Reactant and product substances

This resource is from the **Johnstone's triangle** series which can be viewed at: rsc.li/43jMfSn. In this series you will also find our Johnstone's triangle worksheet which introduces the triangle in the context of the reaction between iron and sulfur: rsc.li/4q4xiNl.

Learning objectives

LO	Objective	Where assessed
1	Recognise that during a physical change no new substance is formed.	Q1
2	Match the name of some elements and compounds to descriptions of their state (at room temperature) and their colour.	Q2(a)
3	Match the chemical formula of some elements and compounds to their names.	Q2(b)
4	Explain an observed change in terms of the formation of a new product substance.	Q3
5	Explain why the colour of a product substance cannot be predicted from the colour of the reacting substances.	Q4

How to use this resource

This resource aims to develop learners' understanding of reactants and products including their appearance and representation with symbols and chemical formulas.

When to use?	Introduce	**Develop**	**Revise**	Assess
	Use after initial teaching or discussion of this topic to develop ideas further. You can also use as a revision activity.			
Group size?	**Independent**	**Small group**	**Whole class**	**Homework**
	Suitable for independent work either in class or at home. Or use the questions for group or class discussions.			
How long?			15–30 mins	

The questions encourage learners to think carefully about observations of colour during chemical reactions. Learners are also supported to understand that atoms have no colour and therefore the colour of the product of a reaction is not related to the colour of the reactants. As a result, learners should develop more secure mental models to support their thinking about this topic.

Johnstone's triangle

Johnstone's triangle is a model of the three different conceptual levels in chemistry: macroscopic, sub-microscopic and symbolic. You can use Johnstone's triangle to build a secure understanding of chemical ideas for your learners.

Find further reading about Johnstone's triangle and how to use it in your teaching at rsc.li/4jnuV6E.

Johnstone's triangle and this resource

The icons in the margin indicate which level of understanding each question is developing to help prompt learners in their thinking.

Macroscopic: what we can see. Think about the properties that we can observe, measure and record.

Sub-microscopic: smaller than we can see. Think about the particle or atomic level.

Symbolic: representations. Think about how we represent chemical ideas including symbols and diagrams.

The levels are interrelated, for example, learners need visual representation of the sub-microscopic to develop mental models of the particle or atomic level. Our approach has been to apply icons to questions based on what the learners should be thinking about.

Questions may be marked with two or all three icons, indicating that learners will be thinking at more than one level. However, individual parts of the question may require learners to think about only one or two specific levels at a time.

Support

This worksheet is ramped so that the earlier questions are more accessible. The activity becomes more challenging in the later questions. You can give extra explanations for the more challenging questions. If completing as an in-class activity it is best to pause and check understanding at intervals, as often one question builds on the previous one.

It is useful for learners to observe macroscopic properties first hand. You could circulate examples of substances in the classroom, run a class practical of a chemical reaction or show a teacher demonstration of properties.

Additional support may be needed for any learners still lacking in confidence in the required symbolic representation, for example by sharing and explaining a diagram or a simulation that can show movement of the particles.

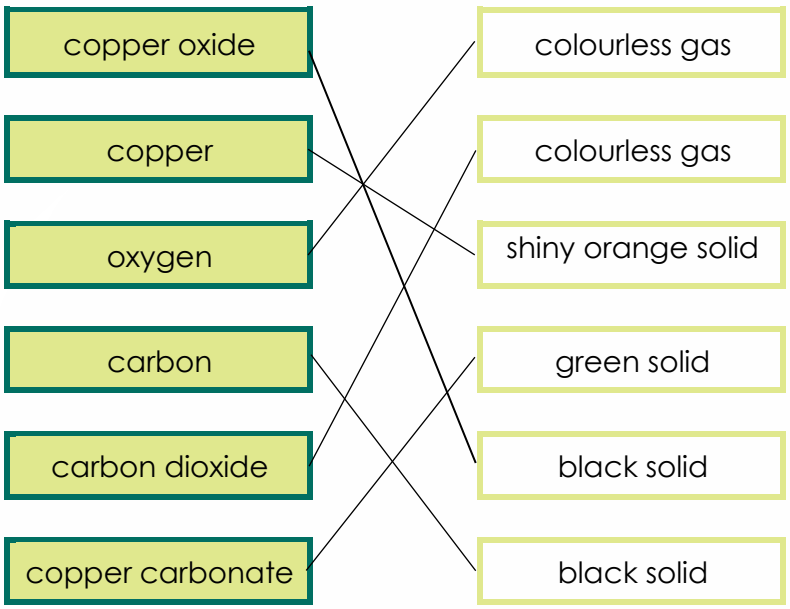
Answers

1. *Guidance note:* This question develops learners' understanding of physical change being a change in which no new substance is formed (macroscopic understanding).

(a) Water
(b) Water
(c) No new substance is formed.
(d) Physical

2. *Guidance note:* This question develops learners' familiarity with a range of substances that they may commonly encounter when first learning about reactants and products. The question supports leaners to develop understanding of the appearance of the different substances (macroscopic understanding) and their representation with symbols or chemical formulas (symbolic understanding). The question also reinforces the idea that the properties of a compound are different to its constituent elements.

(a)



(b)

i. carbon
ii. oxygen
iii. carbon dioxide
iv. copper
v. copper oxide
vi. copper carbonate

(c) Copper carbonate is a compound. The individual elements are no longer present. It therefore has different properties to the individual elements.

3. *Guidance note:* This question develops learners' understanding of how observations of the heating of copper (macroscopic understanding) can be used as evidence for the formation of a new product substance.

(a) Copper
(b) Oxygen
(c) Air
(d) Copper cannot change colour because colour is a property of copper.
(e) Copper oxide

4. *Guidance note:* This question develops learners' understanding of how the colour of the product of a chemical reaction cannot be predicted from the colour of the reactants (macroscopic understanding). The question supports learners in understanding that atoms have no colour and are therefore not the same colour as the bulk substance (sub-microscopic understanding). The question also supports learners to understand that particle diagram colouring is not a representation of the actual colour of atoms (symbolic understanding). It may help to explain that the colouring of particle diagrams is simple as a key to distinguish different types of particles (atoms) in the diagram.

(a) No
(b) No colour
(c) Diagrams showing iron atoms as grey and sulfur atoms as yellow could encourage the misconception that atoms have the same colour as the substance.
(d) The colour of iron sulfide cannot be a mixture of the colours of the atoms of iron and sulfur as the atoms do not have a colour.