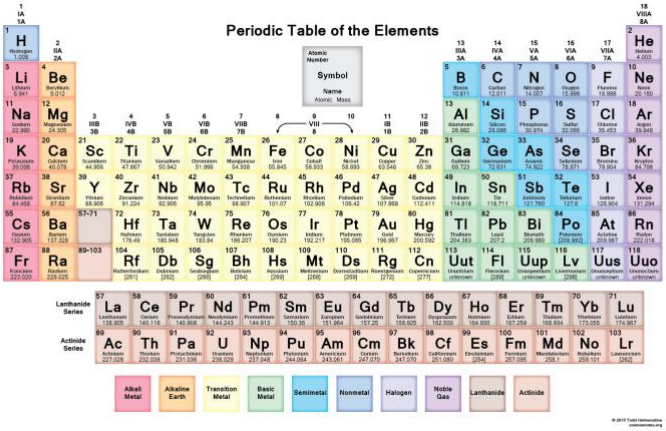
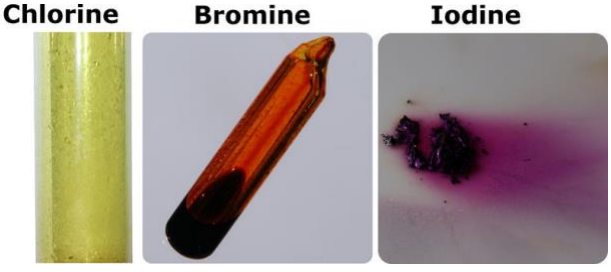
Getting Ready For A Level Chemistry





3. The Periodic Table of Elements

1	2											3	4	5	6	7	0
							1 **H** hydrogen 1										4 **He** helium 2
7 **Li** lithium 3	9 **Be** beryllium 4											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** aluminium 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	[209] **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						

Key

relative atomic mass
atomic symbol
name
atomic (proton) number

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

Cu and **Cl** have not been rounded to the nearest whole number.

The Periodic Table

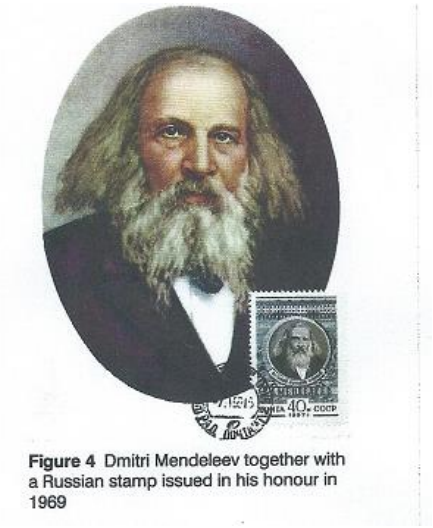


Figure 4 Dmitri Mendeleev together with a Russian stamp issued in his honour in 1969

Other scientists ridiculed his ideas, and refused to accept them.

H 1	F 8	Cl 15	Co & Ni 22	Br 29	Pd 36	I 42	Pt & Ir 50
Li 2	Na 9	K 16	Cu 23	Rb 30	Ag 37	Cs 44	Cs 51
Be 3	Mg 10	Ca 17	Zn 24	Sr 31	Cd 38	Ba & V 45	Hg 52
B 4	Al 11	Cr 19	Y 25	Ce & La 33	U 40	Ta 46	Tl 53
C 5	Si 12	Ti 18	In 26	Zr 32	Sn 39	W 47	Pb 54
N 6	P 13	Mn 20	As 27	Di & Mo 34	Sb 41	Nb 48	Bi 55
O 7	S 14	Fe 21	Se 28	Rh & Ru 35	Te 43	Au 49	Th 56

Figure 3 Newlands and his table of octaves. Looking at Newlands' octaves, a fellow chemist commented that putting the elements in alphabetical order would probably produce just as many groups of elements with similar properties!

Task 1

Research the following 3 scientists:

a) John Dalton

b) John Newlands

c) Dimitri Mendeleev

Write an account on how the work of these 3 scientists contributed towards the forming of the Modern Periodic Table.

Figure 2 Dalton and his table of elements

Your account should also include details of how the Modern Periodic Table is organised today.

Group 1 – The Alkali Metals

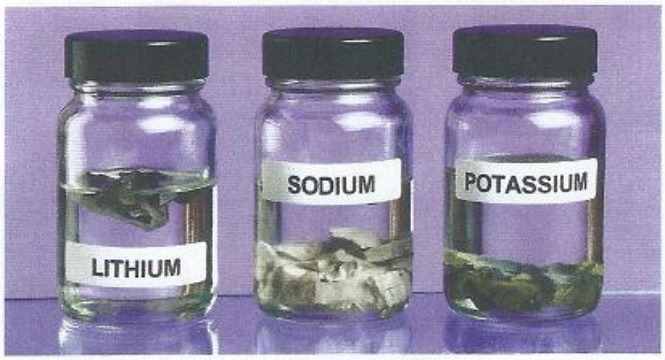


Figure 2 The alkali metals have to be stored in oil

Figure 3 Lithium, sodium and potassium reacting with water (the lithium is on the left of the trough, the potassium has burning hydrogen above it, and the sodium is the molten silvery ball on the right)

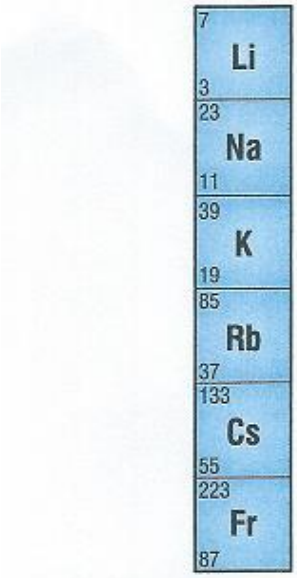


Figure 1 The alkali metals (Group 1)

Task 2

Describe and **explain** the properties of the elements in Group 1 of the Periodic Table. Your account should include the trend in the properties on going down the group.

The properties that you should discuss are:

a) Melting Point and Boiling Point

b) Any other physical properties

c) Reaction with water

d) Reaction with chlorine

Include **chemical equations** where you can to illustrate any chemical reactions.

Group 7 – The Halogens

Figure 1 The Group 7 elements

	F—F (F_2)	Cl—Cl (Cl_2)	Br—Br (Br_2)	I—I (I_2)
Melting Point (°C)	−220	−101	−7	114
Boiling Point (°C)	−188	−35	59	184

Figure 2 The halogens all form molecules made up of a pair of atoms, joined by a covalent bond. We call this type of molecule a diatomic molecule.

	How the halogens react with hydrogen
$F_2(g) + H_2(g) \rightarrow 2HF(g)$	Explosive even at −200°C and in the dark
$Cl_2(g) + H_2(g) \rightarrow 2HCl(g)$	Explosive in sunlight / slow in the dark
$Br_2(g) + H_2(g) \rightarrow 2HBr(g)$	300°C + platinum catalyst
$I_2(g) + H_2(g) \rightleftharpoons 2HI(g)$	300°C + platinum catalyst (very slow, reversible)

Task 3

Describe and **explain** the properties of the elements in Group 7 of the Periodic Table. Your account should include the trend in the properties on going down the group.

The properties that you should discuss are:

a) Melting Point and Boiling Point

b) Conductance of energy and electricity

c) Reaction with hydrogen

d) Displacement reactions between the halogens

Include **chemical equations** where you can to illustrate any chemical reactions.

The Transition Elements

45 **Sc** 21	48 **Ti** 22	51 **V** 23	52 **Cr** 24	55 **Mn** 25	56 **Fe** 26	59 **Co** 27	59 **Ni** 28	63 **Cu** 29	64 **Zn** 30
89 **Y** 39	91 **Zr** 40	93 **Nb** 41	96 **Mo** 42	99 **Tc** 43	101 **Ru** 44	103 **Rh** 45	106 **Pd** 46	108 **Ag** 47	112 **Cd** 48
	178 **Hf** 72	181 **Ta** 73	184 **W** 74	186 **Re** 75	190 **Os** 76	192 **Ir** 77	195 **Pt** 78	197 **Au** 79	201 **Hg** 80

Figure 1 The transition elements. The more common metals are shown in **bold type.** (Strictly speaking, the metals in the first and last columns above should not be called transition elements. This is because of the electronic structure of their ions).

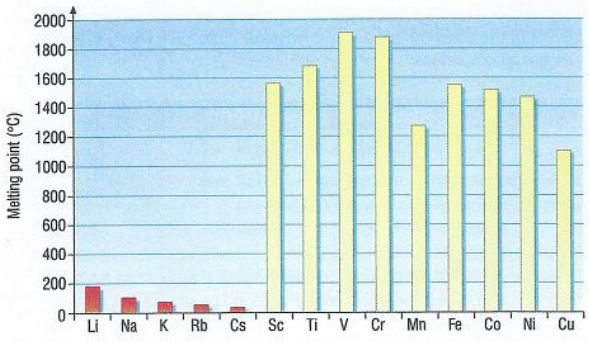


Figure 2 The melting points of the transition elements are much higher than those of the Group 1 elements

Figure 3 Compounds of transition elements are coloured (as opposed to the mainly white compounds of the alkali metals). The colours of many minerals, rocks and gemstones are due to transition element ions. The reddish-brown colour in a rock is often due to iron ions, Fe^{3+}. The blue colour of sapphires and the green of emeralds are both due to transition element ions in the structures of their crystals.

Task 4

Write an account of the Transition Metals.

Your account should include:

a) A description of their physical properties

b) A description of their chemical properties in comparison to the Group 1 Metals

c) Details about some of the compounds that they can form, including information on:

i) The colours of some of the Transition Metal Compounds

ii) The ions that they can form

Include different examples of the **Transition Metals** and their **Ions** to illustrate your answer.