

CHAPTER 24 — CARBOXYLIC ACIDS

- Preparation of Acetic Acid or Ethanoic Acid
- Reactions of Carboxylic Acids as Acids
- Reaction of Carboxylic Acids with Alcohols (Esterification)
- Industrial Applications of Carboxylic Acids and Esters
- Carboxylic Acids and Esters in Daily Life

DESCRIPTIVE QUESTIONS

Preparation of Acetic Acid or Ethanoic Acid

Q.1 What are carboxylic acids? Describe the two methods of preparation of acetic acid?

Ans. Key points: Carboxylic Acids | Preparation of Acetic Acid or Ethanoic Acid

Carboxylic acids

Organic acids or carboxylic acids are the class of organic compounds containing a carboxyl group ($-\text{COOH}$) attached to an alkyl group or hydrogen.

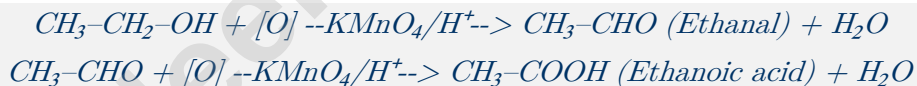
- They are generally weak acids as compared to the mineral acids because they do not give proton easily.
- They occur naturally in living organisms and they can also be synthesized.

Preparation of acetic acid or ethanoic acid

(a) Oxidation of ethanol

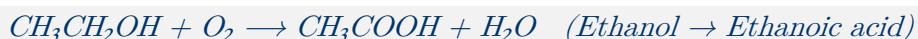
Ethanol is oxidized by the acidified potassium manganate (VII) (or potassium permanganate) to first ethanal which then further undergoes oxidation under the reaction conditions to give ethanoic acid.

Hot acidified potassium manganate (VII) (or potassium permanganate) acts as a very efficient oxidizing agent and oxidizes ethanol to ethanoic acid and during this reaction the purple colour of the reagent changes to colourless.



(b) Preparation of ethanoic acid by oxidative fermentation

In this process ethanol is oxidized to acetic acid by bacteria and in the presence of oxygen. Alcoholic foodstuffs like grain, malt, rice or potato mesh are converted to vinegar when they undergo fermentation reaction in the presence of bacteria. These bacteria can produce vinegar from alcoholic foodstuffs if sufficient oxygen is provided. The overall chemical reaction in this fermentation process is:



Process: In this process, alcohol is fermented to vinegar in a tank provided with a continuous supply of oxygen.

- The liquid present in the tank is stirred continuously when the oxygen is bubbled through it.
- In this method, vinegar containing 15% ethanoic acid can be prepared in only 24 hours.

24.1 Quick Check — 1. Can you oxidize methanol with KMnO_4 just like ethanol?

Yes, methanol can also be oxidized by acidified potassium manganate (VII) (or potassium permanganate) just like ethanol. Oxidation of methanol: $\text{CH}_3\text{OH} + [\text{O}] \xrightarrow{(\text{KMnO}_4/\text{H}^+)} \text{HCHO (Methanal)} + \text{H}_2\text{O}$, then $\text{HCHO} + [\text{O}] \xrightarrow{(\text{KMnO}_4/\text{H}^+)} \text{HCOOH (Methanoic acid / formic acid)}$.

2. Explain the difference between a fermentation reaction and a chemical reaction.

Fermentation reaction	Chemical reaction
A biochemical process in which sugars are broken down by micro-organisms like yeast or bacteria usually without oxygen is called fermentation reaction.	Any process in which substances (reactants) react to form new substances (products) with different properties is called chemical reaction.
It requires microorganisms for completion.	Does not require microorganisms.
Proceeds under mild conditions (normal) temperature and pressure.	Often proceeds under high temperature and pressure or other conditions.
Examples: fermentation of glucose (molasses) to produce alcohols.	Examples: Neutralization, oxidation combustion etc are some examples of chemical reactions.

REACTIONS OF CARBOXYLIC ACIDS AS ACIDS

Q.2 Explain the reactions of carboxylic acid with metals and carbonates.

Ans. Key point: Reactions of Carboxylic Acids as Acids

Reactions of carboxylic acids as acids

Followings are the reactions of carboxylic acids as acids.

(a) Reaction with metals:

Generally carboxylic acids are much weaker acids than the mineral acids. However, some carboxylic acids react with more reactive metals rather slowly to give a salt evolving hydrogen gas.

Example: Dilute ethanoic acid reacts with magnesium metal to give magnesium ethanoate and hydrogen gas.



(b) Reaction with bases:

Reactions of carboxylic acids with bases like metal hydroxides are simple neutralization reactions. Ethanoic acid reacts with sodium hydroxide to give sodium ethanoate and water.



(c) Reaction of carboxylic acids with carbonates:

When solid sodium carbonate is mixed with an aqueous solution of ethanoic acid, effervescence takes place due to evolution of CO_2 gas and sodium ethanoate is formed in the solution.



Reaction proceeds slowly with marble chips (CaCO_3) (limestone).



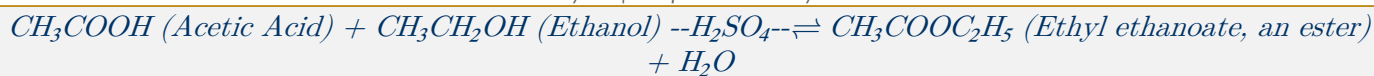
REACTION OF CARBOXYLIC ACIDS WITH ALCOHOLS (ESTERIFICATION)

Q.3 What is esterification reaction? Give examples.

Ans. Key point: Reaction of Carboxylic Acids with Alcohols (Esterification)

Reaction of carboxylic acids with alcohols (Esterification)

Carboxylic acids form esters when they are heated with excess of alcohols in the presence of concentrated H_2SO_4 , as a catalyst. Reaction is called esterification reaction.



Esters act as an artificial flavouring agents.

24.2 Quick Check — 1. Is ethanoic acid a weak acid?

Ethanoic acid is called a weak acid because it does not completely ionize in water. Only a small number of its molecules release hydrogen ions (H^+): $\text{CH}_3\text{COOH} \rightleftharpoons \text{CH}_3\text{COO}^- + \text{H}^+$. Ethanoic acid is weaker than mineral acids like HCl, H_2SO_4 and HNO_3 .

2. How will calcium carbonate react with ethanoic acid?

Ans. Calcium carbonate react with ethanoic acid to produce calcium ethanoate (salt), carbon dioxide gas and water. Effervescence takes place due to evolution of CO_2 gas.



INDUSTRIAL APPLICATIONS OF CARBOXYLIC ACIDS AND ESTERS

Q.4 Describe the industrial applications of carboxylic acid and esters as solvents.

Ans. Key point: Industrial Applications of Carboxylic Acids and Esters

Carboxylic acids and esters as solvents

(a) Ethanoic acid as solvent

- Acetic acid dissolves many compounds such as oils, sulphur, iodine and water.
- In industry, acetic acid is used as a solvent for resins, paints and lacquers.

(b) Ethyl acetate (Esters as solvents)

- Esters are also commonly used as solvents.
- Ethyl acetate is used to extract caffeine from coffee.
- It is also used as nail polish and paint remover.
- Some volatile esters are used as solvents for coatings, paints, varnishes, plastics, resins and lacquers.

Q.5 Explain the uses of carboxylic acids and esters as flavouring agents.

Ans. Key point: Carboxylic Acids and Esters as Flavouring Agents

Carboxylic acids and esters as flavouring agents

- Flavouring agents are substances added to give an additional taste or flavour to a substance.
- They also help in masking unpleasant tastes of drugs especially used by children.
- Organic acids like tartaric acid, citric acid and malic acid are very commonly used as flavour enhancers in food industry.
- The sour taste of foods is largely due to these acids.
- They are also responsible to improve the taste of some food and beverage products especially soft drinks.
- Esters have pleasant odours and flavours. They are added to food products to improve their smell or taste.

Interesting Information — What do you know about glacial acetic acid?

Pure acetic acid is also called glacial acetic acid. It is a corrosive and colourless solid, completely miscible with water.

Q.6 Explain the uses of carboxylic acid and esters as synthetic fibres.

Ans. Key point: Carboxylic Acid and Esters as Synthetic Fibres

Carboxylic acid and esters as synthetic fibres

Esters: Esters have also an important role to play in the production of synthetic polymers. A very important polymer, polyester is made by reacting diols and dicarboxylic acids. Esters are also important in the manufacture of soaps and detergents.

Carboxylic acids: Carboxylic acids and their derivatives are very commonly used to give different types of plastics.

Example: Acetic acid is used in the production of cellulose acetate plastic. Palmitic and stearic acids are extensively used in the production of soaps, cosmetics, pharmaceuticals, candles and protective coatings. Oleic acid is used in the manufacture of soaps and detergents. Acrylic acid is a starting reagent to prepare many long-chain polymers called acrylates.

CARBOXYLIC ACIDS AND ESTERS IN DAILY LIFE

Q.7 Describe the applications of carboxylic acid and esters in daily life.

Ans. Key point: Applications of Carboxylic Acid and Esters in Daily Life as Food, Preservatives, Medicines and Plasticizers

Applications of carboxylic acid and esters in daily life

(i) Food preservatives

Food preservatives are chemical compounds which are added in food stuff to prevent or retard the growth of microorganisms.

Function: The presence of these preservatives helps to maintain the quality of food and extend shelf-life.

Example of preserved food: The foods which are preserved include jams, juices, fruit juices, milk and many other drinks. Acetic acid is very widely used as preservative in pickles.

- Benzoic acid
- Acetic acid
- Propionic acid
- Methyl and ethyl esters of 4-hydroxy benzoic acid

(ii) Carboxylic acid as medicines

- Carboxylic acids and the compounds obtained from them are very commonly used as medicines such as aspirin and ibuprofen.
- Addition of some carboxylic acids during preparation of medicines help to improve drug delivery, absorption, and overall performance.

(iii) Plasticizers and plexiglass

- Citric acid esters are primarily plasticizers which are used in many industries.
- Plexiglass: Polymethyl methacrylate is used as a substitute of glass and it is named as Plexiglass.

(iv) Fragrant items

Carboxylic acids occur in many common household fragrant items. A list of such items is given in the table 24.1:

Table 24.1 — Carboxylic acids in household items

Item	Carboxylic Acid
Vitamin C	Ascorbic acid
Lemons	Citric acid
Vinegar	Acetic acid
Apple, grapes, carrots	Malic acid

Esters as flavouring agents

Esters are an important component of many fruits and are responsible to enhance their flavours. They generally have a pleasant smell and they are commonly used as fragrances in many food products used in daily life. The following table shows the names of the esters and the flavours attached with them.

Table 24.2 — Esters and their flavours

Esters	Flavour
Methyl butyrate	Apple
Ethyl butyrate	Pine apple
n-Amyl acetate	Pears, Bananas
n-Octyl acetate	Orange
Methyl salicylate	Apricot

24.3 Quick Check — 1. Explain the function of a preservative.

The presence of preservative helps to maintain the taste, colour and quality of food and extend shelf-life. A preservative is a substance added to food to prevent the growth of microorganisms such as bacteria, fungi and yeast. This helps to slow down spoilage and increase the shelf life of food.

2. Give examples of some citrus fruits.

Ans. Examples of citrus fruits are lemon, orange, pomelo, shaddock, tangerines etc.

MULTIPLE CHOICE QUESTIONS (EXERCISE)

A. Choose and tick the correct answer from the given choices.

1. Identify the ester functional group:

- (a) $-\text{COOR}$ (b) $-\text{COOH}$ (c) $\text{C}=\text{O}$ (d) $-\text{CH}_2-\text{OH}$

2. During the oxidation of ethanol by acidified KMnO_4 , which element is reduced?

- (a) K (b) O (c) Mn (d) H

3. Fermentation of foodstuff in the presence of acetic acid bacteria needs a sufficient supply of oxygen. What is the role of oxygen in this process?

- (a) It enhances the reactivity of bacteria (b) It oxidizes ethanol which is formed during the reaction (c) It inhibits the destruction of bacteria (d) It inhibits the oxidation of acetic acid

4. Which organic acid is used as a component of food?

- (a) Formic acid (b) Oxalic acid (c) Propanoic acid (d) Acetic acid

5. Which of the following acids is present in apples?

- (a) Citric acid (b) Tartaric acid (c) Acetic acid (d) Malic acid

6. Which substances will react to produce $\text{CH}_3-\text{CH}_2-\text{CH}_2-\text{COOC}_2\text{H}_5$?

- (a) $\text{CH}_3\text{CH}_2\text{CH}_2\text{COOH}$ and CH_3OH (b) $\text{CH}_3\text{CH}_2\text{COOH}$ and $\text{CH}_3\text{CH}_2\text{OH}$ (c) $\text{CH}_3\text{CH}_2\text{CH}_2\text{COOH}$ and $\text{CH}_3\text{CH}_2\text{OH}$ (d) $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{COOH}$ and CH_3OH

7. What is the formula of ester formed by the reaction of methanol with propanoic acid?

- (a) $\text{CH}_3\text{COOCH}_2\text{CH}_3$ (b) $\text{CH}_3\text{CH}_2\text{COCH}_3$ (c) $\text{CH}_3\text{CH}_2\text{COOCH}_3$ (d) $\text{CH}_3\text{CH}_2\text{OCOCH}_3$

8. Which polymer is made by reacting a diol and a dicarboxylic acid?

- (a) Polyethene (b) Polyester (c) Polystyrene (d) Polyamide

9. Which compound is used as a synthetic fiber?

- (a) Methyl acetate (b) Polyester (c) Resin (d) n-Amyl acetate

SLO BASED MULTIPLE CHOICE QUESTIONS

Preparation of Acetic Acid or Ethanoic Acid

10. Organic acids contain which functional group?

- (a) -OH (b) -CHO (c) -COOH (d) -CO

11. Another name for acetic acid is:

- (a) Methanoic acid (b) Ethanoic acid (c) Propanoic acid (d) Butanoic acid

12. Ethanol is oxidized to ethanoic acid using:

- (a) NaCl (b) KMnO_4 (c) HCl (d) NaOH

13. During oxidation of ethanol, the intermediate compound formed is:

- (a) Methanal (b) Ethanal (c) Propanal (d) Butanal

14. The colour of potassium manganate (VII) during oxidation of ethanol changes from:

- (a) Purple to colourless (b) Blue to green (c) Red to yellow (d) Green to black

15. Vinegar contains which percent of ethanoic acid prepared by fermentation:

- (a) 10% (b) 15% (c) 20% (d) 25%

16. Ethanoic acid can be produced by fermentation of:

- (a) Alcoholic food stuffs (b) Ketones (c) Esters (d) Ethers

17. Bacteria convert alcohol into ethanoic acid in the presence of:

- (a) Nitrogen (b) Hydrogen (c) Oxygen (d) Carbon dioxide

Reactions of Carboxylic Acids as Acids

18. Carboxylic acids are generally weaker than:

- (a) Organic acids (b) Mineral acids (c) Alcohols (d) Esters

19. Time required for the preparation of vinegar having 15% ethanoic acid is:

- (a) 12 hours (b) 24 hours (c) 36 hours (d) 40 hours

20. When ethanoic acid reacts with magnesium metal which gas is produced?

- (a) Oxygen (b) Nitrogen (c) Hydrogen (d) Carbon dioxide

21. Ethanoic acid reacts with NaOH to produce:

- (a) Ethanol (b) Sodium ethanoate (c) Methane (d) Propanoic acid

22. Reaction of ethanoic acid with NaOH is an example of:

- (a) Oxidation (b) Reduction (c) Neutralization (d) Polymerization

23. When ethanoic acid reacts with sodium carbonate which gas is released:

- (a) Hydrogen (b) Oxygen (c) Carbon dioxide (d) Nitrogen

24. Effervescence in reaction of carboxylic acids with carbonates is due to:

- (a) Hydrogen gas (b) Oxygen gas (c) Carbon dioxide gas (d) Nitrogen gas

25. Reaction of marble chips with acetic acid is:

- (a) Slow reaction (b) Fast reaction (c) Reversible reaction (d) Redox reaction

26. Marble chips are chemically known as:

- (a) Na_2CO_3 (b) CaCO_3 (c) NaCl (d) CaO

Reaction of Carboxylic Acid with Alcohols (Esterification)

27. The reaction between a carboxylic acid and an alcohol is called:

- (a) Neutralization (b) Oxidation (c) Esterification (d) Polymerization

28. Esterification occurs in the presence of:

- (a) NaClO (b) NaOH (c) Conc. H_2SO_4 (d)

29. When ethanoic acid reacts with ethanol the ester formed is:

- (a) Methyl ethanoate (b) Ethyl ethanoate (c) Ethyl methanoate (d) Propyl ethanoate

NaCl

Industrial Applications of Carboxylic Acids and Esters

30. Ester generally have:

- (a) Bitter taste (b) No smell (c) Pleasant smell (d) Sour taste

31. Ethyl acetate is commonly used as:

- (a) Solvent and nail polish remover (b) Fertilizer (c) Fuel (d) Catalyst

32. Pure acetic acid is called:

- (a) Dilute acetic acid (b) Vinegar (c) Glacial acetic acid (d) Methanoic acid

33. Esters are commonly used in industry as:

- (a) Catalysts (b) Solvents (c) Salts (d) Acids

34. Polyester is produced by reaction between:

- (a) Alcohols and aldehyde (b) Diols and dicarboxylic acids (c) Ketone and alcohol (d) Alkane and acid

35. Acetic acid is used in the production of:

- (a) Cellulose acetate plastic (b) Rubber (c) Glass (d) Steel

36. Palmitic acid and stearic acid are used in making:

- (a) Fertilizers (b) Soap and cosmetics (c) Fuels (d) Plastics

37. Oleic acid is used in the manufacture of:

- (a) Glass (b) Soaps and detergents (c) Cement (d) Paper

38. Acrylic acid is used to prepare:

- (a) Acrylate polymers (b) Alcohols (c) Salts (d) Esters

Carboxylic Acid and Esters in Daily Life

39. Acetic acid is widely used as a preservative in:

- (a) Milk (b) Pickles (c) Bread (d) Rice

40. Food preservatives are used to:

- (a) Change colour (b) Increase sweetness (c) Prevent growth of microorganisms (d) Increase temperature

41. A carboxylic acid used as a substitute of glass (plexiglass) is:

- (a) Methyl butyrate (b) Methyl salicylate (c) Ethyl acetate (d) Polymethyl methacrylate

42. Vitamin C is chemically known as:

- (a) Citric acid (b) Acetic acid (c) Ascorbic acid (d) Malic acid

43. The carboxylic acid present in lemon is:

- (a) Acetic acid (b) Citric acid (c) Malic acid (d) Formic acid

44. Methyl butyrate has flavour of:

- (a) Orange (b) Pineapple (c) Apple (d) Banana

45. Ethyl butyrate has flavour of:

- (a) Apple (b) Pineapple (c) Orange (d) Apricot

46. n-Octyl acetate gives flavour of:

- (a) Apple (b) Pineapple (c) Orange (d) Banana

ANSWER KEY

1	a	2	c	3	b	4	d	5	d	6	c	7	c	8	b
9	b	10	c	11	b	12	b	13	b	14	a	15	b	16	a
17	c	18	b	19	b	20	c	21	b	22	c	23	c	24	c
25	a	26	b	27	c	28	c	29	b	30	c	31	a	32	b
33	b	34	b	35	b	36	a	37	b	38	a	39	b	40	c
41	d	42	c	43	b	44	c	45	b	46	c				

SHORT ANSWER QUESTIONS (EXERCISE)

B. Write Short Answers.

Introduction

8. What do you know about organic acids or carboxylic acids?

Ans. Organic acid or carboxylic acids are the class of organic compounds containing a carboxyl group ($-\text{COOH}$) attached to an alkyl group or hydrogen.

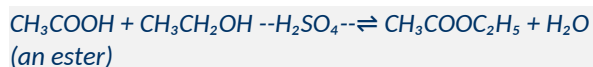
9. Compare the strength of organic acids with mineral acids.

Ans. Organic acids are generally weak acids as compared the mineral acids because they do not give proton easily. Organic acids partially ionize in water and their reactions are slow as compared to mineral acids.

Q.1–Q.7 (as numbered)

1. What is an esterification reaction?

Ans. Esterification: Esterification is a chemical reaction where an acid (usually carboxylic acid) reacts with an alcohol to form an ester and water. Ester have fruity smell. Therefore, they are usually used as flavoring agents.



2. Name an oxidizing agent used to oxidize alcohols.

Ans. Acidified potassium manganate (VII) (or potassium permanganate) is usually used to oxidize alcohols. But, acidified potassium dichromate ($\text{K}_2\text{Cr}_2\text{O}_7 / \text{H}_2\text{SO}_4$) can also be used to oxidize alcohols to give carboxylic acids.

3. Why sufficient oxygen is provided during fermentation to prepare acetic acid from ethanol?

Ans. Sufficient oxygen is provided during fermentation to prepare acetic acid from ethanol because oxygen oxidizes ethanol into acetic acid in the presence of bacteria. The reaction can only be carried out in the presence of sufficient oxygen supply.

4. What is the role of carboxylic acids in the preparation of beverages?

Ans. Carboxylic acid such as citric acid and malic acid act as flavouring agents and give a sour taste to beverages.

5. Give a practical example in which an acid or an ester is used as a flavouring agent.

Ans. Acid as flavouring agent: Citric acid produces flavor of citrus fruits. Esters as flavouring agent: Methyl butyrate produces apple like flavor, so, it is used as flavouring agent in juices.

6. Which carboxylic acids are very often used as flavour enhancers?

Ans. Organic acids like tartaric acid, citric acid and malic acid are very commonly used as flavour enhancers in food industry. The sour taste of foods is largely due to these acids. They are also responsible to improve the taste of some food and beverage products especially soft drinks. Common examples: (i) Tartaric acid — fruit juices, soft drinks and confectionary. (ii) Citric acid — flavour enhancer in soft drinks and juices. (iii) Malic acid — soft drinks, fruit juices, jams and desserts. (iv) Lactic acid — dairy products and pickled vegetables. (v) Acetic acid — pickles and sauces.

7. Which property of acetic acid does make it suitable to act as preservative in pickle?

Ans. Acetic acid inhibits the growth of microorganisms in pickle. So, due to this property of inhibiting growth of microbes, it acts as preservative in pickle.

Preparation of Acetic Acid or Ethanoic Acid

10. How ethanoic acid is prepared by oxidation of ethanol?

Ans. The steps of oxidation of ethanol to ethanoic acid are given:



13. How vinegar is prepared by fermentation of alcohol?

Ans. Fermentation of alcohols: In this process, alcohol is fermented to vinegar in a tank provided with a continuous supply of oxygen. The liquid present in the tank is stirred continuously when the



11. Which reagent is used to oxidize ethanol?

Ans. Hot acidified potassium manganate (VII) (or potassium permanganate) acts as a very efficient oxidizing agent and oxidizes ethanol to ethanoic acid and during this reaction the purple colour of the reagent changes to colorless.

12. What is oxidative fermentation?

Ans. Oxidative fermentation: It is a process in which ethanol is converted into ethanoic acid by bacteria in the presence of oxygen.



oxygen is bubbled through it. Vinegar containing 15% ethanoic acid can be prepared in only 24 hours by this method.

14. What happens when ethanoic acid reacts with a base?

Ans. Ethanoic acid reacts with bases to form salt and water (neutralization reaction).



15. Why is effervescence observed when ethanoic acid reacts with sodium carbonate?

Ans. When ethanoic acid reacts with sodium carbonate, the sodium acetate (sodium ethanoate) is produced with water. CO_2 gas is also released during the reaction which forms effervescence.



Reaction of Carboxylic Acids with Alcohols

16. How methanoic acid reacts with n-propanol?

Ans. Methanoic acid reacts with n-propanol in the presence of sulphuric acid as a catalyst to form propyl methanoate (ester) and water.



17. What is the role of concentrated H_2SO_4 in esterification?

Ans. Concentrated H_2SO_4 acts as a catalyst and dehydrating agent in the reaction of esterification.

18. What are esters?

Ans. Esters are organic compounds formed from carboxylic acids and alcohols usually having pleasant fruity smell. Their general formula is RCOOR .

19. How methyl methanoate is prepared?

Ans. Methyl methanoate is prepared by the esterification of methanol and methanoic acid in the presence of concentrated sulphuric acid.



Industrial Applications of Carboxylic Acids and Esters

20. Why are esters used as flavouring agents?

Ans. Esters have pleasant smell and flavor (fruity smell), therefore, they are used as flavouring agents in different food industries.

21. What are flavouring agents?

Ans. Substances added to improve taste and smell are called flavouring agents. Esters are oftenly used as flavouring agents.

22. Give two uses of esters.

Ans. (i) Used as solvents (paints, varnishes, nail polish remover). (ii) Used as flavouring agents.

23. What are food preservatives?

Ans. Food preservatives are chemical substances added to food to prevent the growth of microorganisms and increase shelf life.

24. Give two examples of food preservatives.

Ans. The examples of food preservatives are: Benzoic acid, Acetic acid.

25. What is polyester?

Ans. Polyester is a synthetic polymer formed by the reaction of diols and dicarboxylic acid. It is used to make clothes and plastic items.

26. Write two uses of carboxylic acid in industry.

Ans. The uses of carboxylic acid in industry are: Manufacture of soap and detergents; Production of plastics and synthetic fibers.

Carboxylic Acids and Ester in Daily Life

27. Give two examples of medicines obtained from carboxylic acid.

Ans. Carboxylic acids and their compounds are commonly used as medicines such as aspirin and ibuprofen.

28. Why are carboxylic acids added during medicines preparations?

Ans. Some carboxylic acids are added during preparation of medicines which help to improve drug delivery, absorption, and overall performance.

29. What are citrus fruits?

Ans. Fruits containing citric acids such as lemon, orange and grapefruit are called citrus fruits.

30. What is Plexiglass?

Ans. Polymethyl methacrylate is used as a substitute for glass and is called plexiglass. It is prepared by using carboxylic acids.

31. Give two examples of carboxylic acids found in household items.

Ans. Citric acid (in lemons); Acetic acid (in vinegar).

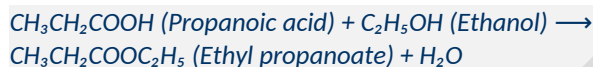
32. Name esters which are found in Apple, Orange, Banana and apricot.

Ans. The names of esters and their flavours are: Methyl butyrate – Apple; n-Octyl acetate – Orange; n-Amyl acetate – Banana; Methyl salicylate – Apricot.

CONSTRUCTED RESPONSE QUESTIONS

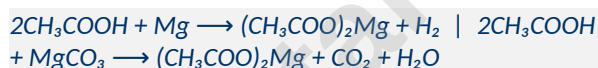
1. How does ethanol react with propanoic acid?

Ans. Ethanol reacts with propanoic acid in the presence of concentrated H_2SO_4 to form ethyl propanoate and water. This reaction is called esterification and the product formed is ethyl propanoate.



2. How does acetic acid react with Mg and MgCO_3 ?

Ans. Reaction of acetic acid with Mg: Acetic acid reacts with Mg to produce magnesium acetate and hydrogen gas. Reaction of acetic acid with MgCO_3 : Acetic acid reacts with MgCO_3 to produce magnesium acetate, carbon dioxide and water.



3. How carboxylic acids are used as solvents?

Ans. Carboxylic acids like acetic acid dissolve many substances such as oils, iodine and sulphur. Therefore, they are used as solvents in paints, resins, lacquers and plastics industries.

4. How carboxylic acid are used in daily life?

Ans. Carboxylic acids are used as: (i) Food preservatives (acetic acid in pickles); (ii) Flavouring agents in foods and beverages; (iii) Manufacture of plastics and polymers; (iv) Production of soap and detergents; (v) Cosmetics and pharmaceuticals.

DESCRIPTIVE QUESTIONS (EXERCISE)

1. Explain fermentation reaction which is used to prepare acetic acid on commercial scale.

Ans. See Q.5 from theory.

2. Describe the industrial applications of carboxylic acids and esters.

Ans. See Q.4, 5, 6 from theory.

3. What are flavouring agents? Which carboxylic acids are used as flavouring agents?

Ans. See Q.5 from theory.

4. Explain the reactions of carboxylic acids with metals and carbonates.

Ans. See Q.2 from theory.

5. Describe applications of esters in daily life.

Ans. See Q.7 from theory.