Brönstedt acids - a comparison of the acidity of an aqueous and an acetonic citric acid solution

(Item No.: P7158500)

Curricular Relevance

Area of Expertise: Chemie

Education Level: Klasse 7-10

Topic: Anorganische Chemie

Subtopic: Säuren und Basen, Protonenübergänge

Experiment: Brönsted Säuren - Aciditätsvergleich einer wässrigen und einer acetonischen Citronensäurelösung

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

Additional Requirements:

Experiment Variations:

Keywords:

Brönsted-acids, acidity, citiric acid

Task and equipment

Information for teachers

Learning objectives

- Acids show typical properties like the coloration of indicators or the reaction with base metals.
- However, substances that can form an acid only show these properties in the form of an aqueous solution.

Notes on set-up and procedure

Preparations
The acetone used for this experiment must be completely free from water. Acetone that has already been stored for a longer period of time must be dried for at least 24 hours over anhydrous calcium chloride. Use some nippers or a similar tool to cut off small pieces of marble which fit into the test tubes.

Remarks on the students' experiments
It is recommended to use rather small pieces of marble and short pieces of magnesium ribbon since otherwise the reaction would takwe too long.

Hazard and Precautionary statements

Magnesium, ribbon:	
H228:	Flammable solid.

Citric acid:	
H319:	Causes serious eye irritation.
P305 + P351 + P338:	IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
Acetone:	
H225:	Highly flammable liquid and vapour.
H319:	Causes serious eye irritation.
H336:	May cause drowsiness or dizziness.
EUH066:	Repeated exposure may cause skin dryness or cracking.
P210:	Keep away from heat/sparks/open flames/hot surfaces. - No smoking.
P233:	Keep container tightly closed.
P305 + P351 + P338:	IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.

Hazards

- Acetone vapours are hazardous to health. Do not inhale them!
- Put on protective glasses!

Notes

Acetone (propanone) as a polar-aprotic solvent has only small solvating power. It is a very poor proton acceptor so that the citric acid which is a weak acid anyway does not show any acid properties when being dissolved in acetone.

Remarks on the method

This experiment leads directly to the Brönstedt theory the fundamental principles of which have been worked out in the first experiment. As far as the answer to question 3 is concerned, the students need to know the concept of ions. However, this experiment together with the preceding one is also appropriate to work out and introduce the ion concept since the conclusion to be drawn from the conductivity determined in this context is the existence of charged particles. Before acids can be finally defined as proton donors, an acid must be submitted to an electrolysis in order to show that the hydrogen ions in an aqueous solution of an acid are present in the form of protons. It is recommended to carry out the electrolysis of hydrochloric acid in the course of a demonstration experiment since in this case the "acid residue" chlorine is formed at the anode.

Waste disposal

Let the aqueous citric acid solution react completely and put it into the collecting tank for acids and alkalis. Put the solution of citric acid in acetone into the collecting tank for organic solvents.

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

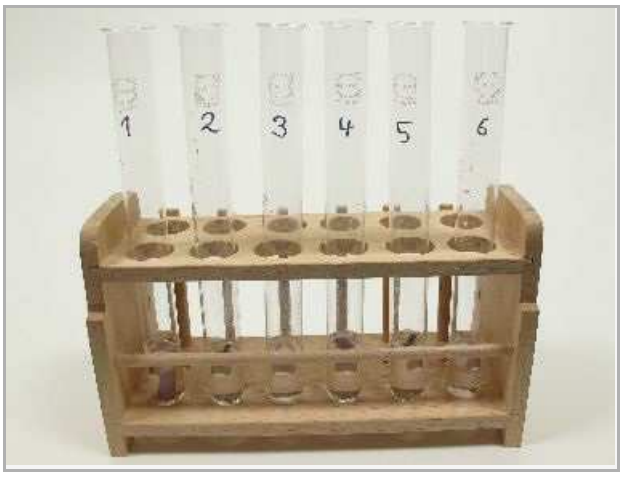
Brönstedt acids - a comparison of the acidity of an aqueous and an acetonic citric acid solution **(Item No.: P7158500)**

Task and equipment

Task

What is the importance of water for acid solutions? (2)

Study the behaviour of citric acid with regard to several substances dissolved in water and acetone.



Equipment

Position No.	Material	Order No.	Quantity
1	Protecting glasses, clear glass	39316-00	1
2	Test tube rack for 12 tubes, holes d= 22 mm, wood	37686-10	1
3	Grad.cylinder,high,PP,50ml	46287-01	2
4	Labor pencil, waterproof	38711-00	1
5	Spatula, powder, steel, l=150mm	47560-00	1
6	Tweezers,straight,blunt, 160 mm	64610-02	1
7	Beaker, 100 ml, low form, stackable, plastic	36081-00	2
8	Litmus paper, blue, 1 box	30678-01	1
9	Test tube, 18x188 mm, 10 pcs	37658-03	(6)
	Acetone, chem.pure 250 ml	30004-25	1
	Citric acid 250 g	30063-25	1
	Magnesium, ribbon, roll, 25 g	30132-00	1
	Marble, pieces 1000 g	30140-70	1
Additional material			
	Tap water		

Set-up and procedure

Set-up

Hazards

- Acetone vapours are hazardous to health. Do not inhale them!
- Put on protective glasses!



Set-up

Number the test tubes from 1 to 6 and put them into the test tube rack (Fig. 1).

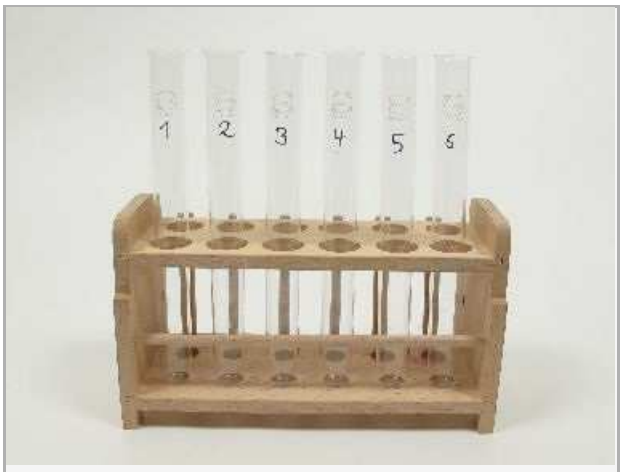


Fig. 1

Fill 20 ml of acetone into one of the beakers (Fig. 2) and add two spatulas of citric acid (Fig. 3). Let the acid dissolve. Fill 20 ml of water taken from the second graduated cylinder into the second beaker. Add two spatulas of citric acid and let it dissolve.


Fig. 2


Fig. 3

Procedure

Distribute the citric acid dissolved in acetone equally to the test tubes 1 to 3 and the citric acid dissolved in water to the test tubes 4 to 6 (Fig. 4).

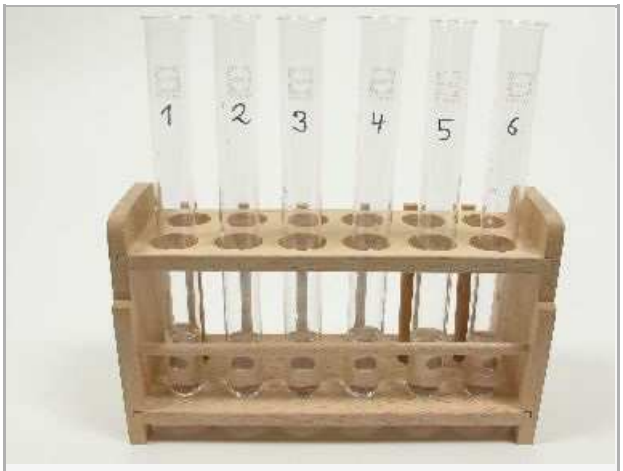


Fig. 4

Put a strip of blue litmus paper into test tube 1 (Fig. 5), a piece of magnesium ribbon into test test tube 2 (Fig. 6) and a piece of marble into test tube 3 (Fig. 7).

Fig. 5

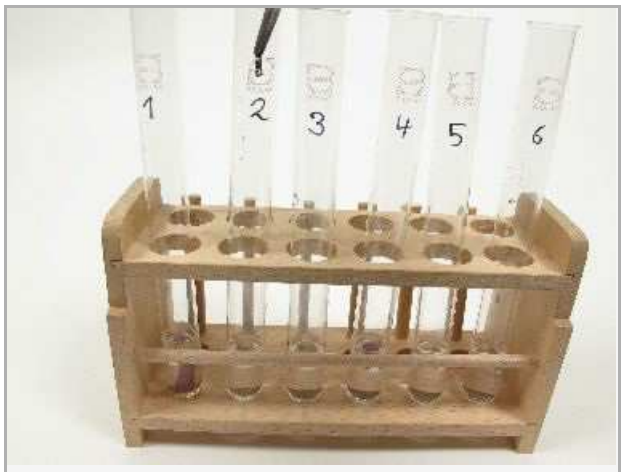


Fig. 6

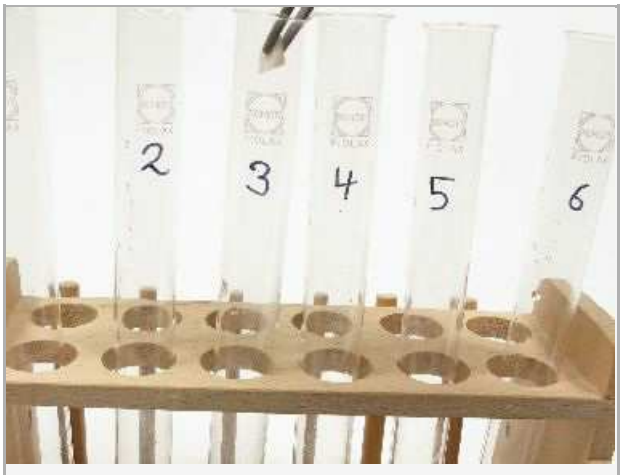


Fig. 7

Put these substances in the same order into the test tubes 4 to 6 (Fig. 8).

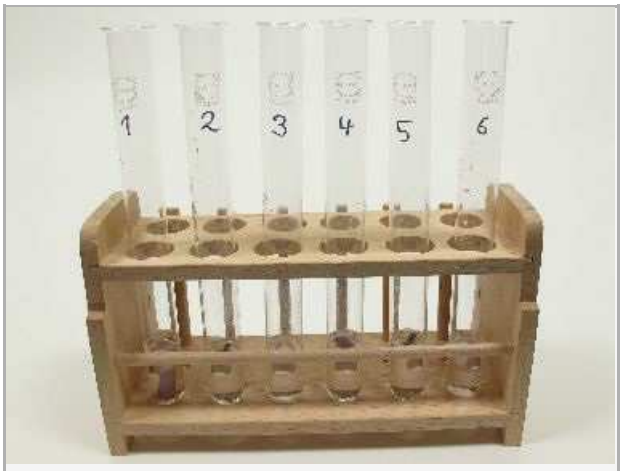


Fig. 8

Waste disposal

Let the aqueous citric acid solution react completely and put it into the collecting tank for acids and alkalis.
Put the citric acid dissolved in acetone into the collection tank for organic solvents.

Report: Brönstedt acids - a comparison of the acidity of an aqueous and an acetonic citric acid solution

Result - Table 1

Enter your observations into Table 1.

	Litmus paper	Magnesium	Marble
Citric acid in acetone	1	1	1
Citric acid in water	1	1	1

Evaluation - Question 1

Draw the conclusions from your observations.

.....

.....

.....

.....

Evaluation - Question 2

Summarize the conclusions in the form of a catchword.

.....

.....

.....

.....

Evaluation - Question 3

What is the role of the water in the formation of an acid solution? Which ions are generated in this context and in what way could their charge be determined?

.....

.....

.....

.....

Robert-Bosch-Breite 10
D - 37079 Göttingen

Tel: +49 551 604 - 0
Fax: +49 551 604 - 107

info@phywe.de
www.phywe.com