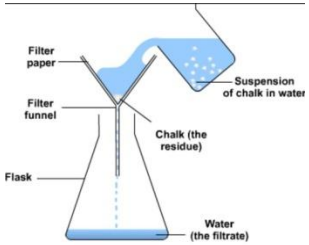
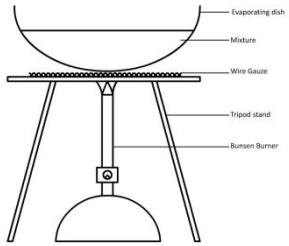
1) Atomic structure and the periodic table

Methods of separating mixtures

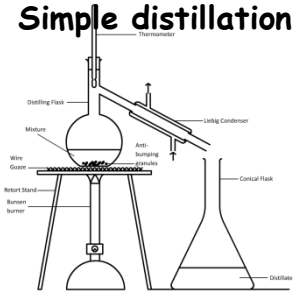
Filtration



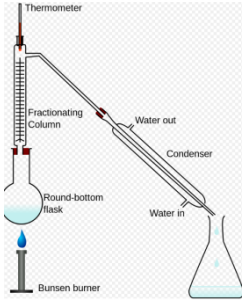
Crystallisation



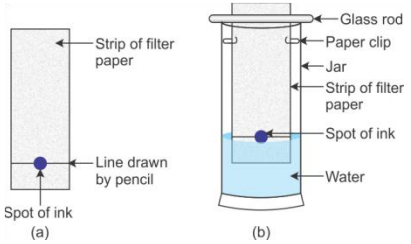
Simple distillation



Fractional distillation



Chromatography



Definitions

Atom -the smallest part of an element that can exist.

Compounds - two or more elements chemically combined in fixed proportions.

Mixture -two or more elements or compounds not chemically combined together.

Element – a pure substance made of one kind of atom.

Word equation - a chemical reaction expressed in words rather than chemical formulas. It states the reactants (starting materials), products (ending materials), and direction of the reaction in a form that could be used to write a chemical equation.

Symbol equation – represents a chemical reaction in the form of symbols and formulae, where the reactants are given on the left-hand side and the products on the right-hand side.

Half equation – shows what is happening in terms of electrons. **(HT)**

Ionic equation - shows only the substances (can be covalent) taking part and being made in the reaction. **(HT)**

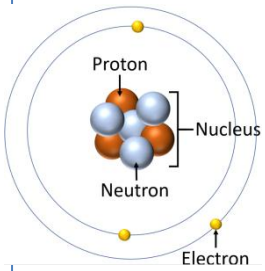
Isotope – Atoms of the same element with the same number of protons and different number of neutrons.

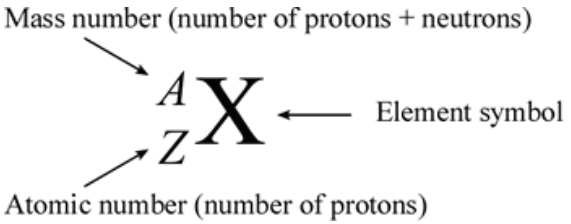
Models of the atom

- Before the discovery of the electron atoms were thought to be **tiny spheres** that could not be divided.
- The discovery of the electron led to the plum-pudding model of the atom. The **plum-pudding model** suggested that the atom was a ball of **positive charge** with **negative electrons** embedded in it.
- The results from the alpha particle scattering experiment led to the plum-pudding model being replaced by the **nuclear model**.
- Niels Bohr adapted the nuclear model by suggesting that **electrons orbit** the nucleus at specific distances. The theoretical calculations of Bohr agreed with experimental observations.
- Later experiments led to the idea that the positive charge of any nucleus could be further divided into a whole number of smaller particles with the same amount of positive charge. The name **proton** was given to these particles.
- The experimental work of James Chadwick provided the evidence to show the existence of **neutrons** within the nucleus.

Atoms

- Atoms are very small their radius is about 1×10^{-10}m.
- The radius of the nucleus is less than 1/10,000 of the radius of the atom.
- Most of the mass of an atom is in the nucleus.





Electron shells

- The electrons in an atom occupy the lowest available energy levels (innermost available shells).
- The **maximum** number of electrons are: **2** electrons in the lowest (first) energy level, **8** in the second energy level and **8** in the third energy level. (2,8,8 rule)

Particle	Relative Mass	Relative Charge
Proton	1	+1
Neutron	1	0
Electron	1/1860	-1

The relative atomic mass is calculated using the equation:

$$A_r = \frac{(\%\ of\ Isotope\ 1 \times mass\ of\ Isotope\ 1) + (\%\ of\ Isotope\ n \times mass\ of\ Isotope\ n)}{100}$$

The periodic table

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

History of the periodic table

•Before the discovery of protons, neutrons and electrons scientists attempted to classify the elements by arranging them in order of their atomic **weights**.
•The early periodic tables were incomplete and some elements were placed in inappropriate groups if the strict order of atomic weights was followed.
•Mendeleev overcame some of the problems by **leaving gaps** for elements that he thought had not been discovered and in some places **changed the order** based on atomic weights.
•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.

Arrangement of the periodic table

Elements that react to form **positive ions are metals**.
Elements that do not form positive ions are **non-metals**.
The majority of elements are metals. Metals are found to the **left** and towards the bottom of the periodic table. Non-metals are found towards the **right** and top of the periodic table.

Group 0 – Noble gases

•They are unreactive and do not easily form molecules because their atoms have stable arrangements of electrons.
• The noble gases have eight electrons in their outer energy level, except for helium, which has only two electrons.
• The boiling points of the noble gases **increase** with increasing relative atomic mass (going down the group).

Group 1 – Alkali metals

They have **1** electron in their outer shell.
In Group 1, the **reactivity** of the elements **increases** going down the group.

Group 7 – The halogens

•They all have **7** electrons in their outer shell.
• They are non-metals and consist of molecules made of pairs of atoms.
• In Group 7, the further down the group an element is, the higher its relative molecular mass, **melting point and boiling point**.
• In Group 7, the reactivity of the elements **decreases** going down the group.
• A more reactive halogen can displace a less reactive halogen from an aqueous solution of its salt.

Transition metals – TRIPLE ONLY

•Many transition elements have ions with different charges form coloured compounds and are useful as catalysts.
•Compared to other metals, most transition metals have:
higher **melting points**
higher **densities**
greater strength
greater hardness