Worksheet 1.2: Relative Formula Mass (Mr) Calculations ChemistrySheets

Specification: AQA 5.3.1.1 / Edexcel SC14 / OCR Gateway C3.1.1

Key Formulae & Concepts:
The **relative formula mass** (M_r) of a compound is the sum of the relative atomic masses (A_r) of the atoms in the numbers shown in the formula.

$$M_r = \sum A_r$$

Key points:
- A_r (Relative atomic mass) is the weighted average mass of an atom of an element compared to 1/12th the mass of a carbon-12 atom. It has **no units**.
- M_r (Relative formula mass) is the sum of the A_r values of all atoms in a formula. It has **no units**.
- For elements that exist as molecules (e.g., O_2, Cl_2), M_r is used. For ionic compounds, M_r is also used.

Common A_r values (approximate): H=1, C=12, O=16, N=14, Na=23, Mg=24, S=32, Cl=35.5, K=39, Ca=40, Fe=56, Cu=63.5.

Section A: Understanding Relative Masses

1. What does A_r stand for? What are its 'units'?

2. What does M_r stand for? What are its 'units'?

3. Explain in your own words how to calculate the M_r of a compound from the A_r values of its constituent elements.

4. Using the A_r values provided in the box above, complete the following:

   (i) The A_r of an element X is 24. What is the mass of 1 mole of X? _____

   (ii) If $M_r(Y_2O_3) = 102$, and $A_r(O) = 16$, what is $A_r(Y)$?

Section B: Practice Calculations

1. Calculate the relative formula mass (M_r) for the following compounds:

   (a) Water, H_2O

   (b) Magnesium hydroxide, $Mg(OH)_2$

(c) A compound has the formula XCl_2. If its relative formula mass (M_r) is 111, calculate the relative atomic mass (A_r) of element X. ($A_r(\text{Cl}) = 35.5$)

(d) Sodium carbonate decahydrate has the formula $Na_2CO_3 \cdot xH_2O$. If its relative formula mass (M_r) is 286, calculate the value of x. ($A_r(\text{Na}) = 23$, $A_r(\text{C}) = 12$, $A_r(\text{O}) = 16$, $A_r(\text{H}) = 1$)

Section C: Challenge Context

1. A student needs to prepare a solution of sodium chloride (NaCl). They weigh out 5.85 g of NaCl.

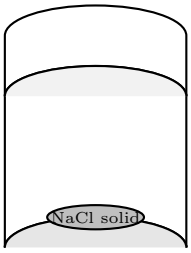

Figure 1: Sodium chloride solid in a beaker.

Calculate the number of moles of sodium chloride weighed out. ($A_r(\text{Na}) = 23$, $A_r(\text{Cl}) = 35.5$)

2. A student investigates the decomposition of hydrated copper(II) sulfate, $CuSO_4 \cdot xH_2O$, by heating it in a crucible.

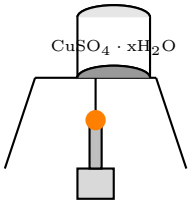

Figure 2: Heating hydrated copper(II) sulfate.

They record the following results:

- Mass of hydrated copper(II) sulfate = 12.5 g
- Mass of anhydrous copper(II) sulfate (after heating) = 8.0 g

Calculate the value of x in $CuSO_4 \cdot xH_2O$. ($A_r(\text{Cu}) = 63.5$, $A_r(\text{S}) = 32$, $A_r(\text{O}) = 16$, $A_r(\text{H}) = 1$)