**Counting atoms**

1. Methane gas burns producing carbon dioxide and water.

A student writes the chemical equation for the reaction:

C3H8(g) + 4O2(g) → 3CO2 + 4H2O(g)

* 1. Count the number of each type of atom (C, H and O) on the left and right-hand side of the chemical equation.

Write your answers in the table below.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Left-hand side (reactants) | | | Right-hand side (products) | | |
| C | H | O | C | H | O |
|  |  |  |  |  |  |

* 1. Is the chemical equation correct?

*Chemistry > Big idea CPS: Particles and structure> Topic CPS4: Understanding reactions > Key concept CPS4.2: Conservation of mass*

|  |
| --- |
| **Response activity** |
| **Counting atoms** |

**Overview**

|  |  |
| --- | --- |
| Learning objective: | During a chemical reaction no atoms are created or destroyed. Mass is conserved. |
| Observable learning outcome: | Check a chemical equation to find out if the number of atoms in the reactants is the same as in the products. |
| Activity type: | clarifying – worked example |
| Key words: | chemical equations, combustion, atom, chemical formula |

This activity can help develop students’ understanding by addressing the misunderstandings revealed by the following diagnostic question:

* Chemical equation checking

**What does the research say?**

A review of empirical research (Taskin and Bernholt, 2012) describes student misunderstandings in translating chemical formulae into particle diagrams. The inclusion of a multiplying coefficient (for example 2N2O) caused additional difficulties.

The review also summarises research findings that concluded that these misunderstandings were contributory factors to student difficulties in balancing chemical equations.

This is consistent with ideas presented by Johnstone (1991) which describe student difficulties in switching between macroscopic, sub-microscopic and symbolic ways of thinking. In the case of checking a chemical equation to find out if there are equal numbers of each type of atom on both sides, it is necessary for students to move between the symbolic chemical equation and a sub-microscopic understanding of the atoms and molecules it represents

**Ways to use this activity**

This question could be used to provide a worked example to the whole class. This may help to address misunderstandings regarding the difference in meaning of the subscript numbers in chemical formulae and the larger coefficients.

*Differentiation*

It may assist some students to use physical counters or particle diagrams to represent at the sub-microscopic level what the symbolic equation shows before counting the atoms.

Some students could be challenged to write the correct chemical equation:

C3H8(g) + 5O2(g) → 3CO2 + 4H2O(g)

**Expected answers**

a

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Left-hand side (reactants) | | | Right-hand side (products) | | |
| C | H | O | C | H | O |
| 3 | 8 | 8 | 3 | 8 | 10 |

b The chemical equation is not correct.

**Acknowledgments**

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Images: None

**References**

Johnstone, A. H. (1991). Why is chemistry difficult to learn? Things are seldom what they seem. *Journal of Computer Assisted Learning,* 7**,** 75-83.

Taskin, V. and Bernholt, S. (2012). Students' understanding of chemical formulae: A review of empirical research. *International Journal of Science Education,* 36(1)**,** 157-185.