Carbon dioxide - preparation and properties

(Item No.: P7153900)

Curricular Relevance

Area of Expertise: Chemie
Education Level: Klasse 7-10
Topic: Anorganische Chemie
Subtopic: Nichtmetalle, Gase und Halbmetalle
Experiment: Kohlenstoffdioxyd, Darstellung und Eigenschaften

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

Additional Requirements:

Experiment Variations:

Keywords:

carbon dioxide, preparation of carbon dioxide, properties of carbon dioxide

Task and equipment

Information for teachers

Learning objectives

- Carbon dioxide can be obtained from carbonates (in this case marble) by adding acids.
- Carbon dioxide has characteristic properties on which it can be recognised. Among them are a very high density and the ability to smother flames.

Notes on set-up and procedure

Preparation
Dilute the hydrochloric acid given in the list of chemicals by adding the twofold volume of water to obtain an approximately 10% acid.

Remarks on the students' experiments

Ensure that no force is used on inserting the glass devices into the rubber stopper. Lubricate the connections with glycerol; insert the devices while turning them.
The gas evolution must continuously occur by uniform dropwise addition of the acid. If necessary, shake the Erlenmeyer flask slightly.
Glass beakers filled with carbon dioxide must be moved cautiously, as otherwise the carbon dioxide diffuses away.



Hazard and Precautionary statements

Hydrochloric acid:

H314:	Causes severe skin burns and eye damage.
H335:	May cause respiratory irritation.
H290:	May be corrosive to metals
P280:	Wear protective gloves and eye/face protection.
P301 + P330 + P331:	IF SWALLOWED: rinse mouth. Do NOT induce vomiting.
P309 + P310:	IF exposed or if you feel unwell: Immediately call a POISON CENTER or doctor/physician.
P305 + P351 + P338:	IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.

Hazards

- Hydrochloric acid and lime water are caustic. If splashed onto your skin, rinse with abundant water!
- Wear protective glasses!
- Lubricate rubber-glass connections with glycerol. Do not use force!

Notes

Calcium carbonate (marble) is, like other carbonates, decomposed by strong acids with CO_2 formation.

$$CaCO_3 + 2\ HCl \rightarrow CaCl_2 + H_2O + CO_2$$

Remarks on the method

Also in this experiment, chemically pure calcium carbonate could have been used. However, the use of natural calcium carbonate (marble) is advantageous because it can show that carbon dioxide, as a component of air, has mineralising effect. This can be followed by a discussion of the increase of the carbon dioxide fraction of air due to combustion process, the green house effect, photosynthesis, etc.

Waste disposal

- Collect the hydrochloric acid remaining in the dripping funnels in labelled containers and reuse it for similar experiments.
- Pour the liquid remaining in the Erlenmeyer flask and the lime water into the collection container for acids and alkalis.

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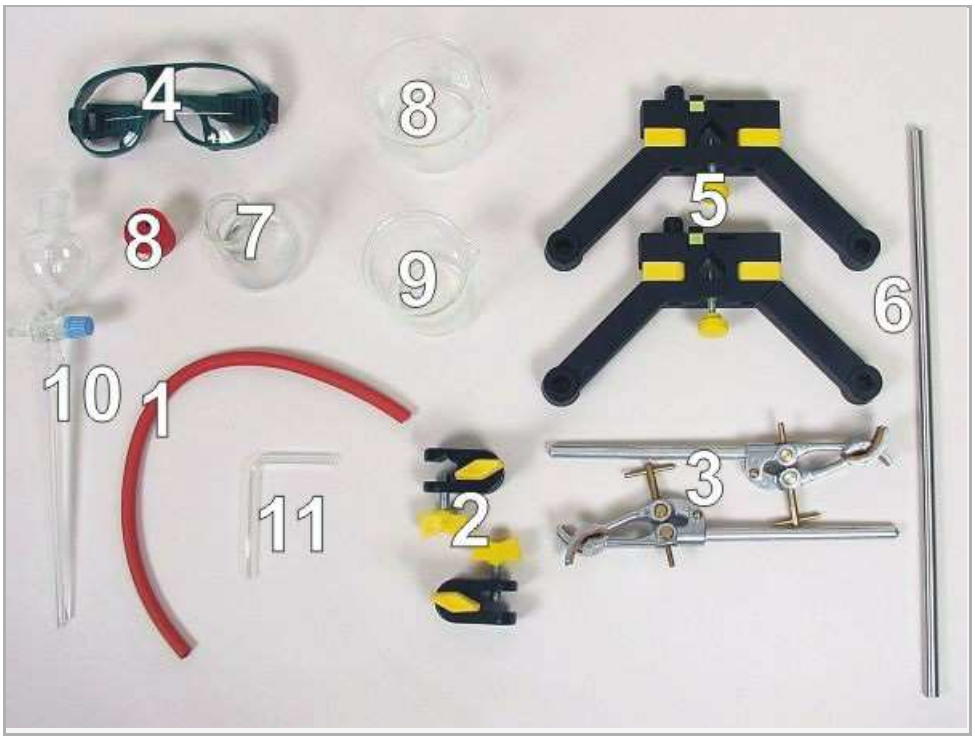
Task and equipment

Task

Which properties does carbon dioxide have; how can it be prepared other than from air?

Prepare carbon dioxide from marble and investigate its properties.

Equipment



Position No.	Material	Order No.	Quantity
1	Rubber tubing, i.d. 6 mm	39282-00	1
2	Boss head	02043-00	2
3	Universal clamp	37715-00	2
4	Protecting glasses, clear glass	39316-00	1
5	Support base, variable	02001-00	1
6	Support rod, stainless steel, l=370 mm, d=10 mm	02059-00	1
7	Erlenmeyer flask 100 ml, wide-neck SB 29	36428-00	1
8	Glass beaker DURAN®, short, 250 ml	36013-00	1
8	Rubber stopper 26/32, 2 holes 7 mm	39258-02	1
9	Glass beaker DURAN®, tall, 250 ml	36004-00	1
10	Dropping funnel with drip nozzle, 50ml	36912-00	1
11	Glass tube,right-angled, 10 pcs.	36701-52	(1)
	Glycerol, 250 ml	30084-25	1
	Marble, pieces 1000 g	30140-70	1
	Hydrochloric acid 37 %, 1000 ml	30214-70	1
	Calcium hydroxide solution 1000ml	31458-70	1
Additional material			
	Candles, 3 pcs (1, 2, 3 cm high)		
	Warming candle		

Set-up and procedure

Set-up

Set-up

- Hydrochloric acid and lime water are caustic. If splashed onto your skin, rinse with abundant wateer!
- Wear protective glasses!
- Lubricate rubber-glass connections with glycerol!



Set-up

Set up the support stand according to Fig. 1- Fig. 4 and attach the Erlenmeyer flask to it such that it stands securely in the working area (Fig. 5 + Fig. 6).

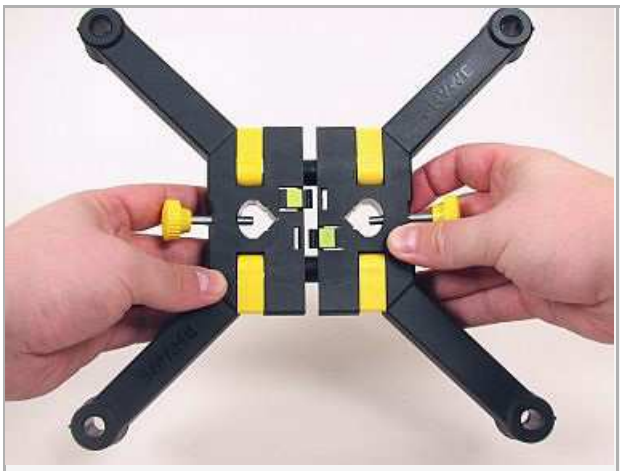


Fig. 1

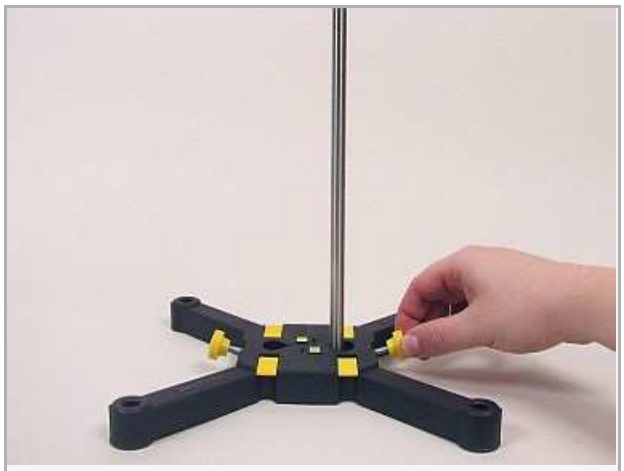


Fig. 2

Fig. 3

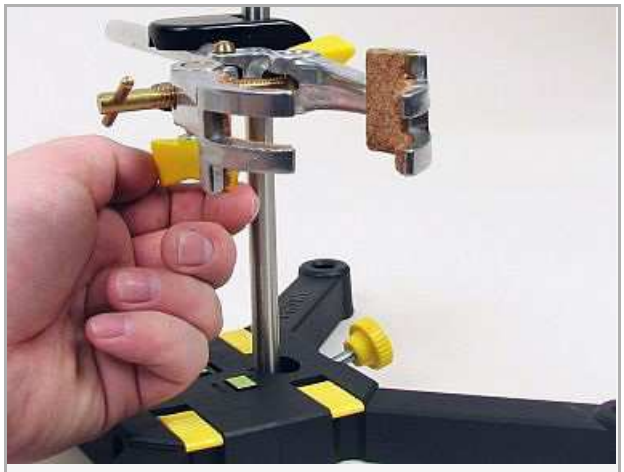


Fig. 4

Fig. 5

Fig. 6

Insert the right-angled tube into the stopper by twisting it (lubricate it with glycerol) (Fig. 7). Subsequently insert the dripping funnel into the second hole in the stopper such that part of the outlet tube extends through the stopper (Fig. 8). Attach an approximately 15 cm long piece of tubing on the right-angled tube (Fig. 9).

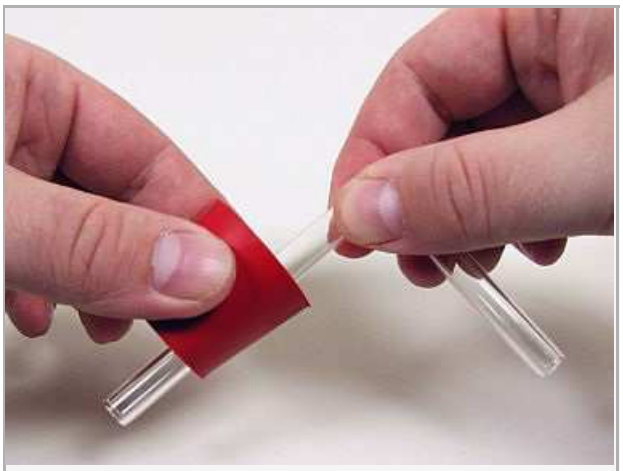


Fig. 7

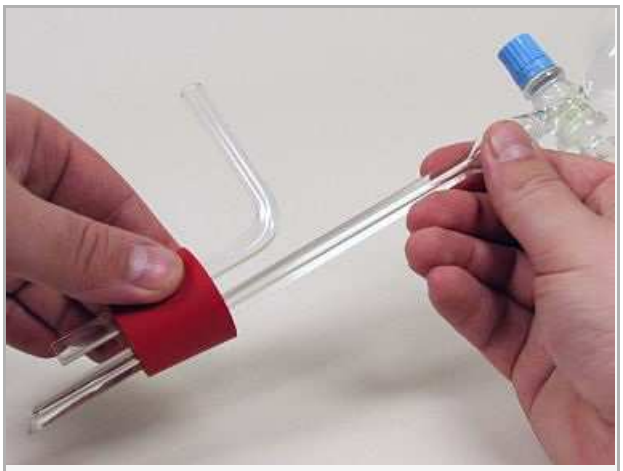


Fig. 8

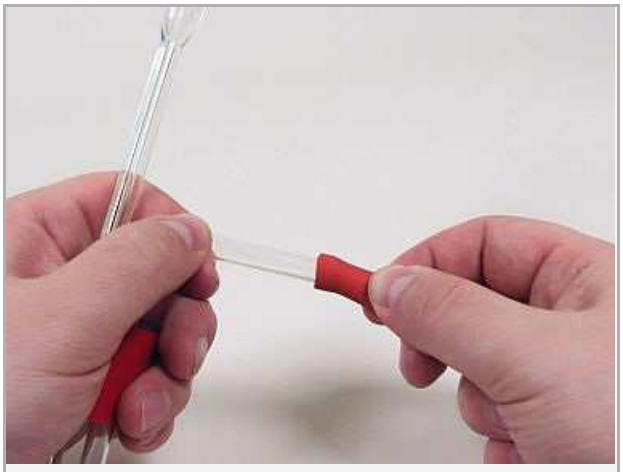


Fig. 9

Put five medium-sized pieces of marble into the Erlenmeyer flask (Fig. 10) and seal it tightly with the stopper (Fig. 11).

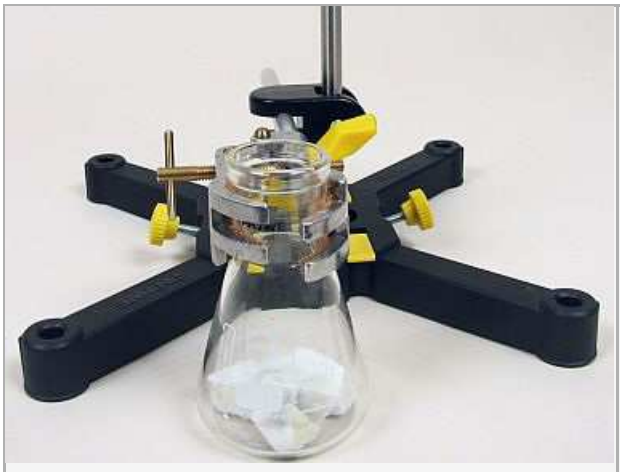


Fig. 10

Fig. 11

Secure the dripping funnel with an universal clamp (Fig. 12 - Fig. 14)

Fig. 12

Fig. 13

Fig. 14

Close the stopcock (Fig. 15) and fill the dripping funnel full with diluted hydrochloric acid (Fig. 16).

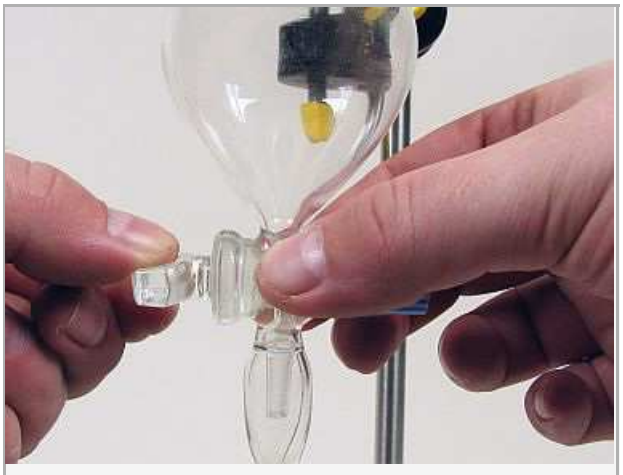


Fig. 15

Fig. 16

Procedure

Procedure

Fill the 250 ml glass beaker one third full with lime water. Open the stopcock only far enough to allow individual drops of hydrochloric acid to fall onto the pieces of marble (Fig. 17). Immerse the end of the tubing into the lime water (Fig. 18). Stop the gas evaluation after approximately 30 seconds by terminating the dripping. Take the tubing out of the lime water and clean it.

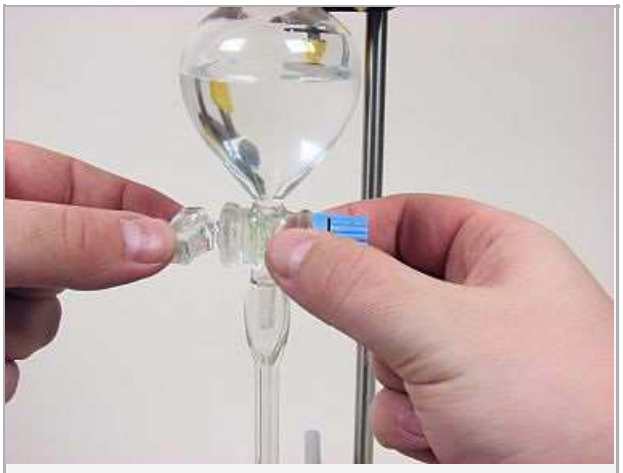


Fig. 17

Fig. 18

With the aid of drops of wax, position the three candles on the bottom of the short 250 ml glass beaker (Fig. 19 + 20). Place the end of the tubing on the bottom of the beaker (Fig. 21), light the candles and restart the gas evolution.

Fig. 19

Fig. 20

Fig. 21

Remove the three candles. Put the warming candle into the tall 250 ml glass beaker and light it (Fig. 22). Fill the short 250 ml beaker with carbon dioxide (Fig. 23) and then pour it cautiously like a liquid into the beaker with the warming candle (Fig. 24).

Fig. 22

Fig. 23

Fig. 24

Waste disposal

Pour the hydrochloric acid remaining in the Erlenmeyer flask and the lime water into the collection container for acids and alkalis.

Report: Carbon dioxide - preparation and properties

Result - Observations

Note your observations.

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Evaluation - Question 1

Make conclusions from your observations.

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Evaluation - Substance description form

Record the observed properties in the general substance description form. Complete it with information from your textbook.

Substance name:	1
Chemical symbol:	1 ±0
Colour:	1
State of aggregation:	1
Melting point:	1
Boiling point:	1
Further properties:	1
Occurence:	1
Applications:	1

Evaluation - Question 2

In what processes is carbon dioxide always evolved? In accordance with the above experiment, from which other substances can carbon dioxide be prepared?

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