Decomposition reactions

This resource accompanies the article **The beauty of a breakup** in *Education in Chemistry* which provides everyday contexts for decomposition reactions. The article can be viewed at: rsc.li/3jb3h21

Learning objectives

1 Identify decomposition reactions from a word equation or symbol equation.

2 Use the law of conservation of mass to balance simple decomposition reactions.

Learning objective 1 is assessed via Q1, Q2b, Q3a, Q3b, Q4a, Q4b, Q5a–d.

Learning objective 2 is assessed via Q3c, Q3d, Q4c, and Q5e.

Introduction

Decomposition reactions are a key part of our everyday lives. The decomposition of hydrogen peroxide is responsible for bleaching hair, cleaning bathrooms and making paper white, while the decomposition of sodium hydrogen carbonate (baking soda) makes cakes rise and puts the bubbles in honeycomb.

Scientists are even looking to decomposition reactions to provide alternatives to fossil fuels, with the decomposition of water producing a cleaner source of energy for hydrogen-fuelled vehicles.

How to use the resources

Decomposition reactions allow lots of opportunities for practical work or demonstrations. Using these question sheets, learners can apply their knowledge to questions that link decomposition reactions to word equations, symbol equations and conservation of mass.

There are two versions of the worksheet. An unscaffolded version where learners can write the answers in their own words and a scaffolded version where learners can use the prompts, key words and fill-in-the-gap style questions to support their answers. The scaffolded version is denoted by the symbol 'S' in the document header. A challenge question is included at the end of both versions.

Answers

1. A reaction where a **compound** is broken **down** into **two** or more simpler compounds or **elements**.

2. (a) All are compounds as they contain two different elements chemically bonded together.

(b) Lead carbonate is a reactant.
Lead oxide is a product.
Carbon dioxide is a product.

3. (a) The reactant, $MgCO_3$, is magnesium carbonate.
The product MgO is magnesium oxide and the product CO_2 is carbon dioxide.

(b) One reactant is broken down into two simpler products.

(c) As there are the **same** number of atoms of each **element** on both sides of the **equation**, the equation is **balanced**.

(d) i.

$$MgCO_3 \rightarrow MgO + CO_2$$

$$18.5\,g \rightarrow 9.6\,g + CO_2$$

$$CO_2 = \mathbf{18.5 - 9.6}$$

$$CO_2 = \mathbf{8.9}\,g$$

ii. The conservation of **mass** states that atoms cannot be created or **destroyed**. Therefore, the mass of the **reactants** must be the same as the mass of the **products**.

4. (a) copper carbonate → copper oxide + carbon dioxide

(b) $CuCO_3 \rightarrow CuO + CO_2$

(c) i.

Element	Number of each element	
	Left-hand side	Right-hand side
Copper	1	1
Carbon	1	1
Oxygen	3	3

ii. This symbol equation is **balanced** as the number of atoms of each **element** is the **same** on both sides of the **equation**.

Challenge answers

5. (a) Mercury, oxygen

(b) Mercury(II) oxide → mercury + oxygen

(c) Hg and O_2

(d) $HgO \rightarrow Hg + O_2$

(e)

Element	Number of each element	
	Left-hand side	Right-hand side
Mercury	1	1
Oxygen	1	2

The equation is not balanced as there are two oxygen atoms on the right-hand side compared to only one on the left-hand side. To balance the oxygens, we must put a two in front of the HgO.

$$2HgO \rightarrow Hg + O_2$$

Element	Number of each element	
	Left-hand side	Right-hand side
Mercury	2	1
Oxygen	2	2

While the oxygen atoms are now balanced, the mercury atoms are no longer balanced. To balance them, we must put a two in front of the Hg on the right-hand side of the equation to balance the equation.

$$2HgO \rightarrow 2Hg + O_2$$

Element	Number of each element	
	Left-hand side	Right-hand side
Mercury	2	2
Oxygen	2	2