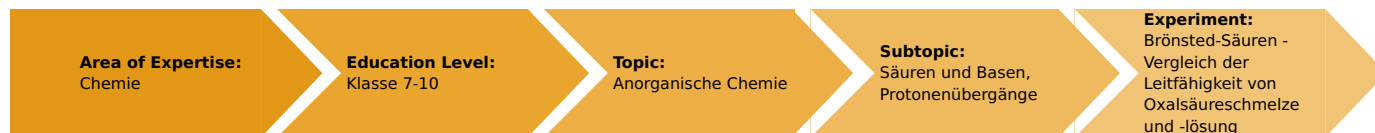


Brönstedt acids - a comparison of the conductivity of molten and dissolved oxalic acid (Item No.: P7158400)

Curricular Relevance



Difficulty



Easy

Preparation Time



10 Minutes

Execution Time



10 Minutes

Recommended Group Size



2 Students

Additional Requirements:

Experiment Variations:

Keywords:

Bronsted-acids, conductivity, oxalic acid

Task and equipment

Information for teachers

Learning objectives

- Acids in the form of solids or melts do not conduct the electric current.
- Since acids in the form of aqueous solution do conduct the electric current, they must be present in the form of charged particles (ions) in this case.

Notes on set-up and procedure

Preparations

The distilled water necessary for this experiment should be as fresh as possible since otherwise it might be contaminated and thus rendered conductive.

Remarks on the students' experiments

Check whether the electric circuits are set up correctly. Make sure that the battery contact is always interrupted (opened) between the individual working steps. The oxalic acid must not disintegrate during melting!



Hazard and Precautionary statements

Oxalic acid:

- H302 + H312: Harmful if swallowed or in contact with skin.
 P262: Do not get in eyes, on skin, or on clothing.
 P302 + P352: IF ON SKIN: Wash with plenty of soap and water.

Hazards

- When oxalic acid is heated, it might splash. Put on protective glasses!

- Be careful whenever voltages are applied. Check the circuits!

Remarks on the method

If the concept of ions has already been treated beforehand, the students can answer the questions 1 and 2 on their own. If, however, this is not the case, they must be informed on the necessary conditions that must be established for conducting the electric current.

Waste disposal

The molten oxalic acid dissolves after storing it in water for a certain period of time. Sticking residues must be removed mechanically. Put the aqueous solutions of the oxalic acid into the collecting tank for acids and bases.

Brönstedt acids - a comparison of the conductivity of molten and dissolved oxalic acid

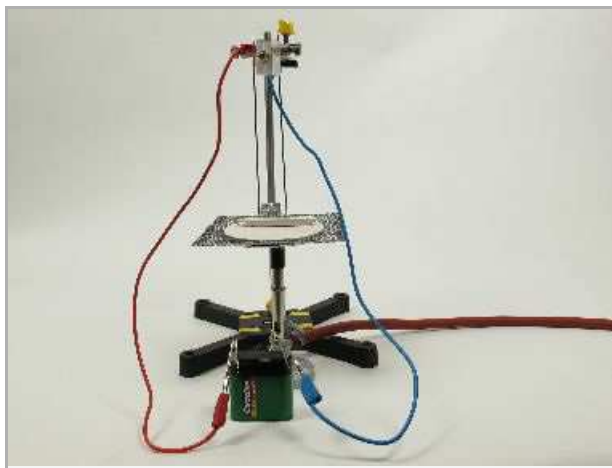
(Item No.: P7158400)

Task and equipment

Task

What is the importance of water for acid solutions? (1)

Study the conductivity of molten oxalic acid and of a solution of oxalic acid.



Equipment



| Position No. | Material | Order No. | Quantity |
|--------------|---|-----------|----------|
| 1 | Protecting glasses, clear glass | 39316-00 | 1 |
| 2 | Wash bottle, 250 ml, plastic | 33930-00 | 1 |
| 3 | Beaker, 100 ml, low form, stackable, plastic | 36081-00 | 1 |
| 4 | Flat battery, 4.5 V | 07496-01 | 1 |
| 5 | Connecting cord,19A,50cm, blue | 07314-04 | 1 |
| 6 | Connecting cord,19A,50cm, red | 07314-01 | 1 |
| 7 | Iron rods, flexible, 5 off | 45127-00 | (2) |
| 8 | Crucible tongs,200mm,stainl.steel | 33600-00 | 1 |
| 9 | Graphite electrode,d=7,l=150,6pc | 44512-00 | (2) |
| 10 | Holder for two electrodes | 45284-01 | 1 |
| 11 | Spatula, powder, steel, l=150mm | 47560-00 | 1 |
| 12 | Alligator clips, bare, 10 pcs | 07274-03 | (2) |
| 13 | Porcelain boats, 10 pcs | 32471-03 | (1) |
| 14 | Lampholder E10, case G1 | 17049-00 | 1 |
| 15 | Lamp 4 V/0,04 A,E 10 | 06154-00 | 1 |
| 16 | Support base, variable | 02001-00 | 1 |
| 17 | Boss head | 02043-00 | 1 |
| 18 | Ring with boss head, i. d. = 10 cm | 37701-01 | 1 |
| 19 | Wire gauze with ceramic, 160 x 160 mm | 33287-01 | 1 |
| 20 | Support rod, stainless steel, l=370 mm, d=10 mm | 02059-00 | 1 |
| | Butane burner f.cartridge 270+470 | 47536-00 | 1 |
| | Butane cartridge CV 300 Plus, 240 g | 47538-01 | 1 |
| | Oxalic acid cryst. 100 g | 30268-10 | 1 |
| | Water, distilled 5 l | 31246-81 | 1 |

Set-up and procedure

Set-up

Hazards

- When oxalic acid is heated, it might splash. Put on protective glasses!



Set-up

Set up the support system according to Fig. 1 + Fig. 2. Fix the support ring approximately at half the height of the support rod (Fig. 3) and place the wire gauze square on top of it (Fig. 4).

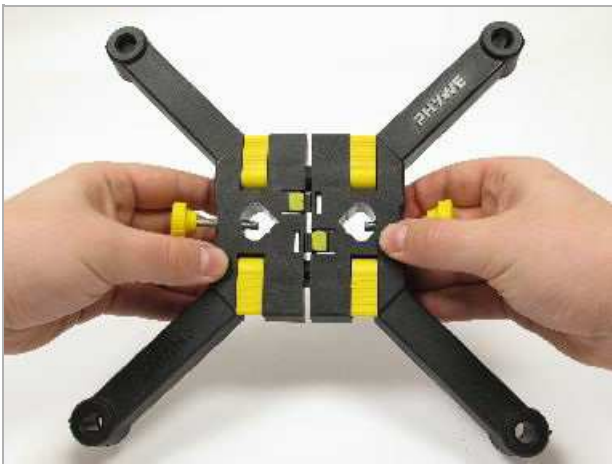


Fig. 1



Fig. 2



Fig. 3



Fig. 4

Clamp the two iron rods into the electrode holder (Fig. 5) and fix it into the bosshead in such a way that the iron rods point downwards (Fig. 6 + Fig. 7).

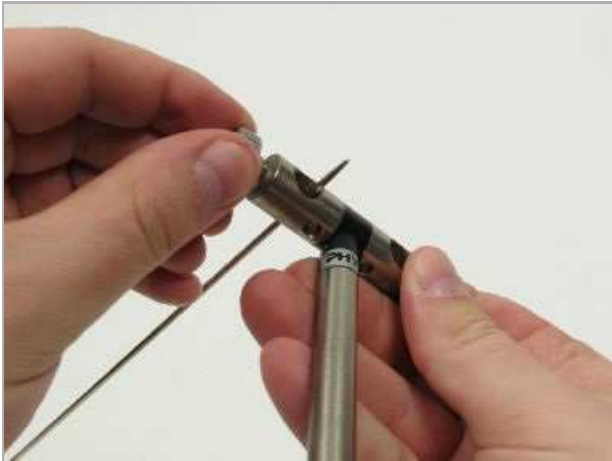


Fig. 5

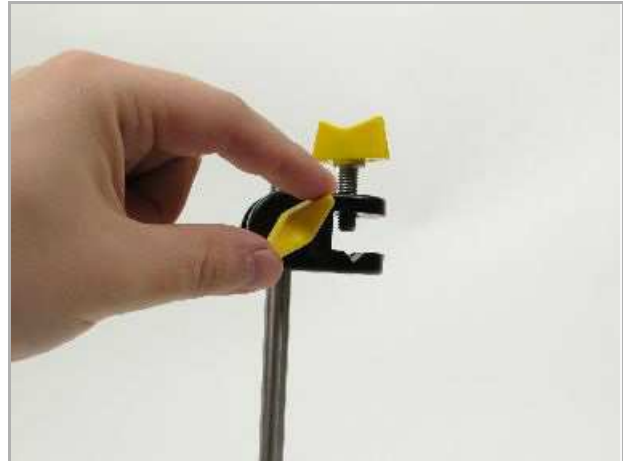


Fig. 6

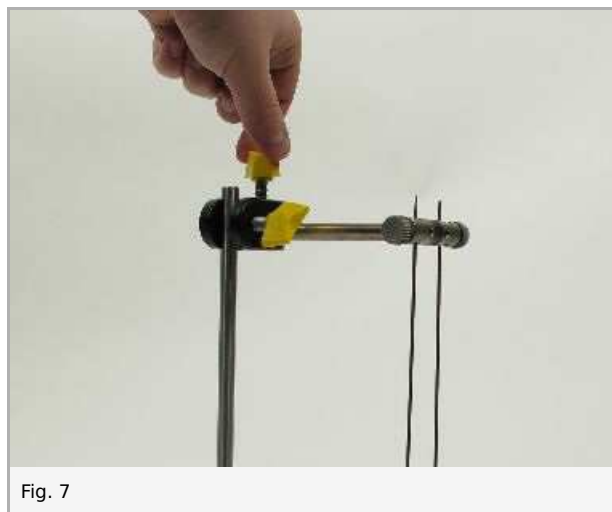


Fig. 7

Screw the filament lamp into the lampholder (Fig. 8). Insert one of the plugs of one of the connecting cords into one of the two free terminals of the electrode holder (Fig. 9). Insert the lampholder plug into the socket of one of the other connecting cords (Fig. 10). The other free plug of the lampholder must be plugged into the free terminal of the electrode holder (Fig. 11).

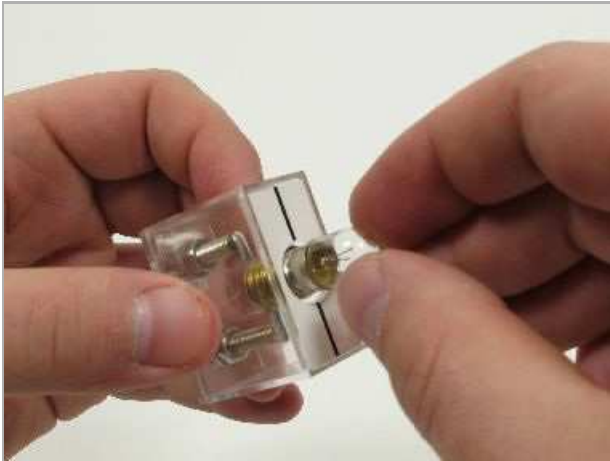


Fig. 8

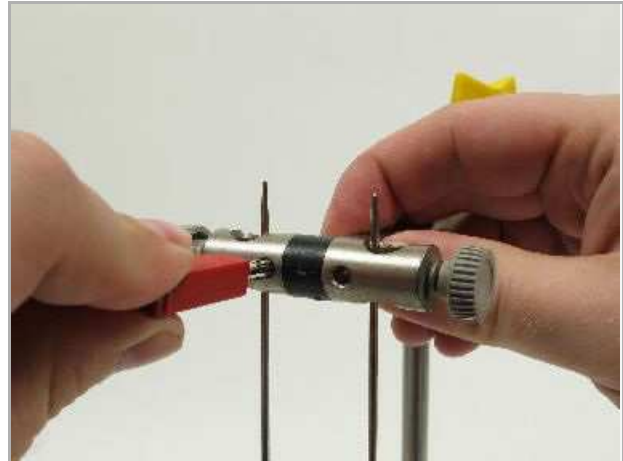


Fig. 9



Fig. 10

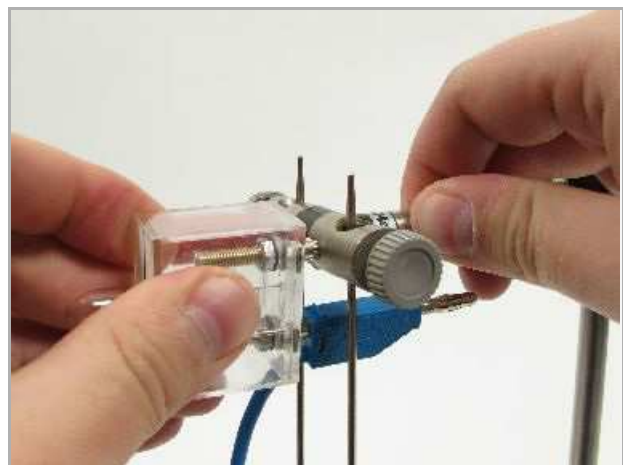


Fig. 11

Connect the ends of the connecting cords with the battery by means of two crocodile clips (Fig. 12 + Fig. 13).

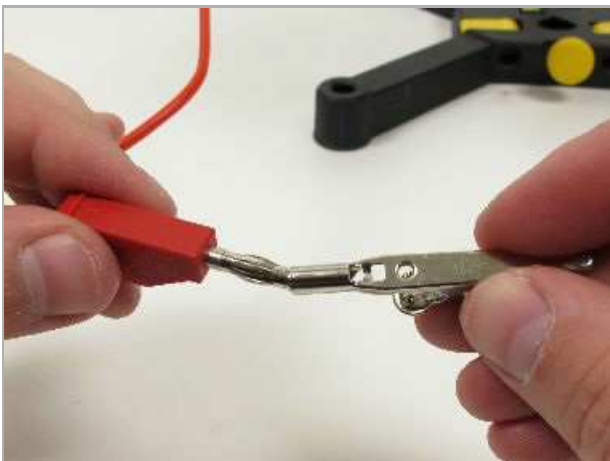


Fig. 12

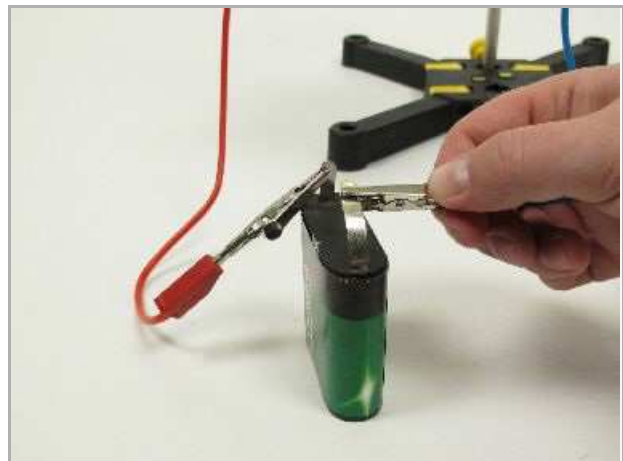


Fig. 13

Procedure

Place the porcelain dish boat onto the wire gauze square and fill it with oxalic acid (Fig. 14). Lower the electrode holder to such an extent that the iron electrodes are dipped into the oxalic acid. Observe the filament lamp in order to study the conductivity of the acid. Enter the result into Table 1 in the report. Open the battery contact (Fig. 15).

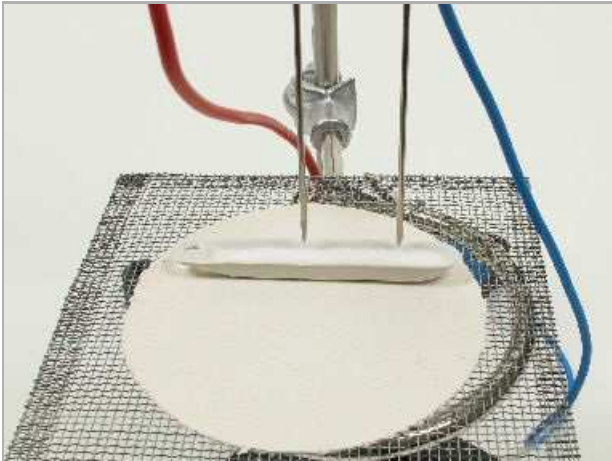


Fig. 14



Fig. 15

Heat the oxalic acid until it melts (Fig. 16), then remove the burner. Make sure that the iron electrodes are dipped into the melt. Observe the filament lamp and enter the result into Table 1 (Fig. 17). Open the battery contact.

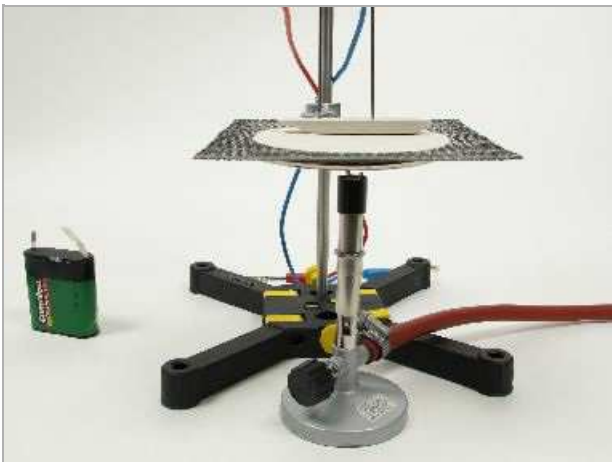


Fig. 16

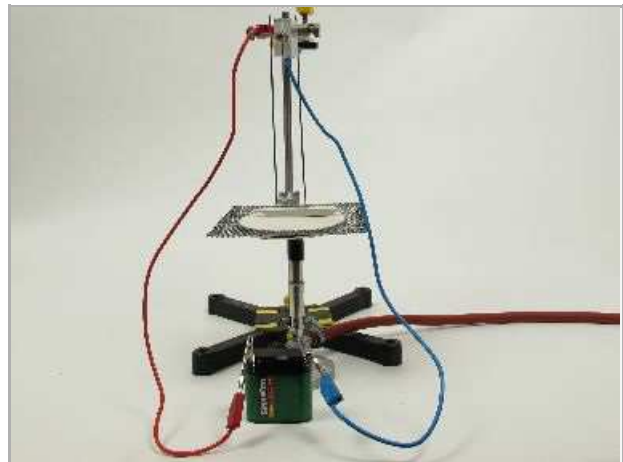


Fig. 17

Let the porcelain dish cool down and remove it with the aid of the crucible tongs (Fig. 18). Replace the iron electrodes by the carbon electrodes (Fig. 19) and close the battery contacts.

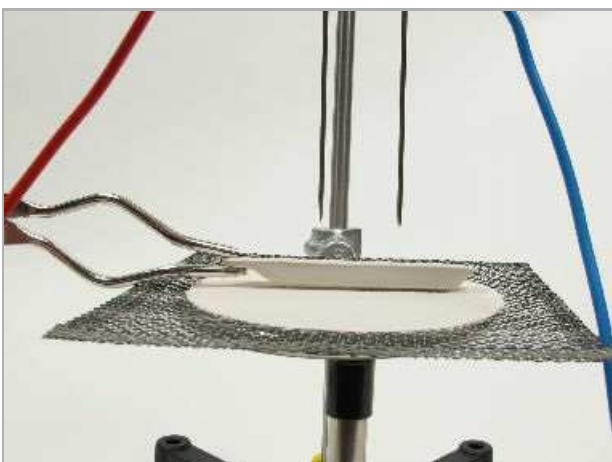


Fig. 18



Fig. 19

Fill the glass beaker half full with distilled water and place it onto the wire gauze square that has cooled down (Fig. 20). Dip the

carbon electrodes into the solution (Fig. 21). Observe what happens and enter the result into Table 1. Add three spatulas of oxalic acid to the water (Fig. 22), let it dissolve and check the conductivity again.

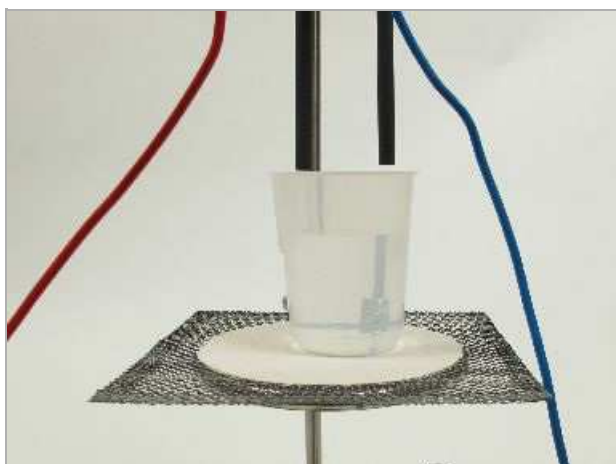


Fig. 20

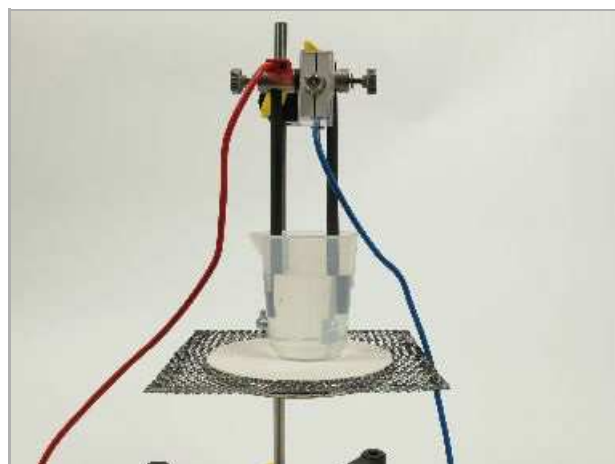


Fig. 21

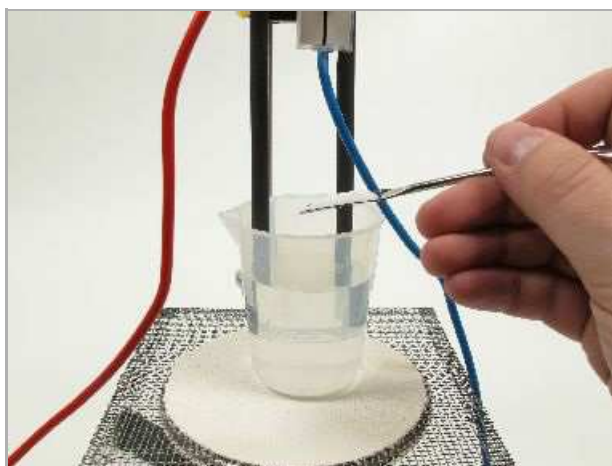


Fig. 22

Waste disposal

Put the porcelain boat containing the molten oxalic acid into a vessel filled with water.
Put the aqueous solution of oxalic acid into the collecting tank for acids and alkalis.

Report: Brönstedt acids - a comparison of the conductivity of molten and dissolved oxalic acid

Result - Observations

Write down your observations in a general form.

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Result - Table 1

Complete Table 1.

| Substance examined | filament on/off |
|---------------------------------|-----------------|
| oxalic acid, solid | 1 |
| oxalic acid, molten | 1 |
| distilled water | 1 |
| oxalic acid, dissolved in water | 1 |

Evaluation - Question 1

Explain the concept of "current conduction" and comment on the result of the experiment on the basis of this definition.

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Evaluation - Question 2

What particles must be contained in aqueous solutions of acids?

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