AQA GCSE Chemistry

Topic 1: Atomic Structure and the Periodic Table

The Periodic Table

Notes

(Content in bold is for Higher Tier only)

The periodic table

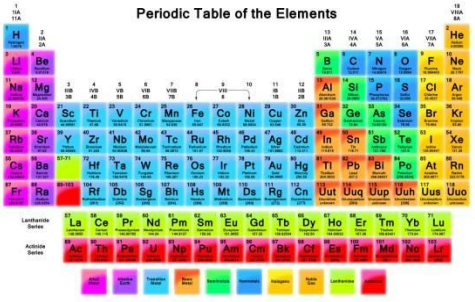
- Elements are arranged in order of atomic (proton) number (smaller number) and so that elements with similar properties are in columns, known as groups.
- Elements in the same periodic group have the same amount of electrons in their outer shell, which gives them similar chemical properties.

The early periodic table

John Newlands	Dmitri Mendeleev
• Ordered his table in order of atomic mass • Realised similar properties occurred every eighth element – 'law of octaves' but broke down after calcium.	• Ordered his table in order of atomic mass, but not always strictly – i.e. in some places he changed the order based on atomic weights. • Left gaps for elements that he thought had not been discovered yet.

- The table is called a periodic table because similar properties occur at regular intervals.
- Elements with similar properties are found in the same column (groups)

The modern periodic table



- Elements with properties predicted by Mendeleev were discovered and filled the gaps.
  - Knowledge of isotopes made it possible to explain why the order based on atomic weights was not always correct.
- When electrons, protons and neutrons were discovered in the early 20th century, elements were ordered in atomic (proton) number.
- When this was done, all elements were placed in appropriate groups.

Metals and non-metals

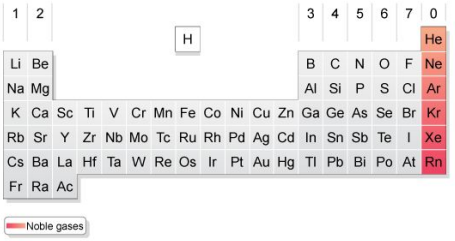
- Metals = elements that react to form positive ions.
  - Majority of elements are metals.
  - Found to the left and towards the bottom of the periodic table.
- Non-metals = elements that do not form positive ions.
  - Found towards the right and top of the periodic table.

Group 1 – Alkali metals

- They have characteristic properties due to the single electron in their outer shell.
- Metals in group one react vigorously with water to create an alkaline solution and hydrogen.
- They all react with oxygen to create an oxide.
- They all react with chlorine to form a white precipitate.
- The reactivity of the elements increases going down the group:

	reaction with oxygen	reaction with water	reaction with chlorine
lithium	burns with a strongly red-tinged flame and produces a white solid	Fizzes steadily, gradually disappears	white powder is produced and settles on the sides of the container
sodium	strong orange flame and produces white solid	Fizzes rapidly, melts into a ball and disappears quickly	burns with a bright yellow flame, clouds of white powder are produced and settle on the sides of the container
potassium	large pieces produce lilac flame, smaller ones make solid immediately	Ignites with sparks and a lilac flame, disappears very quickly	reaction is even more vigorous than with sodium

Group 0 – Noble gases



- They have 8 electrons in their outer shell (except helium, which has 2). All of them (including helium) have full outer shells
- They are unreactive and do not easily form molecules, because they have a stable arrangement of electrons (full outer shell).
- The boiling points of the noble gases increase with increasing relative atomic mass (going down the group).

Group 7 – The halogens

- Similar reactions due to their seven electrons in their outer shell.
- Non-metals and exist as molecules made of pairs of atoms (e.g. Cl_2)
- They react with metals to form ionic compounds in which the halide ion carries a -1 charge.
- they react with nonmetals to form covalent compounds, where there is a shared pair of electrons
- as you go down the group, relative molecular mass, melting point and boiling point all increase
- reactivity decreases down the group because:
    - halogens react by gaining an electron (to increase their number of outer shell electrons from 7 to 8)
    - the number of shells of electrons increases down the group, so down the group the element attracts electrons from other atoms less, so can't react as easily
- decrease in reactivity means that a more reactive halogen (one from higher up group 7) can displace a less reactive one in an aqueous solution of its salt.
        - E.g. Chlorine will displace bromine if we bubble the gas through a solution of potassium bromide:
            - Chlorine + Potassium Bromide → Potassium Chloride + Bromine