

Atoms, Elements and Compounds

(IGCSE Chemistry Syllabus 2016-2018)

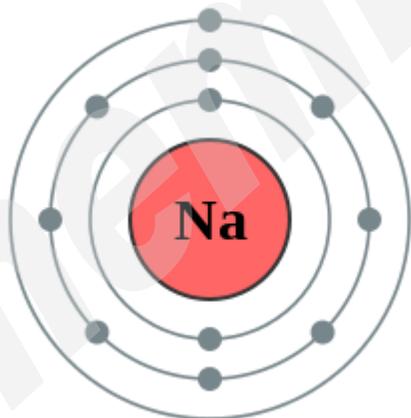
Particle	Relative charge	Mass
Proton	+1	1
Neutron	0	1
Electron	-1	1/1837

2 → proton number/ atomic number

He

4 → nucleon number/ mass number (proton number + neutron number)

- **Proton number:** number of proton in the nucleus of an atom
- Proton number = electron number in an atom
- **Nucleon number** = number of proton + number of neutron in the nucleus of an atom
- **Isotopes:** atoms of the same element with same number of protons and different number of neutrons
 - E.g. carbon-12, carbon-13 and carbon-14
 - Uses of isotopes: cancer treatment, detect the age of fossil, check for leaks
- Electrons are arranged in electron shells



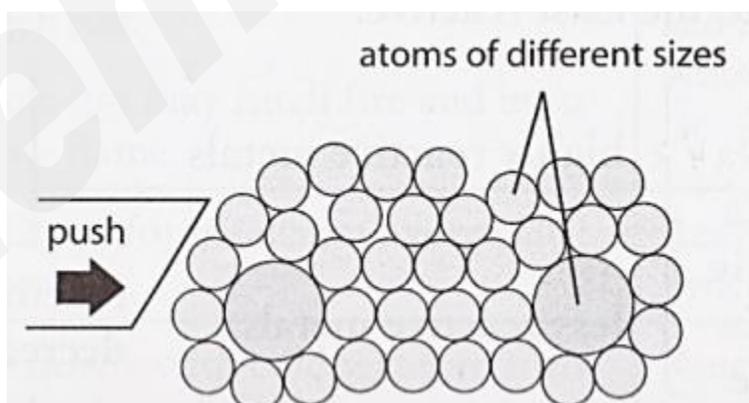
- Na (proton number = electron number = 11)
- Electronic arrangement (2,8,1)
- Full outer shell
 - First shell: 2 electrons
 - Second shell: 8 electrons
 - Third shell: 18 electrons

Bonding: The structure of matter

Element	Mixture	Compound	Ions
Substance that cannot be split into anything simpler Each element has a unique proton number e.g. sodium	Two or more elements mixed together but not chemically bonded e.g. atmospheric gas (oxygen, nitrogen, carbon dioxide...)	Substance in which two or more different elements chemically bonded together e.g. sodium chloride	Positive ions: proton number > electron number Negative ions Proton number < electron number

Metals	Non-Metals
Strong	Brittle
Good conductors of heat and electricity	Poor conductors of heat and electricity
High melting and boiling point	Low melting and boiling point
High density	Low density
Form basic oxides	Form acidic oxides
Form positive ions	Form negative ions
Malleable and ductile	
Sonorous	
Some are magnetic	

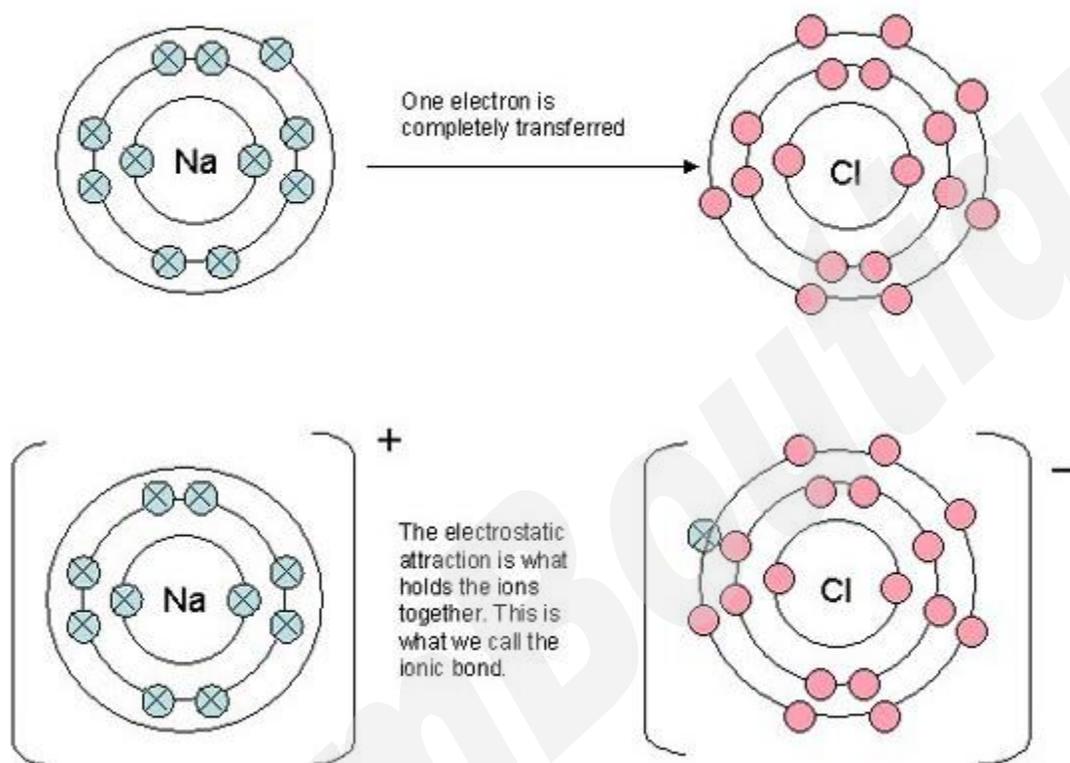
Alloy: mixture of two or more metals or mixture of one or more metal with a non-metal, to improve its properties (hardness)

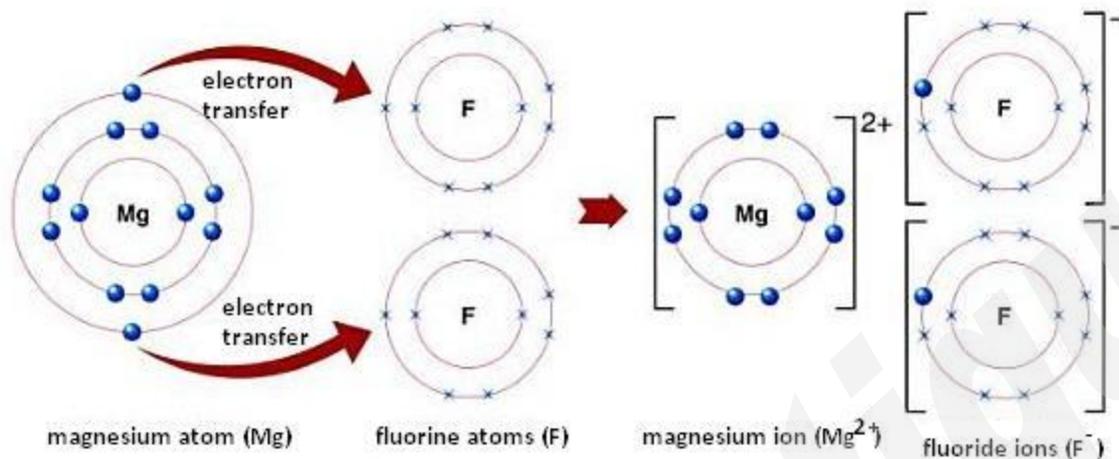


Alloy is harder than pure element: two different metal → two different atoms with different size → harder to slide over each other

Ionic bonding

- Between metal and non-metal
- Electrostatic attraction between positive and negative ions

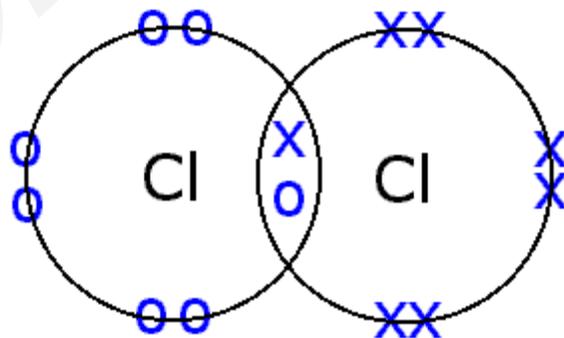


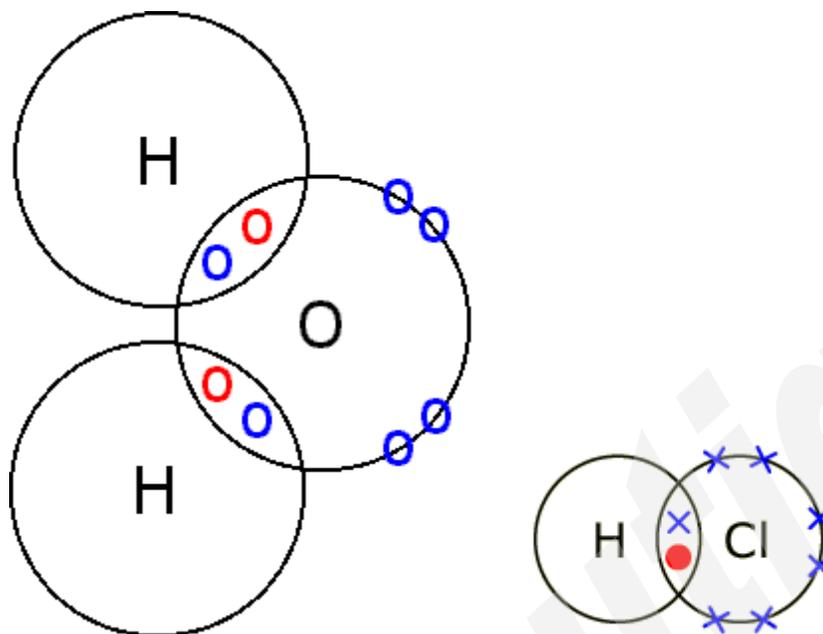


- Properties of ionic compound:
 - Form giant lattice structure (lattice: regular arrangement of positive and negative ions)
 - High melting point and boiling point (strong ionic bond, more energy is required to break the bond)
 - Conduct electricity when it is molten or aqueous state (free moving ions)
 - Soluble in water

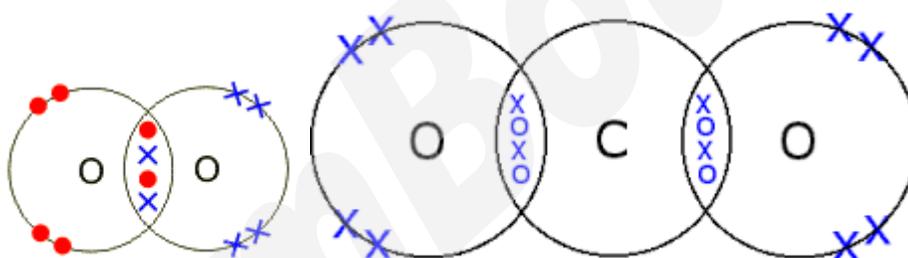
Covalent bonding

- Between non-metal and non-metal
- Bonding is formed through sharing of electrons
- Sharing of 1 pair of electrons = single bond (e.g. Cl-Cl)

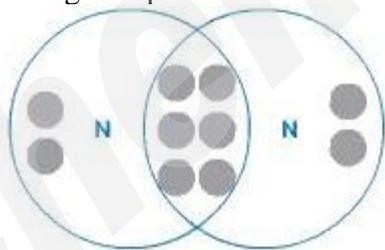




- Sharing of 2 pairs of electron = double bond (e.g. O=O)

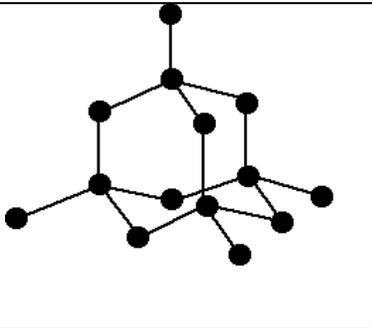
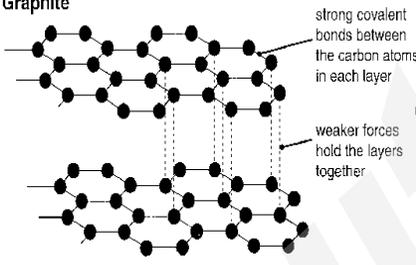
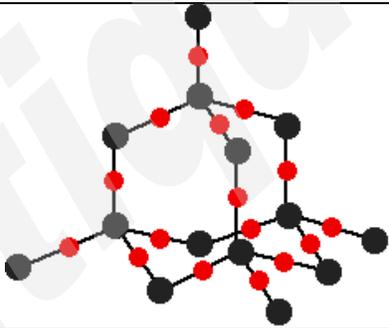


- Sharing of 3 pairs of electron = triple bond (e.g. $\text{N}\equiv\text{N}$)



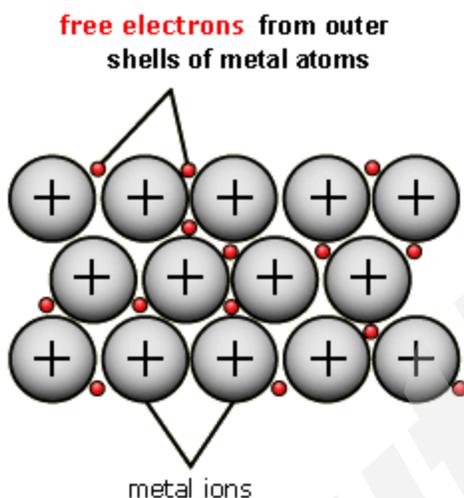
- Properties of covalent compound
 - Low melting and boiling point (weak intermolecular forces)
 - Cannot conduct electricity or heat (no mobile ions/electrons)
 - Insoluble in water

Giant covalent structure/Macromolecule

Diamond	Graphite	Silicon dioxide
	<p>Graphite</p> 	
<ul style="list-style-type: none"> -carbon forms 4 bonds -high melting and boiling point -doesn't conduct electricity -used for cutting → strongest and hardest 	<ul style="list-style-type: none"> - carbon forms 3 bonds with another 3 carbons - flat sheets held together by weak intermolecular forces - soft and slippery as the layers of flat sheet can slide over each other - used as lubricant - can conduct electricity → free moving electrons 	<ul style="list-style-type: none"> - each Si atom is bonded to 4 O atoms - each O atom is bonded to 2 Si atoms - high melting and boiling point - hard - make up sand

- High melting point and boiling point – structure made up of strong covalent bond
- Cannot conduct electricity (except graphite) – no mobile ions or electrons
- Hard (except graphite)

Metallic bond



- Metal atoms have the tendency to donate electrons to form positive ions
- The electrons donated will form sea of electrons
- Metallic bond: electrostatic attraction between positive metal ions and sea of delocalized electrons
- Malleable and ductile: layer of positive metal ions can slide over each other
- Conductor of electricity and heat: Free moving electrons