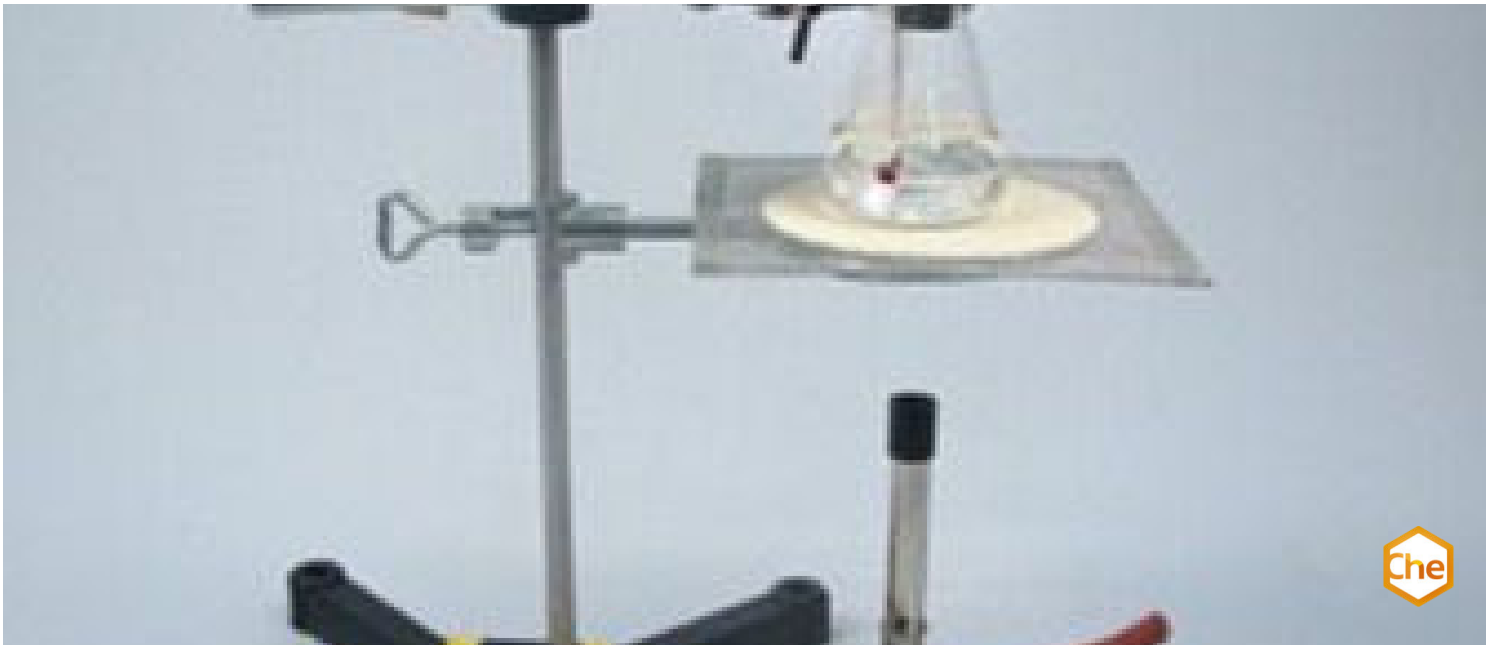
Properties of matter - boiling point



Physics	Thermodynamics	States of matter, dissolution (kinetic particle theory)
Chemistry	General Chemistry	States of matter, dissolution (kinetic particle theory)

Difficulty level	Group size	Preparation time	Execution time
easy	1	10 minutes	10 minutes

This content can also be found online at:

http://localhost:1337/c/5f517c2a739d0a0003ee406f

PHYWE

Teacher information

Application

PHYWE

Experiment set-up

This experiment is about changing the boiling temperature of a solvent by adding a solid. In the experiment, water and saline solutions are brought to boiling point and substances are characterised by characteristic boiling points. Solutions of solids in water have a higher boiling point than pure water. The boiling point is higher the higher the concentration of the solution. In this experiment, the students measure the respective boiling temperatures and plot them on a diagram to show the linearity of the relationship between the increase in boiling point and the amount of salt. For this experiment it is recommended to work in groups and evaluate the experiment together.

PHYWE

Robert-Bosch-Breite 10
37079 Göttingen

Tel.: 0551 604 - 0
Fax: 0551 604 - 107

info@phywe.de
www.phywe.de

Other teacher information (1/2)

PHYWE

Prior knowledge

- The students should have gained initial experimental experience in using the Bunsen burner.
- Substances are characterised by characteristic boiling points. Solutions of solid substances in water have a higher boiling point than pure water. The higher the concentration of the solution, the higher the boiling point.

Scientific principle

In this experiment, water and saline solutions are brought to the boil. The students measure the respective boiling temperatures and plot them on a diagram. Group work and a joint evaluation of the experiment were suitable for this experiment.

Other teacher information (2/2)

PHYWE

Learning objective

- The boiling point allows substances to be precisely identified.
- Contaminated substances have a different boiling point than the respective pure substance.
- Different concentrations of a solution of the same substance have different boiling points.

Tasks

Investigationof the released substances to their boiling temperature.

- Determination of the average boiling temperatures of the various salt solutions and plotting of the measured values in a diagram.
- The relationship between concentration and boiling point of a solution should be worked out in individual groups, to which different quantities of salt are made available.

PHYWE

Robert-Bosch-Breite 10
37079 Göttingen

Tel.: 0551 604 - 0
Fax: 0551 604 - 107

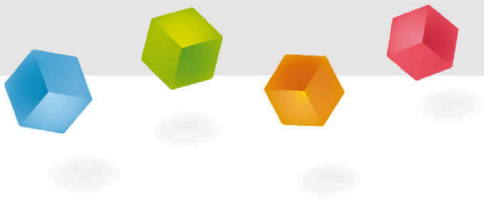
info@phywe.de
www.phywe.de

Safety instructions

PHYWE

- Make rubber-glass joints glide with a drop of glycerine!
- Especially do not insert the thermometer by force!
- To avoid boiling delay, add fresh boiling stones to the liquid!
- Put on protective goggles!
- The general instructions for safe experimentation in science teaching apply to this experiment.

PHYWE



Student Information

PHYWE

Robert-Bosch-Breite 10
37079 Göttingen

Tel.: 0551 604 - 0
Fax: 0551 604 - 107

info@phywe.de
www.phywe.de

Motivation

PHYWE

Water content test of brake fluid

With the help of the boiling point different substances can be distinguished from each other. This applies not only to pure substances but also to mixtures of different substances, so that the boiling point can be used to determine the concentration of individual mixture components. In everyday life, this is used, for example, to examine the water content of the brake fluid in a car.

Tasks

PHYWE

Experiment set-up

Determine the boiling temperature of water and saline solutions.

- A certain amount of common salt is added to water
- The saline solution is heated to boiling point and the boiling temperature is recorded
- Can a change in the boiling temperature be observed?

PHYWE

Robert-Bosch-Breite 10
37079 Göttingen

Tel.: 0551 604 - 0
Fax: 0551 604 - 107

info@phywe.de
www.phywe.de

Equipment

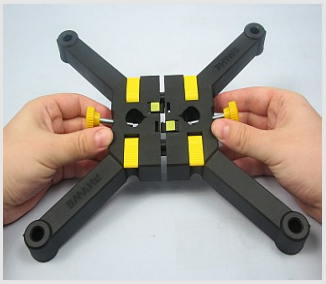
Position	Material	Item No.	Quantity
1	Sodium chloride 250 g	30155-25	1
2	Protecting glasses, clear glass	39316-00	1
3	Rubber gloves, size M (8), one pair	39323-00	1
4	Support base, variable	02001-00	1
5	Support rod, stainless steel, l=370 mm, d=10 mm	02059-00	1
6	Boss head	02043-00	1
7	Universal clamp	37715-01	1
8	Lab thermometer,-10..+150C	38058-00	1
9	Wire gauze with ceramic, 160 x 160 mm	33287-01	1
10	Digital stopwatch, 24 h, 1/100 s and 1 s	24025-00	1
11	Glycerol 99% 100 ml	30084-10	1
12	Wash bottle, 250 ml, plastic	33930-00	1
13	Erlenmeyer flask, stopper bed, 100 mlSB 29	MAU-EK17082301	1
14	Glass tube,right-angled, 10 pcs.	36701-52	1
15	Boiling beads, 200 g	36937-20	1
16	Ring with boss head, i. d. = 10 cm	37701-01	1
17	Butane burner with cartridge, 220 g	32180-00	1
18	Rubber stopper 26/32, 2 holes 7 mm	39258-02	1

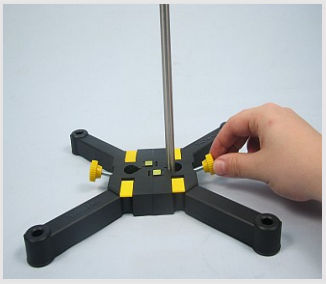
PHYWE
Robert-Bosch-Breite 10
37079 Göttingen
Tel.: 0551 604 - 0
Fax: 0551 604 - 107
info@phywe.de
www.phywe.de

Set-up (1/3)

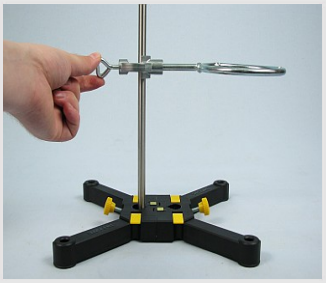
PHYWE

- Assemble the tripod from the tripod base and the tripod rod. See the two illustrations above.





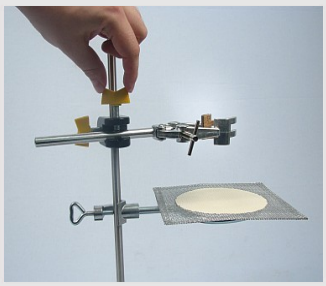
- Attach the tripod ring to the tripod rod and place the wire netting on it. See the two illustrations below.

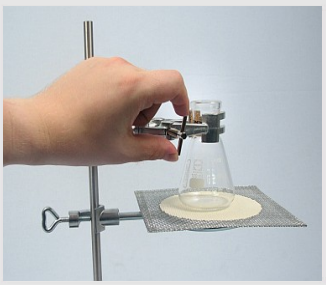


Set-up (2/3)

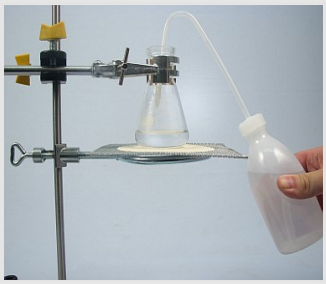
PHYWE

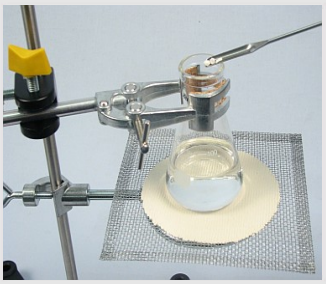
- Attach the Erlenmeyer flask to the support rod using the double sleeve and the universal clamp so that its bottom rests on the wire netting. See the two illustrations above.
- Avoid stresses in the test setup!





- Fill half of the Erlenmeyer flask with water and add 3 boiling stones, see the two illustrations below.





PHYWE

Robert-Bosch-Breite 10
37079 Göttingen

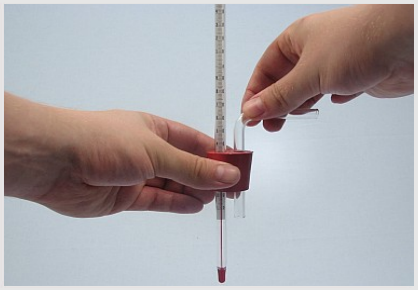
Tel.: 0551 604 - 0
Fax: 0551 604 - 107

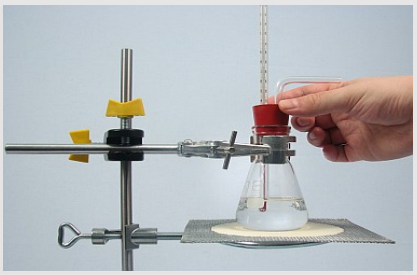
info@phywe.de
www.phywe.de

Set-up (3/3)

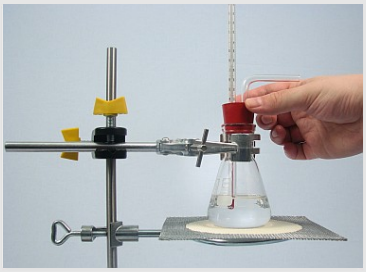
PHYWE

- Insert the thermometer into a hole in the rubber plug after sliding it with a drop of glycerine.
- Hold the thermometer vertically and do not use force!
- Insert the angle tube into the other hole of the plug.
- Close the Erlenmeyer flask with the plug prepared in this way and move the thermometer until it is immersed in the water to a depth of approx. 3 cm.





Procedure (1/2)



- Carefully heat the water with the burner until it begins to boil.
- Now and every 30 seconds thereafter, measure the temperature for five minutes and enter the values in Table 1.
- Extinguish the burner flame.
- Let the water cool down a little and carefully open the Erlenmeyer flask.

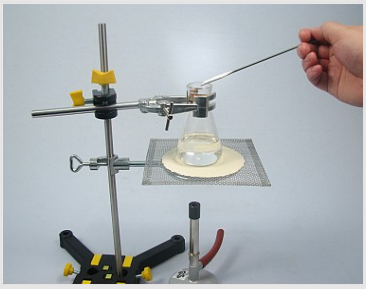
PHYWE

Robert-Bosch-Breite 10
37079 Göttingen

Tel.: 0551 604 - 0
Fax: 0551 604 - 107

info@phywe.de
www.phywe.de

Procedure (2/2)



- Take one of the salt portions (10 g, 20 g, 30 g) given out by the teacher
- Pour the cooking salt into the water with a spoon spatula
- Seal the piston with a stopper
- Heat up again to boiling point and measure the boiling temperature as before.
- **disposal:**
  - The salt solutions can be added to the container for acids and alkalis.

PHYWE

Report

PHYWE

Robert-Bosch-Breite 10
37079 Göttingen

Tel.: 0551 604 - 0
Fax: 0551 604 - 107

info@phywe.de
www.phywe.de

Results

PHYWE

- Make a table for your measurements as well as the measurements of the other groups with different amounts of salt (see figure).
- Calculate the average boiling temperatures of the different salt solutions.
- Compare the boiling temperatures of the different salt solutions and discuss your observations with your group.
- Use your table to complete the following tasks.

Messung	Zeit [sec]	T [°C] Salz 10 g	T [°C] Salz 20 g	T [°C] Salz 30 g
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				

Table of measured values

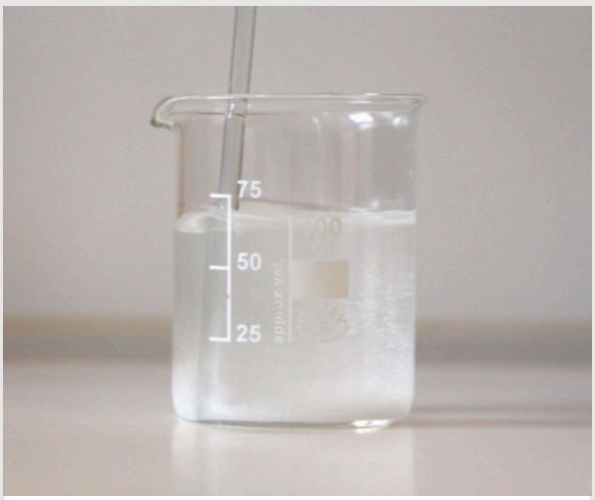
Task 1

PHYWE

Complete the cloze

A salt solution has a different boiling point than pure water. The more salt is dissolved in the water, the [ ] is the boiling point. Solutions have a different boiling point than the pure solvent. The [ ] the concentration of dissolved substances is, the higher the boiling point is.

Check



Saline solution in beaker

PHYWE

Robert-Bosch-Breite 10
37079 Göttingen

Tel.: 0551 604 - 0
Fax: 0551 604 - 107

info@phywe.de
www.phywe.de

Task 2

How does the salt affect the boiling behaviour of the solvent ?

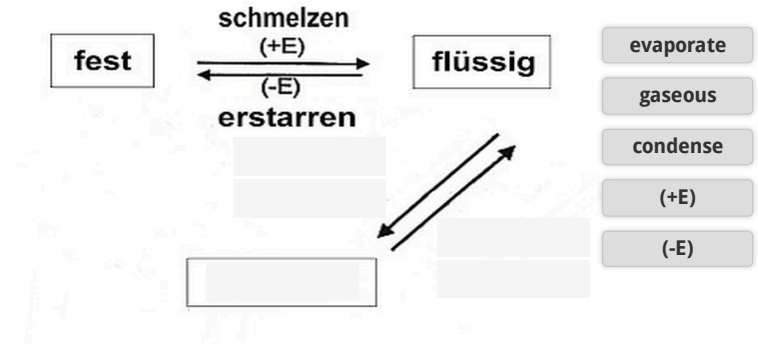
- ○ The salt particles prevent the solvent particles from entering the gas phase
- ○ The salt particles help the solvent particles to enter the gas phase
- ○ Salt particles and solvent particles do not influence each other

Check

Task 3

PHYWE

States of aggregation



evaporate
gaseous
condense
(+E)
(-E)

Check

Boiling water in tea kettle

PHYWE
Robert-Bosch-Breite 10
37079 Göttingen
Tel.: 0551 604 - 0
Fax: 0551 604 - 107
info@phywe.de
www.phywe.de

Slide	Score / Total
Slide 17: Saline solutions	0/2
Slide 18: Boiling behaviour	0/1
Slide 19: States of aggregation	0/5

Total amount 0 / 8

Solutions Repeat

PHYWE
Robert-Bosch-Breite 10
37079 Göttingen
Tel.: 0551 604 - 0
Fax: 0551 604 - 107
info@phywe.de
www.phywe.de