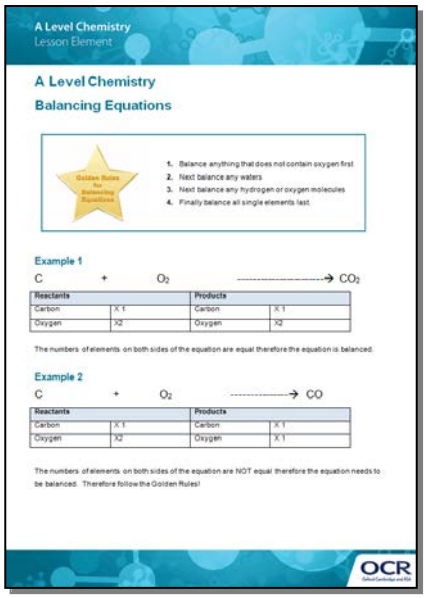
A Level Chemistry

Balancing Equations

Instructions and answers for teachers

These instructions should accompany the OCR resource* 'Balancing Equations' ***activity*** *which supports OCR GCE Chemistry.*



The Activity:

Learning outcomes:

- To recall simple common chemical compounds and molecules
- To understand that new products can only contain elements that the reactants have
- To be able to balance symbol equations.

This activity offers an opportunity for English skills development.

This activity offers an opportunity for maths skills development.

Associated materials:

Balancing Equations learner activity sheet.

Introduction

This activity offers an alternative way of introducing students to balancing equations. Research shows that students have a problem with stoichiometry, often not really understanding why they are balancing equations. The balancing of equations is necessary to ensure that the reaction in question observes the rule for the conservation of mass. Students also struggle with the concept that chemical reactions cannot produce any different substances. For example, if you begin with a magnesium compound you cannot suddenly make a compound that uses aluminium if aluminium is not present.

This activity is designed to consider these two points by combining some simple animations, developing a modelling activity using ham sandwiches as well as a number of questions to help students to develop their skills.

Teachers notes

Activity 1

This animation, allows learners to explore the idea that although chemical reactions make new substances those substances must be made from the starting materials.

Task – the students should watch the short animation 1 and decide in small groups what the animation is trying to say. This gives the teacher the opportunity to assess what the students already know and expel /explore any misconceptions they may have.

Activity 2

Students should be shown animation 2 – The views of students again should be explored as before however in this situation the students should be able to suggest the reasons as to why the second word equation is not correct. In this activity, students would be expected to see that water contains hydrogen and oxygen and carbon does not.

Activity 3 – Making Ham (or suitable vegetarian alternative) Sandwiches

THIS ACTIVITY SHOULD NOT BE CARRIED OUT IN A LABORATORY

A range of ingredients should be provided to make sandwiches. This activity models the fact that all of the ingredients make one thing just as in a chemical reaction. All of the starting materials are still there but not in their original form. Students should gather their ingredients and weigh the ingredients and note their masses and add them together at the end. They should then assemble their sandwich and weigh the completed sandwich. This activity is designed to show two things:

1. That all of the reactants make the product and that no new things are made that weren't there from the beginning.

2. That the reaction always obeys the laws of the conservation of mass. Mass is neither lost nor gained.

Activity 4 - Animation 4

The students should now explain why the equations need balancing. In groups they should explain the animation in their own words considering what they already know about the masses of the sandwich etc. This could be done as a presentation or a simple mini-whiteboard explanation.

Activity 5 – Complete the worksheet

This activity takes the student through a simple method for balancing equations which develop in complexity.

Worksheet answers for balancing of equations

Balance the following equations.

(1) $C_3H_8 + O_2$ ----------→ $CO_2 + H_2O$ (Complete combustion)

$C_3H_8 + 5O_2$ ----------→ $3CO_2 + 4H_2O$

(2) $C_3H_8 + O_2$ ----------→ $CO + H_2O$ (Incomplete Combustion)

$2C_3H_8 + 7O_2$ ----------→ $6CO + 8H_2O$

(3) $Mg + O_2$ ----------→ MgO

$2Mg + O_2$ ----------→ $2MgO$

(4) $Mg + H_2O$ ----------→ $MgO + H_2$

$Mg + H_2O$ ----------→ $MgO + H_2$

(5)$Mg + H_2O$ ----------→ $Mg(OH)_2 + H_2$

$Mg + 2 H_2O$ ----------→ $Mg(OH)_2 + H_2$

(6) $CaCO_3$ ----------→ $CaO + CO_2$

$CaCO_3$ ----------→ $CaO + CO_2$

(7) $Sr(NO_3)_2$ ----------→ $SrO + NO_2 + O_2$

$2Sr(NO_3)_2$ ----------→ $2 SrO + 4 NO_2 + O_2$

(8) Balance the following equations for the complete and incomplete combustion of the following :
C_6H_{12} C_9H_{18} $C_{35}H_{72}$

$C_6H_{12} + 9O_2$ ----------→ $6CO_2 + 6 H_2O$

Teacher notes

Equipment requirements:

- Ingredients for the class to work in groups
- Balances
- Access to a projector
- Animations – to use with suitable method of playing them
- Pens
- Sugar paper/poster paper

Teacher preparation

Teacher should be familiar with balancing equations such as using online resources such as the Khan academy:
https://www.khanacademy.org/test-prep/mcat/physical-processes/stoichiometry/v/balancing-chemical-equations
For practice examples: http://www.rsc.org/learn-chemistry/wiki/Category:Balancing_equations

Student issues

Students have been shown in the past to have a problem with understanding the differences between the stoichiometric numbers and the subscripted numbers within molecules. Teachers need to be aware that this can be a major issue and it needs to be made very clear that the two things are very different and care needs to be taken whilst looking at this.[1, 2]

The idea with regards to using Lego to teach Stoichiometry was first explored in a paper that appeared in the Journal of Chemical Education in 2002[3]. It is important when using any type of model, analogy or modelling activity that students are made aware of the limitations of the model. With the Lego, it is important to reiterate this with the students. For example, the number of bricks used is demonstrating the mass units; some students may consider that 12 block make up one block of carbon. This is a limitation of the model as this number is much bigger. They will discover this if they need to investigate Avagadro's number later on whilst performing titration calculations for example.

Using the theory of a ham sandwich to model chemical reactions is usually used with pupils who are struggling with the quantity aspect of the teaching very similar to the idea put forward in the first animation. With this, the students have been taken to a Food Technology room where the ingredients

are laid out for making a ham sandwich. The activity is modelled in the way where all the ingredients are set out and the sandwich is made. The students are then asked to make the connection between the ingredients and the final product. This is very useful with lower ability students or higher ability students just before lunchtime as you can eat the products.

References

1. http://acell.chem.usyd.edu.au/conceptual-change.cfm
2. Yarroch, W. (1985) *Student understanding of chemical equation balancing* Journal of Research in Science teaching, 22, 449-459
3. Witzel, J.E. (2002) *J. Chem* Educ, **79** (3), 352A-352B