



Lesmahagow High School

National 5 Chemistry: Unit 1

Key Area – Formulae and Equations



Learning Statement								Red	Amber	Green	
The chemical formula of a substance tells us which elements are present and how many of each element we have, e.g. CH ₄ , HBr.								<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
The valency method can be used to work out a chemical formula. The valency of an element is how many bonds it can form. Valency is the number of unpaired electrons in the outermost shell.											
Group	1	2	3	4	5	6	7	8 (or 0)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Valency	1	2	3	4	3	2	1	0			
The valency method involves doing the following:											
Write down element symbols		Write down Valency below each element's symbol		Put in Cross-over Arrows		Follow arrows and cancel down if necessary to get formula					
Si O		Si O 4 2		Si O 4 2		Si ₂ O ₄ ↓ SiO ₂		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
Some chemical names contain a prefix in them, e.g. mono, di, tri, tetra, which tells us how many of the each element we have. This means we can write the formula for these without having to use the valency method.								<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
Compound	carbon mono xide	carbon di oxide	sulfur tri oxide	carbon tetra chloride							
Formula	CO	CO ₂	SO ₃	CCl ₄							
Meaning	mono = 1	di = 2	tri = 3	tetra = 4							
Some formulae involve group ions . Group ions are ions that contain more than one element. A list of group ions can be found on page 8 of the data booklet.								<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
Ion	Formula	Ion	Formula	Ion	Formula	Ion	Formula	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
ammonium	NH ₄ ⁺	ethanoate	CH ₃ COO ⁻	carbonate	CO ₃ ²⁻	phosphate	PO ₄ ³⁻				
		hydrogencarbonate	HCO ₃ ⁻	chromate	CrO ₄ ²⁻						
		hydrogensulfate	HSO ₄ ⁻	dichromate	Cr ₂ O ₇ ²⁻						
		hydrogensulfite	HSO ₃ ⁻	sulfate	SO ₄ ²⁻						
		hydroxide	OH ⁻	sulfite	SO ₃ ²⁻						
		nitrate	NO ₃ ⁻	thiosulfate	S ₂ O ₃ ²⁻						
		permanganate	MnO ₄ ⁻								
The valency of a group ion is the number value of its charge, e.g. sulfate SO ₄ ²⁻ has a valency of 2 as the charge is 2-.								<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
The ionic formula of an ionic compound is a formula that contains ions, therefore has charges in it, e.g. Na ⁺ Cl ⁻ is the ionic formula for sodium chloride.								<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	

Reactions can be described using **word** and **formula** (or **chemical**) equations.

○ **Word Equations**

Describe chemical reactions using words. For example:



○ **Formula (or chemical) Equations**

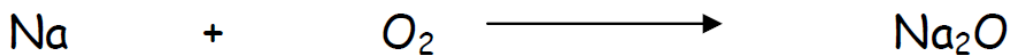
Describe chemical reactions using the chemical formulae for the substances involved. For example:



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Formula (or chemical) equations can be balanced using the following method.

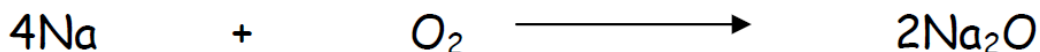
Write down correct chemical formula of all reactants before the arrow and all products after the arrow.



There are 2 oxygen atoms on left hand side but only 1 oxygen atom on right hand side. As the formula of Na_2O cannot be changed, double the number of Na_2O molecules by adding the number 2 *in front* of the formula



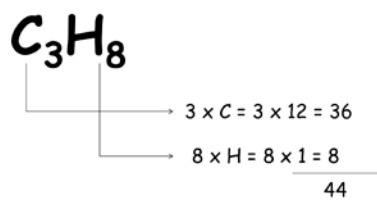
There is 1 sodium atom on the LHS but 4 sodium atoms on the RHS. As the formulae of Na and Na_2O are set and cannot be changed, we must add the number 4 in front of the Na on the LHS to balance the number of Na atoms



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Formula Mass

The formula mass of a substance is the relative atomic masses of all the elements present added together. A list of relative atomic masses can be found on page 7 of the data booklet.

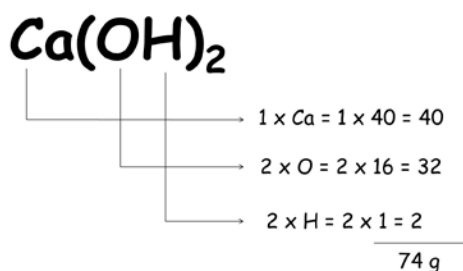


Formula mass has no units.

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Gram Formula Mass (GFM)

The gram formula mass of a substance is the relative atomic masses of all the elements present added together. A list of relative atomic masses can be found on page 7 of the data booklet.



The unit of gram formula mass is **grams, g**.

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The gram formula mass (GFM) of a substance is also known as 1 mole of a substance.

$$1 \text{ GFM} = 1 \text{ mole}$$

Calculations Involving No. of Moles, Mass and GFM

The number of moles, mass and GFM have the following relationship.

	g = no. of grams	mol = no. of moles	GFM = gram formula mass
	$g = \text{mol} \times \text{gfm}$	$\text{mol} = \frac{g}{\text{gfm}}$	$\text{gfm} = \frac{g}{\text{mol}}$

Calculations Involving No. of Moles, Volume and Concentration

The number of moles, volume and concentration have the following relationship.

	mol = no. of moles	c = concentration (mol/l)	v = volume (litres)
	$\text{mol} = v \times c$	$c = \frac{\text{mol}}{v}$	$v = \frac{\text{mol}}{c}$

N.B. Concentration has the unit mol l^{-1} (moles per litre) this means the volume in this equation must be in litres as well.

To convert from cm^3 to litres, divide by 1000.

e.g. $45 \text{ cm}^3 = 45/1000 = 0.045 \text{ litres}$

Worked Example

Calculations involving concentration and number of grams of solid:

e.g. Calculate the concentration of a solution when 5.85g of NaCl is dissolved in 50 cm^3 water.

Calculate the gfm of NaCl	no. of mol = $\frac{\text{no. of grams}}{\text{gfm}}$	concentration = $\frac{\text{no. of moles}}{\text{volume}}$
Na 1 x 23 = 23	= $\frac{5.85}{58.5}$	= $\frac{0.1 \text{ mol}}{0.05 \text{ litres}}$
Cl 1 x 35.5 = 35.5	= $\frac{5.85}{58.5}$	= 2 mol/l
gfm = <u>58.5g</u>	= 0.1 mol	

NB Volume must be in litres!