Atoms, Molecules and Ions Map

Cambridge International AS & A Level Chemistry · Topic 2 Atoms, molecules and stoichiometry

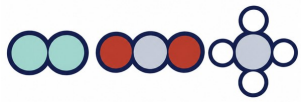
1 Atoms and elements 2.1.2

- **Atom**: smallest particle of an element
- **Element**: only one type of atom
- Monatomic: He, Ne, Ar
- Diatomic: H_2, N_2, O_2, Cl_2
- Polyatomic: P_4, S_8



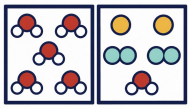
2 Molecules and giant structures 2.1.2

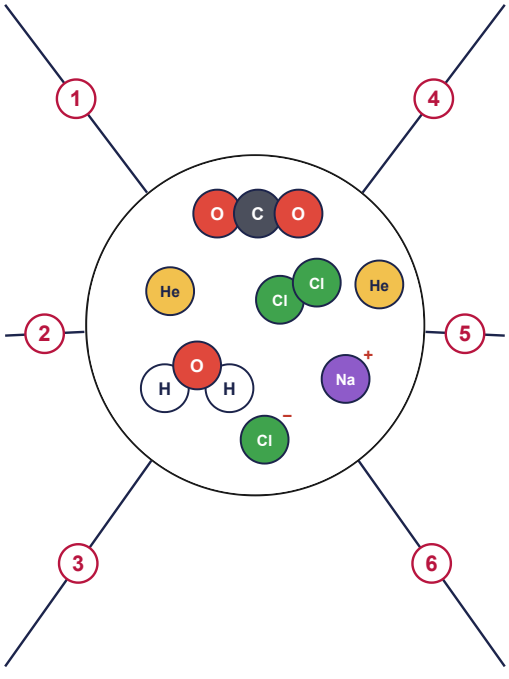
- **Molecule**: two or more atoms bonded
- Element molecules: O_2, O_3
- Molecules: **relative molecular mass**
- Giant structures (NaCl, SiO_2): no molecules
- Giant: **relative formula mass**



3 Compounds and mixtures 2.1.2

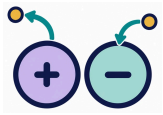
- **Compound**: elements chemically combined
- Always a **fixed ratio**
- **Mixture**: not combined, any ratio
- Pure: sharp melting point
- Air, brass and sea water are mixtures





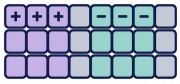
4 Ions 2.3.1

- **Ion**: charged atom or group
- Lose electrons: **positive** (cation)
- Gain electrons: **negative** (anion)
- Electrons = protons − charge
- CO_3^{2-}: 30 protons, 32 electrons



5 Charges from the Periodic Table 2.3.1(a)

- Groups 1, 2, 13: **1+, 2+, 3+**
- Groups 15, 16, 17: **3−, 2−, 1−**
- Roman numeral: **oxidation number**
- Fe(II) is Fe^{2+}; Fe(III) is Fe^{3+}
- One charge only: Zn^{2+}, Ag^+



6 Formulae of ionic compounds 2.3.1

- Total charge **zero**
- Al^{3+} and O^{2-}: **Al_2O_3**
- **Brackets** round repeated groups
- $Mg(OH)_2$, $(NH_4)_2SO_4$
- Formula: the ratio of ions



The ions to recall (2.3.1 b)

learn the formula and charge of each; brackets when more than one is needed

Ion	Formula	Charge	Example compound	Formula
ammonium	NH_4^+	1+	ammonium chloride	NH_4Cl
hydroxide	OH^-	1−	calcium hydroxide	$Ca(OH)_2$
nitrate	NO_3^-	1−	silver nitrate	$AgNO_3$
hydrogencarbonate	HCO_3^-	1−	sodium hydrogencarbonate	$NaHCO_3$
carbonate	CO_3^{2-}	2−	zinc carbonate	$ZnCO_3$
sulfate	SO_4^{2-}	2−	aluminium sulfate	$Al_2(SO_4)_3$
phosphate	PO_4^{3-}	3−	ammonium phosphate	$(NH_4)_3PO_4$

Writing a formula

Simple ions

- Ca^{2+} and Cl^-
- Two Cl^- balance one Ca^{2+}
- **$CaCl_2$**

Swap the numbers

- Al^{3+} and SO_4^{2-}
- 2 × 3+ = 3 × 2−
- **$Al_2(SO_4)_3$**

Working back

- $Fe(NO_3)_3$: three 1− ions
- oxidation number +3: Fe^{3+}
- name: **iron(III) nitrate**

Formulae become balanced equations in the equations section; their masses and moles come in mole calculations.

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