

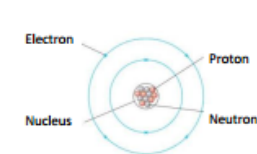
## States of Matter

1. Solid to liquid state change is melting. Liquid to solid state change is freezing. Happens at the melting point.
2. Liquid to gas state change is boiling. Gas to liquid state change is condensing. Happens at the boiling point.
3. The amount of energy needed to change state from solid to liquid and liquid to gas depends on the strength of the forces between the particles of the substance.
4. The nature of the particles involved depends on the type of bonding and the structure of the substance.
5. The stronger the forces between the particles the higher the melting point and boiling point of the substance.
6. Particle model limited by the fact there are no forces, all particles are represented as spheres and that the spheres are solid.
7. States are represented by state symbols in chemical equations, (s), (l) and (g). (aq) for aqueous solutions.



## Atomic Structure

**Atoms** Atoms are tiny, too small to see. They have a radius of 0.1 nanometres ( $1 \times 10^{-10} \text{m}$ ). Atoms have no charge because they have the same number of protons and electrons.



Type of sub-atomic particle	Relative charge	Relative mass
proton	+1	1
neutron	0	1
electron	-1	very small (it would take almost 2000 electrons to have the same mass as one proton or neutron)

Electron  
Orbit around nucleus in shells  
Proton  
Found in the nucleus  
Neutron  
Found in the nucleus

Mass Number : protons + neutrons  
Atomic number: Protons

Mass Number → 23

Atomic Number → 11

**Na**

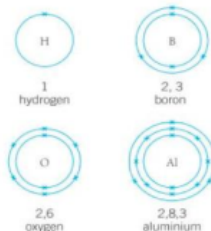
## Ions

**Ions** An ion is an atom that has lost or gained electrons. In an ion the number of protons is not equal to the number of electrons so the atom has an overall charge.

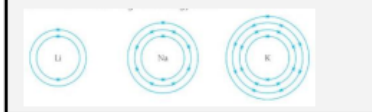
## Electron Configuration

### Electronic Structure

- 1st shell – Lowest energy level and can hold **2 electrons**
- 2nd shell – Energy level can hold up to **8 electrons**
- 3rd shell onwards – Can hold up to **8 electrons**



**Electron structure and the periodic table**  
Elements in the same **group** have the same number of electrons on their outer shell.



Proton number = Electron Number  
Number of neutrons =  
Mass number – Atomic number

## Electron Configuration

The arrangement of the periodic table has changed.

### Early 1800s

- Arranged by **relative atomic mass**.
- Scientists had not yet discovered protons, neutrons or electrons.
- There were gaps for missing elements that had not been found yet.

### Dmitri Mendeleev

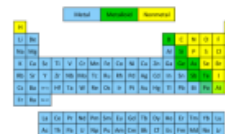
- Ordered mainly by **atomic mass**.
- Elements with similar properties in the same **group**.
- Gaps left for **elements** that hadn't been found yet.

### Modern Day

- In order of increasing **atomic mass**.
- Repeating patterns in the properties of the **elements**.

- **Metals** are on the left and **non-metals** are on the right.

You will need to know the first 20 element names and their symbols

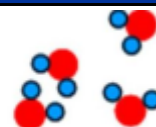


**Properties of metals** - Ductile - Malleable  
- High melting and boiling point  
- Conduct heat - Conduct electricity

**Properties of non-metals** - Brittle  
- Insulators of heat and electricity  
- Not always solids - lower density

## Compounds

- Have a fixed composition
- Can be separated by a **chemical reaction**
- **Chemical bonds** between atoms



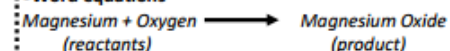
## Key Vocabulary

- Ionic bond** – the electrostatic force of attraction between positively and negatively charged ions.
- Dot and cross diagram** – a drawing to show only the arrangement of the outer shell electrons of the atoms or ions in a substance.
- Covalent bond** – the bond between two atoms that share one or more pairs of electrons.
- Metallic bond** –
- Alloy** – a mixture of two or more elements, at least one of which is a metal.
- Delocalised electrons** – bonding electron that is no longer associated with any one particular atom.
- Fullerene** – form of the element carbon that can exist as large cage-like structures, based on hexagonal rings of carbon atoms.
- Giant covalent structure** – a huge 3D network of covalently bonded atoms.
- Giant structure/lattice** – a huge 3D network of atoms or ions.
- Polymer** – a substance made from very large molecules made up of many repeating units.

## Equations

**Chemical reactions** are shown using:

### • Word equations



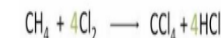
### • Symbol equations – Show the atoms on both sides



### Balancing equations:

- There must always be the same number of atoms on both sides of a symbol equation.

- Atoms can't just disappear.



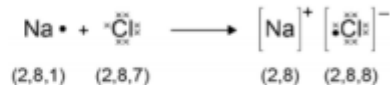
- You balance equations by putting numbers **in front** of the number.



## Ionic bonding

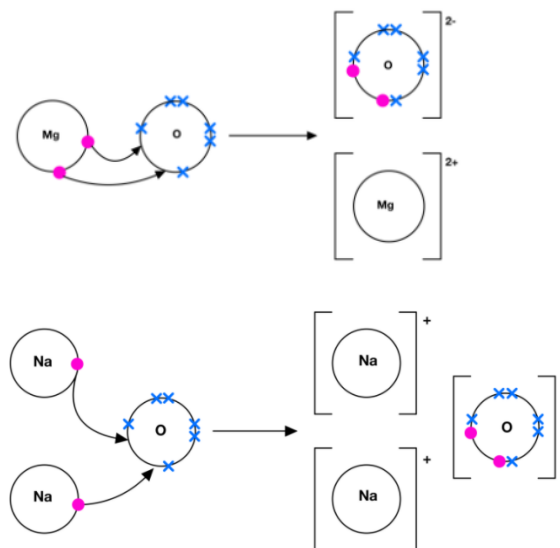
### Ionic Bonding

Bonds between metal positive ions and non-metal negative ions.  
The outer-shell electron of the metal ion transfers to the non-metal ion.  
Can be represented with dot and cross diagrams.



### Ionic Compounds

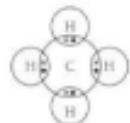
Ionic compounds are held together by strong forces of attraction between their oppositely charged ions.  
These forces act in all directions in the compound.  
Giant regular structure of ions.  
They have high melting and boiling points, due to large amounts of energy being needed to break the strong bonds.  
When melted or dissolved in water, ionic compounds conduct electricity due to free moving ions.



## Covalent Bonding

### Covalent Bonding

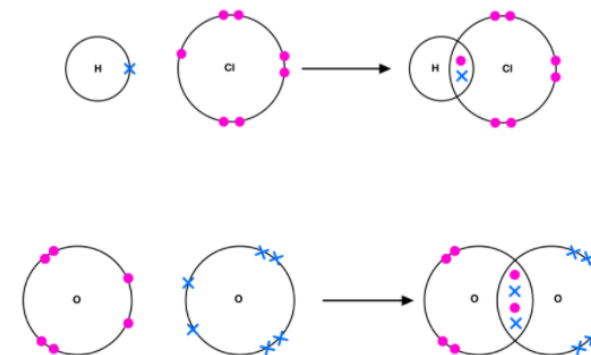
Between non-metal atoms.  
Atoms share pairs of electrons.



dot and cross diagram  
(showing outer shells  
as circles)

### Small Covalent Molecules

Gases or liquids with low melting and boiling points.  
Weak intermolecular forces that break when the substance melts or boils.  
Intermolecular forces increase with the size of the molecules.  
Do not conduct electricity.  
Examples – water, ammonia, carbon dioxide



## Metallic Bonding

### - Metallic Bonding

Giant structures of atoms arranged in a regular pattern.  
Delocalised outer shell electrons are free to move through the whole structure.  
Sharing of delocalised electrons gives rise to strong metallic bonds.

