Salt formation on the basis of the chemical elements

(Item No.: P7159600)

Curricular Relevance

Area of Expertise: Chemie
Education Level: Klasse 7-10
Topic: Anorganische Chemie
Subtopic: Salze
Experiment: Salzbildung aus chemischen Elementen

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

Additional Requirements:

Experiment Variations:

Keywords:

salt formation

Task and equipment

Information for teachers

Learning objectives

- As a rule, salts can be obtained directly from the elements.
- The most common non-metal groups forming salts together with metals are the chalcogens and the halogens.

Notes on set-up and procedure

Preparations
The iron/sulphur mixture ignites under the conditions stated, when reduced iron is used. Crude iron powder which is already slightly oxidised is not suitable. The sulphur pieces must be dried in the drying oven at medium temperature (approximately 50 °C) the night before the experiment since sulphur always tends to become slightly humid when it is stored for a longer time. In order to reduce the time required for the experiment or if there are not enough balances available, the iron/sulphur mixture (mixing ratio 7:4) can be prepared beforehand.

Remarks on the students' experiments
Make sure that the experiments are carried out on a working plate since the test tube might burst in the first part of the experiment. It is recommended to use old test tubes for this experiment since the iron sulphide which forms often can only be withdrawn from the test tubes by cracking them.
As a rule, zinc and iodine react spontaneously and vigorously when water is added while at the same time iodine vapours are released. Make sure that the students do not inhale these vapours. If the reaction is not triggered properly, heat the test tube for a very short period of time.

Hazard and Precautionary statements

Zinc powder:	
H410:	Very toxic to aquatic life with long lasting effects.
P273:	Avoid release to the environment.
P280:	Wear protective gloves/protective clothing/eye protection/face protection.
P308 + P313:	IF exposed or concerned: Get medical advice/attention.
P302 +P352:	IF ON SKIN: Wash with plenty of soap and water.
P305 + P351 + P338:	IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
P501:	Dispose of contents/container in accordance with applicable local, regional, national, and/or international regulations.
Iodine:	
H332:	Harmful if inhaled.
H312:	Harmful in contact with skin.
H400:	Very toxic to aquatic life.
P273:	Avoid release to the environment.
P302 + P352:	IF ON SKIN: Wash with plenty of soap and water.
P501:	Dispose of contents/container in accordance with applicable local, regional, national, and/or international regulations.
Iron powder:	
H228:	Flammable solid.
P210:	Keep away from heat/sparks/open flames/hot surfaces. - No smoking.
P501:	Dispose of contents/container in accordance with applicable local, regional, national, and/or international regulations.
Sulphur, pieces:	
H315:	Causes skin irritation.
P302 + P352:	IF ON SKIN: Wash with plenty of soap and water.
P501:	Dispose of contents/container in accordance with applicable local, regional, national, and/or international regulations.

Hazards

- Iodine vapours are hazardous to health. Do not inhale them!
- When sulphur is heated, harmful gases are released. Do not inhale them!
- Put on protective glasses!

Notes

The reaction of zinc with iodine is triggered when water is added due to the heat of solution, the increase in surface area and the formation of small quantities of hydrogen iodide and hypoiodine acid with a slight catalytic effect.
The iron sulphide can be used again for further experiments (roasting, preparation of hydrogen sulphide etc.).

Remarks on the method

This experiment is very suitable for treating the common properties of the individual groups of the periodic system of elements and the rather problematic concept of salts as it is the case in Question 4 in the report. Since this field is rather complex, the solution to this exercise requires an extensive problem-oriented discussion in class.

Waste disposal

Put the iron sulphide in a special reservoir marked correspondingly for further use. The zinc iodide (solution) can be used again for an electrolysis experiment (zinc/iodine battery) or put into the collecting tank for acids and alkalis.

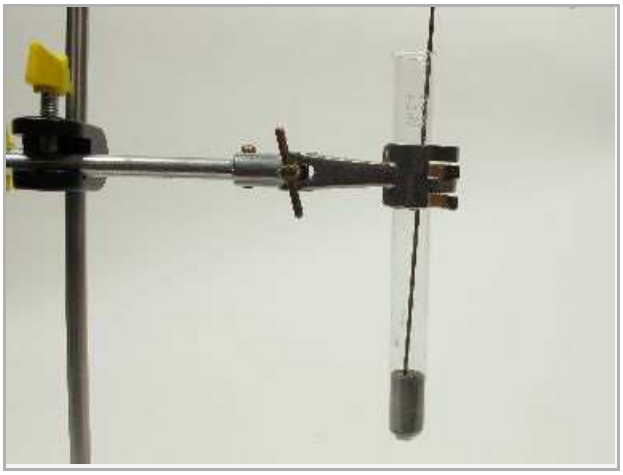
Salt formation on the basis of the chemical elements **(Item No.: P7159600)**

Task and equipment

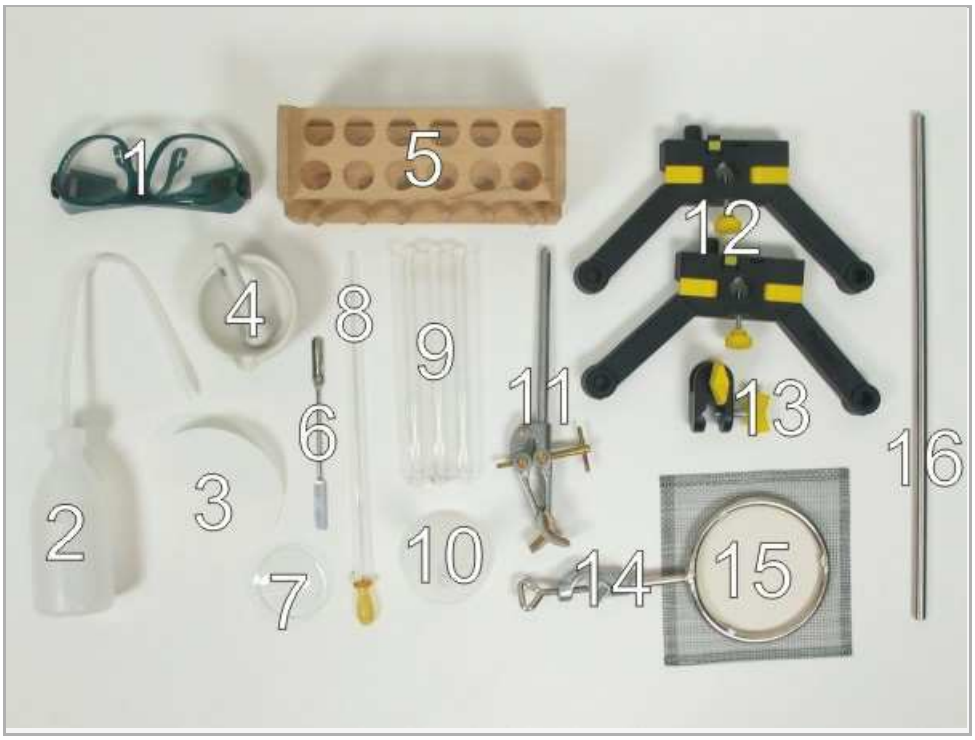
Task

Can salts be obtained directly from the elements?

Let metals react with sulphur and iodine.



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	Circular filter,d 110 mm,100 pcs	32977-04	(1)
4	Mortar w. pestle, 70ml, porcelain	32603-00	1
5	Test tube rack for 12 tubes, holes d= 22 mm, wood	37686-10	1
6	Spatula, powder, steel, l=150mm	47560-00	1
7	Watch glass, dia.60 mm	34570-00	1
8	Pipette with rubber bulb, long	64821-00	1
9	Test tube, 18x188 mm, 10 pcs	37658-03	(3)
10	Filter funnel, PP, d=60 mm	47318-00	1
11	Universal clamp	37715-00	1
12	Support base, variable	02001-00	1
13	Boss head	02043-00	1
14	Ring with boss head, i. d. = 10 cm	37701-01	1
15	Wire gauze with ceramic, 160 x 160 mm	33287-01	1
16	Support rod, stainless steel, l=370 mm, d=10 mm	02059-00	1
	Butane burner f.cartridge 270+470	47536-00	1
	Butane catridge CV 300 Plus, 240 g	47538-01	1
	Iron powder xtra pure 500 g	30068-25	1
	Iodine resublimed 25 g	30093-04	1
	Sulphur, pieces, 500 g	30277-50	1
	Water, distilled 5 l	31246-81	1
	Zinc, powder 100 g	31978-10	1
Additional material			
	Bicycle spoke, knitting needle or something similar		

Set-up and procedure

Set-up

Hazards

- Iodine vapours are hazardous to health. Do not inhale them!
- When sulphur is heated, harmful gases are released. Do not inhale them!
- Put on protective glasses!




Set-up

Set up the support system according to Fig. 1 - Fig. 4 by means of the bosshead and the universal clamp. Place it onto the working surface.

Fig. 1


Fig. 2

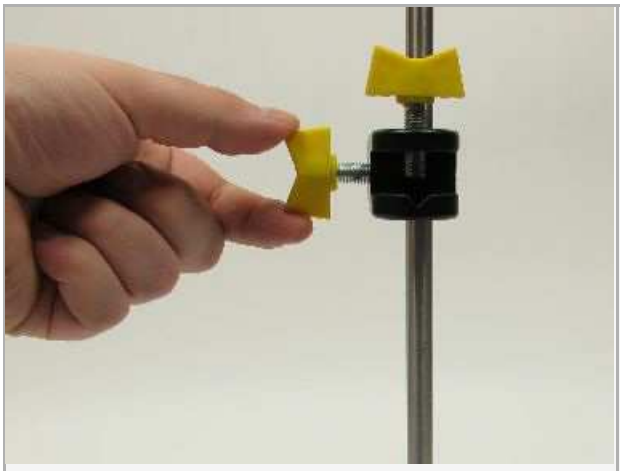


Fig. 3

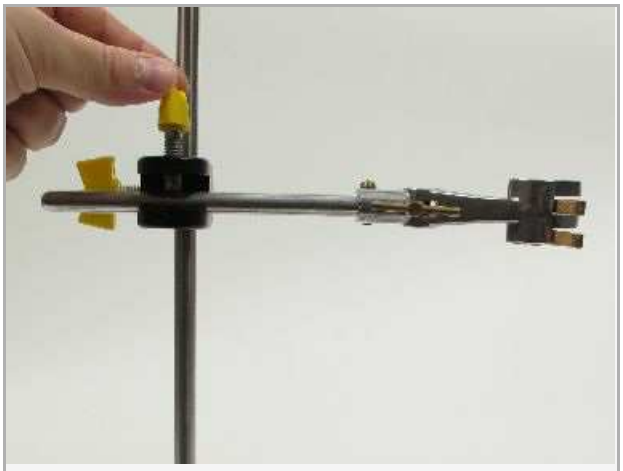


Fig. 4

Grind 4 g of sulphur in the mortar (Fig. 5) and mix it with 7 g of iron (Fig. 6). Fill the mixture into a test tube until it is about one third full (Fig. 7). Densify the mixture by tapping the test tube carefully (Fig. 8).

Fig. 5

Fig. 6

Fig. 7

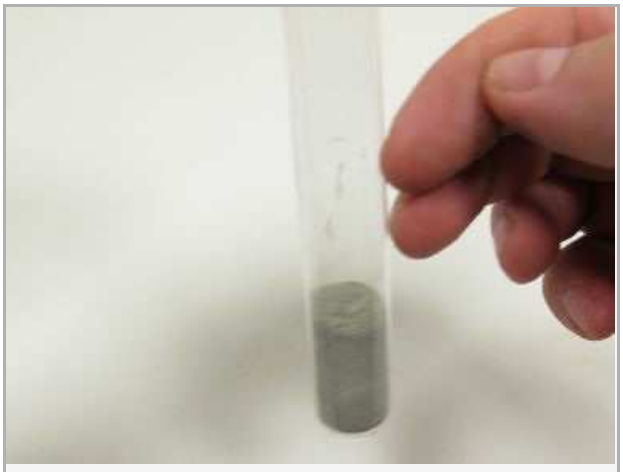


Fig. 8

Procedure

Clamp the test tube in the support system (Fig. 9). Heat a knitting needle in the flame of the burner until it glows (Fig. 10), introduce it into the mixture in the test tube (Fig. 11) and leave it there. Let the test tube cool down and place it in the test tube rack (Fig. 12).

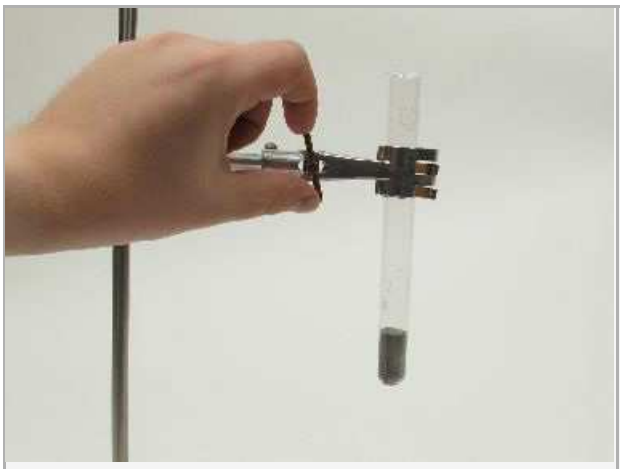


Fig. 9

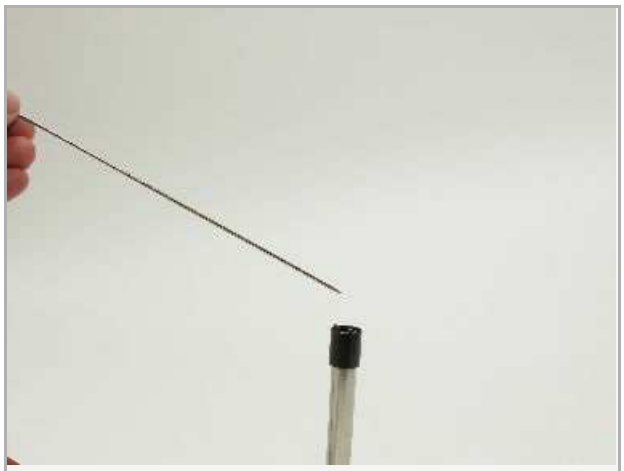


Fig. 10

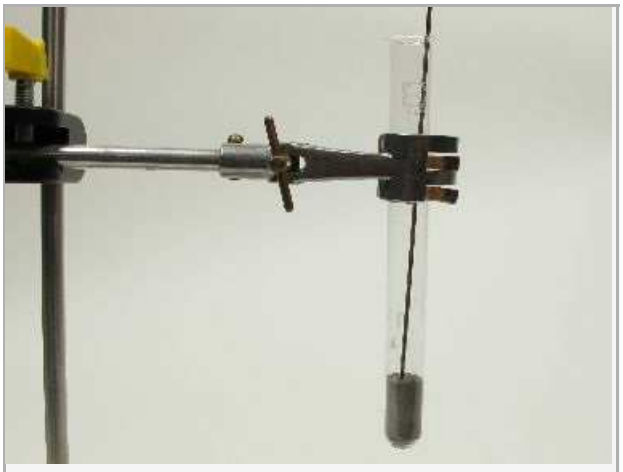


Fig. 11

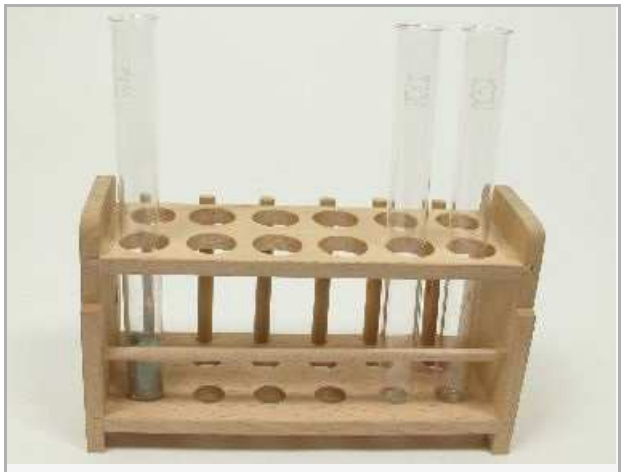


Fig. 12

Fill a spatula-tipfull of rather fine iodine crystals and only a slightly larger quantity of zinc into the second test tube (Fig. 13). Shake the test tube in order to mix both substances.

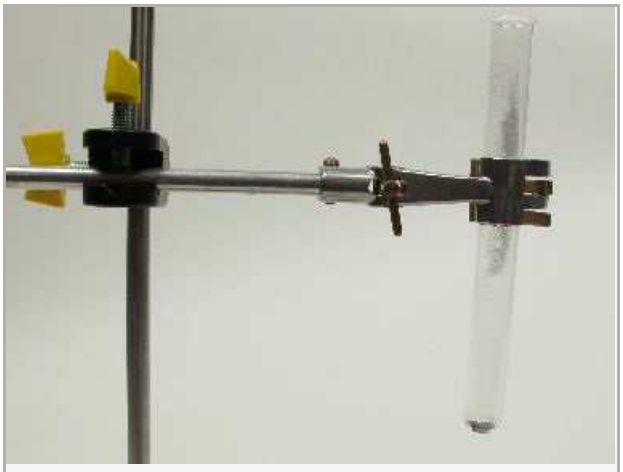


Fig. 13

Clamp the test tube in the support system and use the pipette to add two drops of distilled water to the mixture (Fig. 14). When the reaction is over, fill the test tube up with distilled water (filling height about 1 cm) (Fig. 15) and shake it well.

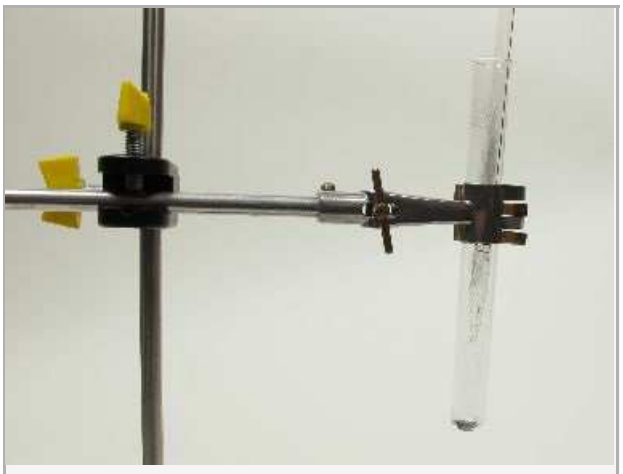


Fig. 14

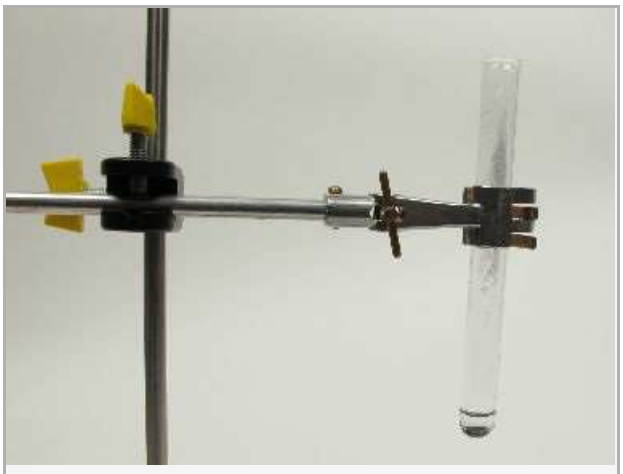


Fig. 15

Fold the filter paper as shown in Fig. 16 - Fig. 19.

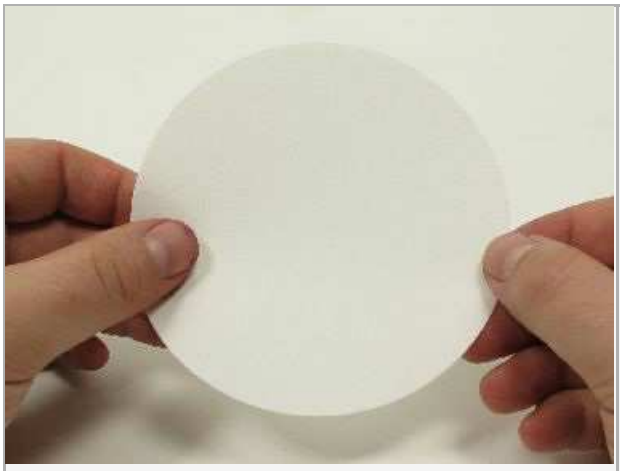


Fig. 16

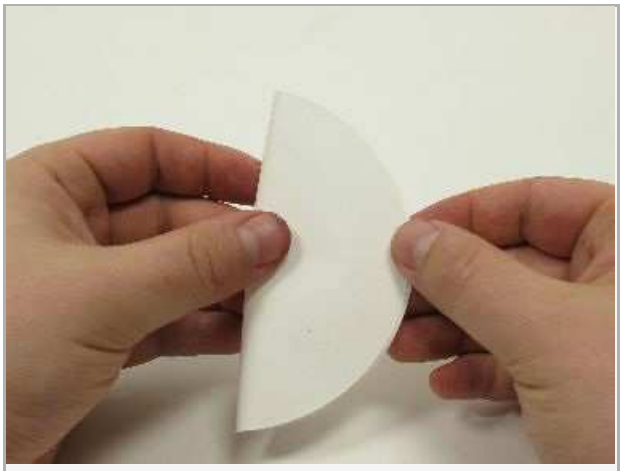


Fig. 17

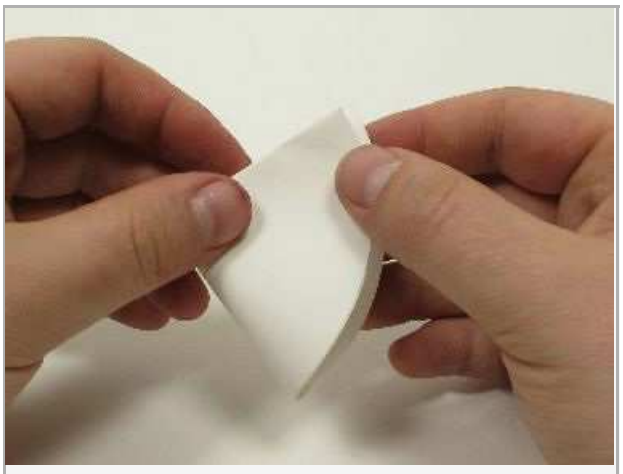


Fig. 18

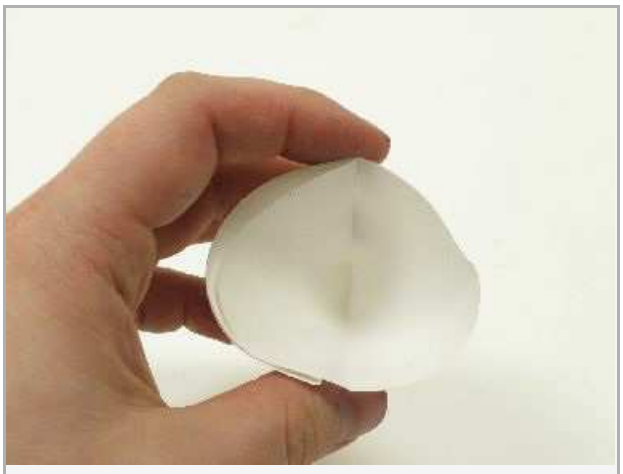


Fig. 19

Filter the solution out into another test tube (Fig. 20).

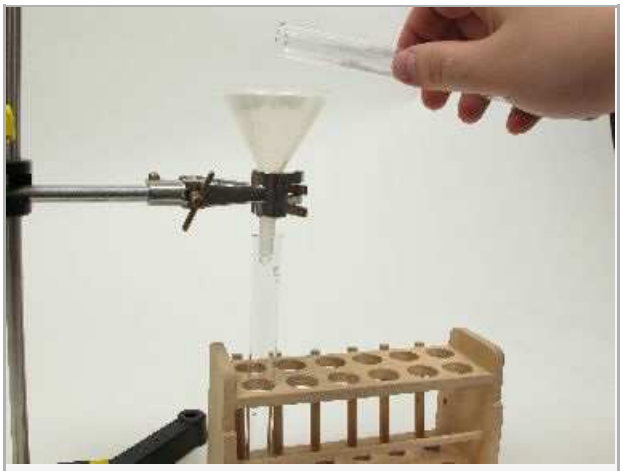


Fig. 20

Replace the bosshed and the universal clamp by the support ring (Fig. 21) and the wire gauze square (Fig. 22). Place the watch glass on top (Fig. 23). Use the pipette to drop about 10 drops of the filtrate onto the watch glass (Fig. 24) and heat it carefully with a small flame (Fig. 25). Stop heating when the water has evaporated nearly completely.


Fig. 21

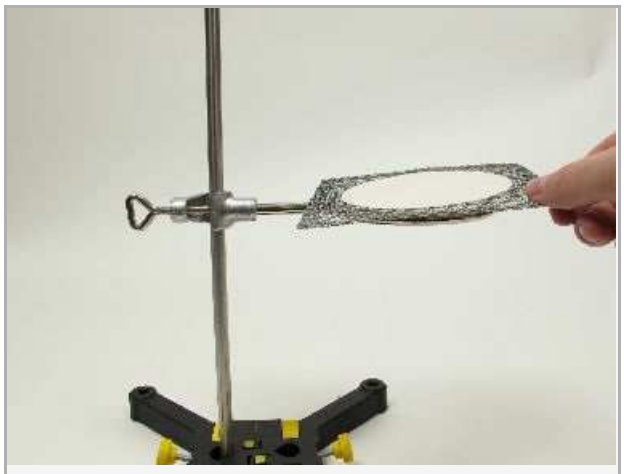


Fig. 22

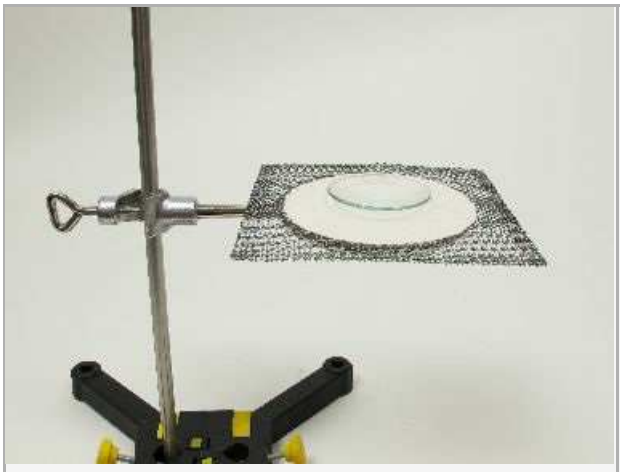


Fig. 23

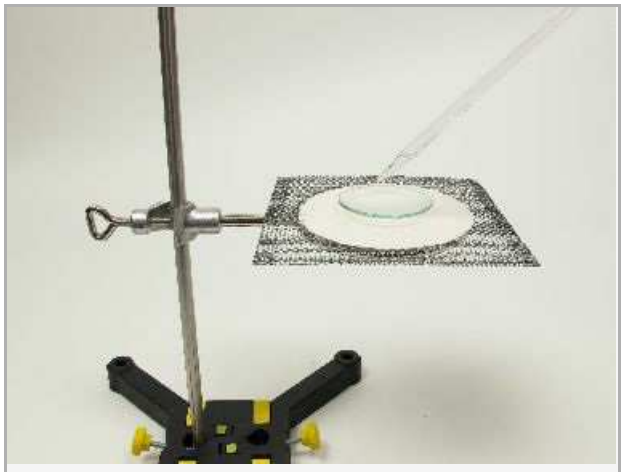


Fig. 24


Fig. 25

Waste disposal

Put the iron sulphide into a special reservoir marked correspondingly. Put the zinc iodide into a special reservoir marked correspondingly or into the collecting tank for acids and alkalis.

Report: Salt formation on the basis of the chemical elements

Result - Observations

Write down your observations on

- part 1 (glowing knitting needle in the iron/sulphur mixture).
- part 2 (addition of water to the iodine/zinc mixture).

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Evaluation - Question 1

Draw the conclusions from your observations. Describe the processes that have taken place in the form of a reaction equation.

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Evaluation - Question 2

Describe the way of producing a salt presented here in the form of a catchword.

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Evaluation - Question 3

How could sodium chloride (common salt) be prepared?

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Evaluation - Question 4

Take the result of the experiment as a basis for explaining why the sulphur group in the periodic system is also known as chalcogens (ore formers) and the fluorine group as halogens. Explain also why from a chemical point of view sulphides, too, can be regarded as salts.

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