AQA GCSE Chemistry

Topic 1: Atomic Structure and the Periodic Table

A simple model of the atom, symbols, relative atomic mass, electronic charge and isotopes

Notes

(Content in bold is for Higher Tier only)

Atoms, elements and compounds

- Atoms make up all substances and are the smallest part of an element that can exist
- Chemical symbols represent an atom of an element e.g. Na represents an atom of sodium
- Compounds are formed from elements by chemical reactions. Chemical reactions always involve the formation of one or more new substances, and often involve an energy change
- Compounds contain two or more elements chemically combined in fixed proportions and can be represented by formulae using the symbols of the atoms from which they were formed e.g. HCl is a compound containing 1 atom of hydrogen and 1 of chlorine per molecule
- Compounds can only be separated into elements by chemical reactions

Mixtures

- A mixture consists of two or more elements or compounds not chemically combined together. The chemical properties of each substance in the mixture are unchanged. (this is different to a compound)
- Can be separated by: filtration, crystallisation, simple distillation, fractional distillation and chromatography. These are physical processes, so do not involve chemical reactions and no new substances are made.

The development of the model of the atom

- First: atoms were thought to be tiny spheres that could not be divided
- Discovery of electron-> plum pudding model (atom is a ball of positive charge with negative electrons embedded in it)
- Alpha particle scattering experiment-> conclusion that the mass of an atom was concentrated at the centre (nucleus) and that the nucleus was charged
  Scattering experiment:
  - A beam of alpha particles was aimed at very thin gold foil and their passage through was detected
  - Some of the alpha particles emerged from the foil at different angles, and some even came straight back
  - the positively charged alpha particles were being repelled and deflected by a small concentration of positive charge in the atom (nucleus)
- Neil Bohr: suggested electrons orbit the nucleus at specific distances (supported by experimental data)

- Later experiments: positive charge of any nucleus could be subdivided into a whole number of smaller particles, each particle having the same amount of positive charge (protons)
- James Chadwick's work: provided the evidence to show the existence of neutrons within the nucleus (had been an accepted scientific idea for about 20 years already)

Relative electrical charges of subatomic particles

- atomic number: the number of protons in an atom of an element.
- All atoms of a particular element have the same number of protons.
- Atoms of different elements have different numbers of protons.

particle	Relative charge
proton	+1
neutron	0
electron	-1

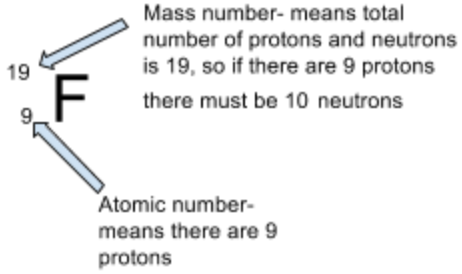
- An atom has an overall charge of 0, so number of protons = number of electrons

Size and mass of atoms

- Atoms are very small (radius of about 0.1 nm) and the radius of a nucleus is less than 1/10,000 of that of the atom, though it holds almost all of the mass

particle	Relative mass
proton	1
neutron	1
electron	Very small

- Mass number: the sum of the protons and neutrons in an atom
- Isotopes: atoms of the same element with different numbers of neutrons
- This is how atoms are shown in the periodic table:



Relative atomic mass

- Relative atomic mass: an average value that takes account of the abundance of the isotopes of the element

- Example question: carbon has 2 isotopes: carbon-14 with abundance 20% and carbon-12 with abundance 80%. Calculate the relative atomic mass of carbon.
  To calculate it: ((isotope 1 mass x abundance) + (isotope 2 mass x abundance)) ÷ 100
  For this question: ((14 x 20) + (12 x 80)) ÷ 100 = 1240 ÷ 100 = 12.4

Electronic structure

- electrons occupy the lowest available energy levels (the shells closest to the central nucleus)
- Electronic structure of an atom tells you how many electrons are in each shell
  e.g. for sodium: 2 electrons in shell 1 (closest to nucleus), 8 in shell 2, 1 in shell 3
  Electronic structure= 2,8,1 or