Topic: Symbols, Formulae, and Equations I

Lesson Outline

Subtopics:

1. **Chemical Symbols of Elements**
2. **Valency: Definition and Common Valencies**
3. **Writing Chemical Formulae from Valency**
4. **Empirical and Molecular Formulae**
5. **Law of Conservation of Matter**
6. **Periodic Table (Arrangement in Order)**

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1. Chemical Symbols of Elements

What is a Chemical Symbol?

A **chemical symbol** is a **short representation** of an element using **letters**.

- The **first letter** is always **capitalized**.
- The **second letter** (if any) is always **lowercase**.

Why Use Symbols?

- To **simplify writing chemical reactions**.
- To create **universal understanding** among scientists.
- To avoid writing long element names repeatedly.

Examples of Symbols:

Element	Symbol	Origin
Hydrogen	H	First letter

Element	Symbol	Origin
Helium	He	First + second letter
Sodium	Na	Latin: Natrium
Potassium	K	Latin: Kalium
Iron	Fe	Latin: Ferrum
Copper	Cu	Latin: Cuprum
Gold	Au	Latin: Aurum
Silver	Ag	Latin: Argentum
Lead	Pb	Latin: Plumbum

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2. Valency

Definition:

Valency is the **combining capacity of an element**.
It tells us how many **bonds an atom can form** when combining with other atoms.

Understanding Valency:

- **Metals** usually **lose electrons** to become stable (positive valency).
- **Non-metals** usually **gain or share electrons** (negative valency or sharing).

Common Valencies of Elements:

Element	Valency
Hydrogen (H)	1
Oxygen (O)	2
Nitrogen (N)	3

Element	Valency
Carbon (C)	4
Sodium (Na)	1
Calcium (Ca)	2
Aluminium (Al)	3
Chlorine (Cl)	1
Sulphur (S)	2 (sometimes 6)
Magnesium (Mg)	2

Valencies of Common Radicals:

Radical	Valency
Hydroxide (OH^-)	1
Nitrate (NO_3^-)	1
Carbonate (CO_3^{2-})	2
Sulphate (SO_4^{2-})	2
Ammonium (NH_4^+)	1
Phosphate (PO_4^{3-})	3

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3. Writing Chemical Formulae

Steps to Write Formulae:

1. **Write the symbols** of the elements or radicals involved.
2. **Write their valencies**.
3. **Cross-multiply** the valencies to balance the formula.
4. Simplify if necessary.

Examples:

Compound	Elements/Radicals	Valencies	Formula
Sodium chloride	Na (1), Cl (1)	1 : 1	NaCl
Magnesium chloride	Mg (2), Cl (1)	2 : 1	$MgCl_2$
Calcium nitrate	Ca (2), NO_3 (1)	2 : 1	$Ca(NO_3)_2$
Aluminium sulphate	Al (3), SO_4 (2)	3 : 2	$Al_2(SO_4)_3$
Ammonium carbonate	NH_4 (1), CO_3 (2)	1 : 2	$(NH_4)_2CO_3$

Why Use Brackets?

When a **radical appears more than once**, use brackets to avoid confusion:

- **Example:** Calcium nitrate → **$Ca(NO_3)_2$**

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4. Empirical and Molecular Formulae

Empirical Formula:

- The **simplest ratio** of atoms in a compound.

Molecular Formula:

- The **actual number of atoms** in a compound.

Examples:

Compound	Molecular Formula	Empirical Formula
Glucose	$C_6H_{12}O_6$	CH_2O
Ethene	C_2H_4	CH_2

Compound	Molecular Formula	Empirical Formula
Benzene	C_6H_6	CH
Water	H_2O	H_2O

How to Derive Empirical Formula:

1. Write the molecular formula.
2. Find the **greatest common factor** (GCF) of the subscripts.
3. Divide all subscripts by the GCF.

Example:

Glucose ($C_6H_{12}O_6$):

- GCF = 6
- Empirical Formula = CH_2O

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5. Law of Conservation of Matter

Statement:

"Matter cannot be created or destroyed during a chemical reaction."

Meaning:

- The **total mass of reactants = total mass of products**.
- No atoms are lost or created—only **rearranged**.

Example:

2H2+O2→2H2O2H_2 + O_2 \rightarrow 2H_2O2H2+O2→2H2O

- Reactants: 4 hydrogen atoms, 2 oxygen atoms

- Products: 4 hydrogen atoms, 2 oxygen atoms
- **Mass is conserved**

Importance:

- It helps in **balancing chemical equations**.
- Prevents errors in **chemical calculations**.

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6. The Periodic Table

Definition:

The **Periodic Table** is a **systematic arrangement of elements** in order of their **atomic numbers**.

Features of the Periodic Table:

- **Groups (columns):** Elements with similar chemical properties
- **Periods (rows):** Elements arranged by **increasing atomic number**

First 20 Elements of the Periodic Table (in order):

Atomic Number	Element Name	Symbol
1	Hydrogen	H
2	Helium	He
3	Lithium	Li
4	Beryllium	Be
5	Boron	B
6	Carbon	C
7	Nitrogen	N

Atomic Number	Element Name	Symbol
8	Oxygen	O
9	Fluorine	F
10	Neon	Ne
11	Sodium	Na
12	Magnesium	Mg
13	Aluminium	Al
14	Silicon	Si
15	Phosphorus	P
16	Sulphur	S
17	Chlorine	Cl
18	Argon	Ar
19	Potassium	K
20	Calcium	Ca

Periodic Trends:

Property	Trend
Atomic Size	Decreases across a period, increases down a group
Reactivity (Metals)	Increases down a group
Reactivity (Non-metals)	Increases up a group
Valency	Changes across a period

Importance of the Periodic Table:

- Predicts **chemical behavior**
- Helps in **writing formulae**
- Organizes elements **systematically**

Summary of Key Points

Term	Meaning
Chemical Symbol	Short form of an element
Valency	Combining power of an atom
Chemical Formula	Representation of a compound
Empirical Formula	Simplest ratio of atoms
Molecular Formula	Actual number of atoms
Law of Conservation of Matter	Matter cannot be created or destroyed
Periodic Table	Systematic arrangement of elements

Conclusion

Understanding **symbols, valency, and formulae** is critical for writing **chemical reactions correctly**. The **Periodic Table** is a tool that helps you predict element properties and reactions.