GCSE Science (Modular) - Module 15 Revision Guide (Chemistry)

Higher Tier

Properties of metals and non-metals

More than three-quarters of the elements are metals, and less than a quarter are non-metals.
You should know their properties (summarised in the table below):

Metals	Non-metals
Usually have a high melting point. All are solids at room temperature (except mercury).	Mostly have low melting points and boiling points. Half are gases, and bromine is a liquid.
Shiny when freshly cut.	Mostly dull.
Mostly tough, strong and can easily be hammered or bent into shape (malleable).	Mostly brittle and crumbly when solid.
Good conductors of heat and electricity when solid or liquid.	Mostly poor conductors of heat and electricity when solid or liquid.
Form alloys (mixtures of metals).	

You should be able to give the common uses of copper, iron and aluminium, and to relate these uses to the properties in the table above.

Chemical properties of metal and non-metal compounds

When a substance dissolves in water it forms an aqueous solution which may be acidic, alkaline or neutral. Water itself is neutral. Indicators can be used to show whether a solution is acidic, alkaline or neutral by the way their colours change.

The pH scale is used to show how acidic or alkaline a solution is:

0 ←	7	→ 14
increasing acidity	neutral	increasing alkalinity

Some metal oxides and hydroxides dissolve in water to produce alkaline solutions. For example:

- sodium oxide and sodium hydroxide;
- potassium oxide and potassium hydroxide; and to some extent
- calcium oxide and calcium hydroxide.

Soluble oxides of non-metals produce acidic solutions. For example:

- carbon dioxide;
- sulphur dioxide; and
- nitrogen dioxide.

An acid reacts with an alkali to produce a salt and water. This reaction is called **neutralisation**.
The word equation for neutralisation is: acid + alkali → salt + water

The particular salt produced in any reaction between an alkali and an acid depends on the metal in the alkali, and the acid used. When neutralised, hydrochloric acid produces chlorides, nitric acid produces nitrates, and sulphuric acid produces sulphates. For example, hydrochloric acid and sodium hydroxide react together to produce sodium chloride and water. The word equation for this reaction would be:

hydrochloric acid + sodium hydroxide → sodium chloride + water

Which metals are most reactive?

Some metals are more reactive than others. A **reactivity series** can be produced by seeing if various metals react with the following (and observing how vigorous any reaction is):

- with air, to produce metal oxides;
- with water (cold, hot or as steam) to produce metal hydroxides (or oxides) and hydrogen; and
- with dilute acids, to produce metal salts and hydrogen.

(A simple laboratory test for the hydrogen produced is that when a test tube of hydrogen is held to a flame, the hydrogen burns in air with a squeaky "pop").

The reactivity series lists metals in order of their reactivity, with the most reactive metal at the top of the list and the least reactive at the bottom (the Data Book has a reactivity series of metals).

A more reactive metal can **displace** a less reactive metal from its compounds.

Where does oil come from and how can so many useful products be made from it?

Fossil Fuels

Coal, oil and natural gas are fossil fuels. They come from dead animals and plants which have been covered by layers of sedimentary rock, and heated under pressure in the absence of air over millions of years.

Crude oil

Crude oil is obtained from the earth's crust. Oil and gas are less dense than water and so rise to the top of porous rock layers. They may then become trapped below a layer of non-porous rock. Trapped gas or oil can be obtained by drilling through the non-porous layer.

Crude oil is a mixture of a very large number of compounds. Most of the compounds in crude oil consist of molecules called **hydrocarbons**, because they are made up of hydrogen and carbon atoms only.

Fractional Distillation

A mixture consists of two or more elements or compounds, not chemically combined. The chemical properties of each substance in a mixture are unchanged, and so the substances can be separated by physical methods, e.g. distillation. The hydrocarbons in crude oil can be separated by **fractional distillation**. This means evaporating the oil and allowing it to condense at different temperatures. This produces various **fractions**, each containing molecules with similar numbers of carbon atoms and boiling points.

Properties of Hydrocarbons, Cracking

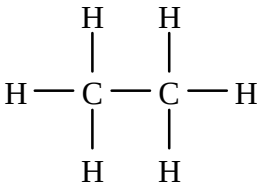
Hydrocarbon molecules in crude oil vary in size. The larger a molecule is (the more carbon atoms it has):

- the higher its boiling point;
- the less volatile it is;
- the less easily it flows (the more viscous it is); and
- the less easily it ignites (the less flammable it is).

This limits the use of large hydrocarbon molecules (such as bitumen) as fuels. So, large hydrocarbon molecules are broken down using a process called cracking. This produces smaller, more useful molecules. Some of these smaller molecules are useful as fuels; others can be used to make plastics (polymers) such as poly(ethene) and poly(vinyl chloride) (PVC).

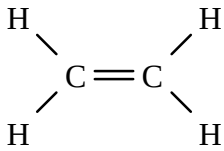
Alkanes

Carbon atoms form the spine of the hydrocarbon molecules. When they are joined by a single covalent C–C bond they are known as alkanes. You should be able to represent and interpret the structure formed, e.g. ethane, C_2H_6 (on the right).



Alkenes

When the hydrocarbons are joined by C=C double covalent bonds they are called alkenes. You should be able to represent and interpret the structure formed, e.g. ethene, C_2H_4 (on the right).



Polymerisation

Unsaturated hydrocarbons are reactive and so are useful for making many other substances including polymers. Polymers have large molecules and are formed when many small molecules of substances called monomers join together. This process is called polymerisation.

When unsaturated monomers join together to form a polymer with no other substance being produced, the process is called addition polymerisation. Plastics made by this process include poly(ethene) from ethene.

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Foundation Tier

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