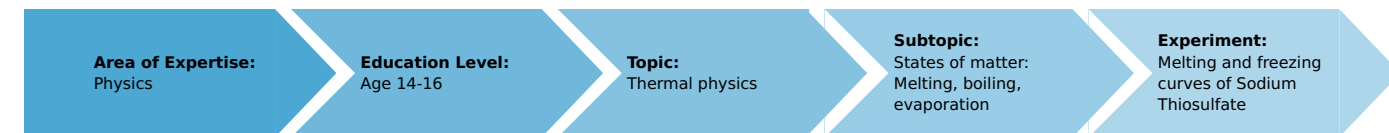


Melting and freezing curves of Sodium Thiosulfate

(Item No.: P1044600)

Curricular Relevance



Difficulty



Intermediate

Preparation Time



10 Minutes

Execution Time



10 Minutes

Recommended Group Size



2 Students

Additional Requirements:

- Butane burner, Labogaz 206 type 32178-00
- Butane cartridge C206, without valve 47535-00
- Sodium thiosulphate pentahydrate, 500 g 30169-50
- Boiling beads, 200 g 36937-20
- Matches

Experiment Variations:

Keywords:

Task and equipment

Information for teachers

Additional Information

The course of sodium thiosulfate's temperature during melting and subsequent freezing is measured. Moreover, it can be clearly seen that heat is necessary for the melting process: the temperature does not rise until all the salt has melted. During freezing this energy is released. This can be seen especially well when the molten salt first undercools and then immediately freezes when a salt crystal is dropped into it. The temperature rises immediately to the melting point.

Remarks

1. The thermometer is fixed in the glass tube holder which rests on the rim of the test tube. The thermometer thus always remains in the same position – even when the salt is melting.
2. The test tube is hot after heating and, thus, should be placed in the other beaker with the aid of the universal clamp.
3. At the end of the experiment the thermometer is frozen tight in the test tube. It must not be forcefully pulled out, otherwise it will break! The salt must be reheated until it melts. Since molten sodium thiosulfate is water soluble, it can be poured down the drain and the test tube can then be cleaned with water.
4. The temperature measurements are made at 30 sec intervals so that the boiling temperature plateau is clearly seen.
5. The course of the temperature is a function of the quantity of salt and the thermal output of the burner. If necessary, the tables must be extended or shortened.

If the molten salt is jarred or contains impurities, undercooling does not occur. Instead, the molten mass slowly freezes. In this case the temperature plateau lies at about 40 °C and the heat increase on dropping in the crystal cannot be shown.

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(Item No.: P1044600)

Task and equipment

Task

What happens during melting and freezing?

Heat sodium thiosulfate until it melts and then let it cool. Measure the course of the temperature as a function of time.



Equipment



Position No.	Material	Order No.	Quantity
1	Support base, variable	02001-00	1
2	Support rod, stainless steel, l = 600 mm, d = 10 mm	02037-00	1
3	Spoon, w. spatula end, 18 cm, plastic	38833-00	1
4	Boss head	02043-00	1
5	Glass tube holder with tape measure clamp	05961-00	1
6	Ring with boss head, i. d. = 10 cm	37701-01	1
7	Universal clamp	37715-00	1
8	Wire gauze with ceramic, 160 x 160 mm	33287-01	1
9	Agitator rod	04404-10	1
10	Students thermometer, -10...+110°C, l = 230 mm	38005-10	1
11	Glass beaker DURAN®, short, 250 ml	36013-00	1
12	Glass beaker DURAN®, short, 400 ml	36014-00	1
13	Stop watch 4	03078-00	1
14	Test tube, 200x30 mm, DURAN	36304-01	1
Additional material			
15	Butane burner, Labogaz 206 type	32178-00	1
16	Butane cartridge C206, without valve	47535-01	1
17	Sodium thiosulphate pentahydrate, 500 g	30169-50	1
18	Boiling beads, 200 g	36937-20	1
19	Matches		

Set-up and procedure

Set-up

Attention!

1. At the end of the experiment the thermometer is frozen tight in the test tube. Do not try to pull it out! Instead heat the sodium thiosulfate again until it melts.
2. Molten sodium thiosulfate is water soluble, it can be poured down the drain. The test tube can then be cleaned with water.
3. During heating of the water the support ring and the wire gauze get extremely hot!

Setup

- Set up the support stand according to the following pictures.

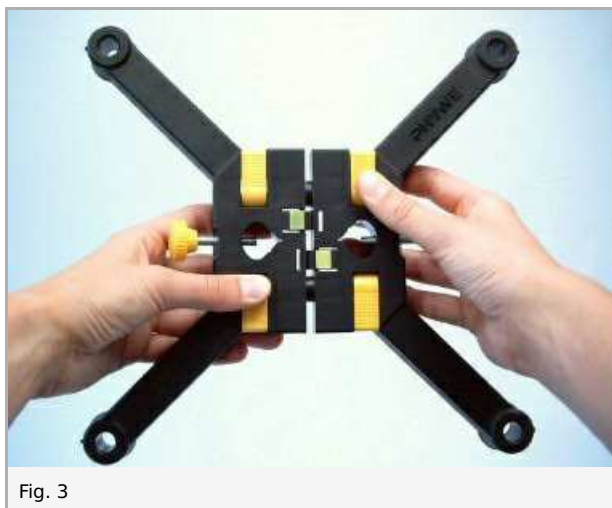




Fig. 4a



Fig. 4b



Fig. 5



Fig. 6

- Fill the test tube about 4 cm high with sodium thiosulfate.



Fig. 7

- Pour about 150 ml of water into the 250 ml beaker and drop a few beads into it.



Fig. 8



Fig. 9

- Immerse the test tube deep enough into the water so that the sodium thiosulfate is completely surrounded by the water.



Fig. 10

- Insert the thermometer into the test tube. Before doing this fix its upper end in the glass tube holder which then rests atop the test tube after insertion. Thus, the thermometer has a fixed position in the test tube.



Fig. 11

- Fill the 400 ml beaker with about 250 ml of cold water.

Procedure

1. Melting

- Read the initial temperature of the sodium thiosulfate and record it in table 1 as $t = 0$ min.
- Light the burner and start the stop watch.
- Read the temperature at 30 s intervals until the salt has completely melted and the temperature has reached 60 °C.
- Stir the water frequently while heating the salt.
- Extinguish the burner and stop the stop watch.

2. Solidification

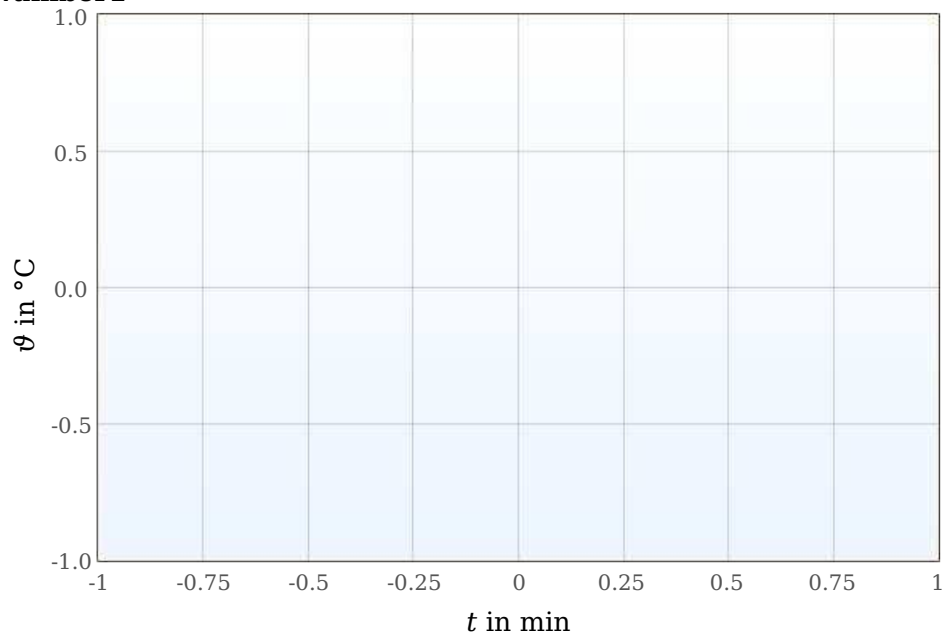
- Using the universal clamp, place the test tube in the beaker containing cold water.
- Start the stop watch and take the first reading immediately ($t = 0$ min in table 2).
- Read the temperature at 30 s intervals until the temperature has reached 35 °C. Stir the water frequently; do not jar the test tube while stirring!
- If the salt is still liquid, drop a salt crystal into the test tube.
- Make a mark next to the time in the table when you dropped the salt crystal into the tube.
- Continue to read the temperature at 30 s intervals until the table is completed.

Result - Table 1

Note down the temperature θ of sodium thiosulfate, measured during melting.

[illegible]

Number1

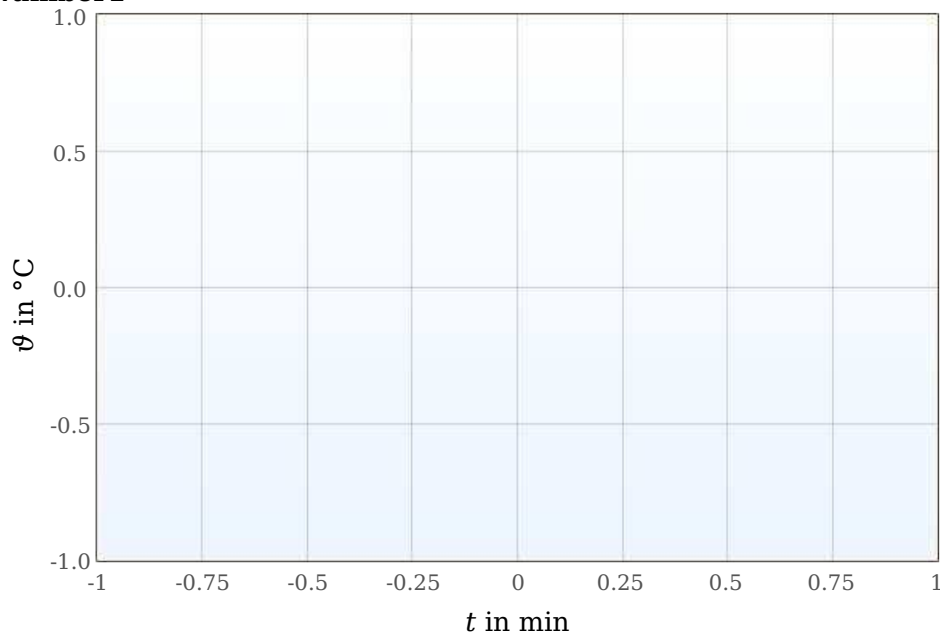


Result - Table 2

Note down the temperature θ of sodium thiosulfate, measured during freezing.

t in min	θ in °C
0	1 ± 1
0.5	1 ± 1
1	1 ± 1
1.5	1 ± 1
2	1 ± 1
2.5	1 ± 1
3	1 ± 1
3.5	1 ± 1
4	1 ± 1
4.5	1 ± 1
5	1 ± 1
5.5	1 ± 1
6	1 ± 1
6.5	1 ± 1
7	1 ± 1
7.5	1 ± 1
8	1 ± 1
8.5	1 ± 1
9	1 ± 1
9.5	1 ± 1
10	1 ± 1

Number1



Evaluation - Question 1

Describe the course of the melting curve which is shown in the first chart.

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Evaluation - Question 2

The burner always supplies the same quantity of heat. To what purpose is this heat used in the different regions of the melting curve?

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Evaluation - Question 3

Describe the course of the solidification curve.

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Evaluation - Question 4

What happens when a crystal is dropped into the undercooled molten salt? Explain your observations.

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