

Exercise walk-through

8.3

Group VII properties

IGCSE Chemistry

Group I – the alkali metals

Group I is **lithium**, **sodium** and **potassium** – **soft** 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** decreases,
- **density** increases,
- **reactivity** increases.

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

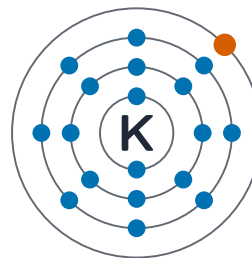
Group I – the alkali metals, in detail



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

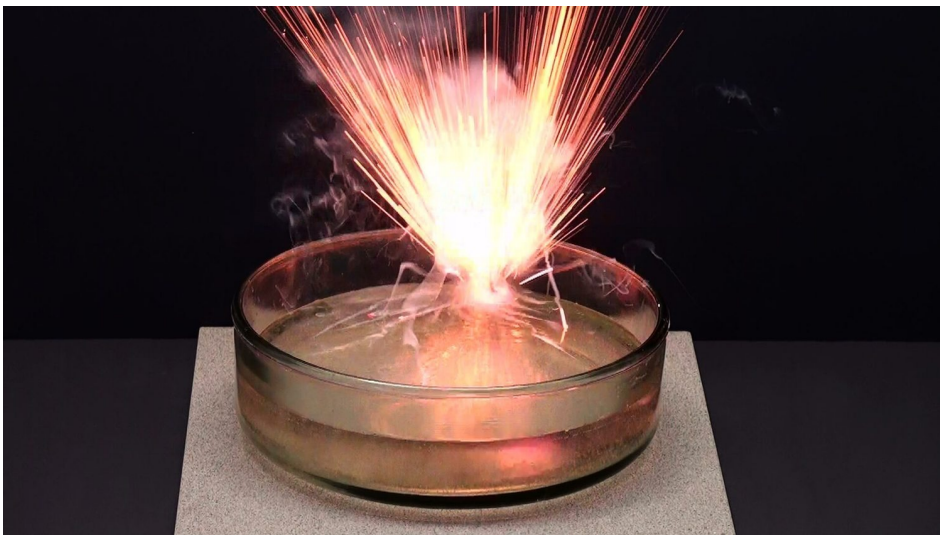
Every Group I atom has **one** electron in its outer shell – which is why they all react in similar ways.

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** (fizzing) - the hydrogen gas escaping.

Group I reactivity



Group I elements are the **alkali metals** : **lithium** , **sodium** and **potassium** .

They are **soft** 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.

Exercises 2.1·2.3

2.1 State the colour and state of chlorine at room temperature. [1]

2.2 State the trend in reactivity down Group VII. [1]

2.3 State the appearance of chlorine, bromine and iodine at room temperature. [3]

Exercises 2.1-2.3

2.1 State the colour and state of chlorine at room temperature.

[1]

2.1

- chlorine at room temperature is a **pale yellow-green gas**
-

2.2 State the trend in reactivity down Group VII.

[1]

2.2

- going down Group VII, **reactivity decreases**
-

2.3 State the appearance of chlorine, bromine and iodine at room temperature.

[3]

2.3

- chlorine: **pale yellow-green gas**
- bromine: **red-brown liquid**
- iodine: **grey-black solid**

Exercises 2.4·2.5

2.4 Explain, in terms of electrons, why chlorine is more reactive than iodine. [3]

2.5 Write the ionic equation for the reaction of chlorine with iodide ions. [2]

Exercises 2.4·2.5

2.4 Explain, in terms of electrons, why chlorine is more reactive than iodine. [3]

2.4

- a halogen reacts by **gaining one electron**
 - chlorine's outer shell is **closer** to the nucleus and less shielded than iodine's
 - chlorine **attracts the incoming electron more strongly**
-

2.5 Write the ionic equation for the reaction of chlorine with iodide ions. [2]

2.5

- $\text{Cl}_2 + 2\text{I}^- \rightarrow 2\text{Cl}^- + \text{I}_2$

Exercise 3.1

3.1 Which halogen is the most reactive?

[1]

☐

A chlorine

B bromine

C iodine

D they are equal

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3.1 Which halogen is the most reactive?

[1]

☐

A chlorine

B bromine

C iodine

D they are equal

3.1 A

- **chlorine** is the most reactive (reactivity decreases down the group)
- B and C are lower; D is false

Exercise 3.2 (a)

3.2 Chlorine is bubbled into colourless potassium iodide solution.

(a) Write the equation for the reaction.

[2]

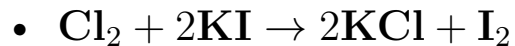
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[2]

(a)



Exercise 3.2 (b)

3.2 Chlorine is bubbled into colourless potassium iodide solution.

(b) State and explain the colour change.

[2]

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[2]

(b)

- the solution turns **brown/orange**
- because **iodine** has been displaced

Exercise 3.3

3.3 Predict whether bromine will displace chlorine from potassium chloride, and explain your answer. [2]

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3.3

- **no** – bromine will not displace chlorine
- only a **more reactive** halogen can displace a less reactive one

Exercise 3.4 (a)

3.4 A student adds chlorine water, bromine water and iodine solution to separate samples of potassium bromide solution and potassium iodide solution.

(a) Complete the table by writing “reaction” or “no reaction” in each cell.

[4]

added to →	potassium bromide	potassium iodide
chlorine water		
bromine water		
iodine solution		

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[4]

added to →	potassium bromide	potassium iodide
chlorine water		
bromine water		
iodine solution		

(a)

- chlorine water: **reaction** with both bromide and iodide
- bromine water: **no reaction** with bromide, **reaction** with iodide
- iodine: **no reaction** with either

Exercise 3.4 (b)

3.4 A student adds chlorine water, bromine water and iodine solution to separate samples of potassium bromide solution and potassium iodide solution.

(b) Describe the colour change the student would see when chlorine water is added to potassium iodide solution. [2]

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(b)

- colourless solution turns **brown**
- because **iodine** has been displaced

Exercise 3.4 (c)

3.4 A student adds chlorine water, bromine water and iodine solution to separate samples of potassium bromide solution and potassium iodide solution.

(c) Write the balanced symbol equation and the ionic equation for that reaction. [3]

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(c)

- $\text{Cl}_2 + 2\text{KI} \rightarrow 2\text{KCl} + \text{I}_2$
- ionic: $\text{Cl}_2 + 2\text{I}^- \rightarrow 2\text{Cl}^- + \text{I}_2$

Exercise 3.4 (d)

3.4 A student adds chlorine water, bromine water and iodine solution to separate samples of potassium bromide solution and potassium iodide solution.

(d) Explain, in terms of the outer shell, why reactivity decreases down Group VII. [3]

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(d) Explain, in terms of the outer shell, why reactivity decreases down Group VII. [3]

(d)

- each halogen **gains one electron** into its outer shell
- going down, that shell is further from the nucleus and more shielded
- the incoming electron is attracted less strongly, so **reactivity falls**

Exercise 3.4 (e)

3.4 A student adds chlorine water, bromine water and iodine solution to separate samples of potassium bromide solution and potassium iodide solution.

(e) State which species is oxidised and which is reduced in the reaction in (c), giving a reason for each. [2]

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(e)

- **chlorine is reduced** (gains electrons)
- **iodide is oxidised** (loses electrons)