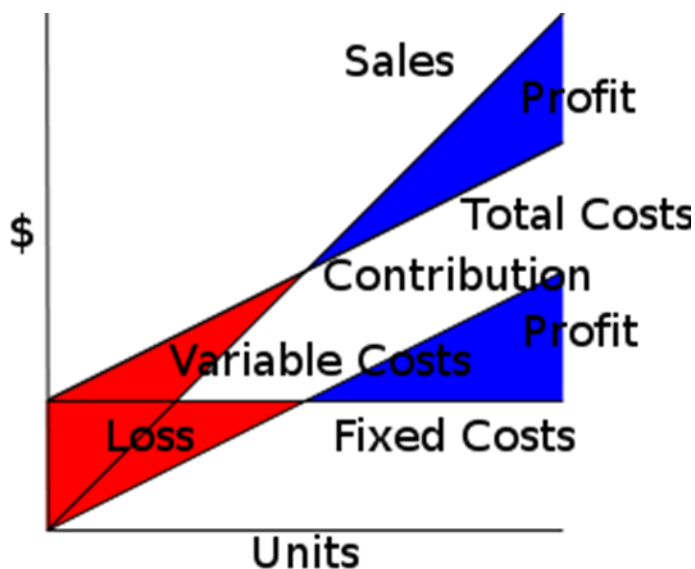


Nat 4/5 Chemistry -



Chemical Formulae



Formulae

☐ Nat 4 outcomes

☐ Nat 5 outcomes

By the end of this unit you should know the following:

- ☐ Chemical and ionic formulae including compounds containing group ions are used.
- ☐ The chemical formula of a covalent molecular substance gives the number of atoms present in the molecule.
- ☐ The formula of a covalent network or ionic compound gives the simplest ratio of atoms/ions in the substance.

Naming Chemical Compounds

Naming Compounds

If a compound contains just **two elements** the compound name consists of the names of both elements but the last part of the second name becomes **-ide**.

e.g. **magnesium** and **oxygen** make **magnesium oxide**.

carbon and **chlorine** make **carbon chloride**.

If a compound contains **more than two elements and one of them is oxygen** the compound name consists of the names of both the other elements but the last part of the second name becomes **-ate** or **-ite** depending on the number of oxygen atoms.

e.g. **copper**, **sulfur** and **oxygen** make **copper sulfate**.

sodium, **phosphorus** and **oxygen** make **sodium phosphate**.

NOTE

Fill in the blanks in the following table:

Elements	Compound Name
silver & sulfur	
&	phosphorus hydride
lithium & iodine	
magnesium, nitrogen & oxygen	
hydrogen, carbon & oxygen	
, &	calcium bromate

Writing Formulae

Valency

Valency of an atom is its 'combining power'. i.e. how many bonds it must make to achieve a stable arrangement.

Remember that stable arrangements have full outer electrons.

Element	Arrangement	outer electrons	Valency
oxygen	2,6	6	2
hydrogen			
lithium			
flourine			
nitrogen			
carbon			
chlorine			
bromine			
phosphorus			
sodium			
magnesium			
calcium			

Area

Covalent Chemical Formulae

Symbols can be used to represent atoms of the different elements. A **chemical formula** is used to represent the **type and number of each element** in a compound.

E.g. water (**hydrogen oxide**) has the chemical formula **H₂O** this means that in every water molecule there are **2 hydrogen** atoms bonded to **1 oxygen** atom.

NOTE

Complete the following table:

You will remember from the previous topic on bonding that atoms join together in order to form a complete outer shell. In covalent bonding they do this by sharing their unpaired outer (valence) electrons.

Name	Chemical formula	Number and type of each element	
hydrogen chloride	HCl		
magnesium fluoride		1 magnesium	2 fluorine
	SiO ₂		
		1 carbon	2 sulfur

NOTE

Complete the following table:

Group Number	1	2	3	4	5	6	7
Valency							

Group Ions Formulae

Writing formula using Group Complex ions

The group ion is always kept together. the atoms are not separated.

The **valency** of the group ion is the number of **charges** it has.

e.g. Formula for **Magnesium hydroxide** (hydroxide is a group ion)

Writing Formulae Using Roman Numerals

Some elements can vary in the valency they have. This usually applies to the transition metals. When this is the case the valency number is given as roman numerals.

Roman Numerals

I - 1

II - 2

III - 3

IV - 4

V - 5

VI - 6

VII - 7

Writing Formulae Using Prefixes

Prefix	Meaning
Mono-	one
Di-	two
tri-	three
tetra-	four
penta-	five
hexa-	six
Hepta-	seven
octa-	eight

Look at the name of the compound if it has a prefix then use this to write the formula.

If no prefix then use the valency rule.

e.g. carbon dioxide (di- 2)

Formula CO_2

e.g. Dinitrogen monoxide (di- 2, mono- 1)

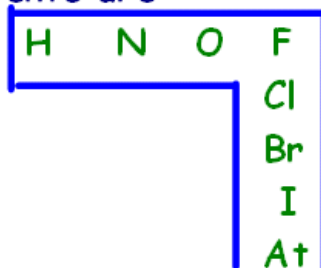
Formula N_2O

Formula of Elements

For most elements the formula is just the symbol.

Some elements exist as diatomic molecules. This means that when the element is on its own it has two atoms in each molecule.

The diatomic elements are



All group 7 elements plus
Hydrogen, Nitrogen and Oxygen

e.g.	Element	Symbol	Formula
	Sodium	Na	Na
	Potassium	K	
	Iron	Fe	
	Oxygen	O	
	Chlorine	Cl	
	Argon	Ar	

NOTES

Work out the chemical formulae of the following compounds using crossing over the valencies method:

1. hydrogen sulfide
2. phosphorous chloride
3. silicon oxide
4. nitrogen hydride

Your teacher may get you to try some extra questions on this.

Exceptions

Unfortunately in chemistry there are lots of substances that don't have chemical formulae that can be worked out using the above method, sometimes two elements can combine in two or more different ways. However these exceptions are given names that allow us to simply work out the formula from the name. Prefixes such as mon, di, tri, tetra, etc. are used to give the number of atoms of each element in the compound.

NOTES

Complete the following table:



Prefix	Number of atoms	Prefix	Number of atoms
mon		tetra	
di		penta	
tri		hexa	



Quick Test 1

1. Complete the following table:

NAME OF COMPOUND	ELEMENTS PRESENT
Potassium chloride Sodium nitrate Copper(II) sulfate Lithium fluoride Magnesium nitrate Silver(I) bromide Hydrogen chloride Calcium carbonate	

2. Work out the chemical formulae of the following compounds.

- a. phosphorus chloride b. nitrogen iodide c. sulfur bromide
- d. hydrogen fluoride e. silicon carbide f. germanium hydride
- g. dihydrogen oxide h. silicon tetrafluoride
- i. uranium hexafluoride j. phosphorus pentachloride

3. The compound N_2O_4 is called

- A. nitrogen monoxide
B. nitrogen dioxide
C. dinitrogen tetroxide
D. dinitrogen trioxide

4. The valency of phosphorus in P_2S_3 is:

- A. 2
B. 3
C. 5
D. 1



Quick Test 2

- The correct formula for sodium oxide is
 - SO_2
 - S_2O
 - NaO
 - Na_2O
- The correct formula for copper(II) nitrate is
 - CuNO_3
 - $\text{Cu}(\text{NO}_3)_2$
 - Cu_2NO_3
 - Cu_2N_3
- In the compound $\text{Cr}_2(\text{SO}_4)_3$, chromium has a valency of
 - 4
 - 3
 - 2
 - 1
- X is a metal. It forms a compound with fluorine with the formula XF_2 . The metal X must belong to group
 - 1
 - 2
 - 3
 - 4
- Z is a non-metal. It forms a compound with magnesium with the formula Mg_3Z_2 . The non-metal Z must belong to group
 - 3
 - 5
 - 6
 - 2
- Which of the following pairs of elements would form a compound with a formula of the type X_2Y_3 ? Where X is a metal and Y is a non-metal

	X	Y
A	potassium	chlorine
B	calcium	oxygen
C	magnesium	nitrogen
D	aluminium	sulfur