



## The composition and formula of water

### Learning objectives

- 1 Describe how water is formed during the redox reaction of copper oxide with hydrogen.
- 2 Accurately record experimental observations and data.
- 3 Determine the formula of water from the experimental data.

### Introduction

Your teacher will demonstrate the reaction between copper oxide and hydrogen gas, in which water is a product. During the demonstration, you will record your observations, then use the experimental data to determine the formula of water.

### Questions

1. Write the word equation for the reaction

\_\_\_\_\_ + \_\_\_\_\_ → \_\_\_\_\_ + \_\_\_\_\_

2. Select the correct words to complete the sentences.

In a redox reaction, oxidation and reduction occur at the same time.

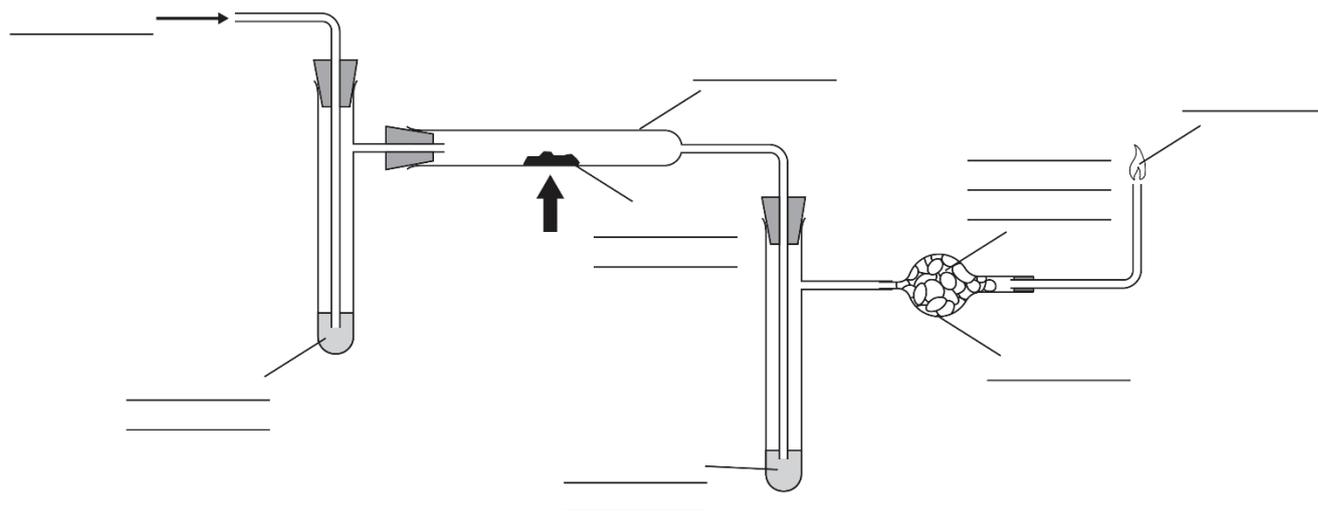
Reduction occurs when a substance **loses/gains** oxygen. Oxidation occurs when a substance **loses/gains** oxygen.

In this experiment, the copper oxide is **oxidised/reduced** and the hydrogen is **oxidised/reduced**.



3. Label the diagram using the following words:

concentrated sulfuric acid    heat    drying tube  
 combustion tube    copper oxide    concentrated sulfuric acid  
 exhaust fumes    anhydrous copper chloride    hydrogen in



4. State why concentrated sulfuric acid was added to the side arms.  
 Hint: Concentrated sulfuric acid is a drying agent.

It was added to the left-hand arm to dry \_\_\_\_\_  
 It was added to the right-hand arm to \_\_\_\_\_

5. List two safety precautions taken during the reaction.

- i. \_\_\_\_\_  
 ii. \_\_\_\_\_

6. Record the masses in the table.

	Mass before heating / g	Mass after heating / g
Mass of combustion tube and contents	M1 = _____	M2 = _____
Mass of combustion tube, side arm and contents	M3 = _____	M4 = _____



7. Note your observations in the table. Use the final column to explain your observation.

	Observation	Explanation
Before heating	The solid in the combustion tube was _____	
During heating	_____ was seen on the side of the combustion tube. It then _____	
After heating	The solid in the combustion tube was _____	

8. Use the data recorded in your table to calculate:
- (a) The mass of oxygen lost from the copper oxide ( $M_5$ ) =  $M_1 - M_2 =$  \_\_\_\_\_ g
- (b) The mass of water formed during the reaction ( $M_6$ ) =  $M_4 - M_3 =$  \_\_\_\_\_ g
- (c) The mass of hydrogen in the water formed ( $M_7$ ) =  $M_6 - M_5 =$  \_\_\_\_\_ g

9. The relative atomic mass of oxygen is 16 and the relative atomic mass ( $A_r$ ) of hydrogen is 1.

*Hint:* number of moles = mass/ $A_r$

Calculate:

- (a) The number of moles of oxygen in the water =  $M_5/16 =$  \_\_\_\_\_ mol
- (b) The number of moles of hydrogen in the water =  $M_7/1 =$  \_\_\_\_\_ mol
- (c) The mole ratio of H:O in the water = \_\_\_\_\_

10. Write the formula of water and describe its composition.

The formula of water is \_\_\_\_\_.

A molecule of water is made up of two \_\_\_\_\_ atoms bonded to one \_\_\_\_\_ atom.

11. Complete the balanced symbol equation for the reaction.

