# The acidic character of carboxylic (alkane) acids

**(Item No.: P7172800)**

## Curricular Relevance

**Area of Expertise:** Chemie
**Education Level:** Klasse 7-10
**Topic:** Organische Chemie
**Subtopic:** Sauerstoffhaltige organische Verbindungen
**Experiment:** Säurecharakter der Alkansäuren

| Difficulty | Preparation Time | Execution Time | Recommended Group Size |
|---|---|---|---|
| Easy | 10 Minutes | 10 Minutes | 2 Students |

**Additional Requirements:**

**Experiment Variations:**

**Keywords:**

carboxylic acid, acidic character

## Task and equipment

## Information for teachers

## Learning objectives

- Acetic acid and formic acid are examples of carboxylic acids, and react with metals under the formation of hydrogen. They are neutralized by bases, forming salts.
- The carboxylic acids show the same reaction behaviour as inorganic acids.

## Notes on the setup and procedure

Preparation:
Provide 10% formic acid (12 ml of the acid as listed to 100 ml water), 10% acetic acid (11 ml of the acid as listed to 100 ml water) and 10% caustic soda (12 g NaOH to 100 ml water).

Remarks on the students experiments:
Ensure that the Bunsen burner is not put near the test tubes, as otherwise the hydrogen could ignite. The watch glasses must be carefully heated, as they otherwise very easily crack.



## Hazard and precautionary statements

| | |
|---|---|
| Formic acid: | |
| H226: | Flammable liquid and vapour. |
| H314: | Causes severe skin burns and eye damage. |
| P260: | Do not breathe dust/fume/gas/mist/vapours/spray. |
| P280: | Wear protective gloves/protective clothing/eye protection/face protection. |
| P301 + P330 + P331: | IF SWALLOWED: Rinse mouth. Do NOT induce vomiting. |
| P305 + P351 + P338: | IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses if present and easy to do – continue rinsing. |
| P309 + P310: | IF exposed or you feel unwell: Immediately call a POISON CENTER or doctor/physician. |

| | |
|---|---|
| Acetic acid: | |
| H226: | Flammable liquid and vapour. |
| H314: | Causes severe skin burns and eye damage. |
| P280: | Wear protective gloves/protective clothing/eye protection/face protection. |
| P301 + P330 + P331: | IF SWALLOWED: Rinse mouth. Do NOT induce vomiting. |
| P307 + P310: | IF exposed: Immediately call a POISON CENTER or doctor/physician. |
| P305 + P351 + P338: | IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses if present and easy to do – continue rinsing. |

| | |
|---|---|
| Sodium hydroxide: | |
| H290: | May be corrosive to metals. |
| H314: | Causes severe skin burns and eye damage. |
| P280: | Wear protective gloves/protective clothing/eye protection/face protection. |
| P301 + P330 + P331: | IF SWALLOWED: Rinse mouth. Do NOT induce vomiting. |
| P305 + P351 + P338: | IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses if present and easy to do – continue rinsing. |
| P309 + P310: | IF exposed or you feel unwell: Immediately call a POISON CENTER or doctor/physician. |

| | |
|---|---|
| Phenolphthalein solution: | |
| H226: | Flammable liquid and vapour. |
| P210: | Keep away from heat/sparks/open flames/hot surfaces – No smoking. |

## Hazards

- Formic acid, acetic acid and caustic soda are corrosive! Wash splashes off the skin with copious water!
- Wear protective glasses!
- Explosive gases are formed during the experiment. Do not bring the Bunsen burner near to the test tubes!

## Remarks on the method

It is assumed that the typical reactions of inorganic acids are known. Should they have not have been discussed yet, sulphuric acid or hydrochloric acid can be used in parallel tests, to demonstrate that there are no principle differences between organic and inorganic acids.

## Waste disposal

- Let the magnesium in the test tubes react completely.
- Put the contents of all vessels in the container for acidic and alkali waste.


Robert-Bosch-Breite 10
D - 37079 Göttingen
Tel: +49 551 604 - 0
Fax: +49 551 604 - 107
info@phywe.de
www.phywe.com

# The acidic character of carboxylic (alkane) acids **(Item No.: P7172800)**

## Task and equipment

### Task

### Which reaction behaviour do carboxylic acids exhibit?

Examine the acidic behaviour of acetic acid and formic acid.

## Equipment


| Position No. | Material | Order No. | Quantity |
|---|---|---|---|
| 1 | Support base, variable | 02001-00 | 1 |
| 2 | Support rod, stainless steel, l=370 mm, d=10 mm | 02059-00 | 1 |
| 3 | Wire gauze with ceramic, 160 x 160 mm | 33287-01 | 1 |
| 4 | Test tube, 180x18 mm,100pcs | 37658-10 | (4) |
| 5 | Pipette with rubber bulb | 64701-00 | 1 |
| 6 | Test tube rack for 12 tubes, holes d= 22 mm, wood | 37686-10 | 1 |
| 7 | Ring with boss head, i. d. = 10 cm | 37701-01 | 1 |
| 8 | Watch glass, dia.60 mm | 34570-00 | 2 |
| 9 | Dropping funnel with drip nozzle, 50ml | 36912-00 | 1 |
| 10 | Graduated cylinder, 10 ml, plastic | 36636-00 | 1 |
| 11 | Universal clamp | 37715-00 | 1 |
| 12 | Boss head | 02043-00 | 1 |
| 13 | Erlenmeyer flask 100 ml, narrow neck, PN 19 | 36418-00 | 2 |
| 14 | Spoon, special steel | 33398-00 | 1 |
| 15 | Protecting glasses, clear glass | 39316-00 | 1 |
| 16 | Test tube brush w. wool tip,d25mm | 38762-00 | 1 |
| | Butane burner f.cartridge 270+470 | 47536-00 | 1 |
| | Butane catridge CV 300 Plus, 240 g | 47538-01 | 1 |
| | Formic acid 98-100% 250 ml | 30021-25 | 1 |
| | Magnesium, ribbon, roll, 25 g | 30132-00 | 1 |
| | Sodium hydroxide, flakes, 1000 g | 30157-70 | 1 |
| | Water, distilled 5 l | 31246-81 | 1 |
| | Acetic acid 99...100%, pure 1 l | 31301-70 | 1 |
| | Phenolphthalein, 0,5% soution in ethanol, 100 ml | 31715-10 | 1 |

# Set-up and procedure

## Set-up

## Hazards

- Formic acid, acetic acid and caustic soda are corrosive! Wash splashes off the skin with copious water!
- Wear protective glasses!
- Explosive gases are formed during the experiment. Do not bring the Bunsen burner near to the test tubes!

## Setup

Set up the stand as shown in Fig. 1. Fit the dropping funnel in the universal clamp and half-fill it with 10% sodium hydroxide solution.

Fig. 1

Place two test tubes in the test tube rack and put a small piece of the magnesium ribbon in each.

## Procedure

Pour about 5 ml of 10% formic acid into the first test tube and hold an inverted test tube over the mouth of it (Fig. 2+3). Perform the oxyhydrogen test with the collected gas.


Fig. 2

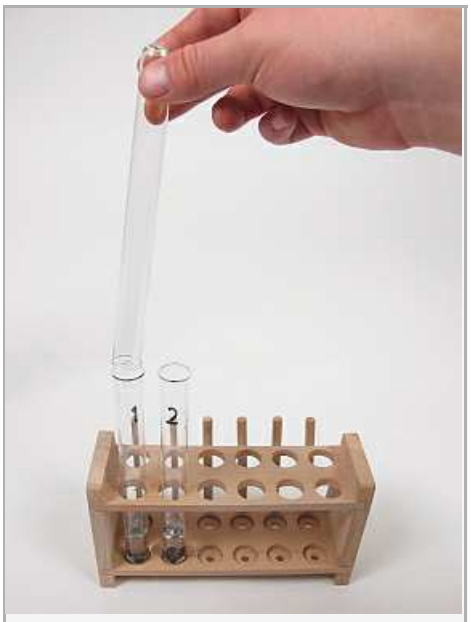


Fig. 3

Pour the same amount of acetic acid into the second test tube and repeat the procedure above.

Pour 10 ml of formic acid into the Erlenmeyer flask (Fig. 4), add a few drops of phenolphthalein solution (Fig. 5) and position the flask beneath the outlet tube of the dropping funnel. Open the tap of the dropping funnel so that the sodium hydroxide solution flows out dropwise (Fig. 6). Stop the addition as soon as the change in colour remains even after shaking.

Fig. 4

Fig. 5

Fig. 6

Change the Erlenmeyer flask and repeat the procedure with the same amount of acetic acid.

Using a pipette, put a few drops of the solution from the first Erlenmeyer flask on a watch glass (Fig. 7). Replace the universal clamp with the support ring, place the wire gauze on this and put the watch glass on the wire gauze (Fig. 8). Warm the watch glass carefully with a small flame, until the solution has almost evaporated.

Fig. 7

Fig. 8

Repeat this procedure with solution from the second Erlenmeyer flask.

## Waste disposal

- Let the magnesium in the test tubes react completely.
- Put the contents of all vessels in the container for acidic and alkali waste container.

# Report: The acidic character of carboxylic (alkane) acids

## Result - Observations

Note the observations you make.

a) Reaction with magnesium.

b) Reaction with sodium hydroxide solution:

c) Evaporation of the solution.

.....

.....

.....

.....

## Evaluation - Question 1

Draw conclusions from your observations.

.....

.....

.....

.....

## Evaluation - Question 2

Compare the properties determined for the two carboxylic acids with the properties of inorganic acids.

.....

.....

.....

.....

## Evaluation - Question 3

Formulate the equations for the reactions which took place.

.....

.....

.....

.....