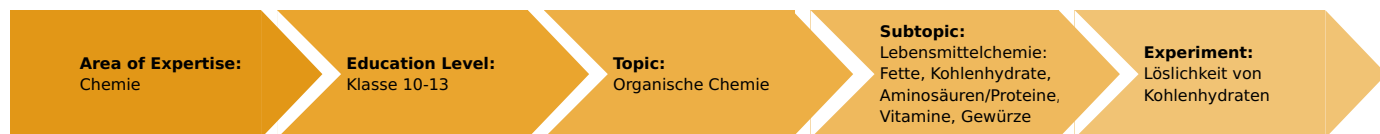


# The solubility of carbohydrates (Item No.: P7186700)

## Curricular Relevance



### Difficulty



Intermediate

### Preparation Time



10 Minutes

### Execution Time



20 Minutes

### Recommended Group Size



2 Students

### Additional Requirements:

### Experiment Variations:

### Keywords:

carbohydrate, solubility

## Task and equipment

## Information for teachers

## Additional Information

When a salad dressing is prepared, the sugar dissolves only after vinegar or water are added. Sugar dissolves quicker in coffee without adding milk.

## Notes on content and learning objectives

- Clarification of the terms hydrophilic and hydrophobic is a prerequisite.
- The dipole action of water.
- Carbohydrates are hydrophilic substances which are soluble in water and alcohol.
- The -OH groups of carbohydrates are primarily responsible for their solubility.

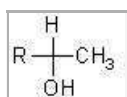
## Notes on the method

The meaning of the terms hydrophilic and hydrophobic must be clear to the students. The difference between hydrophilic and hydrophobic substances can be introduced and deepened by solubility experiments. The decision whether to touch on the formula of glucose depends upon the state of knowledge of the students.

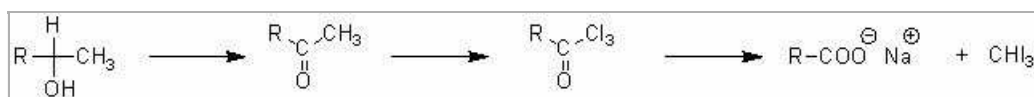
The theory of the iodoform test should be worked out in a classroom discussion.

## Fundamentals and remarks

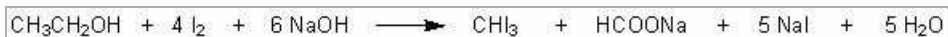
Alcohols have a structural formula of the type



react with iodine, producing iodoform (triiodomethane). Iodoform has a typical chemical smell and forms small, yellow crystals. In the iodoform reaction, alcohol is oxidized to an aldehyde or ketone, which is then halogenated and finally split to iodoform.



For example:



## Hints on going deeper

- According to requirements, the opportunity is given here to address the terms polar and unpolar.
- The dipole action of water should be introduced.

## Notes on the set-up and procedure

### Preparation:

Pentane or other alkanes can be used as unpolar solvent.

Prepare dilute caustic soda in advance (approx. 10 g of NaOH to 100 ml).

### Notes on the students experiment:

Take care to ensure that all open flames are extinguished before combustible liquids are handled.



## Hazard and Precautionary Statements

Ethanol:

H225: Highly flammable liquid and vapour.

P210: Keep away from heat/sparks/open flames/hot surfaces – No smoking.

Sodium hydroxide:

H314: Causes severe skin burns and eye damage.

H290: May be corrosive to metals.

P280: Wear protective gloves/protective clothing/eye protection/face protection.

P301 + P330 + P331: IF SWALLOWED: Rinse mouth. Do NOT induce vomiting.

P309 + P310: IF exposed or you feel unwell: 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.

Petroleum ether:

H225: Highly flammable liquid and vapour.

H304: May be fatal if swallowed and enters airways.

H315: Causes skin irritation.

H361f: Suspected of damaging fertility or the unborn child.

H336: May cause drowsiness or dizziness.

H373: May cause damage to organs through prolonged or repeated exposure.

H411: Toxic to aquatic life with long lasting effects.

P210: Keep away from heat/sparks/open flames/hot surfaces – No smoking.

P233: Keep container tightly closed.

P240: Ground/bond container and receiving equipment.

P273: Avoid release to the environment.

P281: Use personal protective equipment as required.

P301 + P310: IF SWALLOWED: Immediately call a POISON CENTER or doctor/physician.

P302 + P352: IF ON SKIN: Wash with soap and water.

P304 + P340: IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing.

P308 + P313: IF exposed or concerned: Get medical advice/attention.

P331: Do NOT induce vomiting.

P403 + P235: Store in a well ventilated place. Keep cool.

## Hazards

- Ethanol and petroleum ether are highly inflammable. Extinguish all open flames before handling them.
- Wear protective glasses!

- Sodium hydroxide is caustic. Iodine potassium iodide solution attacks mucous membranes. Avoid skin-contact with these liquids.
- Carry out the experiment in a fume cupboard whenever possible.

## Waste disposal

Pour the solutions in test tube 1 to drain.

Pour the solution in test tubes 2 and 3 into the container for combustible organic solvents.

Pour the solution in test tube 4 into the container for acid and alkali waste.

# The solubility of carbohydrates (Item No.: P7186700)

## Task and equipment

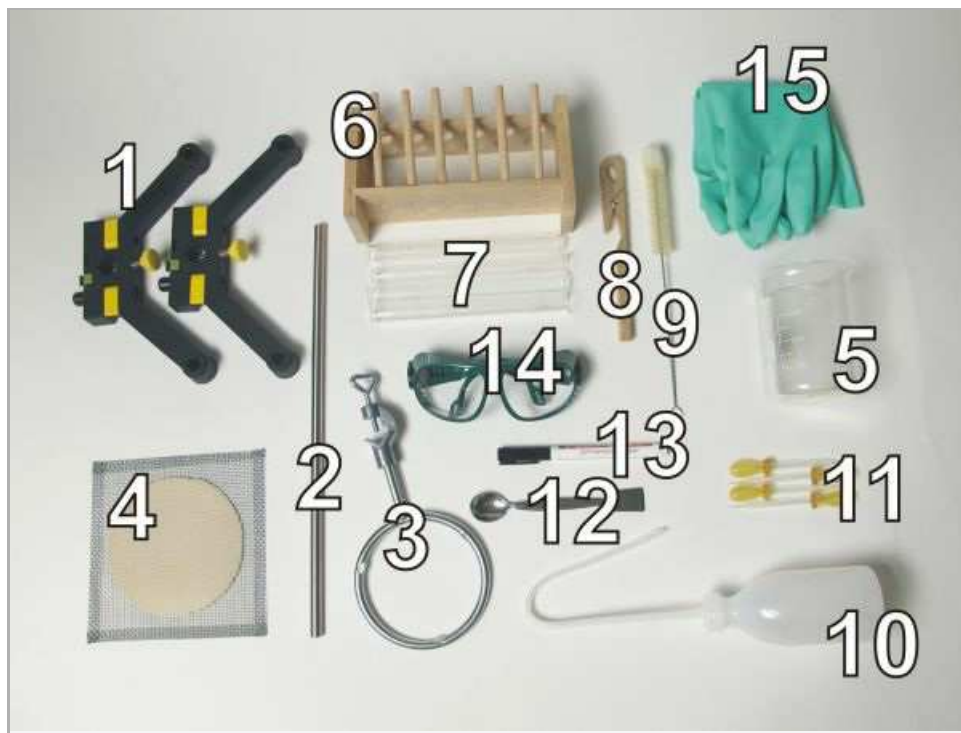
### Task

### Which functional groups are responsible for the solubility of carbohydrates?

Examine the solubility of glucose.



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	(4)
8	Test tube holder, up to d 22mm	38823-00	1
9	Test tube brush w. wool tip,d25mm	38762-00	1
10	Wash bottle, 250 ml, plastic	33930-00	1
11	Pipette with rubber bulb	64701-00	4
12	Spoon, special steel	33398-00	1
13	Labor pencil, waterproof	38711-00	1
14	Protecting glasses, clear glass	39316-00	1
15	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
	Ethanol extra pure ab.95% 1000 ml	30008-70	1
	Iodine potass.iodide sol., 250 ml	30094-25	1
	Sodium hydroxide, flakes, 1000 g	30157-70	1
	Petroleum ether, 40-60 gr 1000 ml	30184-70	1
	D(+)-glucose 1000 g	30237-70	1
	Water, distilled 5 l	31246-81	1
	Boiling beads, 200 g	36937-20	1
Additional material			
	Fume cupboard		

## Set-up and procedure

### Set-up

### Hazards

- Ethanol and petroleum ether are highly inflammable. Extinguish all open flames before handling them!
- Wear protective glasses!
- Sodium hydroxide is caustic. Iodine potassium iodide solution attacks mucous membranes. Avoid skin contact with these liquids.
- Carry out the experiment in a fume cupboard whenever possible.



### Setup

Number four test tubes from 1 to 4 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. Heat it to boiling, then put it aside. Extinguish the bunsen burner flame!

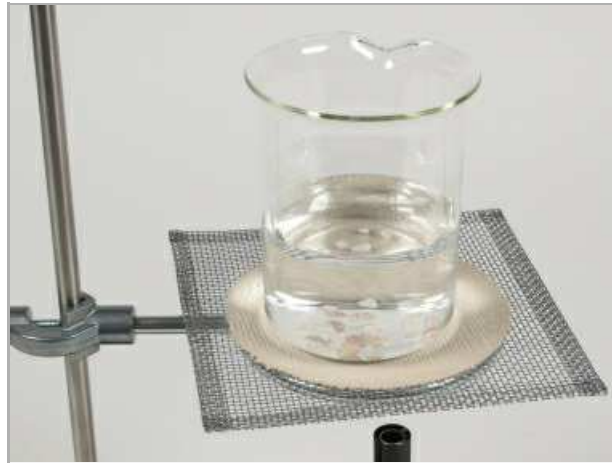


Fig. 7

## Procedure

Pipette distilled water into test tube 1 to a height of 3cm. Pipette the same quantity of ethanol into test tube 2, and of petroleum ether into test tube 3 (Fig. 8).

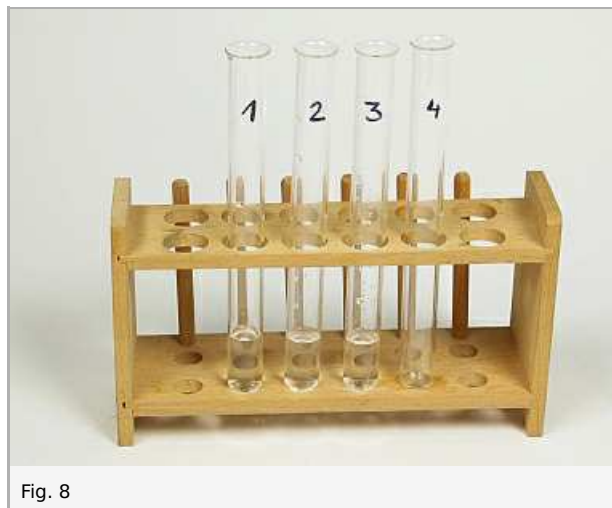


Fig. 8

Test the solubility of glucose in the three liquids in the following way:  
Successively add glucose to each test tube in small portions, under shaking, until an insoluble residue remains (Fig. 9-10).





Put a spatula tip of glucose in test tube 4. Add caustic soda to a height of 3 cm (Fig. 11). Carefully shake the solution until the glucose has completely dissolved. Add iodine potassium iodide solution dropwise, until the solution is just coloured brown.



Place the test tube in the prepared beaker of hot water (Fig. 12). After a few minutes, test the smell at the mouth of the test tube and watch the solution as it cools.



Fig. 12

## Waste disposal

Pour the solutions in test tube 1 to drain.

Pour the solution in test tubes 2 and 3 into the container for combustible organic solvents.

Pour the solution in test tube 4 into the container for acid and alkali waste.

## Report: The solubility of carbohydrates

### Result - Table 1

Note your observations in the following succession.

Test tube	Liquid	Solubility
1	Water	1
2	Alcohol	1
3	Petroleum ether	1

### Result - Observations

Note your observations.

- Solubility of glucose
- Reaction of glucose with iodine (Test tube 4)

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### Evaluation - Question 1

Draw conclusions from your observations.

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### Evaluation - Question 2

Draw the structural formula of the carbohydrate glucose.

**Evaluation - Question 3**

Complete the following statements.

1. Carbohydrates are ..... substances, which are ..... soluble in water and alcohol.
2. Carbohydrates are ..... in ..... which are not miscible with water.
3. The ..... groups of carbohydrates are responsible for their solubility.