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AQA GCSE Atomic structure and periodic table part 2

Alkali metals

Halogens

Noble gases

Transition metals

1	2											3	4	5	6	7	0
H																	He
Li	Be											B	C	N	O	F	Ne
Na	Mg											Al	Si	P	S	Cl	Ar
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
Cs	Ba	La	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn
Fr	Ra	Ac	Rf	Db	Sg	Bh	Hs	Mt	?	?	?						

Metals to the left of this line, non metals to the right

The Periodic table

Elements arranged in order of atomic number	*Elements with similar properties are in columns called groups*	Elements in the same group have the same number of outer shell electrons and elements in the same period (row) have the same number of electron shells.

Development of the Periodic table

Before discovery of protons, neutrons and electrons	*Elements arranged in order of atomic weight*	Early periodic tables were incomplete, some elements were placed in inappropriate groups if the strict order atomic weights was followed.
Mendeleev	*Left gaps for elements that hadn't been discovered yet*	Elements with properties predicted by Mendeleev were discovered and filled in the gaps. Knowledge of isotopes explained why order based on atomic weights was not always correct.

Metals and non metals

Metals	*To the left of the Periodic table*	Form positive ions. Conductors, high melting and boiling points, ductile, malleable.
Non metals	*To the right of the Periodic table*	Form negative ions. Insulators, low melting and boiling points.

Group 1

Alkali metals	*Very reactive with oxygen, water and chlorine*	Only have one electron in their outer shell. Form +1 ions.
	Reactivity increases down the group	Negative outer electron is further away from the positive nucleus so is more easily lost.

With oxygen	Forms a metal oxide	Metal + oxygen → metal oxide	e.g. $4Na + O_2 \rightarrow 2Na_2O$
With water	Forms a metal hydroxide and hydrogen	Metal + water → metal hydroxide + hydrogen	e.g. $2Na + 2H_2O \rightarrow 2NaOH + H_2$
With chlorine	Forms a metal chloride	Metal + chlorine → metal chloride	e.g. $2Na + Cl_2 \rightarrow 2NaCl$

Compared to group 1	• *Less reactive* • *Harder* • *Denser* • *Higher melting points*	• *Cu^{2+} is blue* • *Ni^{2+} is pale green, used in the manufacture of margarine* • *Fe^{2+} is green, used in the Haber process* • *Fe^{3+} is reddish-brown* • *Mn^{2+} is pale pink*
Typical properties	• *Many have different ion possibilities with different charges* • *Used as catalysts* • *Form coloured compounds*	

Group 0

Noble gases	*Unreactive, do not form molecules*	This is due to having full outer shells of electrons.
	Boiling points increase down the group	Increasing atomic number.

Transition metals (Chemistry only)

Group 7

Halogens	*Consist of molecules made of pairs of atoms*	Have seven electrons in their outer shell. Form -1 ions.
	Melting and boiling points increase down the group (gas → liquid → solid)	Increasing atomic mass number.
	Reactivity decreases down the group	Increasing proton number means an electron is more easily gained

With metals	Forms a metal halide	Metal + halogen → metal halide e.g. Sodium + chlorine → sodium chloride	e.g. NaCl metal atom loses outer shell electrons and halogen gains an outer shell electron
With hydrogen	Forms a hydrogen halide	Hydrogen + halogen → hydrogen halide e.g. Hydrogen + bromine → hydrogen bromide	e.g. $Cl_2 + H_2 \rightarrow 2HCl$
With aqueous solution of a halide salt	A more reactive halogen will displace the less reactive halogen from the salt	Chlorine + potassium bromide → potassium chloride + bromine	e.g. $Cl_2 + 2KBr \rightarrow 2KCl + Br_2$

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Page 1 of 20

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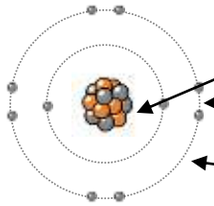
AQA GCSE Atomic structure and periodic table part 1

Atoms, elements and compounds

	The smallest part of an element that can exist	Have a radius of around 0.1 nanometres and have no charge (0).
	Contains only one type of atom	Around 100 different elements each one is represented by a symbol e.g. O, Na, Br.
	Two or more elements chemically combined	Compounds can only be separated into elements by chemical reactions.



	Contains protons and neutrons
	Contains electrons

Name of Particle	Relative Charge	Relative Mass
	+1	1
	0	1
	-1	Very small

Electronic structures

Electronic shell	Max number of electrons
1	
2	
3	
4	

Relative electrical charges of subatomic particles

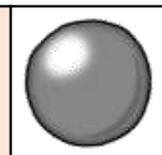
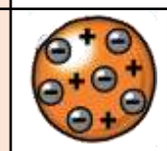
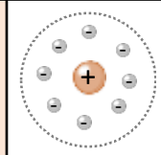
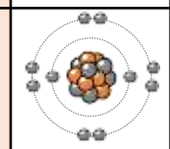
7
Li
3

	The sum of the protons and neutrons in the nucleus	
	The number of protons in the atom	Number of electrons = number of protons

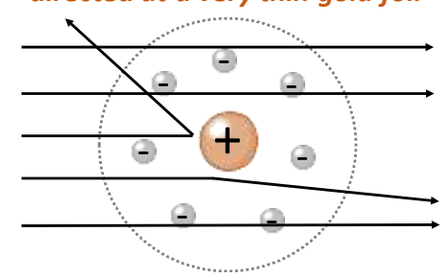
	Two or more elements or compounds not chemically combined together	Can be separated by physical processes.

Method	Description	Example
	Separating an insoluble solid from a liquid	To get sand from a mixture of sand, salt and water.
	To separate a solid from a solution	To obtain pure crystals of sodium chloride from salt water.
	To separate a solvent from a solution	To get pure water from salt water.
	Separating a mixture of liquids each with different boiling points	To separate the different compounds in crude oil.
	Separating substances that move at different rates through a medium	To separate out the dyes in food colouring.

The development of the model of the atom

		*Tiny solid spheres that could not be divided*	Before the discovery of the electron, John Dalton said the solid sphere made up the different elements.
		*A ball of positive charge with negative electrons embedded in it*	JJ Thompson 's experiments showed that showed that an atom must contain small negative charges (discovery of electrons).
		*Positively charge nucleus at the centre surrounded negative electrons*	Ernest Rutherford's alpha particle scattering experiment showed that the mass was concentrated at the centre of the atom.
		*Electrons orbit the nucleus at specific distances*	Niels Bohr proposed that electrons orbited in fixed shells; this was supported by experimental observations.

	Provided the evidence to show the existence of neutrons within the nucleus

	A beam of alpha particles are directed at a very thin gold foil 	Most of the alpha particles passed right through. A few (+) alpha particles were deflected by the positive nucleus. A tiny number of particles reflected back from the nucleus.

	Show chemical reactions - need reactant(s) and product(s) energy always involves and energy change	Law of conservation of mass states the total mass of products = the total mass of reactants.
	Uses words to show reaction **reactants → products** magnesium + oxygen → magnesium oxide	Does not show what is happening to the atoms or the number of atoms.
	Uses symbols to show reaction **reactants → products** $2Mg + O_2 \rightarrow 2MgO$	Shows the number of atoms and molecules in the reaction, these need to be balanced.

Relative atomic mass

	Atoms of the same element with the same number of protons and different numbers of neutrons	^{35}Cl (75%) and ^{37}Cl (25%) Relative abundance = (% isotope 1 x mass isotope 1) + (% isotope 2 x mass isotope 2) ÷ 100 **e.g. (25 x 37) + (75x 35) ÷ 100 = 35.5**

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Page 6 of 20

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AQA GCSE QUANTITATIVE CHEMISTRY 1

Relative formula mass (M_r)

M_r	*The sum of the relative atomic masses of the atoms in the numbers shown in the formula*	The sum of the M_r of the reactants in the quantities shown equals the sum of the M_r of the products in the quantities shown.	$2Mg + O_2 \rightarrow 2MgO$ 48g + 32g = 80g 80g = 80g

Mass changes when a reactant or product is a gas

Mass appears to increase during a reaction	*One of the reactants is a gas*	Magnesium + oxygen → magnesium oxide
Mass appears to decrease during a reaction	*One of the products is a gas and has escaped*	Calcium carbonate → carbon dioxide + calcium oxide

Conservation of mass and balanced symbol equations

Conservation of mass	*No atoms are lost or made during a chemical reaction*	Mass of the products equals the mass of the reactants.

Balanced symbol equations

Represent chemical reactions and have the same number of atoms of each element on both sides of the equation	$H_2 + Cl_2 \rightarrow 2HCl$ Subscript — Normal script Subscript numbers show the number of atoms of the element to its left. Normal script numbers show the number of molecules.

Moles (HT only)

Chemical amounts are measured in moles (mol)	*Mass of one mole of a substance in grams = relative formula mass*	One mole of H_2O = 18g (1 + 1 + 16) One mole of Mg = 24g

Avogadro constant

One mole of any substance will contain the same number of particles, atoms, molecules or ions.	6.02×10^{23} per mole One mole of H_2O will contain 6.02×10^{23} molecules One mole of NaCl will contain 6.02×10^{23} Na^+ ions

Number of moles = $\frac{\text{mass (g)}}{A_r}$ or $\frac{\text{mass (g)}}{M_r}$	How many moles of sulfuric acid molecules are there in 4.7g of sulfuric acid (H_2SO_4)? Give your answer to 1 significant figure. $\frac{4.7}{98}$ = 0.05 mol 98 ← (M_r of H_2SO_4)

Amounts of substances in equations (HT only)

Chemical equations show the number of moles reacting and the number of moles made

$Mg + 2HCl \rightarrow MgCl_2 + H_2$ *One mole of magnesium reacts with two moles of hydrochloric acid to make one mole of magnesium chloride and one mole of hydrogen*	If you have a 60g of Mg, what mass of HCl do you need to convert it to $MgCl_2$? A_r : Mg =24 so mass of 1 mole of Mg = 24g M_r : HCl (1 + 35.5) so mass of 1 mole of HCl = 36.5g So 60g of Mg is 60/24 = 2.5 moles Balanced symbol equation tells us that for every one mole of Mg, you need two moles of HCl to react with it. So you need 2.5x2 = 5 moles of HCl You will need 5 x 36.5g of HCl= 182.5g

Limiting reactants (HT only)

The reactant that is completely used up	*Limits the amount of product that is made*	Less moles of product are made.

Chemical measurements

Whenever a measurement is taken, there is always some uncertainty about the result obtained	*Can determine whether the mean value falls within the range of uncertainty of the result*	1. Calculate the mean 2. Calculate the range of the results 3. Estimate of uncertainty in mean would be half the range

Example:
1. Mean value is 46.5s
2. Range of results is 44s to 49s = 5s
3. Time taken was 46.5s ±2.5s

Concentration of solutions

Measured in mass per given volume of solution (g/dm³)	*Conc. = $\frac{\text{mass (g)}}{\text{volume (dm}^3\text{)}}$*	HT only Greater mass = higher concentration. Greater volume = lower concentration.

Using moles to balance equations (HT only)

The balancing numbers in a symbol equation can be calculated from the masses of reactants and products	*Convert the masses in grams to amounts in moles and convert the number of moles to simple whole number ratios.*

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Page 17 of 20