PENANG SANGAM HIGH SCHOOL
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LESSON NOTES

Year/Level: 11 C/D **Subject:** Chemistry

Strand	3 Reactions
Sub Strand	3.1 chemical equations and calculations
Content Learning Outcome	Carry out calculations to verify the Law of Definite Composition

Law of Definite Composition

- The law of definite composition was proposed by **Joseph Proust** based on his observations on the fixed composition of chemical compounds.
- **This law states that chemical compounds are composed of a fixed ratio of elements as determined by mass.**
- Elements combine in whole numbers: it is not possible to have a compound with portion an atom.

Example 1

The compound water, H_20, always is a chemical combination of hydrogen and oxygen in a 1:8 ratio by mass. If a mixture of hydrogen and oxygen in some other ratio, say 1:2, were reacted, there would be water formed, but there would also be some un- reacted oxygen, because water always forms in the 1:8 ratio by mass.

	$2H_{2(g)} + O_{2(g)}$	$\longrightarrow$	$2H_2O$
mass ratio	1g : 8g		9g
or	2g : 16g		18g

Example 2

Glucose has the chemical formula $C_6H_{12}O_6$. This means that for glucose to be formed, it must be comprised of 6 atoms of carbon, 12 atoms of hydrogen, and 6 atoms of oxygen. The carbon makes up 40 % of glucose; the hydrogen makes up 6.7% of glucose and the oxygen makes up 53.3% of glucose.

Calculations on Law of Definite Proportion

$$\% \text{ of element} = \frac{\text{Mass of the element}}{\text{Total mass of the compound}} \times 100$$

Example 1

What is the experimental percentage of oxygen in CO_2 if 42.0 g of carbon reacted completely with 112.0 g of oxygen?

$$C_{(s)} + O_{2\,(g)} \rightarrow CO_{2\,(g)}$$

$$\%\ O = \frac{\text{Mass of oxygen}}{\text{Mass of carbon dioxide}} \times 100$$

$$= \frac{112\ g}{112\ g + 42\ g} \times 100$$

$$= 72.7\%$$

Example 3:

A sample of calcium hydroxide, ($Ca(OH)_2$), with a mass of 7.4g contains 4g of calcium, 3.2g of oxygen and 0.2g of hydrogen.

(a) Find the percentage composition of the sample

(b) How many grams of calcium would you expect to find in a sample of calcium hydroxide with a mass of 25g?

Solution:

(a) Find the percentage composition

Calcium :	$\frac{4.0g}{7.4g}$	x	$\frac{100}{1}$	=	54%
Oxygen :	$\frac{3.2g}{7.4g}$	x	$\frac{100}{1}$	=	43%
Hydrogen:	$\frac{0.2g}{7.4g}$	x	$\frac{100}{1}$	=	3%
Total				=	**100%**

(b) Find the mass of calcium in a 25g sample

$$54\% \times 25g = \frac{54}{100} \times 25 = \mathbf{13.5g}$$

ACTIVITY:

1. Calculate the % composition of each element in $Al_2(SO_4)_3$.