

The Periodic Table

IGCSE Chemistry 0620 · Topic 8 revision notes

Everything from the 5 lessons of this topic on a few pages: the key idea of each lesson, the diagram to remember, the points to learn and the traps examiners set. Read it, cover it, test yourself.

1. Arrangement of the Periodic Table

2. Group I: the alkali metals

3. Group VII: the halogens

4. Transition elements

5. Noble gases

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1 Arrangement of the Periodic Table

Syllabus 8.1

The Periodic Table arranges elements in order of increasing **proton number**. Vertical columns are **groups**; horizontal rows are **periods**. For Groups I to VII the group number equals the number of **outer-shell electrons**, and the period number equals the number of occupied shells. Elements change from **metallic to non-metallic** across a period.

Extended: elements in the same group have similar chemical properties because they have the same number of outer electrons; the group number predicts the charge on the ion: I +1, II +2, III +3, V -3, VI -2, VII -1.

	I	II	transition elements						III	IV	V	VI	VII	VIII
1														
2														
3														
4														
5														

■ metals ■ transition metals ■ non-metals

group number = outer-shell electrons (Groups I to VII)

period number = number of occupied electron shells

the staircase line separates metals from non-metals

Fig. 1: the layout of the Periodic Table

Group = outer electrons, period = shells.

- ✓ **Order:** increasing proton number.
- ✓ **Group** number = outer-shell electrons (I to VII).
- ✓ **Period** number = occupied shells.
- ✓ **Across:** metal to non-metal.

Watch out!

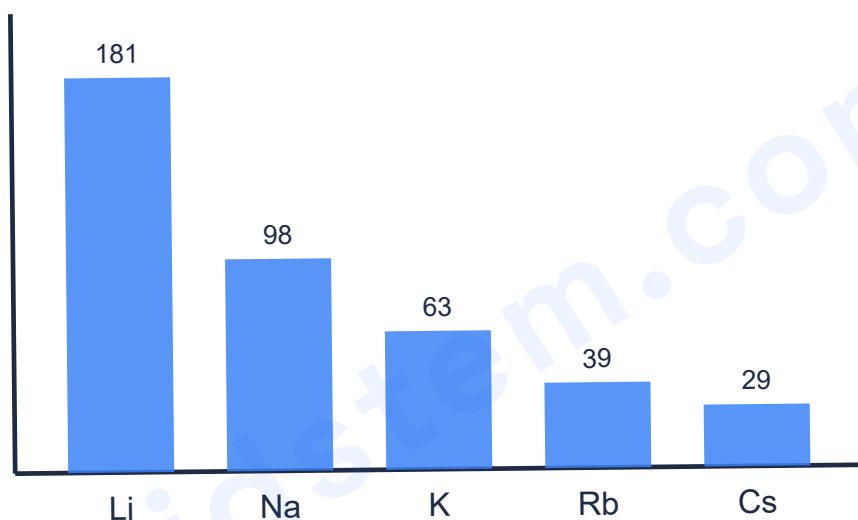
The Periodic Table is ordered by **proton number**, not by relative atomic mass. Argon (A_r 40) comes before potassium (A_r 39) because argon has 18 protons and potassium 19. And Group VIII (noble gases) has 8 outer electrons, except helium, which has 2.

2 Group I: the alkali metals

Syllabus 8.2

The Group I **alkali metals** are soft, have relatively low melting points and low densities, and are good conductors. They react with cold water to form an alkaline hydroxide and hydrogen: $2\text{Na} + 2\text{H}_2\text{O} \rightarrow 2\text{NaOH} + \text{H}_2$. Down the group, the **melting point decreases**, the density generally **increases** and the **reactivity increases**. Their outer electron is further from the nucleus and more easily lost.

melting point / °C



down the group: lower melting point, more reactive with water

Fig. 1: melting points of the Group I metals

Down Group I: softer, lower, faster.

- ✓ **Water:** metal hydroxide + hydrogen.
- ✓ **Melting point** decreases down the group.
- ✓ **Reactivity** increases down the group.
- ✓ **Reason:** outer electron further out, lost more easily.

Watch out!

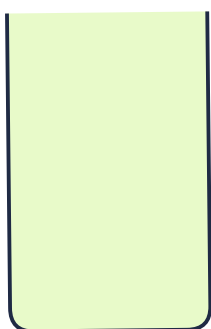
Reactivity **increases** down Group I but **decreases** down Group VII. Do not carry the Group I trend over to the halogens. And the solution formed with water is alkaline because of the hydroxide, not because of the hydrogen gas.

3 Group VII: the halogens

Syllabus 8.3

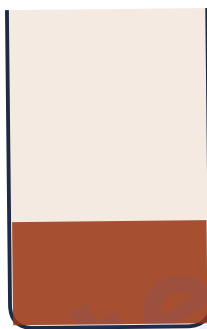
The Group VII **halogens** are diatomic non-metals: chlorine (Cl_2) is a pale yellow-green gas, bromine (Br_2) a red-brown liquid and iodine (I_2) a grey-black solid. Down the group the **colour gets darker**, the **density increases** and the **reactivity decreases**. A more reactive halogen **displaces** a less reactive halogen from a solution of its halide: $\text{Cl}_2 + 2\text{KBr} \rightarrow 2\text{KCl} + \text{Br}_2$.

chlorine, Cl_2



pale yellow-green
gas

bromine, Br_2



red-brown
liquid

iodine, I_2



grey-black solid,
purple vapour

down the group: darker colour, higher density, less reactive

Fig. 1: chlorine, bromine and iodine at room temperature

More reactive displaces less reactive.

- ✓ Cl_2 green gas, Br_2 red-brown liquid, I_2 grey-black solid.
- ✓ **Down the group:** darker, denser, less reactive.
- ✓ **Displacement:** only a more reactive halogen reacts.
- ✓ **Colours:** bromine orange, iodine brown in solution.

Watch out!

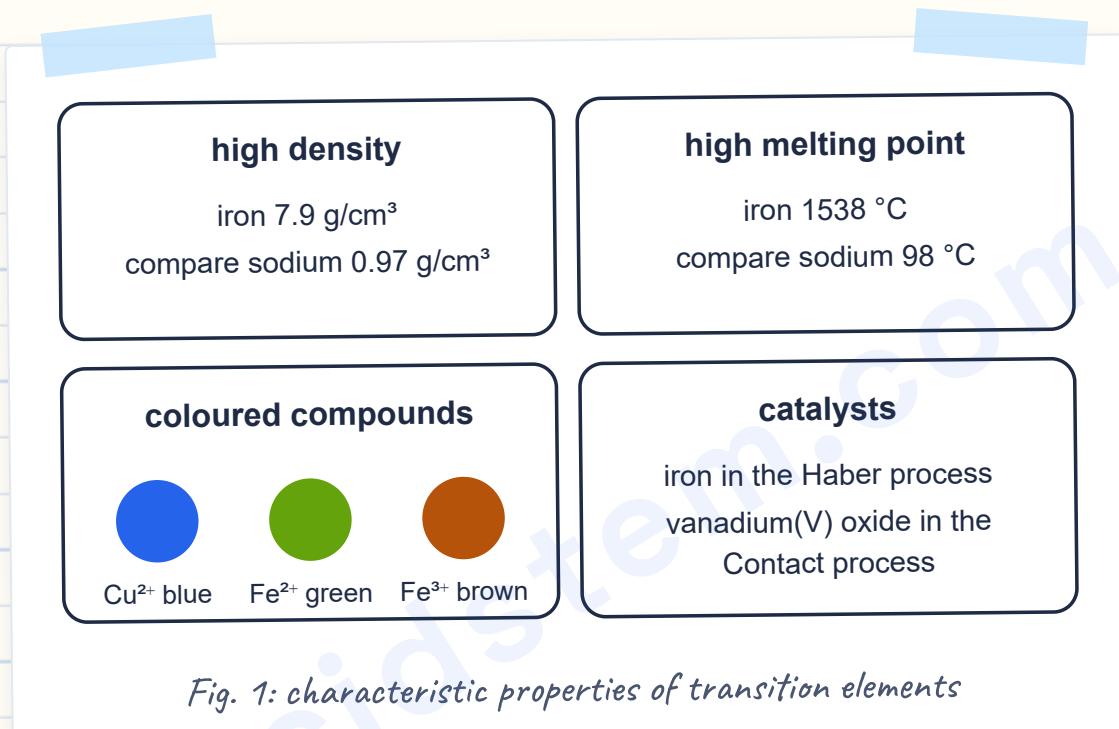
In a displacement reaction the **colour change** comes from the halogen that is formed, not the one added. Aqueous bromine is orange and iodine solution is brown, so "the solution turns brown" with potassium iodide means iodine has been made.

4 Transition elements

Syllabus 8.4

The **transition elements** are metals with **high densities** and **high melting points**. They form **coloured compounds**, and the elements and their compounds often act as **catalysts**.

Extended: transition elements have ions with **variable oxidation numbers**, such as iron(II), Fe^{2+} , and iron(III), Fe^{3+} .



Four typical properties.

- ✓ **High density** and **high melting point**.
- ✓ **Coloured compounds**.
- ✓ **Catalysts** (as the element or a compound).
- ✓ **Extended:** variable oxidation numbers.

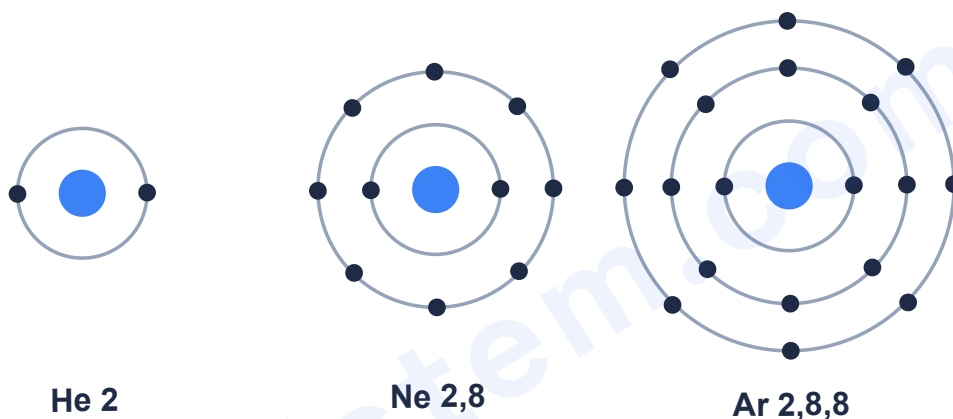
Watch out!

"Coloured compounds" is about the **compounds**, not the metals: copper metal is pink-brown, but the property that marks a transition element is that its compounds and solutions are coloured. And a catalyst is not used up, so "iron reacts in the Haber process" is wrong.

5 Noble gases

Syllabus 8.5

The **noble gases** in Group VIII are **unreactive, monatomic** gases. Their atoms have **full outer shells** (helium 2, neon 2,8, argon 2,8,8), so they do not need to gain, lose or share electrons to become stable. Because they are unreactive they are used where a non-reactive gas is needed: **argon** in lamps and as an inert atmosphere, **helium** in balloons and airships, **neon** in advertising signs.



full outer shells: no need to gain, lose or share electrons

Fig. 1: full outer shells of helium, neon and argon

Full outer shell, no reaction.

- ✓ **Monatomic** and unreactive.
- ✓ **Full outer shells:** He 2, Ne 2,8, Ar 2,8,8.
- ✓ **Down the group:** boiling point and density increase.
- ✓ **Uses** depend on unreactivity plus one other property.

Watch out!

Helium replaced hydrogen in airships because it is **unreactive** (it does not burn), not just because it is light: hydrogen is even less dense but is flammable. And helium has **2** outer electrons, not 8, yet its outer shell is still full.