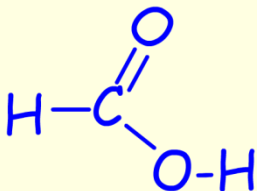
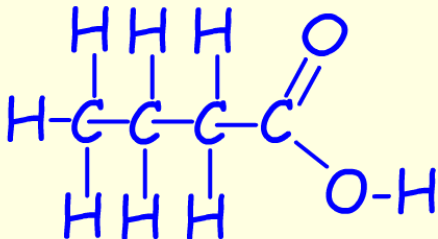


CARBOXYLIC ACIDS

REACTIONS AND PROPERTIES

Answer all the questions below then check your answers

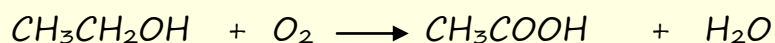
1. The table below shows the first carboxylic acids. Complete the table by filling in all the blanks.

Carboxylic acid	Structural formula	Displayed formula
		
	CH_3COOH	
propanoic		
		

2. Carboxylic acids are a homologous series of organic compounds.
- What is a homologous series?
 - What functional group is present in all carboxylic acids?
 - What is the general formula for the carboxylic acids?
3. Carboxylic acids can be prepared by the oxidation of alcohols using an oxidising agent. Suitable oxidising agents include sodium dichromate or even silver and copper metals can be used e.g.

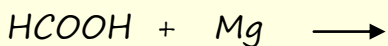
Ethanol can be oxidised to ethanoic and water by passing ethanol vapour over a hot silver catalyst at 500°C .

Ethanol + oxygen \longrightarrow ethanoic acid + water

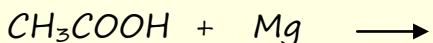


- Balance this equation.
 - How can this reaction be said to be an oxidation reaction?
 - Write similar word and symbolic equations to show the oxidation of methanol to methanoic acid.
4. Carboxylic acids are weak acids. What does this mean?
- What will be a likely pH of a solution formed by dissolving a carboxylic acid in water?
 - Which hydrogen atom on a carboxylic acid molecule is the acidic one?
5. Carboxylic acids react with metals to produce a salt and hydrogen gas. Complete the equations below to summarise these reactions.

a. methanoic acid + magnesium \longrightarrow



b. ethanoic acid + magnesium \longrightarrow

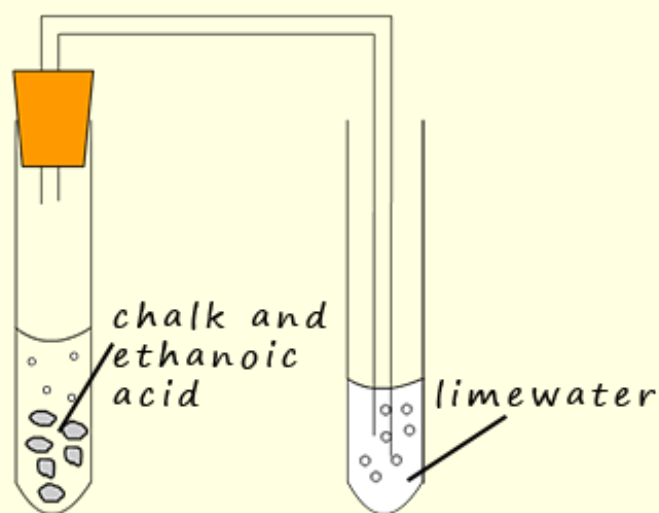


c. How are the reactions of the carboxylic acids with magnesium different from those of strong acids such as hydrochloric acid with magnesium?

6. Carboxylic acids react with metal carbonates to produce a salt, water and carbon dioxide gas.

a. Write a word equation for the reaction of ethanoic acid with calcium carbonate.

b. Will this reaction be faster or slower than the reaction of hydrochloric acid with calcium carbonate? Explain your answer.



7. A student measured out 25 ml of ethanoic into an insulated cup. She then added 30ml of potassium hydroxide solution and noticed a temperature rise.

a. What type of reaction is taking place here?

b. Write a word and symbolic equation for this reaction.

Answers

1. The table below shows the first carboxylic acids. Complete the table by filling in all the blanks.

Carboxylic acid	Structural formula	Displayed formula
Methanoic	HCOOH	
Ethanoic	CH_3COOH	
propanoic	$\text{CH}_3\text{CH}_2\text{COOH}$ or $\text{C}_2\text{H}_5\text{COOH}$	
Butanoic	$\text{CH}_3\text{CH}_2\text{CH}_2\text{COOH}$	

2. Carboxylic acids are a homologous series of organic compounds.
- What is a homologous series? A series of compounds which show a gradual change in their chemical and physical properties, they can all be represented by the same general formula.
 - What functional group is present in all carboxylic acids? Carboxylate group, COOH
 - What is the general formula for the carboxylic acids? $\text{C}_n\text{H}_{2n+1}\text{COOH}$

3. Carboxylic acids can be prepared by the oxidation of alcohols using an oxidising agent. Suitable oxidising agents include sodium dichromate or even silver and copper metals can be used e.g.

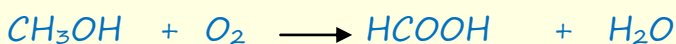
Ethanol can be oxidised to ethanoic and water by passing ethanol vapour over a hot silver catalyst at 500°C .

Ethanol + oxygen \longrightarrow ethanoic acid + water



- i Balance this equation.
- ii How can this reaction be said to be an oxidation reaction? You are adding oxygen and removing hydrogen from the ethanol molecule to form ethanoic acid.
- iii Write similar word and symbolic equations to show the oxidation of methanol to methanoic acid.

methanol + oxygen \longrightarrow methanoic acid + water



4. Carboxylic acids are weak acids. What does this mean?

They only partly ionise or dissociate when added to water.

- i What will be a likely pH of a solution formed by dissolving a carboxylic acid in water?

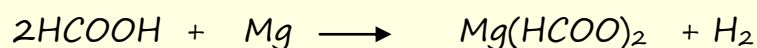
Weak acids so pH range 3-6

- ii. Which hydrogen atom on a carboxylic acid molecule is the acidic one?

The hydrogen on the functional group $-\text{COOH}$ is the acidic hydrogen

5. Carboxylic acids react with metals to produce a salt and hydrogen gas. Complete the equations below to summarise these reactions.

a. methanoic acid + magnesium \longrightarrow magnesium methanoate + hydrogen



b. ethanoic acid + magnesium \longrightarrow magnesium ethanoate + hydrogen



c. How are the reactions of the carboxylic acids with magnesium different from those of strong acids such as hydrochloric acid with magnesium? *Since carboxylic acids are weak acids, there are less $\text{H}^+(\text{aq})$ ions available, so the reactions are much slower.*

6. Carboxylic acids react with metal carbonates to produce a salt, water and carbon dioxide gas.

a. Write a word equation for the reaction of ethanoic acid with calcium carbonate.



b. Will this reaction be faster or slower than the reaction of hydrochloric acid with calcium carbonate? Explain your answer. *Slower since ethanoic acid is a much weaker acid than hydrochloric acid, which is a strong acid.*

7. A student measured out 25 ml of ethanoic into an insulated cup. She then added 30ml of potassium hydroxide solution and noticed a temperature rise.

a. What type of reaction is taking place here? *It's a neutralisation reaction, potassium hydroxide solution is a strong alkali.*

b. Write a word and symbolic equation for this reaction.

ethanoic acid + potassium hydroxide → *potassium ethanoate + water*

