

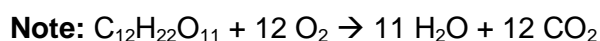
## C1 We burn sugar – Cellular respiration and respiratory chain

Note: This answer sheet will go into the analyses for the individual subexperiments only if experience shows that there could be particular difficulties.

### 1 Sugar can be burned

#### 1.5 Analysis

Formulate a reaction equation or word equation for the burning of sugar.



Sucrose ("sugar") + oxygen → water + carbon dioxide

#### 1.6 Questions

- a) What is the name of the reaction type to which combustion processes belong?

**Answer:** All combustion processes have one thing in common: They require oxygen. The chemical term for the reaction of a substance with oxygen is oxidation. Therefore, the associated reaction type is oxidation. In a broad sense, any reaction in which a substance (formally) gives up electrons is oxidation in modern chemistry.

- b) What happens at the particle level during combustion?

**Answer:** In every chemical reaction, including combustion, the smallest particles (molecules or atoms) of the reaction partners must hit each other with high energy so that they can react with each other. They must therefore have very high kinetic energy.

- c) What properties must the reaction partners have in a combustion process?

**Answer:** Apart from combustion at an extremely high temperature, most combustible materials react with oxygen only when they are in gaseous form. Thus, melting the sugar is not sufficient. The sugar must first be partially degraded into flammable gases and carbon due to the effect of the flame. Then these gases will mix with oxygen in the air and burn. The carbon will not vaporize and burn on the surface of the remaining carbon ("smolder out") until a higher temperature is reached. The necessary ignition temperature or the activation energy for sugar degradation is so high that the sugar will burn only in an external flame. If you remove the external flame, for example, the lighter, the sugar will stop burning immediately.

- d) What effect does the ash have in our experiment?

**Answer:** The ash serves as a catalyst for the pyrolysis (thermal degradation) of the sugar and the surface combustion of the carbon. This means that the activation energy is reduced to the extent that now the sugar can continue to burn on its own, even at a relatively low temperature.

## 2 Verification of reaction products in the air that is breathed: Substance A

### 2.6 Questions

- a) What is the name of the gas (substance A) in the exhaled air that condenses on the test tube?

**Answer:** The gas is water vapor. You can recognize this because the same effect occurs when you cook noodles, for example. When the water in the pot is boiling and you lift the lid, you can observe that a window pane, which is considerably cooler, steams up from the water.

- b) This experiment verifies a reaction product of human metabolism. What substances are converted in the body and how do they get there? How do these starting substances get into your body for further conversion?

**Answer:** The body needs carbohydrates, proteins, and fats (lipids) for its structure and to maintain its energy metabolism. All of these substances are supplied to the body with food. These substances are usually present in food in a chemically bound form and must first be broken down by means of digestion into substances that can be absorbed by the body.

For example, during digestion the carbohydrates are converted to glucose, which is stored in the muscle cells and the liver in the form of glycogen. The body accesses these stores especially when it needs energy for a short time.

The fat in food is broken down into fatty acids and stored in body tissue as the body's own fat. It serves as the body's energy reserve during physical exertion for a medium to long time.

The proteins are broken down into amino acids and stored as the body's own proteins, especially in the muscles. Normally, the body uses these proteins only as an energy reserve during long periods of hunger.

## 3 Verification of reaction products in the air that is breathed: Substance B

### 3.6 Questions

What are the processes that take place in the human body for breaking down the carbohydrates that are absorbed with food? Explain them.

**Answer:** Summarized in the answer to 2.6 b). You will find detailed information in the teacher instructions for experiments "C2 Carbohydrates as providers of energy for metabolism – Starch and sugar" and "C3 How does human digestion break down fats? – Saponification of edible oil".