Chemical bonding

Unit 3

Elements, compounds, mixtures

- Elements are the building blocks of the universe.
- Elements are divided into **metals** and **non-metals.**
- Elements combine chemically to make compounds.
- Chemical formulae indicates the ratio of of the atoms involved in making the compound.
- A mixture contains two or more elements or compounds that are not chemically bonded together.
- Definition of elements and compounds, pg 49.

Difference between compounds and mixtures

Compounds	Mixtures
A compound is a single substance.	A mixture contains two or more substances.
The composition is always the same.	The composition can be varied.
The formation involves a chemical reaction.	No chemical change takes place when made.
The properties are very different from the elements present in the compound.	The properties of the substances making the mixture are still present.
Can only be broken down by chemical reactions.	The substances present can be separated by physical methods.

- Examples of compounds include NaCl, H_2O, NH_3
- Examples of mixtures include iron and sulfur powder, salt water

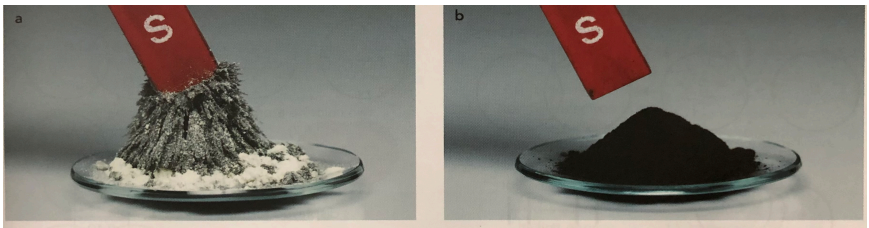
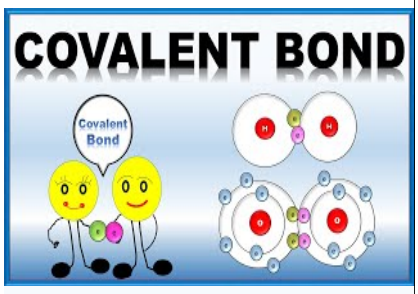
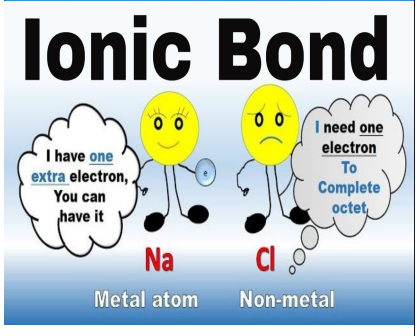


Figure 3.4 a: A mixture of iron and sulfur can be separated with a magnet. **b:** Iron powder and sulfur react together to form the black compound, iron sulfide, which is not magnetic.

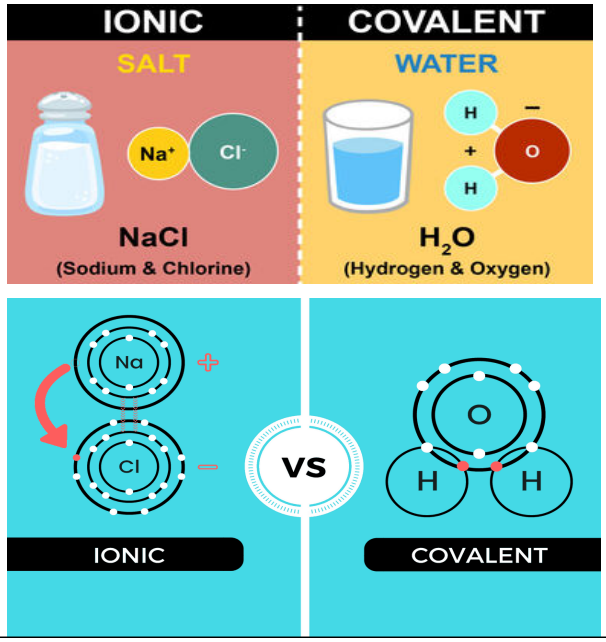
Chemical bonding

- In compounds, atoms of the elements are **chemically bonded**, which involves the outer electrons of each atom.
- There are two types of chemical bonding:
- Molecular (covalent) bonding: Atoms are bonded together by sharing their outer shell electrons**.** Water, ammonia, methane, carbon dioxide are examples of simple molecular substances. Covalent bonding occurs between non-metals.
- Ionic compounds: Atoms are bonded together by losing and/or gaining their outer shell electrons. The atoms form charged atoms (ions) that are held together in a regular structure. Ionic bonding occurs between metals and non-metals. Examples: sodium chloride.



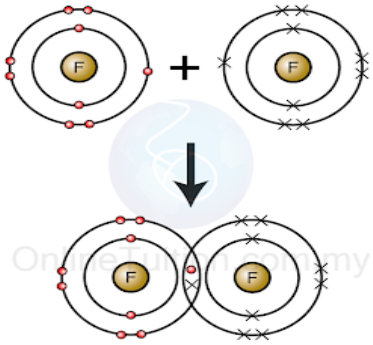


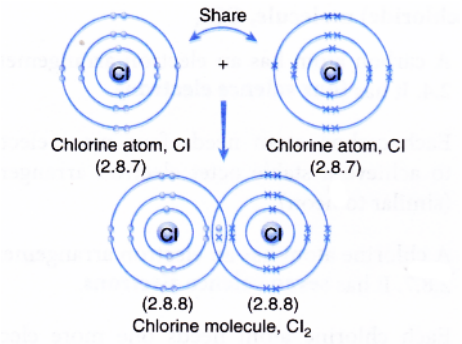
Chemical bonding

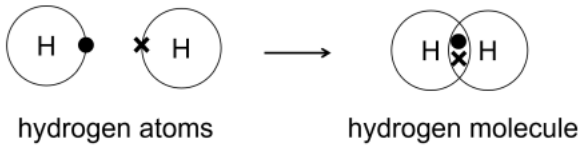


Covalent bonding in simple molecular elements and compounds

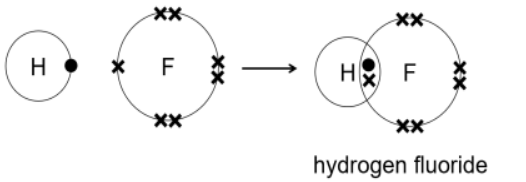
- Elements are not simply made up of separate atoms individually arranged. Elements such as oxygen (O_2) and (H_2) consist of **diatomic molecules**.
- The only elements that are made up of individual atoms moving almost independently are noble gases (Group 8). They are **monoatomic**.
- The sharing of electrons by each atom is represented by a **dot-and-cross diagram**.

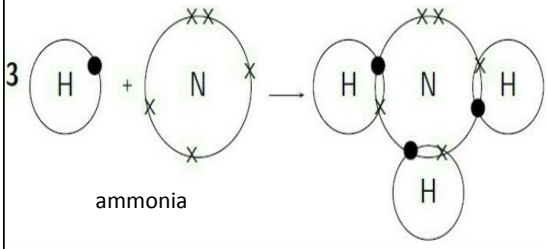


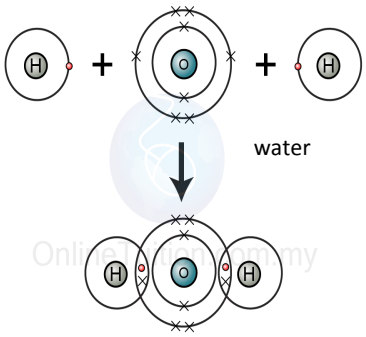


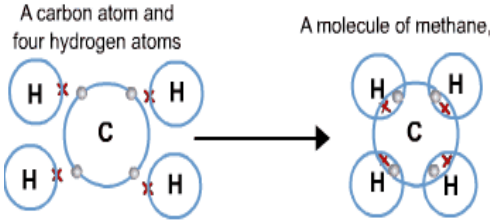


Diatomic single covalent bonds
More examples in book pg 52

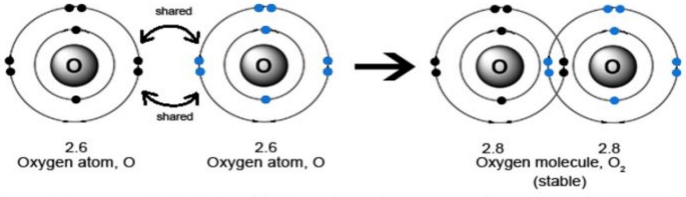








Covalently bonded (single) molecules. More examples in Pg 54



Double & triple bonded covalent compounds
More examples in pg 55

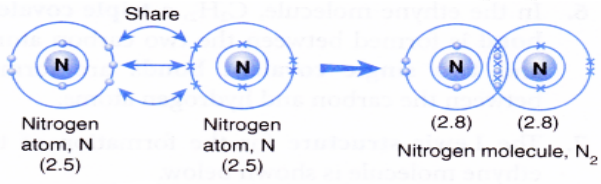
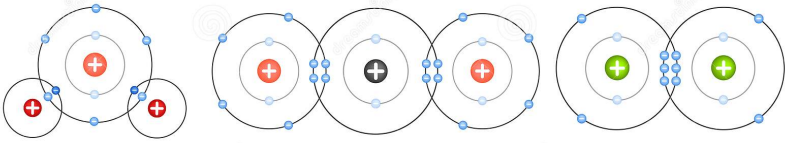


Figure *Formation of a nitrogen molecule, N_2*



$H-O-H \longrightarrow H_2O$
SINGLE BOND IN WATER MOLECULE

$O=C=O \longrightarrow CO_2$
DOUBLE BOND IN CARBONDIOXIDE MOLECULE

$N\equiv N \longrightarrow N_2$
TRIPLE BOND IN NITROGEN MOLECULE

Simple covalent compounds

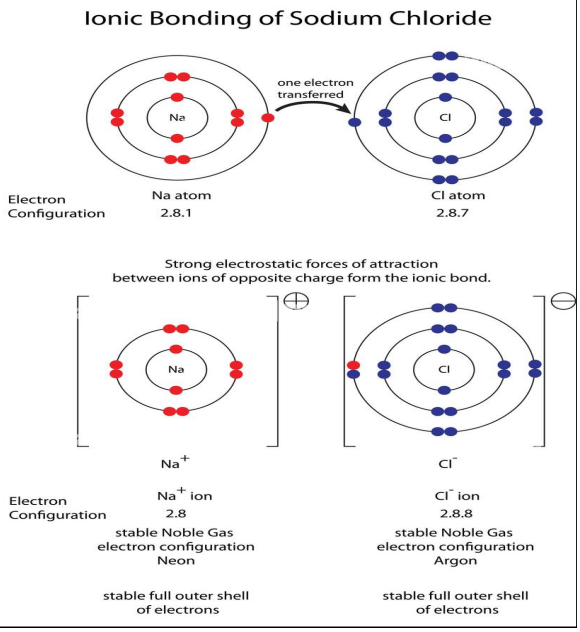
- Physical properties of simple covalent compounds Pg 56 table 3.2
- The covalent bonds within the molecules are strong and difficult to break (intramolecular force)
- However, the forces between the molecules, the intermolecular forces, are only weak and are easily broken.

Ionic compounds – Formation of ions

- Ionic bonding
- Ions
- Electrostatic forces

Definition Pg 57

- Cations & anions (Pg 58)
- Only outer shell electrons are involved in ionic bonding (same as covalent bonding)
- Metal atoms lose their outer electrons to form +ve (positive) ions (cations). Number of +ve charge on a metal ion is equal to the number of electrons lost.
- Non-metals gain electrons in their outer shell to become −ve (negative) ions. Number of −ve charge on a non-metal ion is equal to the number of electrons gained.



More examples of ionic bonding