

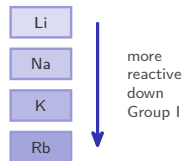
The Periodic Table

IGCSE Chemistry ■ Topic 8

IGCSE Chemistry

What we will cover

- 1 How the elements are arranged
- 2 Group I – alkali metals
- 3 Group VII – halogens
- 4 Group trends & displacement
- 5 Transition elements
- 6 Group VIII – noble gases



group trends

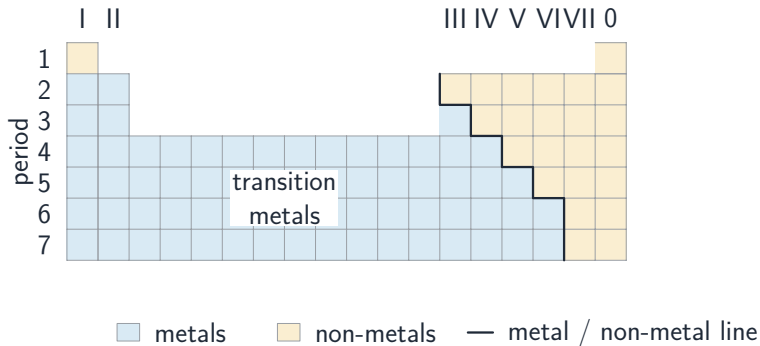
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Arrangement

How the elements are arranged

- Across a period, the elements change from **metals** 金属 on the left to **non-metals** 非金属 on the right.
- The group number tells you the charge of the **ions** 离子 that the elements form. Group I forms +1 ions, Group II forms +2 ions, and Group VII forms -1 ions.
- Elements in the same group have similar chemical properties. This is because they have the same number of outer-shell **electrons** 电子, which is what decides how an element reacts.

How the elements are arranged, in detail



The group number tells you the charge of the **ions** 离子 that the elements form.

2

Group I and VII

Group I – the alkali metals

Group I is **lithium** 锂, **sodium** 钠 and **potassium** 钾 – **soft** 柔软 metals you can cut with a knife, each with **one** electron in its outer shell.

Going down the group there are three trends to learn:

- **melting point** 熔点 **decreases**,
- **density** 密度 **increases**,
- **reactivity** 活泼性 **increases**.

The trends let you **predict**: rubidium sits below potassium, so it would be even more reactive and melt at an even lower temperature.

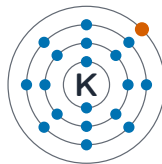
Group I – the alkali metals, in detail



lithium
2,1



sodium
2,8,1



potassium
2,8,8,1

every Group I atom has **one** electron in its outer shell (shown in orange), so they react in similar ways

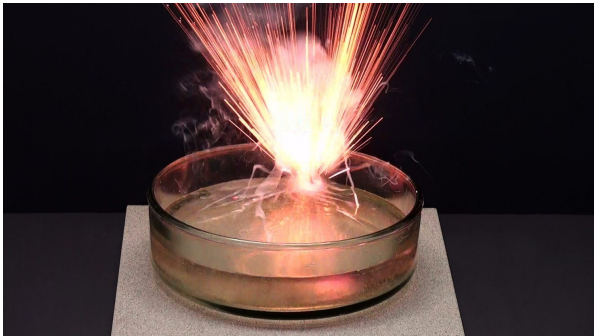
Every Group I atom has **one** electron in its outer shell – which is why they all react in similar ways.

Reaction with water, and what you see

This is the reaction the exam asks about most.

- it **floats** - the metal is less dense than water.
- it **melts into a ball** - the reaction gives out heat, and the metal's melting point is low.
- it **moves about** on the surface - the hydrogen jetting off pushes it around.
- there is **effervescence** 泡腾 (fizzing) - the hydrogen gas escaping.

Group I reactivity



Group I elements are the **alkali metals** 碱金属: **lithium** 锂, **sodium** 钠 and **potassium** 钾.

They are **soft** 柔软 metals (you can cut them with a knife).

Sodium on water: what you would actually see

why it matters

“describe what you see” is worth marks of its own

it floats

sodium is less dense than water

it melts into a ball

the reaction is exothermic enough to melt it, and surface tension pulls it round

it fizzes and moves

hydrogen is given off, driving it across the surface

it gets smaller and disappears

as it is used up

the solution turns alkaline

universal indicator goes purple – it is now sodium hydroxide

The trend shows in how violent it is: lithium fizzes steadily but does not melt; sodium melts and darts about; potassium ignites the hydrogen with a lilac flame.

Group VII – the halogens

chlorine

pale green gas

bromine

red-brown liquid

iodine

grey-black solid

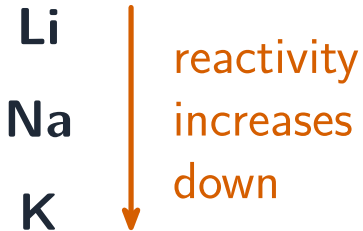
Halogens 卤素 are **diatomic** 双原子 non-metals (Cl_2). Down the group: density up, reactivity
down.

Opposite group trends

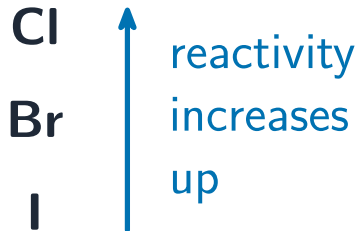
- Group I: more reactive **down**
- Group VII: less reactive **down**

Metals lose electrons more easily lower down; non-metals gain them less easily.

Group I

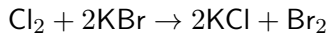


Group VII

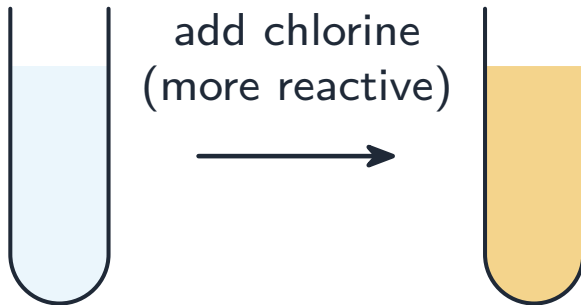


Displacement reactions

A more reactive halogen **displaces** 置換 a less reactive **halide** 卤化物.



The released bromine turns the solution orange.



3

Other blocks

Transition elements and noble gases

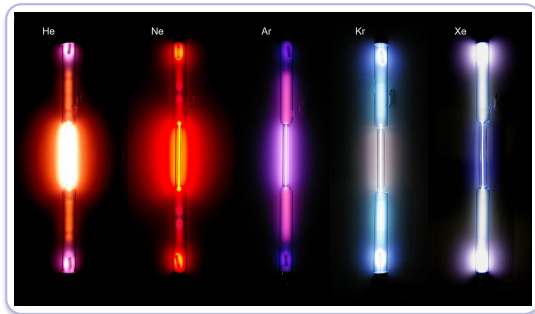
transition elements 过渡元素

high density & melting point;
coloured compounds; catalysts;
variable oxidation numbers ($\text{Fe}^{2+}/\text{Fe}^{3+}$)

noble gases 稀有气体

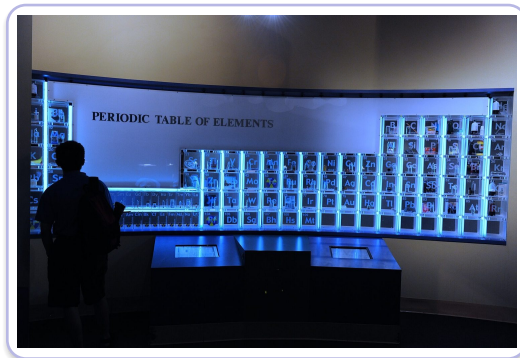
Group VIII; **monatomic**
单原子 & unreactive – they
already have a full outer shell

Group VIII – the noble gases



Passing electricity through each noble gas makes it glow a characteristic colour – this is how neon signs and other lights work

Arrangement of the elements



The periodic table arranges the elements in order of atomic number.

Transition elements



Transition metals form coloured compounds: each of these solutions contains a different transition-metal ion

Exam tips

- The Periodic Table is ordered by **proton number**. Elements in the same **group** (column) have the same number of outer electrons, so they react in similar ways; **periods** are the rows.
- **Group I** (alkali metals) get *more* reactive going down; **Group VII** (halogens) get *less* reactive going down – opposite trends.
- A more reactive **halogen displaces** a less reactive one from a solution of its salt – for example chlorine displaces bromine.
- **Noble gases** are unreactive because they have a full outer shell. **Transition elements** are hard and dense, form coloured compounds, act as catalysts and have variable oxidation numbers.

4

Recap

Worked example – predicting Group I behaviour

Predict how rubidium reacts with water, compared with sodium.

- Group I reactivity **increases down** the group.
- Rb's outer electron is **further from the nucleus** and more **shielded**.
- So it is **lost more easily** than sodium's.
- Rb reacts **more violently**, giving $\text{RbOH} + \text{hydrogen}$ – and the H_2 ignites.

Group I gets **more** reactive down (easier to **lose** an electron); Group VII gets **less** reactive down (harder to **gain** one). Opposite trends.

Topic 8 – key takeaways

1

Arrangement

by proton number; groups share outer electrons

2

Group I

soft metals; more reactive down the group

3

Group VII

diatomic; less reactive down; displacement

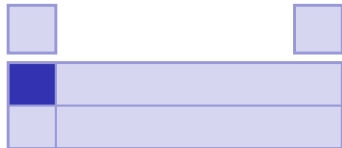
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Other blocks

transition: coloured, catalysts;
noble: inert

Check yourself

- 1 What does the group number tell you about electrons?
- 2 How does Group I reactivity change going down?
- 3 What state is iodine at room temperature?
- 4 Why are noble gases unreactive?



Answers 1. the number of outer-shell electrons 2. it increases 3. a grey-black solid
4. they have a full outer shell