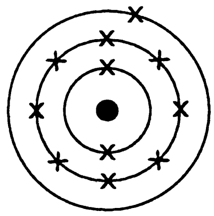
GCSE Science (Modular) - Module 16 Revision Guide (Chemistry)

Foundation Tier

Atoms

Atoms have a small central **nucleus** made up of **protons** and **neutrons**.
Around the nucleus there are **electrons**. Electrons occupy particular **energy levels**.
Each electron in an atom is at a particular energy level. The electrons in an atom occupy the lowest available energy levels.

You should be able to represent the electronic structure of the first twenty elements of the periodic table as shown on the right:

for sodium  and 2,8,1

The periodic table

The chemical elements can be arranged in the order of the proton (atomic) number of their atoms.
This list can then be arranged in rows so that elements with similar properties are in the same columns, known as **Groups**. The resulting table is known as the periodic table.

The periodic table can be seen as an arrangement of the elements in terms of their electronic structure. From left to right, across each horizontal row (period) of the periodic table, a particular energy level is gradually filled up with electrons; in the next period, the next energy level is filled with electrons.

The similarities and differences between the properties of elements in the same group of the periodic table can be explained by the electronic structure of their atoms.

There have been several attempts to classify the elements in a systematic way, including those by Newlands and Mendeleev, which have lead to the modern periodic table. You should be able to:
- describe early attempts to classify the elements; and
- explain how the growth of chemical knowledge has led to the periodic table in its present form.

Group 1

The elements in Group 1 (known as the alkali metals):
- are metals;
- react with non-metals to form ionic compounds in which the metal ion carries a 1+ charge;
- react with water releasing hydrogen;
- form hydroxides which dissolve in water to give alkaline solutions.

In Group 1, the further down the group an element is:
- the more reactive the element;
- the lower its melting point and boiling point.

When a piece of lithium, sodium or potassium is placed in cold water the metal floats, may melt and moves around the surface of the water. The metal reacts with the water to form a metal hydroxide solution and hydrogen gas. The more reactive the metal, the more vigorous is the reaction with water. A simple laboratory test for hydrogen is the “squeaky” pop test with a lighted splint.

Group 7

The elements in Group 7 (known as the halogens):

- are non-metals;
- have coloured vapours;
- consist of molecules which are made up of pairs of atoms;
- form ionic salts with metals in which the chloride, bromide or iodide ion carries a 1– charge;
- form molecular compounds with other non-metallic elements.

In Group 7, the further down the group an element is:

- the less reactive the element;
- the higher its melting and boiling point.

A more reactive halogen can displace a less reactive halogen from an aqueous solution of its salt.

Group 0

The elements in Group 0 (known as the noble gases):

- are all chemically very unreactive gases;
- exist as individual atoms rather than as diatomic gases like other gaseous elements;
- are used as inert gases in filament lamps and in electrical discharge tubes.

The transition metals

In the centre of the periodic table is a block of metallic elements. These elements, which include iron and copper, are known as transition metals.

How do metal-halogen compounds compare with their elements, and what use are they?

Sodium chloride (common salt) is a compound of an alkali metal and a halogen. It is found in large quantities in the sea and in underground deposits.

The electrolysis of sodium chloride solution (brine) is an important industrial process. Chlorine gas is formed at the positive electrode and hydrogen gas at the negative electrode. A solution of sodium hydroxide is also formed.

Each of these products can be used to make other useful materials:

- chlorine is used to kill bacteria in drinking water and in swimming pools, and to manufacture disinfectants, bleach and the plastic (polymer) PVC;
- hydrogen is used in the manufacture of ammonia and margarine;
- sodium hydroxide is used in the manufacture of soap, paper and ceramics.

A simple laboratory test for chlorine is that it bleaches damp litmus paper.

Silver chloride, silver bromide and silver iodide (silver halides) are reduced to silver by the action of light, X-rays and the radiation from radioactive substances. They are used to make photographic film and photographic paper.

Hydrogen halides are gases which dissolve in water to produce acidic solutions.

Chemical symbols, formulae and equations

A chemical reaction can be described using a word equation: reactants → products

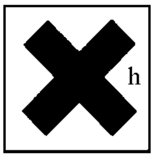
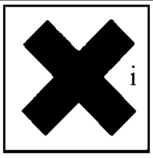
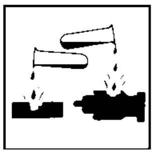
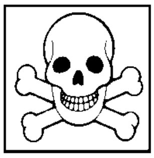
You should be able to write word equations for all reactions in the syllabus.

Each element is represented by a different symbol (the Data Book has the symbols of the elements). The symbols for elements are used to write chemical formulae for compounds which show the ratios of atoms from different elements which are combined to form the compounds.

You should be able to write down the correct formulae for simple ionic compounds (the Data Book has the formulae of, and charges on, common ions).

Hazard symbols

You should be able to **recognise** and **draw** diagrams of simple chemical apparatus. You should be able to recognise, and explain the meaning of, these hazard symbols and give an example of each type of substance:

	**Oxidising** These provide oxygen which allows other materials to burn more fiercely.		**Harmful** These are similar to toxic substances but less dangerous.		**Irritant** These are not corrosive but can cause reddening or blistering of the skin.
	**Highly flammable** These easily catch fire.		**Corrosive** These attack and destroy living tissues, including eyes and skin.		**Toxic** These can cause death when swallowed, breathed in or absorbed through the skin.

How can we speed up, or slow down, chemical reactions?

The rate of a chemical reaction can be followed by measuring the rate at which the **products are formed**, or the rate at which the **reactants are used up**. This allows the changing rate of a chemical reaction under different conditions to be studied. You should be able to interpret graphs showing the amount of product formed (or reactant used up) against time.

Chemical reactions can only occur when reacting particles **collide** with each other and with **sufficient energy**. The minimum amount of energy particles must have to react is the **activation energy**. Increasing the rates of chemical reactions is important in industry because it helps to reduce costs. The speed (rate) of a chemical reaction increases:

- If the temperature increases, the speed of the reacting particles increases so that they collide more frequently and with more energy. This increases the rate of reaction.
- If the concentration of dissolved reactants or the pressure of gases increases, the frequency of collisions increases, and so increases the rate of reaction.
- If solid reactants are in smaller pieces (greater surface area), more of the solid reactant particles come into contact with the other reactants.
- If a catalyst is used. A catalyst increases the rate of a reaction but it is not used up during the reaction. It is used over and over again. Different reactions need different catalysts.

Do chemical reactions always release energy?

When fuels burn, energy is released as heat.
Whenever chemical reactions occur, energy is usually transferred to or from the surroundings:

- **exothermic** reactions give out energy, often as heat, **to** the surroundings.
- **endothermic** reactions take in energy, often as heat, **from** the surroundings.