

Materials

Frame for complete experiments	45500.00	1	Cannula, Luer, $d = 0.60$ mm	02599.04	1
Rear cover for complete experiment panel	45501.00	1	Rubber caps, pack of 20 (1 only)	02615.03	1
Panel for complete experimental set-ups	45510.00	1	Funnel, glass, $d = 80$ mm	34459.00	1
Clamping holder, $d = 18...25$ mm	45520.00	4	Spoon with spatula end, $l = 220$ mm, steel, wide	40874.00	1
Clamping holder, $d = 18...25$ mm, turnable	45521.00	1	Tweezers, $l = 200$ mm, straight, blunt, st. steel	40955.00	1
Apparatus carrier with fixing magnets	45525.00	1	Quartz glass wool, 10 g	31773.03	1
Spring plugs, 50 pcs.	45530.00	1	Activated charcoal, granulated, 250 g	30011.25	1
G-clamp	02014.00	2	Sulphuric acid, 95...98%, 250 ml	30219.25	1
Funnel for gas generator, GL 18, 50 ml	35854.15	1	Sodium chloride, 250 g	30155.25	1
Round bottom flask, short necked, DURAN, 100 ml, GL 25/12	35841.15	1	Water, distilled, 5 l	31246.81	1
Glass sphere with tubes, 500 ml, 4 x PN 19	44551.00	1	Bromthymol blue solution, 0.1%, 50 ml	48004.05	1
Rubber stopper, PN 19, 1 hole 7 mm	39255.01	4	Glycerol, 99%, 100 ml	30084.10	1
Glass stopcock, T-shaped	36731.00	1			
Glass stopcock, straight	36705.00	2			
Glass tube, straight, $l = 150$ mm	36701.64	1			
Glass tube, straight, $l = 80$ mm	36701.65	1			
Glass tube, straight with tip, $l = 65$ mm	36701.62	1			
Drying tube, $l = 200$ mm	36941.00	1			
Beaker, DURAN, tall form, 600 ml	36006.00	1			
Hose connector, Y-piece, $d = 6-7$ mm	47518.02	1			
Rubber tubing, $d = 6$ mm	39282.00	1			
Syringe 1 ml, Luer, pack of 10	02593.03	1			

Safety measures



Hydrogen chloride, which is a poisonous and corrosive gas, is generated in the experimental apparatus during this experiment. As this is captured by activated charcoal in a glass tube at the end of the apparatus, however, with

Fig. 1



appropriate care, the experiment can also be carried out outside of a fume cupboard.

Hydrogen chloride is poisonous when inhaled and causes severe corrosion. It irritates the respiratory organs, eyes and skin, and, in the presence of moisture (mucous membranes), forms hydrochloric acid, which strongly attacks tissue.

Concentrated sulphuric acid is a colourless and odourless, viscous, very hygroscopic liquid that is miscible with water. It causes very severe corrosion and destroys skin and textiles.

Avoid contact of the chemicals with skin and eyes. Do not inhale gases, vapours or aerosols. Wear suitable protective clothing, protective gloves and protective goggles when working with them!

Observe the detailed information on safety measures in the appendix.

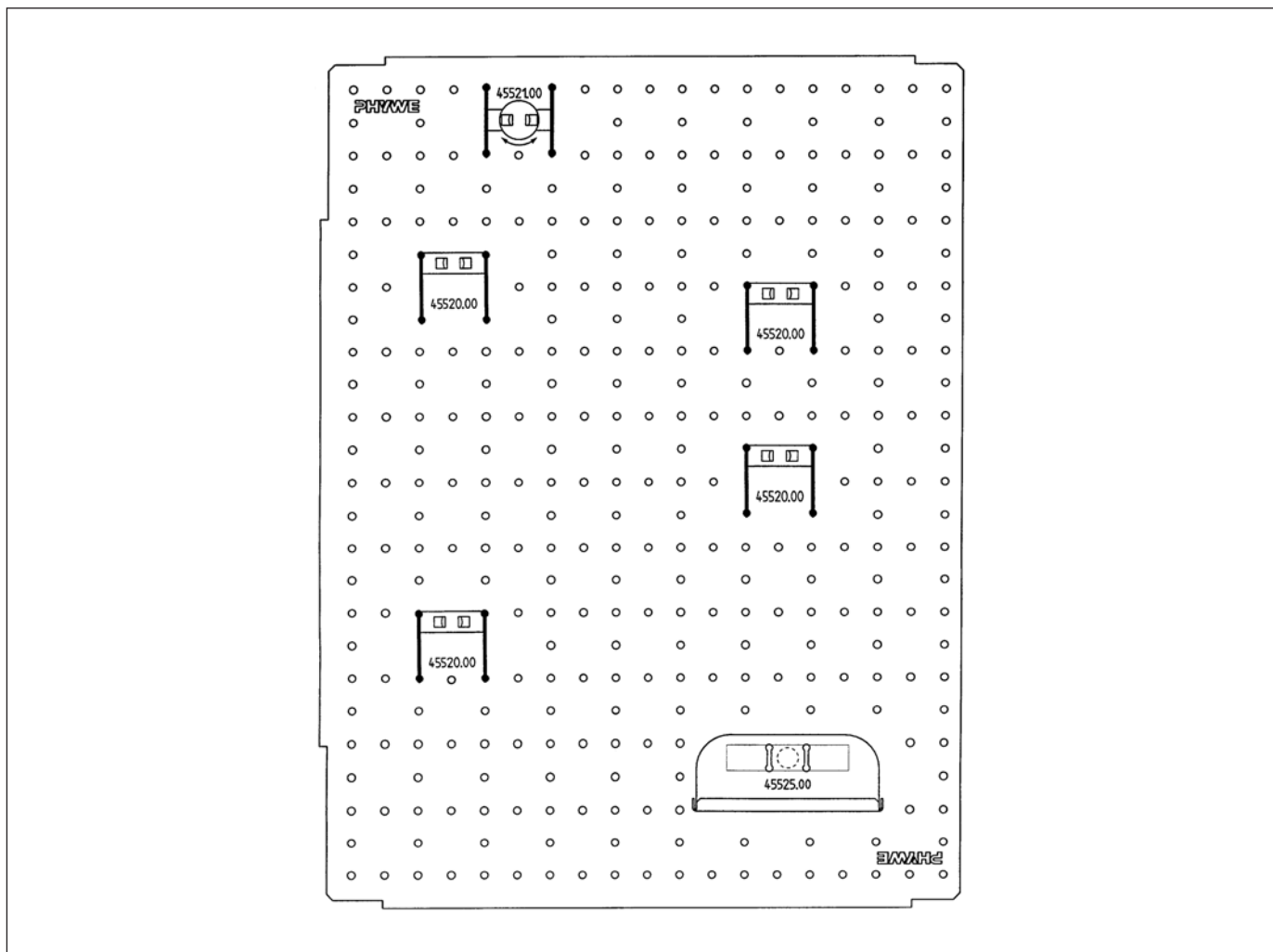
Set-up

Position the clamping holders on the panel for complete experiments as shown in Fig. 2. The apparatus is to be subsequently assembled and fixed to the clamping holders as shown in Fig. 1.

Prior to this, place two to three grams of sodium chloride in the 100 ml round bottom flask, and about 20 ml of concentrated sulphuric acid in the dropping funnel. For the adsorption of excess hydrogen chloride, fill activated charcoal into the drying tube between small plugs of quartz glass wool at each end which hold it in position. Pour a little more than half a litre of distilled water into the beaker and add an indicator of your choice (universal indicator or bromthymol blue are naturally very suitable – to make the colour change more pronounced, the water can be made slightly (!) alkaline).

Fit the four bored stoppers onto the glass sphere with tubes. Fit a straight stopcock in the top stopper, and a short glass tube in the stopper on the right. Close this tube with a rubber cap, so that it can be pierced with a syringe later if necessary. Fit the other straight stopcock in the bottom stopper. Connect the 15 cm long glass tube to the stopcock with a short length of tubing as ascending tube. Fit the short glass tube with tip to the stopper inside the glass sphere, so that the tip is about 3 cm below the upper stopper bed. Fit the T-shaped stopcock in the stopper on the left. Should it be difficult fit the stopper over the glass capillary connector, lubricate it with a little glycerol.

Fig. 2



Procedure

First position the T-shaped stopcock so that the gas that is produced flows into the sphere. The stopcock to the beaker is closed, the one to the drying tube is open.

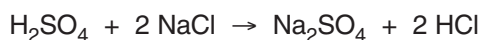
Now let acid slowly drop onto the salt and observe the gas development. After some time (roughly three to five minutes) the sphere should be filled with hydrogen chloride, and extensively free of air. Turn the T-shaped stopcock so that the gas produced is led directly to the drying tube, and open the stopcock to the ascending tube in the beaker. Should no fountain result on its own accord within a few seconds, initiate it by injecting a millilitre of water through the rubber cap.

Results

A gas is evolved when acid is dropped onto sodium chloride. When, after some time, the left and upper stopcocks on the sphere are closed, and the stopcock to the beaker opened, then water is drawn into the flask at high speed. This had only functioned now and then after having added a millilitre of water with the syringe. The indicator colour changes.

Explanation

The gas that is produced is hydrogen chloride:



Because the HCl gas escapes, equilibrium is shifted so that the reaction continues to take place. The hydrogen

chloride prepared and collected in the flask dissolves in water. This results in a vacuum, that draws water into the flask. The experiment is based on the extreme solubility of the gas that is produced. The indicator colour change is due to the now acidic pH value of the water drawn in.

Notes

It is not necessary to dry the hydrogen chloride gas, as it is sufficiently dry when prepared from concentrated sulphuric acid and sodium chloride.

A repeat of this experiment can only be made with well dried apparatus!

Ammonia is naturally also a gas that would be suitable for a fountain. The only change to the apparatus would be the drying process. For this, a U-tube with hose nipples on each side, filled with sodium hydroxide, is fitted between the gas generator and the T-shaped stopcock. Ammonia is generated from concentrated ammonia solution and sodium hydroxide pellets. The following materials are then additionally required:

Clamping holder, $d = 8 \dots 10$ mm, turnable	45522.00	1
U-shaped tube, GL 25	36959.15	1
Sodium hydroxide pellets, 250 g	30157.25	1
Ammonia solution, 25%, 250 ml	30933.25	1

There are many descriptions of this experiment. Common variations can be found in the technical literature and in the PHYWE literature series. This arrangement avoids the need to re-fit the flask filled with gas- the complete experiment is carried out in the one set-up.

**KV
1.16**

A chemical fountain



Room for notes