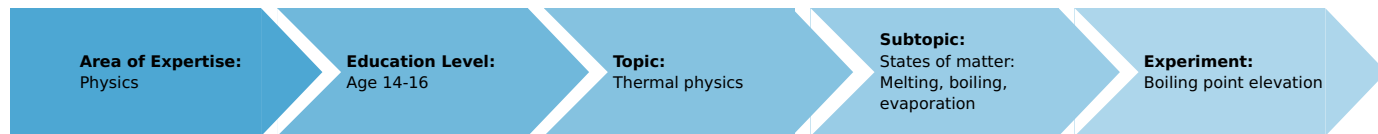


# Boiling point elevation (Item No.: P1045400)

## 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
- Glycerol, 250 ml 30084-25
- Sodium chloride, 250 g 30155-25
- Boiling beads, 200 g 36937-20
- Matches

### Experiment Variations:

- with universal balance

### Keywords:

## Task and equipment

## Information for teachers

## Additional Information

The boiling points of water and of two salt solutions with different concentrations are determined. With this information it can be shown that the boiling point increases with increasing quantities of dissolved salt.

## Remarks

1. The burner must always be extinguished and the liquid should have cooled somewhat before the salt is added. Otherwise, there is a danger of being burned by the hot steam.
2. The stopper may only be pressed loosely into the Erlenmeyer flask since it must be removed from the hot flask to add salt.
3. The steam is diverted through a piece of tubing. There are two reasons for this:
  - The students do not burn themselves on the hot, rising steam.
  - The thermometer's scale is not heated. Therefore it indicates the correct temperature.
4. The salt solution must only boil for a short time before the temperature is determined. If it boils for a longer period of time, the water evaporates (Distillation!) and the concentration of the salt solution increases. This leads to an increase in the boiling point.
5. The increase in the boiling point is not dependent on the chemical properties of the dissolved substance, but rather on the mole fraction (i.e. on the number of dissolved molecules in relation to the total number of molecules). Therefore, the relative molecular mass of the dissolved substance can be determined from the increase in the boiling point.
6. The quantity of salt can also be weighed with a balance. Suitable balances are on the Material page.

# Boiling point elevation (Item No.: P1045400)

## Task and equipment

### Task

#### What is the boiling point of a salt solution?

Determine the boiling point of water and from salt solutions containing 3 and 6 spoonfuls of salt.



Equipment



Position No.	Material	Order No.	Quantity
1	Support base, variable	02001-00	1
2	Support rod, stainless steel, l = 250 mm, d = 10 mm	02031-00	1
3	Support rod, stainless steel, l = 600 mm, d = 10 mm	02037-00	1
4	Spoon, w. spatula end, 18 cm, plastic	38833-00	1
5	Boss head	02043-00	1
6	Glass tube holder with tape measure clamp	05961-00	1
7	Ring with boss head, i. d. = 10 cm	37701-01	1
8	Universal clamp	37715-00	1
9	Wire gauze with ceramic, 160 x 160 mm	33287-01	1
10	Beaker, low form, plastic, 100 ml	36011-01	1
11	Glass beaker DURAN®, short, 250 ml	36013-00	1
12	Erlenmeyer flask 100 ml, wide-neck SB 29	36428-00	1
13	Glass tubes, l. 250 mm, pkg. of 10	36701-68	1 piece
14	Glass tube, straight, l=80 mm, 10/pkg.	36701-65	1 piece
15	Graduated cylinder 100 ml, PP transparent	36629-01	1
16	Pipette with rubber bulb	64701-00	1
17	Students thermometer, -10...+110°C, l = 230 mm	38005-10	1
18	Rubber stopper 26/32, 2 holes 7 mm	39258-02	1
19	Silicone tubing i.d. 7mm	39296-00	1
Additional material:			
20	Butane burner, Labogaz 206 type	32178-00	1
21	Butane cartridge C206, without valve	47535-01	1
22	Glycerol, 250 ml	30084-25	15 ml
23	Sodium chloride 250 g	30155-25	1
24	Boiling beads, 200 g	36937-20	1
25	Matches		
As an alternative	(Additional Information on the Information for teachers page)		
	Universal balance, 3000 g	46009-00	1 or
	Sliding weight balance, 101 g	44012-01	



## Set-up and procedure

### Set-up

### Attention!

1. Do not press the rubber stopper too tightly into the Erlenmeyer flask as it must be removed to add salt.
2. Hot water vapour is conducted through the tubing and the glass tube! Always hold the tube so that the end points perpendicularly down.
3. Always insert the thermometer or glass tubes in the rubber stopper using glycerol.

### Setup

- Set up the support stand according to the following pictures. The wire gauze should be about 5 cm over the burner.



Fig. 1



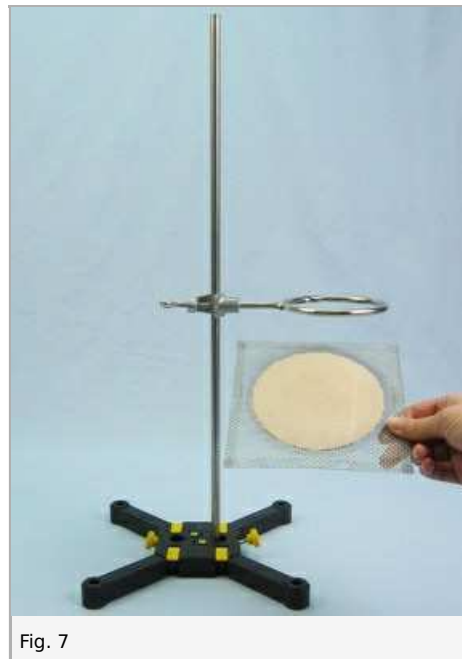
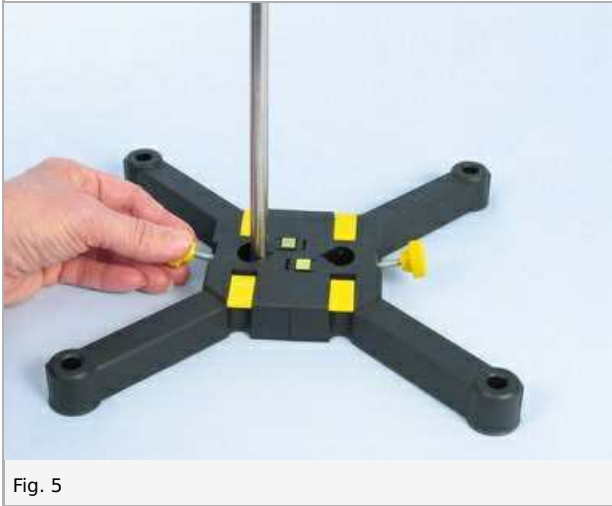
Fig. 2



Fig. 3



Fig. 4



- Add 70 ml of water to the Erlenmeyer flask and place 2 beads in it.



Fig. 8



Fig. 9

- Insert the thermometer and the short glass tube into the rubber stopper and press it only lightly into the Erlenmeyer flask.

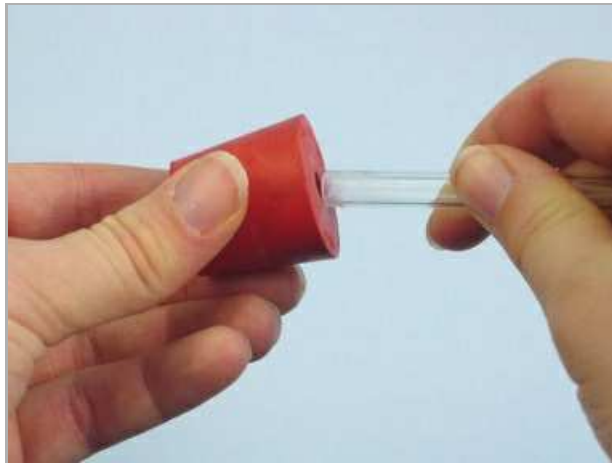


Fig. 10

- Place the Erlenmeyer flask onto the wire gauze and clamp it in place with the universal clamp.

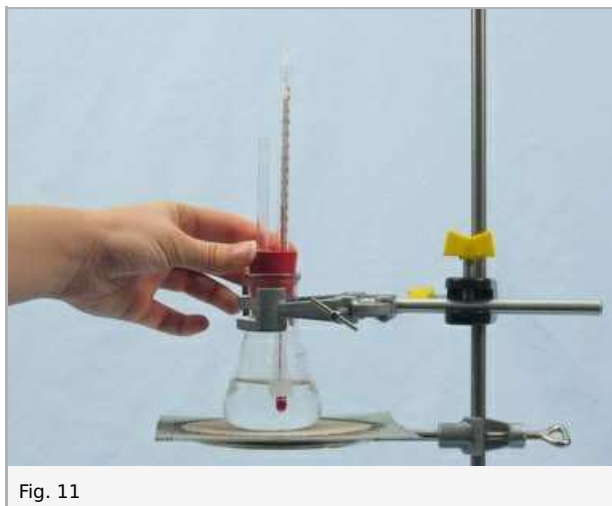


Fig. 11

- Slip one end of a piece of silicone tubing about 50 cm long over the upper end of the short tube and stick the long glass tube into its other end.

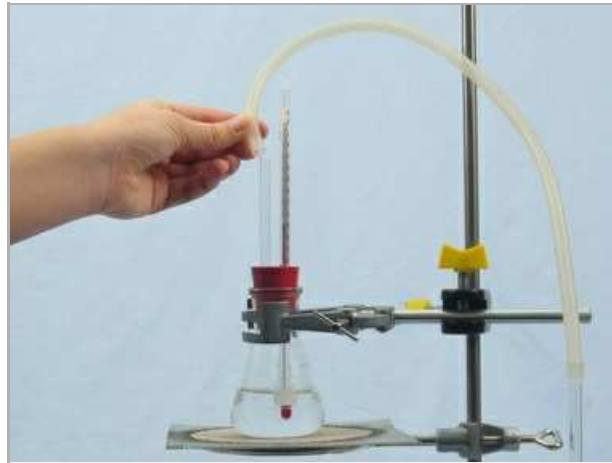


Fig. 12

- Using the glass tube holder, hold the long glass tube vertically and place the large beaker under it.



Fig. 13



Fig. 14

## Procedure

- Light the burner and bring the water to a boil.
- Measure and record the boiling point of water  $\theta_0$  in the table in the report.
- Extinguish the burner and wait until the water has stopped boiling.
- Remove the stopper from the Erlenmeyer flask and add 3 spoonfuls of salt to it.
- Replace the stopper.
- Relight the burner and bring the salt solution to a boil.
- Measure the solution's boiling point  $\theta_1$  (report).
- In the same way add 3 more spoonfuls of salt to the solution.
- Measure and record the boiling point of this solution  $\theta_2$ .



## Report: Boiling point elevation

### Result - Table 1

Record the measured temperatures in the table.

Boiling point of	$\theta$ in °C
water ( $\theta_0$ )	1 ±0
+ 3 spoonfuls salt ( $\theta_1$ )	1 ±0
+ 6 spoonfuls salt ( $\theta_2$ )	1 ±0

### Evaluation - Question 1

How does the boiling point of water change when salt is dissolved in it?

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## Evaluation - Question 2

What is the correlation between salt content and temperature change?

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