**Writing word equations**

1. Read the description of a chemical reaction below.

Methane burns in oxygen producing carbon dioxide and water. During burning, a flame is observed.

Select the correct word equation for this reaction.

oxygen

A methane → carbon dioxide + water

B methane + oxygen → carbon dioxide + water + fire

C methane + oxygen → carbon dioxide + water

D methane → carbon dioxide + water

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

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| **Diagnostic question** |
| **Writing word equations** |

**Overview**

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| Learning focus: | A chemical reaction can be summarised by a chemical equation. |
| Observable learning outcome: | Select the word equation that correctly represents the chemical reaction described. |
| Question type: | simple multiple choice |
| Key words: | word equation, reactant, product |

**What does the research say?**

Research by Taber and Bricheno (2009) cautions that although word equations may seem straightforward, some students still find them conceptually challenging. This could be because the conceptual framework needed by students to confidently interpret what a word equation represents (a chemical reaction) may be insufficiently developed when word equations are first introduced.

Research (Johnson, 2000) suggests that two key concepts are required in order for students to understand chemical reactions. The first is the concept of chemical substance which then enables understanding of chemical change as the formation of a new substance or substances.

Research (Stavridou and Solomonidou, 1998) found that even where students had developed the conceptual idea that a chemical reaction results in the formation of a new substance (product) they may still have some misunderstandings. For example, some students thought that a ‘new product’ constituted something that was different to the original substance. This extended to include not only chemical substances, but also other observed phenomena such as ‘fire’.

**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.

The answers to the question will show you whether students understood the concept sufficiently well to apply it correctly.

If there is a range of answers, you may choose to respond through structured class discussion. Ask one student to explain why they gave the answer they did; ask another student to explain why they agree with them; ask another to explain why they disagree, and so on. This sort of discussion gives students the opportunity to explore their thinking and for you to really understand their learning needs.

**Expected answers**

C

**How to respond - what next?**

A student who selects option D may consider that oxygen is simply not a reacting substance. Selection of option A acknowledges the presence of oxygen but placement over the arrow indicates the student may consider it to be a bystander to the actual reaction.

A student opting for B may misunderstand that the right-hand side of a word equation should show only the chemical substances produced.

If students have misunderstandings about what constitutes the product of a reaction, they may need to revisit ideas about chemical substances.

The following BEST ‘response activities’ could be used in follow-up to this diagnostic question:

* Product discussion

**Acknowledgments**

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Images: None

**References**

Johnson, P. (2000). Children's understanding of substances, part 1: recognizing chemical change. *International Journal of Science Education,* 22(7)**,** 719-737.

Stavridou, H. and Solomonidou, C. (1998). Conceptual reorganization and the construction of the chemical reaction concept during secondary education. *International Journal of Science Education,* 20(2)**,** 205-221.

Taber, K. S. and Bricheno, P. (2009). Coordinating procedural and conceptual knowledge to make sense of word equations: Understanding the complexity of a 'simple' completion task at the learner's resolution. *International Journal of Science Education,* 31(15)**,** 2021-2055.