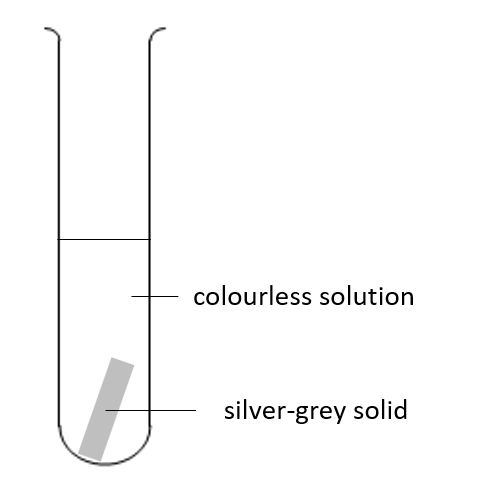
**Reaction observations**



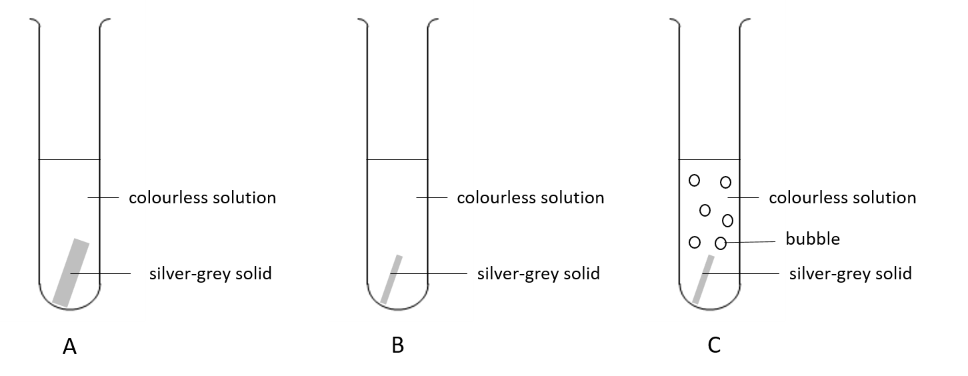
1. Look at the following chemical equation.

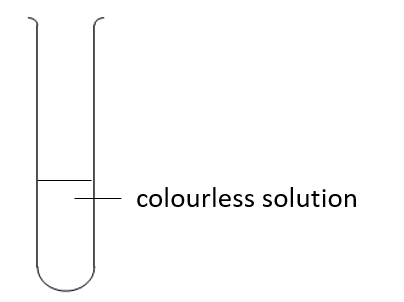
Mg (s) + 2HCl (aq) →MgCl2 (aq) + H2 (g)

The diagram on the right shows the reactants at the start of the reaction.

Look at the diagrams below.

Which diagrams shows what will be observed during the reaction?



1. Look at the following chemical equation.

AgNO3 (aq) + NaCl (aq) → AgCl(s) + NaNO3 (aq)

The diagram shows the reactants at the start of the reaction.

What will be observed when the reaction is complete?

A No change

B A solid white lump

C A cloudy white suspension

*Chemistry > Big idea CPS: Particles and structure > Topic CPS4: Understanding reactions > Key concept CPS4.1: Representing reactions*

|  |
| --- |
| **Diagnostic question** |
| **Reaction observations** |

**Overview**

|  |  |
| --- | --- |
| Learning focus: | A chemical reaction can be summarised by a chemical equation. |
| Observable learning outcome: | Link a symbolic chemical equation to macroscopic observations of a reaction. |
| Question type: | simple multiple choice |
| Key words: | state symbol, solid, liquid, gas, aqueous |

**What does the research say?**

Johnstone (1991) used a triangle to summarise three levels of representation that he proposed are needed in order to understand chemistry.



*Figure 1 Johnstone’s triangle*

Johnstone (2000) highlights how in chemistry teaching students are often introduced to all three levels of representation simultaneously. Whilst an experienced chemist may be able to manipulate all three, he suggests that this may overload the “working space” (working memory) of school students.

Jaber and BaJaoude (2012) build on previous work (Treagust, Chittleborough and Mamiala, 2003) that links levels of understanding to the use of different levels of representation in chemistry.

They propose that at an instrumental level of understanding (knowing how) students learn chemical concepts at the three levels separately. This may lead to fragmented and compartmentalised knowledge.

They then suggest that in order to acquire a relational level of understanding (knowing why) students need to develop ways to move easily and skilfully within Johnstone’s triangle.

The researchers then compared an experimental group with a control group where the experimental group received:

* explicit teaching at and about macro, micro and symbolic levels and the interplay between them
* use of multiple schematic and symbolic representations
* explicit teaching about models

In conclusion, the research recommends the adaption of a macro-micro-symbolic approach to instructions and suggests that this should become a ‘habit of teaching’.

This diagnostic question checks whether students are able to make the link between a symbolic representation (a chemical equation) and a macroscopic observation of a chemical reaction.

**Ways to use this question**

Students should complete the question individually. This could be a pencil and paper exercise, or you could use an electronic ‘voting system’ or mini white boards and the PowerPoint presentation.

Asking students to then share their answers and reasons may help to provide more information about their understanding.

*Differentiation*

Some students may benefit from being able to observe real life samples.

**Expected answers**

1C, 2C

**How to respond - what next?**

The selection of A or B for question 1 suggests that a student may not have related the (g) state symbol in the products to the formation of bubbles during the reaction.

Selection of A, in addition, implies that a student has not noted that Mg(s) is not present in the final products, from which should be inferred that during the reaction the size of the piece of magnesium decreases.

For question 2, selection of A could mean that the student has not linked the (s) symbol in the products to the macroscopic observation that the test tube will no longer contain a clear solution.

Selection of B suggests that the student has directly interpreted the (s) to mean a solid lump of a substance, rather than applying understanding of what is observed when a precipitate forms.

If students have difficulties in switching between a symbolic representation of a reaction and macroscopic observations, then this could be reinforced over time with a range of different chemical reactions. For example, students could be shown the symbolic chemical equation for a reaction being studied and asked to make predictions about observations. Conversely students could observe a reaction first and then explain who their observations link with the chemical equation.

**Acknowledgments**

Developed by Helen Harden (UYSEG).

Images: Alistair Moore and Helen Harden

**References**

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Treagust, D., Chittleborough, G. and Mamiala, T. (2003). The role of submicroscopic and symbolic representations in chemical explanations. *International Journal of Science Education,* 25(11)**,** 1353-1368.