MINISTRY OF EDUCATION

SECONDARY ENGAGEMENT PROGRAMME

GRADE 10

CHEMISTRY

WEEK 10 **LESSON 1**

Topic: Writing Equations

Sub-topic: Writing and Balancing Chemical Equations

Objective: Given the steps to writing and balancing whole equations students will convert word equations to balance chemical equations, getting at least 8 out of 10 correct.

Step by step guide to writing a chemical equation for a chemical reaction

- Write down a word equation for the chemical reaction
- Write down the unbalanced equation using correct chemical symbols for all the reactants and products
- Balance the equation by inspection. (Ensure that the same number of each type of atom appears on both sides of the equation)
- Write the state symbol after each chemical symbol

By writing the physical states of substances, a chemical equation becomes more informative.

- Gaseous state is represented by symbol (g).
- Liquid state is represented by symbol (l).
- Solid state is written by symbol (s).
- Aqueous solution is written by symbol (aq).
- Writing the condition in which reaction takes place: The condition is generally written above and/or below the arrow of a chemical equation.

Steps for balancing the equation

- Typically, you balance H (hydrogen) atoms first, followed by O (oxygen) atoms then any other atoms. OR you can start by balancing the most complicated molecule.
- Never change the chemical symbol of a substance. (Do not change the subscripts in the chemical symbols of reactants or products)
- A number in front of a formula multiplies every symbol that follows it
- Remember that atoms cannot be created or destroyed in a chemical reaction (i.e. do not 'eat' any chemical symbols)

Examples:

Formation of iron(III) chloride from the reacting iron with chlorine gas

- Iron + chlorine → iron (III) chloride
- Before balancing: **$Fe + Cl_2 \rightarrow FeCl_3$**
- Balance number of Cl atoms: There are 2 Cl atoms on the left and 3 Cl atoms on the right. The simplest way to balance Cl atoms is to multiply 3 on the left and 2 on the right to make a total of 6 Cl atoms.
- We obtain: **$Fe + 3Cl_2 \rightarrow 2FeCl_3$**
- Notice that the number of Fe atoms are not the same for both sides: 1 on the left and 2 on the right. Hence, we will just have to multiply 2 on the left.
- We have: **$2Fe + 3Cl_2 \rightarrow 2FeCl_3$**
- Not forgetting to include the state symbols: **$2Fe(s) + 3Cl_2(g) \rightarrow 2FeCl_3(s)$**

Formation of carbon dioxide and water from methane and oxygen. (OR is known as Combustion of methane in oxygen)

- methane + oxygen → carbon dioxide + water
- Convert the above to chemical symbols: $CH_4 + O_2 \rightarrow CO_2 + H_2O$
- Balance H first: There are 4 H atoms on the left and 2 on the right. Hence, we will have to multiply the chemical symbol containing H on the left by 2. (I.e. multiply H_2O by 2)
- We have: $CH_4 + O_2 \rightarrow CO_2 + 2H_2O$
- Balance O: There are 2 O atoms on the left and 4 O atoms on the right. We will have to multiply the O_2 on the left by 2.
- We have: $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$

- The carbon atoms are balanced so we do not have to multiply them.
- Including the state symbol: $CH_{4(g)} + 2O_{4(g)} \rightarrow CO_{2(g)} + 2H_2O_{(l)}$

Balance: $Pb_3O_4 + HNO_3 \rightarrow PbO_2 + Pb(NO_3)_2 + H_2O$

Notice that there are 3 Pb atoms on the left and 2 Pb atoms on the right. There are several ways to go about balancing the Pb atoms – we can multiply PbO_2 by 2

Or $Pb(NO_3)_2$ by 2 or multiply both sides of the equation. Anyone of the ways is correct. But some 'ideal' way will be shorter than the others.

- We shall look at multiplying $Pb(NO_3)_2$ by 2. (shortest method in this case)
- We have: **$Pb_3O_4 + HNO_3 \rightarrow PbO_2 + 2Pb(NO_3)_2 + H_2O$**
- We have 1 N atom on the left and 4 N atoms on the right. We will have to multiply the HNO3 by 4
- We have: **$Pb_3O_4 + 4HNO_3 \rightarrow PbO_2 + 2Pb(NO_3)_2 + H_2O$**
- Balance H atom: **$Pb_3O_4 + 4HNO_3 \rightarrow PbO_2 + 2Pb(NO_3)_2 + 2H_2O$**
- Notice that the number of O atoms are balanced. We are done!
- Including state symbol:

  $Pb_3O_4\ (s) + 4HNO_3\ (aq) \rightarrow PbO_2\ (s) + 2Pb(NO_3)_2\ (aq) + 2H_2O\ (l)$

Important: Always express your equation as the simplest form.

For example: **$2Pb_3O_4\ (s) + 8HNO_3\ (aq) \rightarrow 2PbO_2\ (s) + 4Pb(NO_3)_2\ (aq) + 4H_2O\ (l)$**

The above equation is not correct as it is not in its simplest form. (You can divide throughout by 2)

Reference

1. https://www.minichemistry.com/how-to-write-a-chemical-equation.html
2. https://www.chemteam.info/Equations/Net-Ionic-Equation.html