

Atoms:

Radius: $1 \times 10^{-10} \text{m}$

Nucleus:

In centre

Has protons & neutrons so has positive charge

Radius: 1×10^{-14}

Most of atom's mass concentrated in nucleus

Electrons:

In energy levels orbiting nucleus (volume of their orbits determines atom's size)

Negatively charged

Number of Protons = Number of Electrons so atoms have no overall charge (opposite charges cancel out)

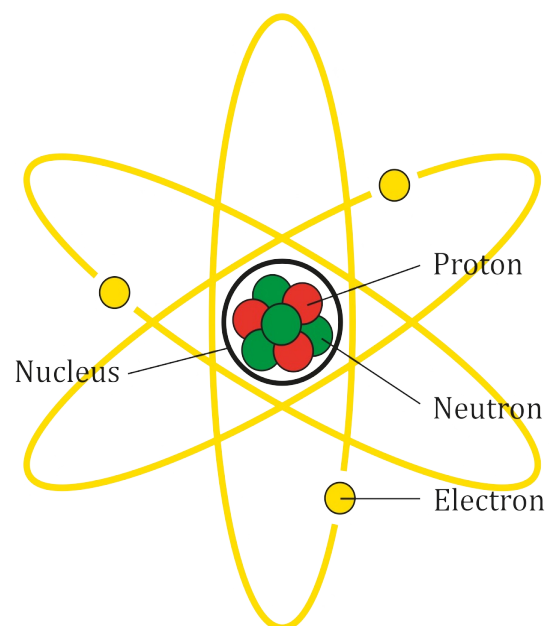
Atomic number: number of protons/electrons

Mass number: protons + neutrons in nucleus

Neutrons = Mass number - Atomic number

Properties of protons, neutrons and electrons

	<i>Position in the atom</i>	<i>Relative mass</i>	<i>Relative electric charge</i>
PROTON	nucleus	1	+ 1
NEUTRON	nucleus	1	0
ELECTRON	outside nucleus	0.005	- 1



Elements:

Substance that contains atoms with same number of protons (there are about 100)

Isotopes = atoms of the same element with same number of protons & different number of neutrons

So same atomic number, different mass number

E.g. Carbon-12 & Carbon-13

Relative atomic mass (A_r): an elements mass of 1 of its atoms relative to $1/12$ the mass of one atom of Carbon-12

$A_r = \text{sum of (isotope abundance} \times \text{isotope mass number)} / (\text{sum of abundances of all isotopes})$

Compounds:

Substances of >2 elements chemically combined

Properties of compounds = different to original elements

Use chemical reactions to separate compounds

CO_2 = 1 atom of carbon, 2 atoms of oxygen

Ca(OH)_2 = 1 atom of calcium, 2 atoms of oxygen & 2 atoms of hydrogen

Balanced symbol equations:

Mass of reactants = Mass of products (conservation of mass)



$$\text{Fe} = 4$$

$$\text{O} = 6$$

$$\text{C} = 3$$

$$\text{Fe} = 4$$

$$\text{O} = 6$$

$$\text{C} = 3$$

Mixtures:

Substances made of >2 elements, NOT chemically bonded

Substance has similar properties to original elements

Use physical separation techniques to separate

E.g Air = mixture of: nitrogen, oxygen & argon, Crude oil = mixture of dif length hydrocarbon molecules

Separation techniques:

Filtration: separates insoluble solids from liquids

1. Pour solution into filter paper in a funnel into a beaker
2. Soluble molecules stick to paper so collect liquid in beaker

Soluble solids from solutions:

Evaporation:

1. Pour solution into evaporating dish
2. Heat with Bunsen & crystals will form as H₂O evaporates
3. Collect dry crystals

Crystallisation:

1. Heat solution (in an evaporating dish) with a Bunsen
2. H₂O will begin to evaporate, crystals will form
3. Filter crystals out of solution & leave to dry

Separating salt from seawater:

1. Mix sand & salt with H₂O in a solution
2. Stir to dissolve sand
3. Filter the solution (the sand will stick to the filter paper)
4. Evaporate H₂O off = dry crystals

Distillation:

Simple: separates liquid from solution

1. Heat solution
2. Vapour cools & condenses in the condenser & is collected

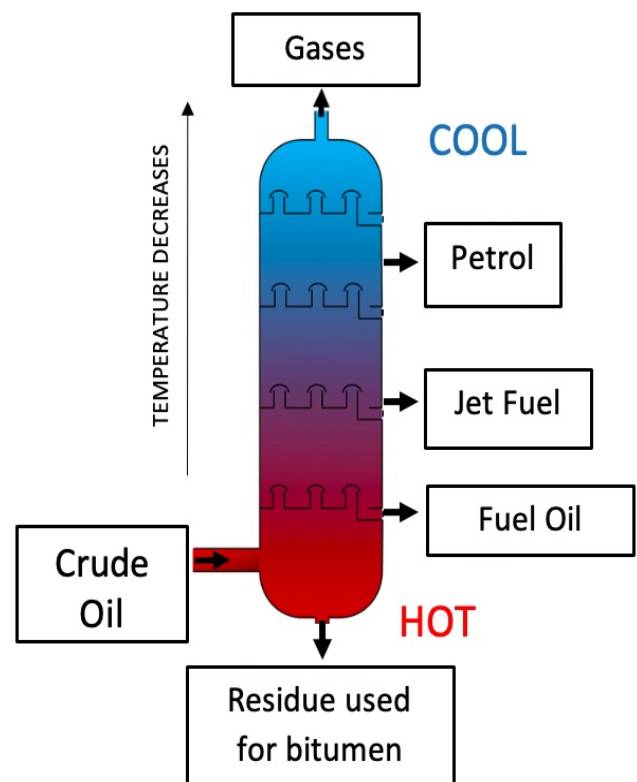
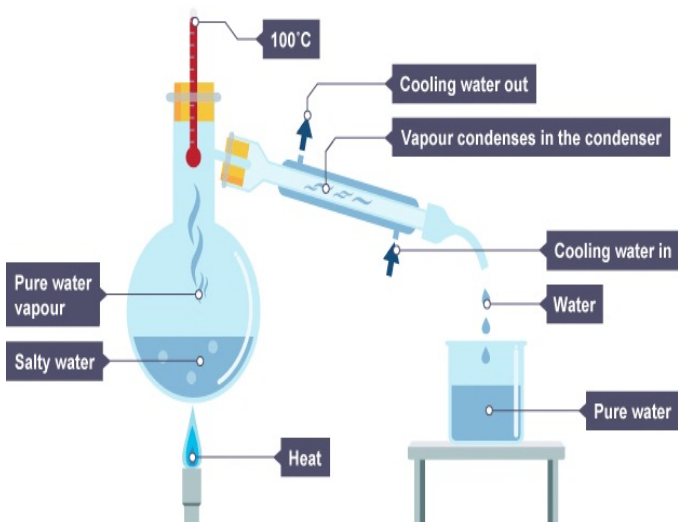
Can get pure water from seawater, H₂O evaporates & salt collects in flask

But can only use simple distillation to separate substances with DRASTIC boiling points (bp)

Fractional distillation:

Separates mixture of liquids with SIMILAR bp's

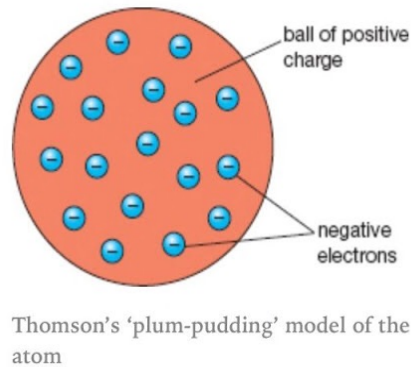
1. Heat mixture in flask using Bunsen
2. Liquids evaporate at dif points depending on their bp
3. Liquid with lowest bp evaporates 1st, condenses (column is cooler at the top) & is collected (once the thermometer temp of the mixture reaches its bp)



History of atom:

Dalton: atoms = solid spheres

1897: Thompson debunked this, by discovering electrons = Plum pudding model created (ball of positive charge with negative electrons embedded in it)



1909: Alpha Scattering experiment

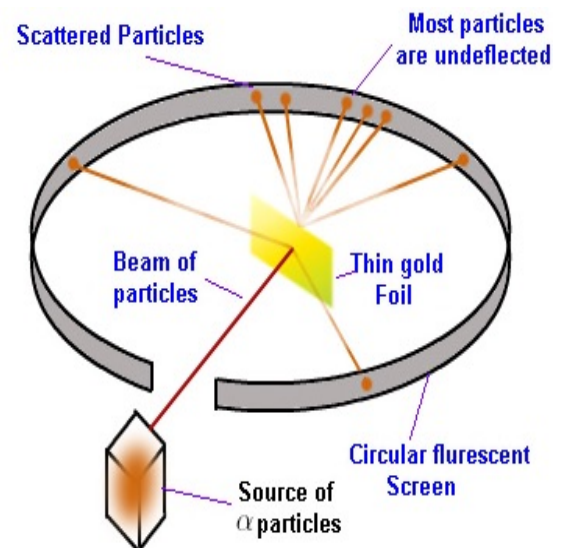
Rutherford fired positive alphas at sheet of gold

Results:

Alphas reflected = central, nucleus with positive charge

Alphas straight through = atom is mostly empty space

Alphas deflected = atom's mass concentrated in nucleus

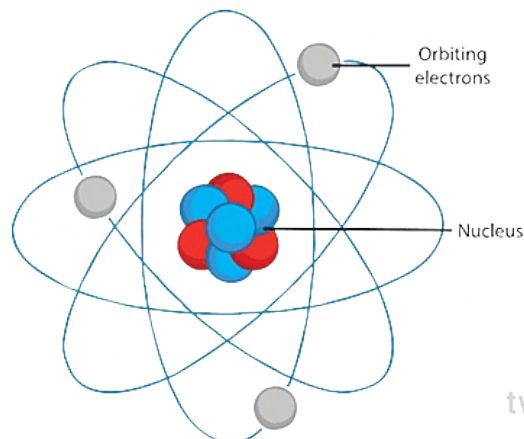


Bohr: electrons orbit nucleus in fixed energy levels (a cloud of electrons would've caused the atom to collapse due to their attraction to the nucleus)

Rutherford: nucleus can be divided into smaller positive particles (had the same charge as hydrogen nucleus) = protons

Chadwick: discovered neutrons in nucleus

So Nuclear model created



Electronic structure:

Lowest energy levels (closest to nucleus) filled 1st

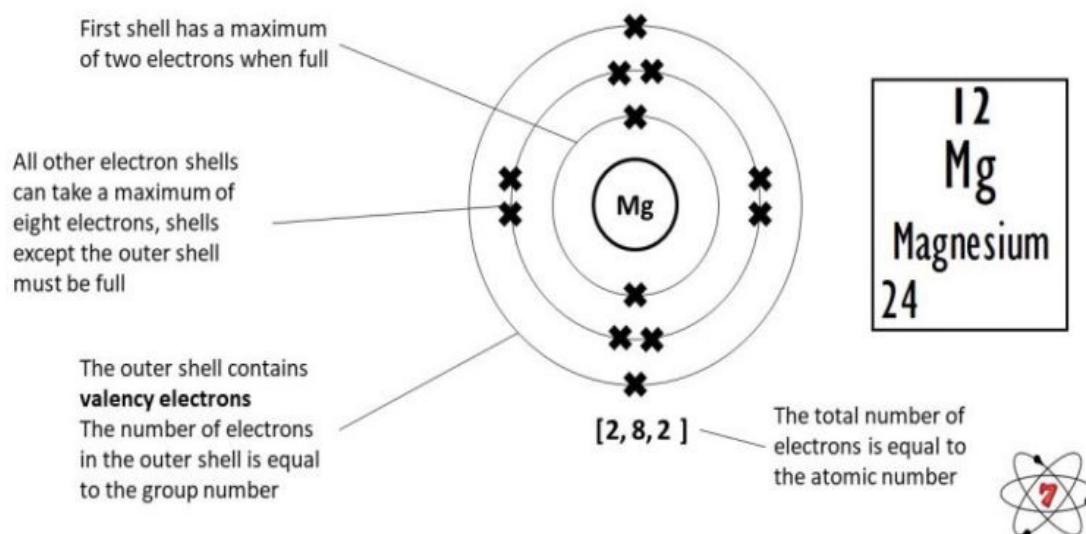
2,8,8 = configuration

Thus...

2 electrons on 1st shell, 8 on the 2nd, 8 on the 3rd shell

Atoms = stable if have full outer electron shell

Drawing Electron Configuration



Development of periodic table:

<20th cent: elements categorised by: physical & chemical properties and atomic weight

So wrong arrangement due to elements being arranged by atomic weight (mass)

1869: Mendeleev created periodic table of 50 elements

He ordered elements by: atomic weight BUT left gaps by predicting the properties of elements

His predictions were correct & isotopes proved order wasn't just based on weight but also properties of elements (isotopes= different masses, same properties)

Modern periodic table:

100 elements

Metals on left, non-metals on right

Periods (across) = elements in order of atomic number

Groups (down) = elements by properties (determined by electrons in outer shell so elements in the same group have same proton number)

Elements in same group react similarly & are ordered by reactivity

Mendeleev's Periodic Table (1869)									
I	II	III	IV	V	VI	VII	VIII		
H 1.01									
Li 6.94	Be 9.01	B 10.8	C 12.0	N 14.0	O 16.0	F 19.0			
Na 23.0	Mg 24.3	Al 27.0	Si 28.1	P 31.0	S 32.1	Cl 35.5			
K 39.1	Ca 40.1		Ti 47.9	V 50.9	Cr 52.0	Mn 54.9	Fe 55.9	Co 58.9	Ni 58.7
Cu 63.5	Zn 65.4			As 74.9	Se 79.0	Br 79.9			
Rb 85.5	Sr 87.6	Y 88.9	Zr 91.2	Nb 92.9	Mo 95.9		Ru 101	Rh 103	Pd 106
Ag 108	Cd 112	In 115	Sn 119	Sb 122	Te 128	I 127			
Ce 133	Ba 137	La 139		Ta 181	W 184		Os 194	Ir 192	Pt 195
Au 197	Hg 201	Tl 204	Pb 207	Bi 209					
			Th 232		U 238				

1	2											3	4	5	6	7	0				
		1 H hydrogen 1 4 He helium 2																			
7 Li lithium 3	9 Be beryllium 4	Key relative atomic mass atomic symbol name atomic (proton) number										11 B boron 5	12 C carbon 6	14 N nitrogen 7	16 O oxygen 8	19 F fluorine 9	20 Ne neon 10				
23 Na sodium 11	24 Mg magnesium 12											27 Al aluminum 13	28 Si silicon 14	31 P phosphorus 15	32 S sulfur 16	35.5 Cl chlorine 17	40 Ar argon 18				
39 K potassium 19	40 Ca calcium 20	45 Sc scandium 21	48 Ti titanium 22	51 V vanadium 23	52 Cr chromium 24	55 Mn manganese 25	56 Fe iron 26	59 Co cobalt 27	59 Ni nickel 28	63.5 Cu copper 29	65 Zn zinc 30	70 Ga gallium 31	73 Ge germanium 32	75 As arsenic 33	79 Se selenium 34	80 Br bromine 35	84 Kr krypton 36				
85 Rb rubidium 37	88 Sr strontium 38	89 Y yttrium 39	91 Zr zirconium 40	93 Nb niobium 41	96 Mo molybdenum 42	[98] Tc technetium 43	101 Ru ruthenium 44	103 Rh rhodium 45	106 Pd palladium 46	108 Ag silver 47	112 Cd cadmium 48	115 In indium 49	119 Sn tin 50	122 Sb antimony 51	128 Te tellurium 52	127 I iodine 53	131 Xe xenon 54				
133 Cs caesium 55	137 Ba barium 56	139 La* lanthanum 57	178 Hf hafnium 72	181 Ta tantalum 73	184 W tungsten 74	186 Re rhenium 75	190 Os osmium 76	192 Ir iridium 77	195 Pt platinum 78	197 Au gold 79	201 Hg mercury 80	204 Tl thallium 81	207 Pb lead 82	209 Bi bismuth 83	[208] Po polonium 84	[210] At astatine 85	[222] Rn radon 86				
[223] Fr francium 87	[226] Ra radium 88	[227] Ac* actinium 89	[261] Rf rutherfordium 104	[262] Db dubnium 105	[266] Sg seaborgium 106	[264] Bh bohrium 107	[277] Hs hassium 108	[268] Mt meitnerium 109	[271] Ds darmstadtium 110	[272] Rg roentgenium 111	Elements with atomic numbers 112 – 116 have been reported but not fully authenticated										

* The Lanthanides (atomic numbers 58 – 71) and the Actinides (atomic numbers 90 – 103) have been omitted.

Relative atomic masses for Cu and Cl have not been rounded to the nearest whole number.

Metals & non-metals:

Metals:

Form positive ions

Non-metals:

Form negative ions

Group 1 & 2:

electrons on higher energy levels are further from the nucleus so have a lower electrostatic attraction

so larger atomic radius = easier to LOOSE electrons to get a full outer shell

Group 6 & 7:

electrons on lower energy levels are closer to the nucleus so have a higher electrostatic attraction

so smaller atomic radius = easier to GAIN electrons to get a full outer shell (to gain electrons, need strong electrostatic attraction between nucleus & electrons)

Properties of metals:

Metallic bonding so:

Strong but malleable (bent into shape)

Good conductors of heat & electricity

High b.p & m.p

Properties of non-metals:

Dull

Lower b.p & m.p

Group 1 elements:

Alkali metals properties:

Have 1 outer electron (so very reactive)

Soft with low densities

Trend:

Reactivity INCREASES DOWN the group (more energy is released in reactions)

As atomic radius increases, there's a weaker electrostatic attraction between the nucleus & electrons so easier to lose outer electron

So LOWER bp & mp DOWN with a HIGHER Ar

Form +1 ions (via ionic bonding):

Reactions: (vigorous):

Water + Metal $\rightarrow$ Metal hydroxide + hydrogen

Chlorine + Metal $\rightarrow$ Metal chloride salt

Oxygen + Metal $\rightarrow$ Metal oxide

Alkali metals more reactive, less dense with lower mp than Transition metals

Group 7 elements:

Halogens:

Non-metals with coloured vapours e.g. Fluorine (yellow gas) & Bromine (red, volatile liquid)

All diatomic

Trends:

DOWN group reactivity DECREASES

As atomic radius increases, the electrostatic attraction between the nucleus & electrons decreases so it's harder to GAIN electrons

Higher mp & bp DOWN the group

Higher relative atomic masses DOWN the group

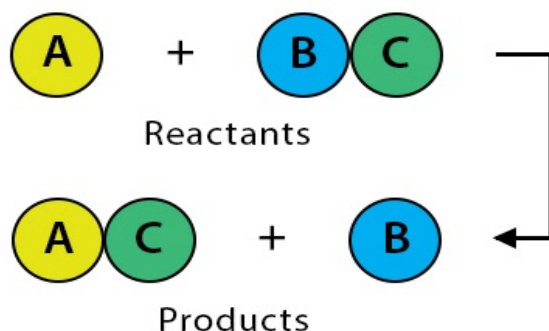
Bond covalently to form elements with simple molecular structures

Bond ionically to form halides

Displacement reactions:

Occurs with more reactive halogen & less reactive salt which is displaced

Single-replacement Reaction



Group 0 elements:

Nobel Gases are:

Inert (have full outer shell so not flammable),
colourless gases at room temp

All monatomic gases (single un- bonded atoms)

Trends:

Bp INCREASES DOWN the group (more
electron shells = greater intermolecular forces
so need more energy to overcome)

Ar increases DOWN the group