:
 - (i) B is a pungent smelling mobile liquid.
 - (ii) It is miscible with water, alcohol or ether.
 - (iii) It is corrosive and produces blisters on contact with skin.
 - (iv) B can be obtained by passing the vapours of A with air over platinum black catalyst.
 - (v) B liberates H_2 with sodium.
 - (vi) It gives CO_2 with NaHCO_3 .
- 1. What is the molecular mass of A?
- 2. Identify A, X and B.
- 3. Give five appropriate reactions to confirm the identities of A, X and B.
- 4. State one large-scale use of either A, X or B.

Ans.

(a) Molecular mass = $2 \times \text{Vapour density}$
 = $2 \times 15 = 30 \text{ a.m.u}$

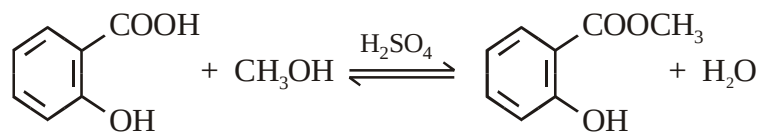
- (b) The compound having C, H and O may be some aldehyde or ketone and not an alcohol. Smallest ketone is acetone having molecular mass 58 a.m.u. The simplest aldehyde with molecular mass 30 a.m.u is form aldehyde.



Properties of X(CH_3OH):

- (i) CH_3OH is colourless liquid, miscible with water.
- (ii) CH_3O is neutral to litmus.

- (iii) When CH_3OH is warmed with few drops of conc. H_2SO_4 and salicylic acid, a characteristic smell of methyl salicylic acid is obtained.

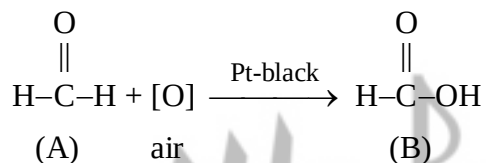


- (c) When CH_3OH (X) undergoes oxidation, it changes to formic acid (B).



Properties of Formic Acid (B):

- (i) HCOOH has pungent smell.
- (ii) It is miscible with water, alcohol and ether due to hydrogen bonding.
- (iii) It is corrosive and produces blisters when in contact with skin.
- (iv) "A" on air oxidation in the presence of catalyst changes to B.



- (v) $\text{HCOOH} + 2\text{Na} \longrightarrow 2\text{HCOONa} + \text{CO}_2 + \text{H}_2\text{O}$
 A = HCHO B = HCOOH C = CH_3OH

DO YOU KNOW?

1. Acetyl salicylic acid is called aspirin.
2. Grignard's reagents react with CO_2 to form carboxylic acids.
3. Amyl acetate has banana flavour.
4. Octyl acetate has orange flavour.
5. Ethyl butyrate has pine apple flavour.
6. Benzyl acetate has Jasmine flavour.
7. Acetic acid solidifies at 17°C as ice like mass. It is called glacial acetic acid.
8. The amino acids which the body can synthesize are called non-essential amino acids.
9. The amino acids which the body is not able to synthesize are called essential amino acids.
10. Poly peptide having molar mass more than 10,000 is called protein.
11. Amino acids exist as Zwitter ion.
12. Alanine is neutral amino acid.
13. Aspartic acid is acidic amino acid.
14. Lysine is basic amino acid.
15. Amyl-butyrates has apricot flavour.
16. Formula of tear-gas is $\text{C}_6\text{H}_5 - \text{CO} - \text{CH}_2\text{Cl}$.