AQA Chemistry GCSE

Topic 1: Atomic Structure and the Periodic Table

Flashcards

What is an atom?

What is an atom?

An atom is the smallest part of an element that can exist

What is an element?

What is an element?

An element is a substance of only one type of atom.

How are the elements listed and approximately how many are there?

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They are listed in the periodic table; there are approximately 100.

Elements can be classified into two groups based on their properties; what are these groups?

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Metals and non-metals

Elements may combine through chemical reactions to form new products; what are these new substances called?

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Compounds

What is a compound?

What is a compound?

Two or more elements combined chemically in fixed proportions which can be represented by formulae

Do compounds have the same properties as their constituent elements?

Do compounds have the same properties as their constituent elements?

No, they have different properties.

What is a mixture? Does it have the same chemical properties as its constituent materials?

What is a mixture? Does it have the same chemical properties as its constituent materials?

A mixture consists of two or more elements or compounds not chemically combined together; it does have the same chemical properties

What are the methods through which mixtures can be separated (there are five)? Do these involve chemical reactions?

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Filtration, crystallisation, simple distillation, fractional distillation and chromatography; they do not involve chemical reactions

Describe and explain simple distillation.

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Simple distillation is used to separate liquid from a solution – the liquid boils off and condenses in the condenser. The thermometer will read the boiling point of the pure liquid. Contrary to evaporation, we get to keep the liquid.

Describe and explain crystallisation/evaporation.

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Evaporation is a technique for separation of a solid dissolved in a solvent from a solvent (e.g. salt from H_2O).
The solution is heated until all the solvent evaporates; the solids stays in the vessel.

Crystallisation is similar, but we only remove some of the solvent by evaporation to form a saturated solution (the one where no more solid can be dissolved). Then, we cool down the solution. As we do it, the solid starts to crystallise, as it becomes less soluble at lower temperatures. The crystals can be collected and separated from the solvent *via* filtration.

Describe and explain fractional distillation

Describe and explain fractional distillation

Fractional distillation is a technique for separation of a mixture of liquids.

It works when liquids have different boiling points.

The apparatus is similar to the one of simple distillation apparatus, with the additional fractionating column placed on top of the heated flask.

The fractionating column contains glass beads. It helps to separate the compounds. In industry, mixtures are repeatedly condensed and vapourised. The column is hot at the bottom and cold at the top. The liquids will condense at different heights of the column.

Describe and explain filtration

Describe and explain filtration

Filtration is used to separate an insoluble solid is suspended in a liquid.
The insoluble solid (called a residue) gets caught in the filter paper, because the particles are too big to fit through the holes in the paper.
The filtrate is the substance that comes through the filter paper.
Apparatus: filter paper + funnel.

Describe and explain chromatography

Describe and explain chromatography

Chromatography is used to separate a mixture of substances dissolved in a solvent.

In paper chromatography, we place a piece of paper with a spot containing a mixture in a beaker with some solvent. The bottom of the paper has to be in contact with the solvent. The solvent level will slowly start to rise, thus separating the spot (mixture) into few spots (components).

What is a separating funnel?

What is a separating funnel?

A separatory funnel is an apparatus for separating immiscible liquids. Two immiscible liquids of different densities will form two distinct layers in the separatory funnel.

We can run off the bottom layer (the liquid with greater density) to a separate vessel.

Describe the plum-pudding model

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The atom is a ball of positive charge with negative electron embedded in it.

Describe the Bohr/nuclear model and how it came about

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The nuclear model suggests that electrons orbit the nucleus at specific distances (shells) – it came about from the alpha scattering experiments

Later experiments led to the discovery of smaller, positive particles in the nucleus; what are these particles called?

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Protons

What did the work of James Chadwick provide evidence for?

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The existence of neutrons in the nucleus

Describe the structure of an atom

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The atom has a small central nucleus (made up of protons and neutrons) around which there are electrons

State the relative masses and relative charges of the proton, neutron and electron

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Masses: 1, 1, very small ; Charges: 1, 0 , -1 (respectively)

Explain why atoms are electrically neutral.

Explain why atoms are electrically neutral.

They have the same number of electrons and protons

What is the radius of an atom?

What is the radius of an atom?

0.1 nm

What is the radius of a nucleus and what is it compared to that of the atom?

What is the radius of a nucleus and what is it compared to that of the atom?

1×10^{-14} m and 1/10000

What name is given to the number of protons in the nucleus?

What name is given to the number of protons in the nucleus?

Atomic number

Atoms of the same element have the same number of which particle in the nucleus?

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Protons

Where is the majority of mass of an atom?

Where is the majority of mass of an atom?

The nucleus

What is the mass number?

What is the mass number?

The total number of protons and neutrons

How does one calculate the number of neutrons using mass number and atomic number?

How does one calculate the number of neutrons using mass number and atomic number?

Subtract the atomic number from the mass number

What is an isotope? Do isotopes of a certain element have the same chemical properties?

What is an isotope? Do isotopes of a certain element have the same chemical properties?

Atoms of the same element (same proton number) that have a different number of neutrons.

They have the same chemical properties as they have the same electronic structure

What is the relative atomic mass?

What is the relative atomic mass?

The average mass value which takes the mass and abundance of isotopes of an element into account, on a scale where the mass of ^{12}C is 12.

Give the electronic configurations of He (2), Be (4), F (9), Na (11), and Ca (20) to demonstrate how shells are occupied by electrons.

He, Be, F, Na, Ca configurations (respectively):

2

2,2

2,7

2,8,1

2,8,8,2

What are ions?

What are ions?

Ions are charged particles. They are formed when atoms lose electrons (positive ions) or gain (negative ions) electrons.

E.g. sodium positive ion, Na^+, has an electronic configuration of 2,8 (same as Ne). An atom of sodium has lost one electron.

Compare the properties of metals and non-metals

Compare the properties of metals and non-metals

Property	Metals	Non-metals
Boiling/meting point	High	Low
Conductivity	Heat and electricity	Don't conduct heat, electricity (with exception of graphite)
Appearance	Shiny	Dull
Malleability	Yes	Brittle
Density	High	Low
Oxides	Basic	Acidic

What is formed when a metal reacts with a non-metal?

What is formed when a metal reacts with a non-metal?

An ionic compound (made of positive and negative ions).

What is formed when a non-metal reacts with a non-metal?

What is formed when a non-metal reacts with a non-metal?

A molecular compound containing covalently bonded atoms.

Atoms share electrons, as opposed to transferring electrons between each other (cf. ionic compounds).

Explain the following: solute, solvent, solution, miscible, immiscible, soluble, insoluble.

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A solute is a substance that is dissolved in a solvent. Together, they form a solution.

Miscible refers to the substances (particularly liquids) that mix together, e.g. water and alcohol. Water and oil are immiscible, i.e. they do not mix.

Soluble refers to the substance that can be dissolved in a solvent, e.g. salt in water. Insoluble substance won't dissolve in a particular solvent.

The columns of the periodic table are called…?

The columns of the periodic table are called?

Groups

The rows of the periodic table are called…?

The rows of the periodic table are called…?

Periods

Are elements in the same group similar or different?

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They may have similar chemical properties, as they have the same number of outer shell electrons.

In terms of energy levels, what are the differences between elements of the same period?

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They have the same number of energy levels

Electrons occupy particular energy levels, with each electron in an atom at a particular energy level; which available energy level do electrons occupy?

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The lowest available energy level

The elements of Group 0 are more commonly known as…?

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The noble gases

What makes the periodic table periodic?

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Similar properties of elements occur at regular intervals

Elements in the same group have the same number of electrons in their outer shell; what does this tell us about their chemical properties?

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They have similar chemical properties

In terms of shells, what is the difference between elements in the same period?

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They have the same number of shells

What change in shell number is seen as one moves down a group?

What change in shell number is seen as one moves down a group?

The number of shells increases

Early periodic tables were incomplete and elements were placed in inappropriate groups if what was to be followed?

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The strict order of atomic weights

Knowledge of what made it possible to explain why the order based on atomic weights was not always correct?

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Isotopes

Mendeleev overcame some problems with the table by doing what? He also changed the order of some elements based on what?

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Leaving gaps; atomic weights

The majority of elements are…?

The majority of elements are…?

Metals

Elements that react to form positive ions are…?

Elements that react to form positive ions are…?

Metals

Elements that do not form positive ions are…?

Elements that do not form positive ions are…?

Non-metals

Elements in Group 1 are known as…?

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The alkali metals

State three characteristics of the Alkali Metals

State three characteristics of the Alkali Metals

All have one electron in their outer shell; have low density; are stored under oil (to prevent reactions with oxygen or water); are soft (can be cut with knife).

How do Group 1 elements react with non-metals? Why are these reactions similar for the different Group 1 elements?

How do Group 1 elements react with non-metals? Why are these reactions similar for the different Group 1 elements?

They form ionic compounds which are soluble white solids which form colourless solutions – they all have one electron in their outer shell.

How do Group 1 elements react with water?

How do Group 1 elements react with water?

They release hydrogen and form hydroxides which dissolve to form alkaline solutions; react vigorously with water fizzing and moving around on the surface of the water.

How does the reactivity change moving down Group 1? Why?

How does reactivity change moving down Group 1? Why?

Reactivity increases as the atoms get larger and the distance between the nucleus and the outer electrons increases and thus attraction from the nucleus decreases, allowing them to more easily lose electrons.

State five characteristics of Group 7

State five characteristics of Group 7

- 7 electrons in outer shell
- Coloured vapours
- Diatomic molecules
- Form ionic salts with metals
- Form molecular compounds with non-metals

State Group 7 elements and their states of matter.

State five State Group 7 elements and states of matter of molecules they form

- Fluorine, F. F_2 is a pale yellow gas.
- Chlorine, Cl. Cl_2 is a pale green gas.
- Bromine, Br. Br_2 is dark brown liquid
- Iodine, I. I_2 is a grey solid.

State three changes that occur in Group 7 as one moves down the group

State three changes that occur in Group 7 as one moves down the group

- Higher relative molecular mass
- Higher melting and boiling point
- Less reactive – less easily gain electrons

A more reactive halogen displaces a less reactive one from an aqueous solution of its salt; write the equations and state the colour change seen when chlorine reacts with sodium bromide and when chlorine/bromine reacts with sodium iodide.

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$Cl_2 + 2\ NaBr \rightarrow Br_2 + 2\ NaCl$, or
$Cl_2 + 2Br^- \rightarrow Br_2 + 2\ Cl^-$;
in this reaction, an orange colour of Br_2 would appear

$Cl_2 + 2\ NaI \rightarrow I_2 + 2\ NaCl$, or $Cl_2 + 2I^- \rightarrow I_2 + 2\ Cl^-$
$Br_2 + 2\ NaI \rightarrow I_2 + 2\ NaBr$, or $Br_2 + 2I^- \rightarrow I_2 + 2\ Br^-$;
in these two reactions, a brown colour of I_2 would appear

A more reactive halogen displaces a less reactive one from an aqueous solution of its salt; explain the trend in reactivity of halogens in these reactions

A more reactive halogen displaces a less reactive one from an aqueous solution of its salt; explain the trend in reactivity of halogens in these reactions

Reactivity decreases down the group. As we go down the group, the atoms get larger, so an incoming electron will be less tightly held by the attractive forces from the nucleus. That's why Cl_2 displaces Br^- and I^-.

Compare Group 1 metals and transition metals

Compare group 1 metals with transition metals

Group 1 metals and transition metals are heat and electricity conductors. They are shiny when polished and form ionic compounds with non metals.

Transition metals have higher densities and higher melting points than Group 1 metals. They are less reactive and harder than Group 1 metals.

State three common characteristics of transition metals

State three common characteristics of transition metals

- Ions with different charges
- Coloured compounds
- Catalytic properties

What is a catalyst?

What is a catalyst?

A catalyst is a chemical substance that increases the rate of a chemical reaction.

It is not used up over the course of the reaction.

State the colours of flames observed when lithium, sodium, and potassium burn in oxygen

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Crimson-red, Li
Yellow-orange, Na
Lilac, K

Describe the properties of noble gases. Discuss the trend in boiling point down the group.

Describe the properties of noble gases. Discuss the trends in properties down the group.

Non-metals, gases, low boiling points, unreactive (full outer shell; they don't easily accept or lose electrons).

The boiling point increases down the group, as the atoms get heavier.