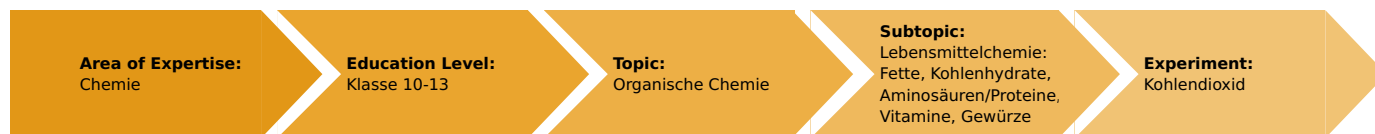


Carbon dioxide (Item No.: P7188100)

Curricular Relevance



Difficulty



Intermediate

Preparation Time



10 Minutes

Execution Time



20 Minutes

Recommended Group Size



2 Students

Additional Requirements:

Experiment Variations:

Keywords:

food chemistry, carbon dioxide

Task and equipment

Information for teachers

Additional Information

Most soft drinks are treated with carbon dioxide (carbonated).

Notes on content and learning objectives

- Carbon dioxide reacts with calcium hydroxide to form a white precipitate of calcium carbonate.
- Mineral water frequently contains natural or added carbon dioxide.
- Carbon dioxide forms a weak acid with water, carbonic acid. Carbon dioxide is therefore designated as the anhydride of carbonic acid.

Notes on the method

There are many examples of the generation of carbon dioxide which can be worked on, such as generation during fermentation. The molecular structure of carbon dioxide, and the chemical stability resulting from it, should be the subject of a classroom discussion.

The significance of reactions of carbon dioxide with lime-stone for forming "hard water" and re-forming of rock can be a further topic.

Fundamentals and remarks

Carbon dioxide is a colourless, non-combustible gas, which is about 1.5 times heavier than air. It is released to the atmosphere from breathing, combustion and fermentation processes.

Carbon dioxide is chemically a very stable compound, which is used in food technology as additive for various beverages, such as mineral water and lemonades, and as a protective gas.

It only forms carbonic acid to 0.1 % in water, the rest is present unchanged.

Hints on going deeper

- The reason why carbon dioxide is added to soft drinks should be a topic for a classroom discussion.

Notes on set-up and procedure

Preparation:

Prepare calcium hydroxide solution as follows:

Add three spatula tips of solid calcium hydroxide to 20 ml of distilled water. Heat the solution while stirring. Allow to cool and filter.

Calcium hydroxide solution is also known as "limewater".

Notes on the students experiment:

Other crystalline compounds, such as grape sugar or common salt, can be used in place of sugar to cause the evolution of carbon dioxide.

The pH of the mineral water can also be determined before and after heating with universal indicator paper or a pH meter.

Carbon dioxide can be detected in a similar way by passing it through barium hydroxide solution (baryta water).



Hazard and Precautionary statements

Calcium hydroxide:

- H315: Causes skin irritation.
- H318: Causes serious eye damage.
- H335: May cause respiratory irritation.
- P261: Avoid breathing dust/fume/gas/mist/vapours/spray.
- P280: Wear protective gloves/protective clothing/eye protection/face protection.
- P305+P351+P338: IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses if present and easy to do - continue rinsing.

Ethanol

- H225: Highly flammable liquid and vapour.
- P210: Keep away from heat/sparks/open flames/hot surfaces - No smoking.

Hazards

- Ethanol in the mixed indicator is highly inflammable. Extinguish all open flames before handling it!
- Calcium hydroxide is corrosive. Avoid skin contact with this chemical.
- Wear protective glasses and protective gloves!

Waste disposal

Pour the solutions to drain.

Carbon dioxide (Item No.: P7188100)

Task and equipment

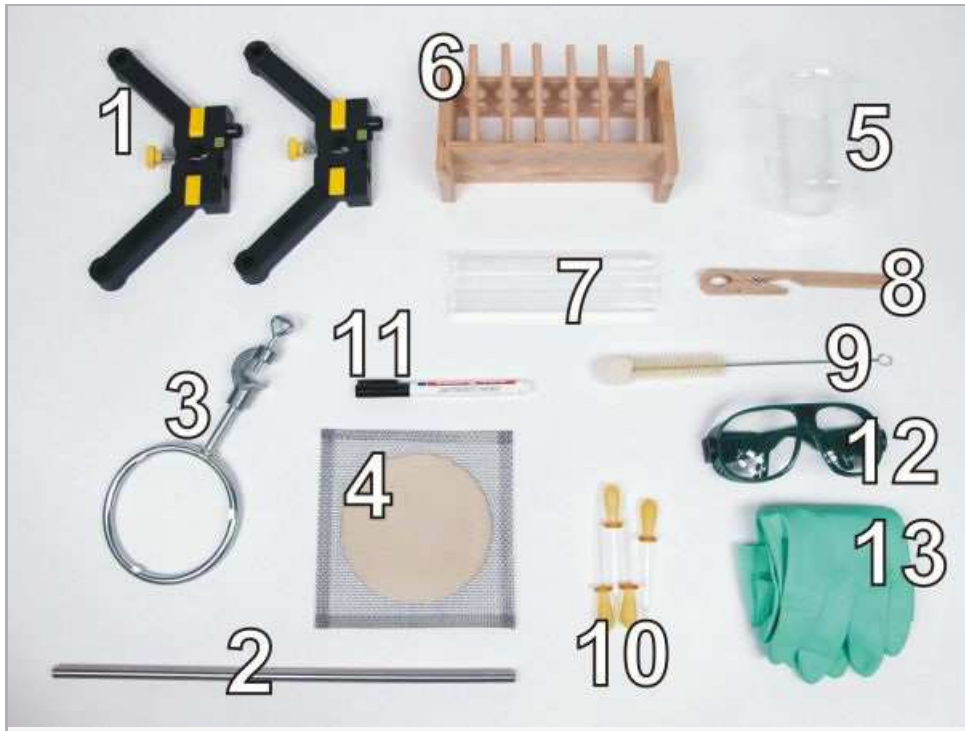
Task

How can carbon dioxide be detected?

Examine various reactions of carbon dioxide.



Equipment



Position No.	Material	Order No.	Quantity
1	Support base, variable	02001-00	1
2	Support rod, stainless steel, l=370 mm, d=10 mm	02059-00	1
3	Ring with boss head, i. d. = 10 cm	37701-01	1
4	Wire gauze with ceramic, 160 x 160 mm	33287-01	1
5	Glass beaker DURAN®, short, 400 ml	36014-00	1
6	Test tube rack for 12 tubes, holes d= 22 mm, wood	37686-10	1
7	Test tube, 180x18 mm, 100pcs	37658-10	(3)
8	Test tube holder, up to d 22mm	38823-00	1
9	Test tube brush w. wool tip, d25mm	38762-00	1
10	Pipette with rubber bulb	64701-00	3
11	Labor pencil, waterproof	38711-00	1
12	Protecting glasses, clear glass	39316-00	1
13	Rubber gloves, size S (7)	39325-00	1
	Butane burner f. cartridge 270+470	47536-00	1
	Butane cartridge CV 300 Plus, 240 g	47538-01	1
	Calcium hydroxide solution 1000ml	31458-70	1
	Boiling beads, 200 g	36937-20	1
	Liquid Indicator pH1-13 UNISOL113	47014-02	1
Additional material			
	Mineral water, still		
	Sugar, when possible cube sugar		

Set-up and procedure

Set-up

Hazards

- Ethanol in the mixed indicator is highly inflammable. Extinguish all open flames before handling it!
- Calcium hydroxide is corrosive. Avoid skin contact with this chemical.
- Wear protective glasses and protective gloves!



Setup

Number three test tubes from 1 to 3 and stand them next to each other in the test tube rack (Fig. 1).



Fig. 1

Assemble the stand as shown in figures 2 to 6. Fasten the support ring to the support rod and place the wire gauze on it. Adjust the height of the support ring so that the flame of the burner just reaches the wire gauze.



Fig. 2



Fig. 3



Fig. 4



Fig. 5



Fig. 6

Half-fill a 400 ml beaker with water and add a few boiling stones (Fig. 7). Heat it to boiling, then put it aside. Extinguish the bunsen burner flame!



Fig. 7

Procedure

Fill mineral water into test tube 1 to a height of 4 cm. Add a sugar cube or two spatula tips of sugar (Fig. 8).

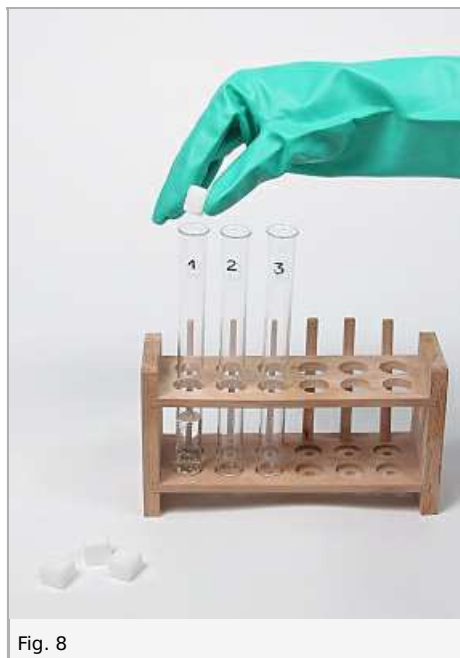


Fig. 8

Fill mineral water into test tube 2 to a height of 4 cm. Pipette a few drops of mixed indicator into it (Fig. 9). Place test tube 2 in the prepared hot water bath for approx. 5 minutes.



Fig. 9

Pipette approx. 2 ml of calcium hydroxide solution into test tube 3. Pipette mineral water dropwise into this (Fig. 10). When turbidity forms, add further mineral water until the mixture again is clear.



Fig. 10

Place test tube 3 in the hot water bath.

Waste disposal

Pour the solutions to drain.

Report: Carbon dioxide

Result - Observations

Note your observations

- a) Mineral water with sugar
- b) Heating mineral water
- c) Mineral water with calcium hydroxide solution

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Evaluation - Question 1

Draw conclusions from your observations.

- a) *Mineral water with sugar*
- b) *Heating mineral water*
- c) *Mineral water with calcium hydroxide solution*

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Evaluation - Question 2

Where does carbon dioxide occur in nature?

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Evaluation - Question 3

What is a "still" water?

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Evaluation - Question 4

Complete the following statements.

1. When carbonated drinks are heated, or when sugar or salt is added to them, is driven out. The solubility of carbon dioxide is very
2. Carbon dioxide reacts partly with water to form a weak
3. The pH of carbonated mineral water is in the weakly region.
4. Carbon dioxide reacts with calcium hydroxide to form, which is deposited out as a white turbidity.