

# Chapter 1

## Atomic Structure and the Periodic Table

### Keywords

#### Compound

Substance that contains at least two different elements, chemically combined

#### Mixture

Made up of many substances that can be easily separated, that aren't chemically combined

#### Element

A substance that cannot be broken down chemically (and is made up of all the same type of atom)

#### Atom

The 'basic building block' of an element - which cannot be chemically broken down

#### Subatomic Particle

Atoms are made up of three particles: protons, neutrons and electrons. Subatomic means "smaller than an atom".

#### (Law of) Conservation of Mass

the total mass of reactants equals the total mass of products formed

#### Inert

Unreactive

#### Displacement

Chemical reaction where one element 'swaps out' a less reactive element from a compound

#### Trend

A change in properties in a general direction  
E.g. there is a trend of decreasing reactivity down the group

### Periodic Table

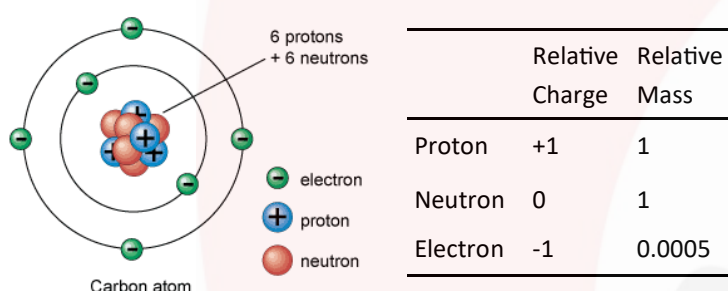
The Periodic Table is arranged in such a way that elements with the same properties can be found together in 'groups'.

Elements in the same group have the same number of electrons in their outershell (these are known as valence electrons).

Elements in the same period have the same number of electron shells.

### Atomic Structure

The atomic number is the number of protons.  
The number of electrons = number of protons.  
The number of neutrons = mass number - atomic number.

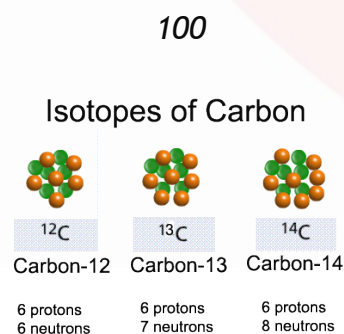


### Isotopes

These are different forms of the same element.  
Same atomic number (same protons)  
Different mass number (change in neutrons)

Relative atomic mass =

$$\frac{\sum(\text{isotope abundance}\% \times \text{isotope mass number})}{100}$$



### Separation Techniques

**Chromatography** - separates out different liquids. An Rf value can be calculated to compare the different parts.

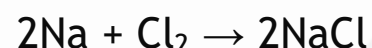
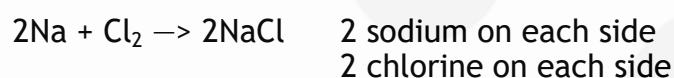
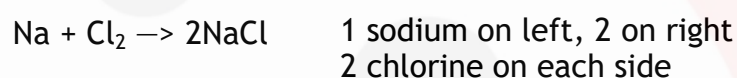
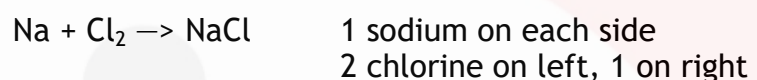
**Filtration** - Separates a solid (S) from a liquid (L).

**Crystallisation** - Separates out a solid that has dissolved in a liquid. The liquid evaporates leaving the solid behind.

**Distillation** - Separates out liquids that have different boiling points, or to keep a liquid from a S+L mixture.

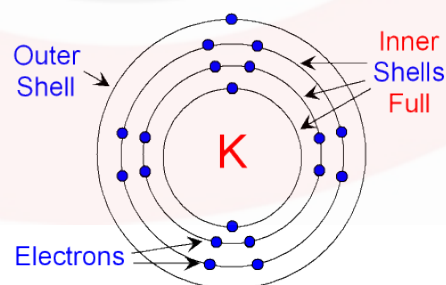
### Balancing Equations

The same number of atoms of each element are needed on each side of an equation:



### Electron Configuration

Atoms fill to a maximum of 2 electrons in the first shell, 8 in the second and 8 in the third. Each shell is filled before starting the next shell.



### Group 1 (Alkali Metals)

React with water to form an alkaline solution:  
Lithium + water  $\rightarrow$  lithium hydroxide + hydrogen

React vigorously when heated with chlorine gas:  
Sodium + chlorine  $\rightarrow$  sodium chloride

Reactivity increases down the group - the outer negative electron is further from the positive nucleus so more easily lost.  
Lower melting and boiling points down the group.

### Group 7 (Halogens)

Exist as pairs of atoms.

Less reactive down the group - the outer shell is further from the nucleus so harder to gain an electron.  
Higher melting and boiling points down the group.  
A more reactive halogen will displace a less reactive halogen.

### Group 0 (Noble Gases)

These elements have full outer shells so are inert.

Boiling point increases down the group as atoms have more electrons so stronger intermolecular forces form between molecules.

### Metals

Metals generally have the properties of : strong, dense, shiny, malleable, ductile, good conductors of heat and electricity.

Transition metals each have more than one ion, and generally form coloured compounds.

These metals are often used as catalysts, as they can alter the rate of a reaction without taking part themselves.

### Newlands vs Mendeleev

Newlands noticed similarities between elements with atomic weights that had a difference of seven. He called this The Law of Octaves.

Mendeleev arranged his table in order of atomic weight, and noticed a pattern emerging too. Where the elements didn't fit the pattern, he moved them (sometimes leaving gaps) - something Newlands didn't do.

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Atoms are made up of three particles: protons, neutrons and electrons. Subatomic means "smaller than an atom".

**(Law of) Conservation of Mass**  
the total mass or reactants equals the total mass of products formed

**Inert**  
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Chemical reaction where one element 'swaps out' a less reactive element from a compound

**Trend**  
A change in properties in a general direction  
E.g. there is a trend of decreasing reactivity down the group

### Periodic Table

Describe the position of carbon in the periodic table.

### Atomic Structure

If an atom has 3 protons, 4 neutrons and 3 electrons, what is its atomic mass? What element is this?

### Isotopes

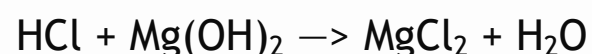
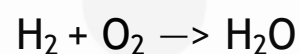
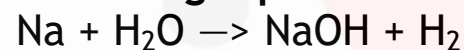
There are two atoms  $^{28}\text{Si}$  and  $^{30}\text{Si}$  of abundance 96% and 4%, respectively. What is the relative atomic mass of Si?  
Give your answer to 3s.f.

### Separation Techniques

Describe how you would separate sodium chloride solution if you:

- Wanted only the solid
- Wanted both the solid and liquid

### Balancing Equations



### Electron Configuration

Explain where an atom with an electronic configuration of 2,8,2 is positioned in the periodic table.

### Group 1 (Alkali Metals)

Give the word and symbol equation for the reaction of potassium with water.

### Group 7 (Halogens)

Compare the trend of reactivity with that in group 1.

### Group 0 (Noble Gases)

Explain the reactivity of the elements in Group 0.

### Metals

Give two differences between metals and non metals.

### Newland vs Mendeleev

Explain why we use Mendeleev's version of the Periodic table today, rather than Newland's

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### Periodic Table

Describe the position of carbon in the periodic table.

*Carbon is in group 4 because it has 4 electrons on its outer shell, and it is in period 2 as it has 2 shells of electrons.*

### Atomic Structure

If an atom has 3 protons, 4 neutrons and 3 electrons, what is its atomic mass? What element is this?

*Atomic mass = 7  
Lithium*

### Isotopes

There are two atoms  $^{28}\text{Si}$  and  $^{30}\text{Si}$  of abundance 96% and 4%, respectively. What is the relative atomic mass of Si?

Give your answer to 3s.f.

*$((28*96)+(30*4))/100 = 28.1$*

### Separation Techniques

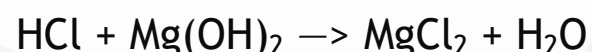
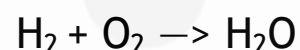
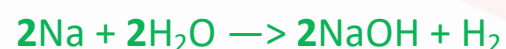
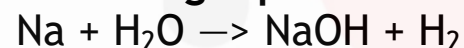
Describe how you would separate sodium chloride solution if you:

- Wanted only the solid
- Wanted both the solid and liquid

*Description of crystallisation*

*Description of distillation*

### Balancing Equations



### Electron Configuration

Explain where an atom with an electronic configuration of 2,8,2 is positioned in the periodic table.

*Group 2 (2 outer electrons), period 3 (3 shells)*

### Group 1 (Alkali Metals)

Give the word and symbol equation for the reaction of potassium with water.

*Potassium + water  $\rightarrow$  potassium hydroxide + hydrogen*



### Group 7 (Halogens)

Compare the trend of reactivity with that in group 1.

*As you go down group 1 the reactivity increases as the outer electron is further away from the nucleus, easily lost. This is also the reason why the reactivity decreases down group 7 as it's harder to attract an electron.*

### Group 0 (Noble Gases)

Explain the reactivity of the elements in Group 0.

*Not reactive (inert) as they have a full outer shell of electrons already.*

### Metals

Give two differences between metals and non metals.

*Any two different correct properties given*

### Newland vs Mendeleev

Explain why we use Mendeleev's version of the Periodic table today, rather than Newland's

*Mendeleev left gaps in his table as some of the elements didn't fit in his model. He predicted the properties of these elements... and was correct.*