Elements, compounds and mixtures:

An element is when all the atoms are the same and it only contains one type of atom

Compounds contain two or more different elements that are chemically combined

Mixtures are when you have two or more different elements which are not chemically combined

A molecule has any elements chemically combined such as CO_2 or O_2

Interpreting a chemical formula:

Each element starts with a capital letter

The small number of the element represents the number of atoms for the element

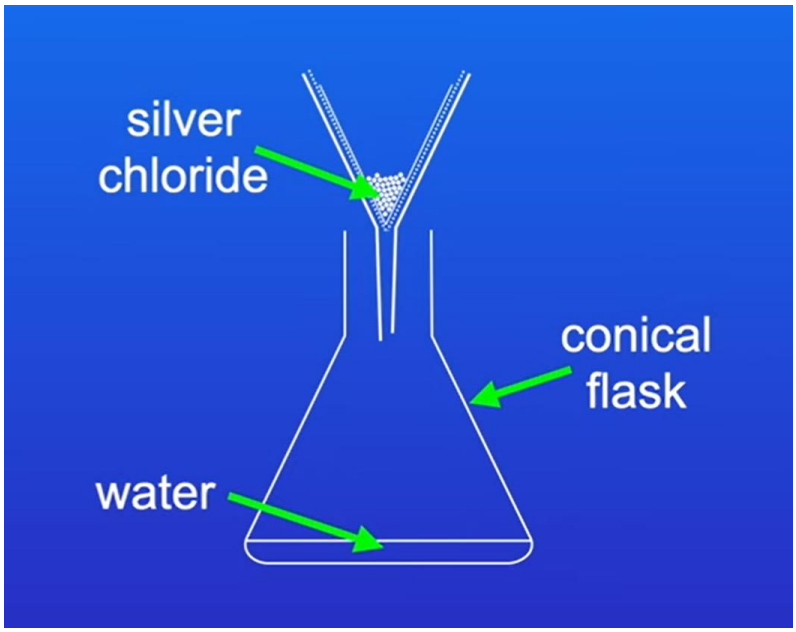
Filtration and Crytallisation:

Filtration is used to separate an insoluble (does not dissolve in liquid) solid from a liquid

How to perform filtration:

1. We get a conical flask

2. We get a filter funnel and filter paper
3. We place the filter paper inside the filter funnel and pour the mixture
4. The liquid passes through the pores in the filter paper but the solid cannot pass through
5. The liquid that is in the conical flask is called the “filtrate”



Aqueous solution means that the liquid is dissolved in water

Crystallisation is to separate a soluble solid from a liquid

How to perform crytallisation:

1. Pour the mixture into the evaporating dish
2. Gently heat the mixture with a Bunsen burner

3. Stop heating the mixture when crystals start to form
4. Leave to cool
5. After more crystals have formed filter the crystals from the solution
6. Dry the crystals by leaving it in a warm place

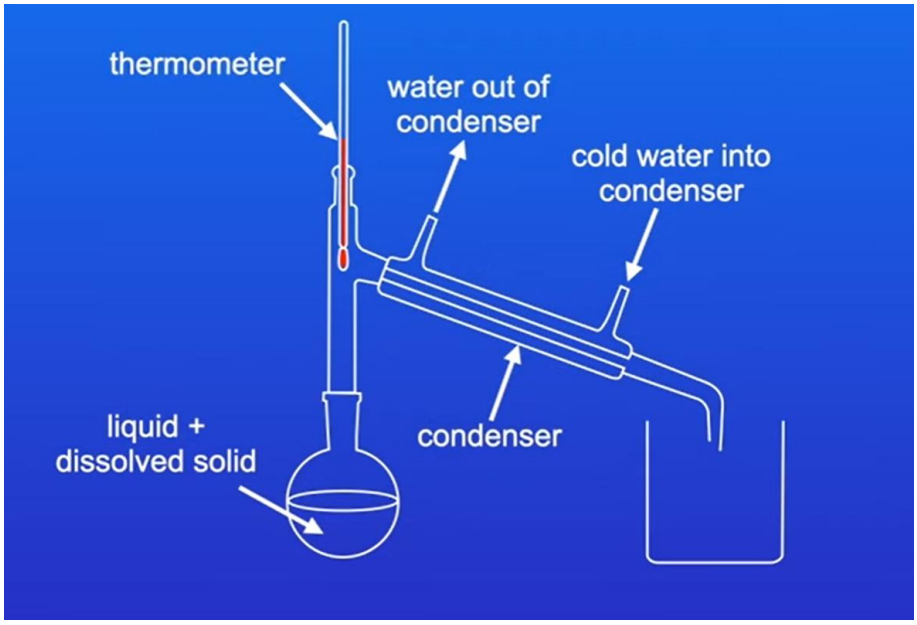
Sometimes the chemical is broken down if we heat the chemical so it is better to let it evaporate on it's own

Simple distillation:

Three stages of simple distillation:

- Heat
- Evaporate the liquid by heating
- Condense (cool) the vapour back to a liquid by cooling

Apparatus for simple distillation:



First we place the solution and dissolved solid into the flask

The flask is connected to a continuous glass tube

The condenser has cold water from the tap running continuously and the tap water goes down the sink

There is a thermometer to measure the temperature

How to perform simple distillation:

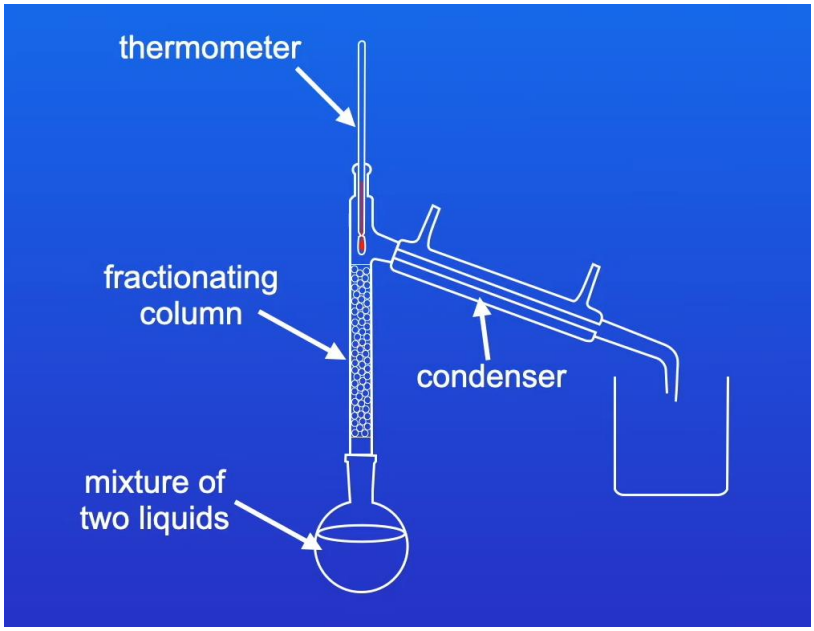
1. We heat the solution by using a Bunsen burner
2. Vapour is released when heating

3. The vapour rises up the glass tube and passes through the thermometer and the reading increases
4. We heat the solution until it boils
5. The vapour condenses as the liquid passes through the condenser
6. We can collect the liquid in the beaker
7. At the end we are left with crystals in the flask and the liquid in the beaker

A great deal of energy is required to carry out this process

Fractional distillation:

Apparatus:



Note: The liquids in the mixture must be at different boiling points for this to work

How to perform fractional distillation:

1. We gently heat the mixture
2. The liquids will start to evaporate and pass through the fractionating column
3. The one with the lower boiling point will evaporate more easily
4. As the liquid passes through the fractionating column, the liquids condense and drip back into the flask where the liquids will evaporate again
5. This repetition will increase the amount of the lower boiling point chemical in the fractionating column
6. The temperature on the thermometer will increase
7. The vapour passes through the condenser and becomes a liquid and ends up in the beaker

The liquid in the beaker is still a mixture

There comes a point when the thermometer stops rising. The temperature will be the lower of the two boiling points

8. At this point, we only have one chemical passing into the condenser

9. We can collect the liquid in the beaker
10. This is a proper fraction
11. We can do this for the other chemical that we got earlier

Paper Chromatography:

Allows you to separate substances with different solubilities

This can be used to check if we want to know how many different colours are present in the colour marker

How to perform:

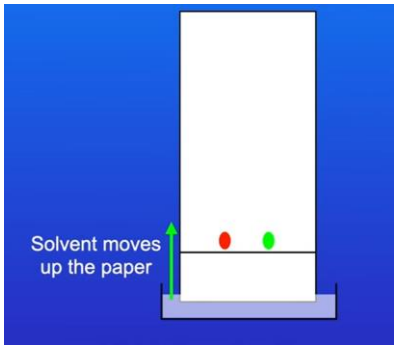
1. First we get a chromatography paper
2. We draw a pencil line near the bottom (2cm away)
3. We put a dot of the first colour on the pencil line and next to it we put our second colour
4. We can do this for multiple colours as long as it fits onto the paper
5. We now place the bottom of the paper into a solvent
6. The solvent makes it way up the paper and the ink is carried up the paper dissolved into the solvent

The paper is called the stationary phase because it doesn't move

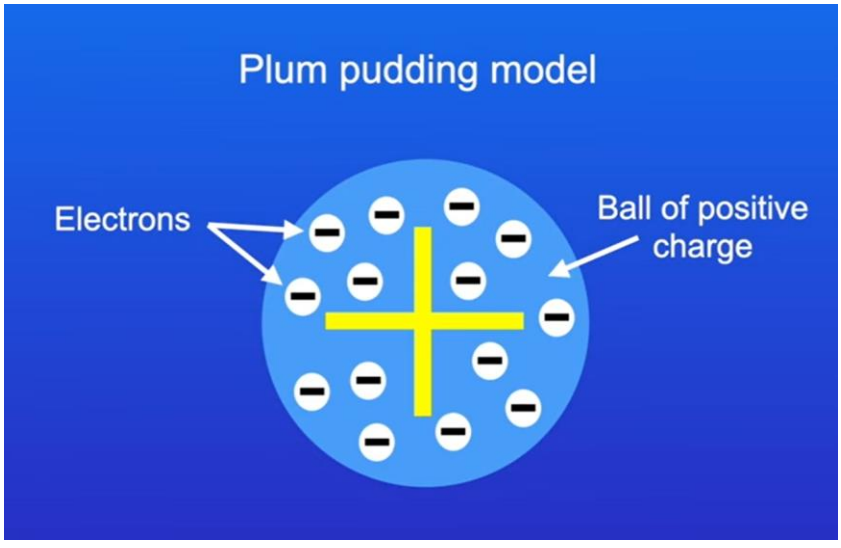
The solvent is called the mobile phase because it moves

If the colour has more than one colour spots left over than it is made up of more than one element

We draw the line in pencil because if we draw it in pen then the ink of the pen can get dissolved



Alpha scattering experiment:



What was the alpha scattering experiment:

1. Scientists first took a gold foil. They used gold because we can hammer gold into very thin pieces
2. Scientist then fired alpha particles (these have a positive charge) at the gold foil
3. They found out that most of the alpha particles passed straight through the gold foil without changing direction
4. Sometimes some alpha particles deflected and some bounced straight off

Since most of the electrons went straight through, this shows that there is empty space in the atom

Since some particles deflected from the foil, this told the scientist that the nucleus was positively charged

Since some of the particles bounced off, this told scientists that the nucleus had a concentrated mass

Nuclear model structure:

Neils Bohr said that electrons orbit the nucleus at specific distances rather than just in a general

area. We call this energy levels or shells. These shells have a fixed amount of energy

Scientists later found out that the nucleus was positively charged because it has protons

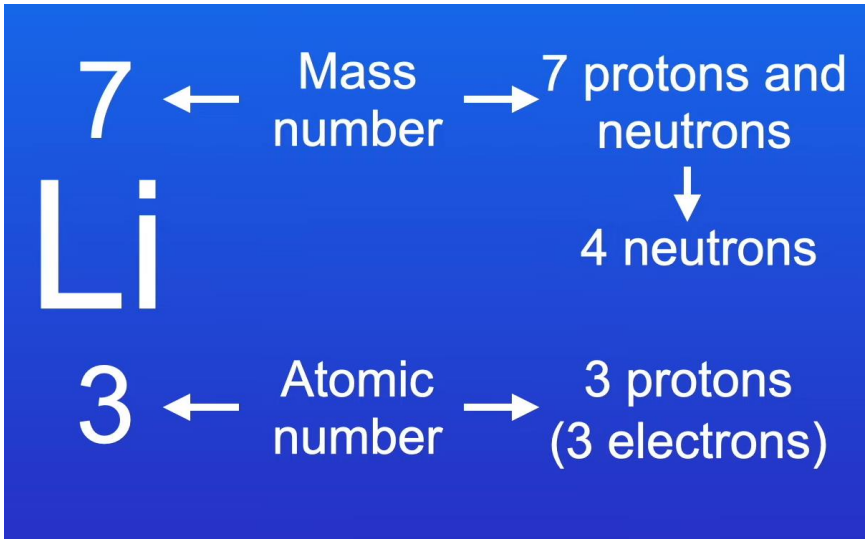
James Chadwick discovered that there were also neutrons which exist in the nucleus

The radius of an atom is 0.1 nanometer or $1x10^{-10}m$

Atoms do not have an overall charge because there are the same number of protons and electrons

	Relative charge	Relative mass
Proton	+1	1
Neutron	0	1
Electron	-1	very small

Atomic number and mass number:

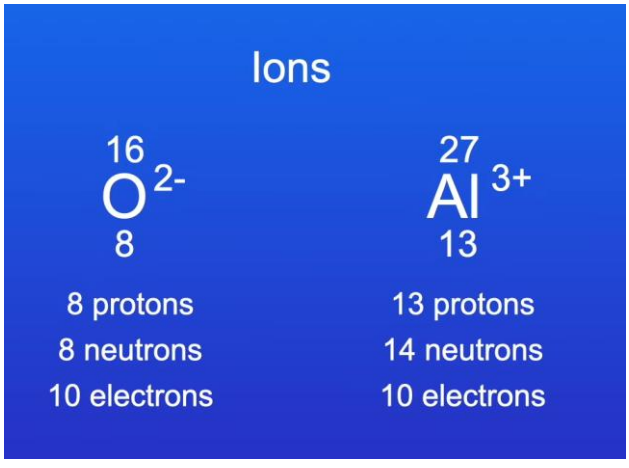


Number of protons = Number of electrons

Number of neutrons = Atomic mass – Atomic number

Isotopes are atoms of the same element with different number of neutrons than the original

Ions are atoms with an overall charge, this is because these ions have gained or lost electrons

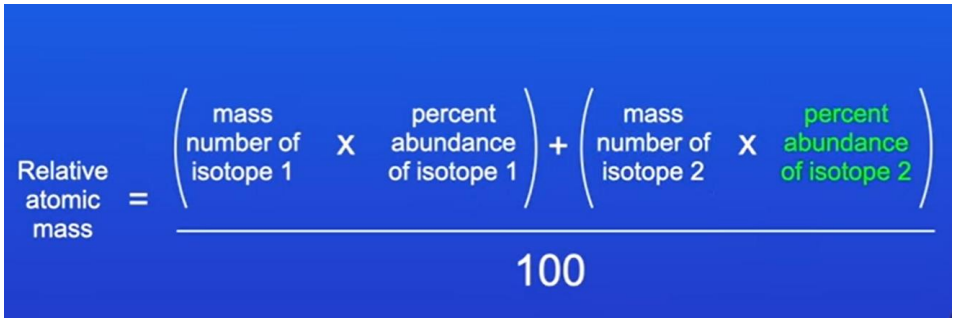


If the ion has lost or gained electrons, the proton number Is the same but you need to add on the

extra or subtract the electrons from the proton number

Relative atomic mass:

Relative atomic mass = The mass of an element is determined by finding the average mass of each isotope



Electron energy levels:

First shell has 2 electrons

Second shell has 8 electrons

Third shell has 8 electrons

Development of periodic table:

Dmitri Mendeleev started to put elements in **increasing atomic mass**. He would **switch the order of some elements so they fit the pattern of other elements in the same group**. He also **left gaps** because he predicted that there were still elements that hadn't been discovered. The problem of ordering elements in increasing atomic weight is that it would appear to be in the wrong order because of isotopes. He fixed this by switching elements around.

Elements in the same group of the periodic table have similar properties because they have the same number of electrons in the outer shell so they react with other chemicals in similar ways

Why the discovery of chemicals lead to Mendeleev period table accepted:

- Fitted the gaps that Mendeleev had left
- The chemical properties were predicted correctly by Mendeleev

Why was Mendeleev's periodic table accepted?

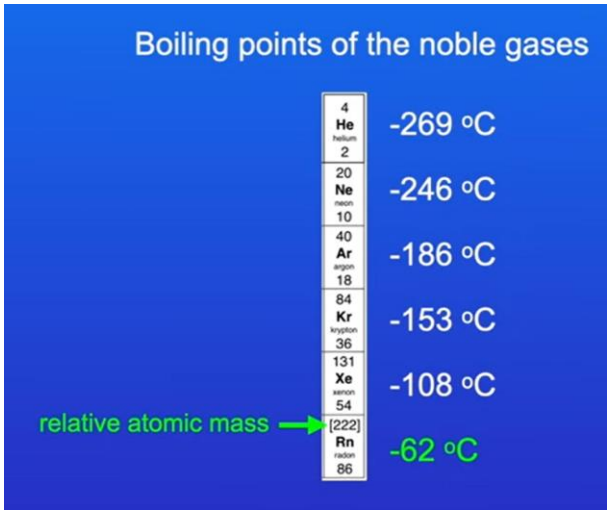
Mark Scheme Answer:

- He accurately **predicted the properties** of undiscovered elements. (1 mark)
- When these elements were discovered, their properties matched his predictions. (1 mark)
- His arrangement explained patterns in **chemical and physical properties**. (1 mark)

Group 0 (noble gases):

Noble gases are unreactive because the elements in group 0 have a full outer shell

As you move down the group, the boiling point increases



Metals:

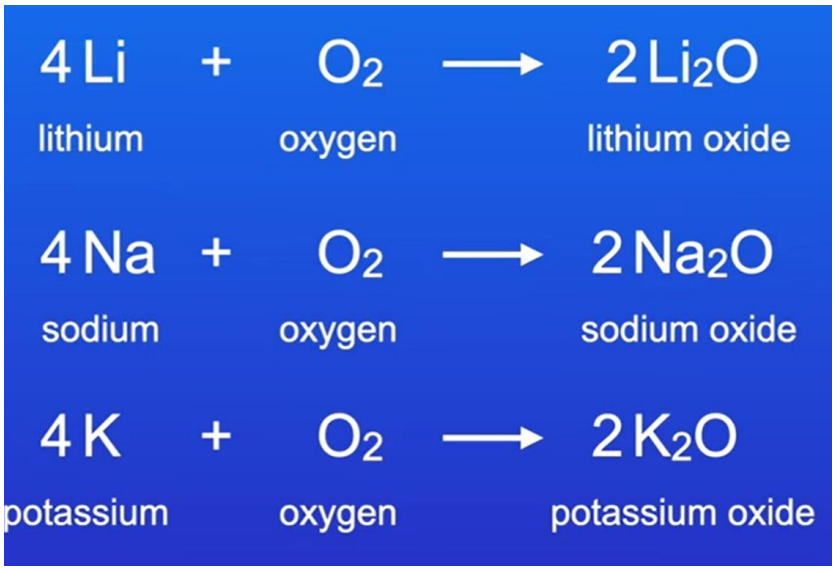
The metals are located on the left and middle of the periodic table

When metals react, they lose electrons to gain a full outer shell so this means that metals always form positive ions

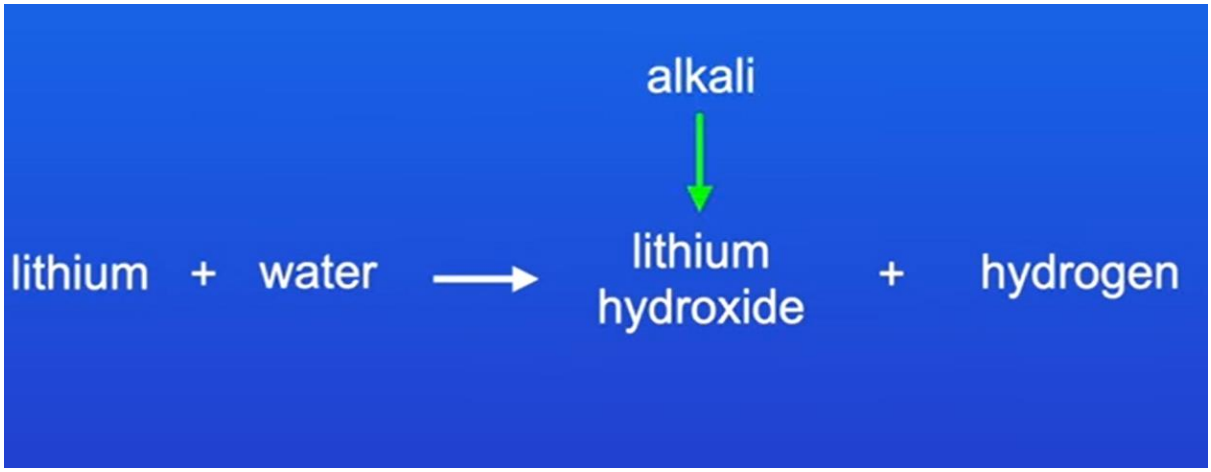
Reactions of group and metals:

Group 1 is called the alkaline metals

As we go down group 1, the metals react more rapidly with oxygen and water



Group 1 metals and group 7 have ionic bonds when reacting together



The reason why group 1 metals become more reactive is because it loses one electron and elements that have the outer electron more far away from the nucleus, the weaker the force of the electron so it is easier to lose the electron so it is more reactive

The electrons in the other shells repel the outer electron decreasing the force of attraction of the nucleus and the outer shell. This is called ‘shielding’. As we move down the group, the shielding increases making there be a much more decrease in the force of attraction.

Group 7:

Group 7 Is also known as the halogens

Group 7 elements have 7 electrons on the outer shell

Every group 7 element is bonded in a covalent bond

As we move down the group, the melting and boiling point increases

Group 7 elements form covalent bonds when reacting with other non metals

When group 7 elements react with metals, they form ionic bonds

As we move down group 7, the metals become less reactive (opposite of group 1) because there is a greater distance from the nucleus and the shielding of the internal electrons in the other shells make it difficult to attract electrons as you go down the group to form a full outer shell (complete opposite of group 1).

A more reactive halogen can displace a less reactive halogen from an aqueous solution of it's salt (displacement).

Transition metals:

Transition metals have hard strong metals and have high melting points (apart from mercury).

They have a high density

Less reactive

These metals form coloured compounds

These metals can be used as catalysts

Comparison between metals and non metals:

Metals tend to be good conductors of electricity and heat, have high melting points, and are malleable (can be hammered into shape). **Non-metals**, on the other hand, are poor conductors of electricity and heat, have lower melting points, and are often brittle.

Mendeleev's Periodic Table (3 marks):
Describe how Mendeleev arranged the elements in his periodic table and explain why he left gaps in the table.
Answer Outline:

- Mendeleev arranged elements in increasing order of **atomic mass**.

- He left **gaps** in the table where he predicted **undiscovered elements** would fit.
- The properties of these elements were predicted based on their position in the table.