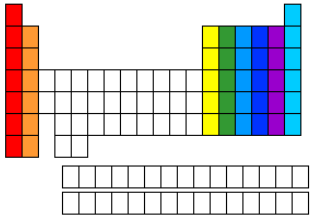
SCIENCE

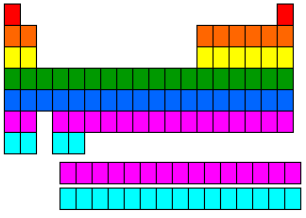
Year 9: Atoms and Periodic Table

1) The Periodic Table

- The periodic table contains every **element** that has been discovered.
- When the periodic table was being developed, a number of scientists including **Dimitri Mendeleev** organised it based on **increasing mass** and they left **gaps** for **undiscovered** elements.
- Elements are arranged into **groups** (columns) and **periods** (rows) as shown below:



GROUPS ALONG THE VERTICAL COLUMNS



PERIODS ALONG HORIZONTAL ROWS

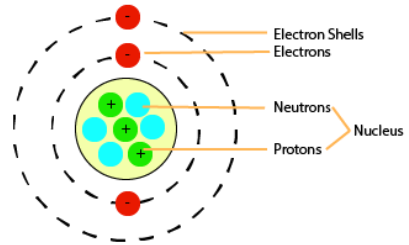
- Elements in the same **group** have similar **properties** and have the same **number of electrons in their outer shell**
- Elements in the same **period** have the **same number of electron shells**

2) Atoms and ions

Everything in the world is made up of **atoms**. An atom is a **particle** with **no charge** made up of a **nucleus**, with **protons** and **neutrons**, and surrounded by **electrons** on shells. Each **element** in the periodic table has a **unique** atom.

Protons, neutrons and electrons have different masses and charges.

particle	symbol	charge	mass
proton	p	+1	√
neutron	n	0	√
electron	e	-1	×



An **ion** is a particle with a **different number of protons and electrons**, due to electrons being lost or gained. This results in the particle being **charged**.

Loss of **electrons** results in a **positive** charge and **gain** of **electrons** results in a **negative** charge.

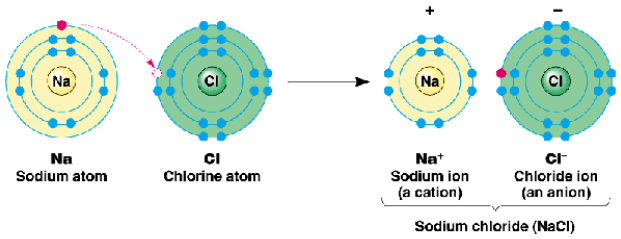
Isotopes form when an atom has a **different number of neutrons** in its nucleus.

Keyword	Meaning	Keyword	Meaning
Atom	A particle with no charge made up of a nucleus, with protons and neutrons, and surrounded by electrons on shells	**Group**	The name given to each vertical column in the periodic table
Proton	A positively charged particle found in the nucleus of an atom	**Period**	The name given to each horizontal row in the periodic table
Neutron	A neutral (no charge) particle found in the nucleus of an atom	**Element**	A substance only containing one type of atom
Electron	A negatively charged particle found on electron shells surrounding the nucleus of an atom. Shown as dots or crosses on diagrams.	**Compound**	A substance made up of two or more elements chemically bonded together
Nucleus	Central part of an atom containing protons and neutrons	**Ion**	A charged particle containing different numbers of protons and electrons
Shell	The region an electron occupies surrounding an atoms nucleus	**Electronic structure**	The distribution of electrons on each electron shell

3) Ionic bonding

Elements can **chemically bond** together by gaining or losing an electron from another element. This is known as **ionic bonding,** and results in **oppositely charged ions which attract** forming an ionic compound.

Ionic bonds form between **metals** and **non-metals**, for example sodium chloride.
An atom of **sodium** will **lose** an **electron** and form a **positive** ion. An atom of **chlorine** will **gain** an **electron** and form a **negative** ion.



Sodium has an **electronic structure 2, 8, 1** so must lose 1 electron to have a full outer shell and become stable .

Chlorine has an **electronic structure 2, 8, 7** so must gain an electron to have a full outer shell and become stable.
When sodium and chlorine bond together ionically there is **one** of each element in the compound so the formula is **NaCl**.

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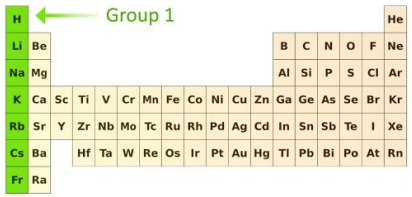
• 4) Group 1 elements and their properties



The **Group 1** elements are known as the **Alkali Metals**. They are positioned to the **left** most hand side of the periodic table.

All the group 1 metals are very **reactive** and must be stored in **oil** to prevent them reacting with water or water vapour.

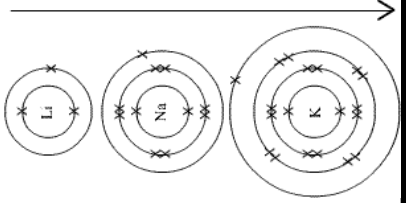
Increasing reactivity down the group.

The outer elctron is less strongly attracted to the nucleus, so is more easily lost.

Group 1 elements form an **alkaline solution** (pH 8-14) when they react with **water**; **hydrogen gas** is released and a **metal hydroxide** is also **produced**.

Group 1 elements:

- have **1 electron in their outer shell**,
- as you go down the group the number of **electron shells increases**. This increases the **size** of the **atom**
- the **distance** of the outer electron from the **nucleus** increasese



Lithium reacting with water produces some **fizzing**, sodium is a slightly more **vigorous** reaction with more fizzing and floating on top of the water, potassium has a very vigorous reaction producing a **purple flame** and lots of fizzing.

The **speed** and **violence** of the reaction **increases** as you go **down** the group. This shows the **reactivity** of group 1 metals increases down the group.

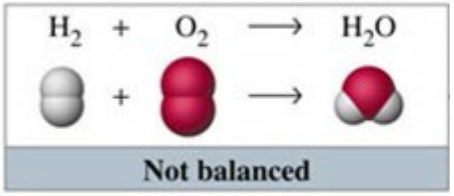
5) Properties of other groups

Elements in the same **group** on the periodic table have **similar properties**.

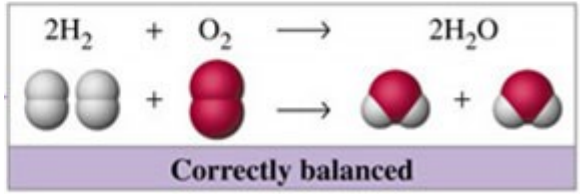
- The **group 7** elements are known as the **Halogens**. They all have **seven outer electrons**, they **decrease** in **reactivity down** the group and they **increase** in **density down** the group.
- The **group 0** elements are known as the **Noble Gases**. They all have **full outer shells** and their **density increases down** the group.
- **Carbon** can form single, double or triple bonds with other carbon atoms. They can form **up to four bonds** and can form very long chains. Carbon is **essential** to life.

6) Balancing equations

The law of **conservation** of **mass** states that **no atoms can be created or lost** in a chemical reaction. All of the **reactants react** together in different ways to **form** the **products**. This is why we must **balance** chemical equations.

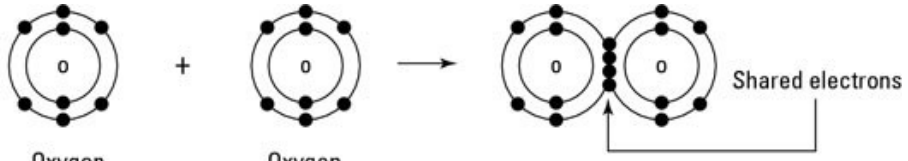


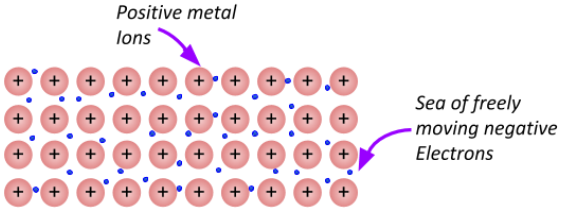
Balancing equations means ensuring that the **number** of **atoms** of each **element** are the **same** in the **reactants and products**.



7) Other types of bonding

Covalent bonding occurs when **two non-metal** atoms **share electrons**. Electrons involved are on the **outer shell** of the atoms and **complete** the outer shell. These bonds are **strong**. Atoms may form multiple covalent bonds.



Molecules of oxygen gas (O_2) formed by a covalent bond. Atoms share electrons to make each more stable.

Metallic bonding is the electrostatic **attraction** between **free/delocalised electrons and positive metal ions** within a metal. The free/delocalised electrons allow metals to **conduct** electricity.