

Exercise walk-through

8.2

Group 1 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.

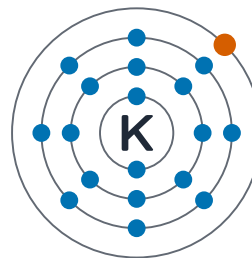
Group I – the alkali metals, in detail



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

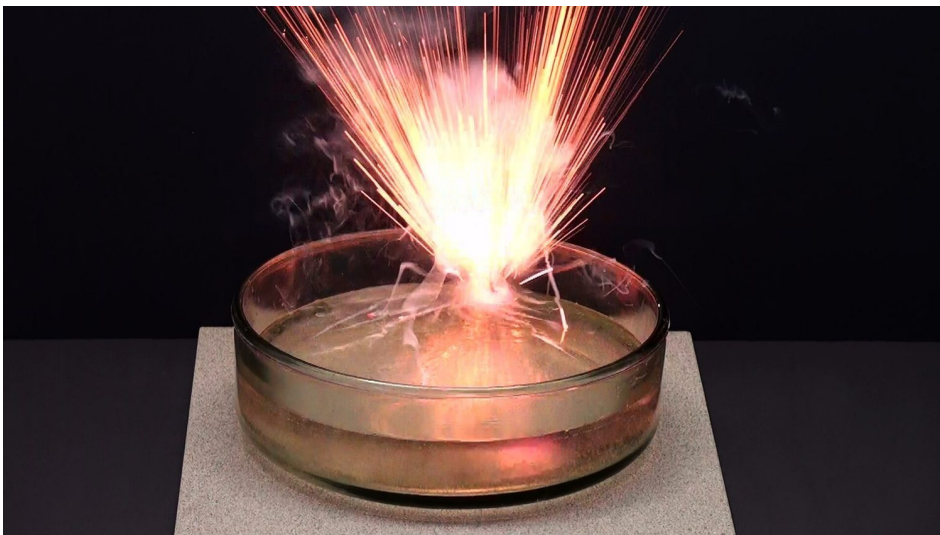
Every Group I atom has **one** electron in its outer shell – which is why they all react in similar ways.

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 number of outer-shell electrons in a Group I atom. [1]

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

2.3 Write the balanced equation for the reaction of potassium with water. [2]

Exercises 2.1·2.3

2.1 State the number of outer-shell electrons in a Group I atom. [1]

2.1

- Group I atoms have **one** outer-shell electron
-

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

2.2

- going down Group I, **reactivity increases**
-

2.3 Write the balanced equation for the reaction of potassium with water. [2]

2.3

- $2\text{K} + 2\text{H}_2\text{O} \rightarrow 2\text{KOH} + \text{H}_2$

Exercises 2.4·2.5

2.4 Explain, in terms of electrons, why reactivity increases down Group I. [3]

2.5 State two observations when sodium is added to water. [2]

Exercises 2.4·2.5

2.4 Explain, in terms of electrons, why reactivity increases down Group I. [3]

2.4

- one more shell, so the outer electron is **further from the nucleus**
 - more inner shells **shield** it
 - it is held less strongly and **lost more easily**, so the metal is more reactive
-

2.5 State two observations when sodium is added to water. [2]

2.5

- any **two** of: melts into a ball / moves quickly / fizzes rapidly / disappears / solution becomes alkaline

Exercise 3.1

3.1 Going down Group I, the melting point:

[1]

☐

A increases

B decreases

C stays the same

D increases then decreases

Exercise 3.1

3.1 Going down Group I, the melting point:

[1]

☐

A increases

B decreases

C stays the same

D increases then decreases

3.1 B

- melting point **decreases** down Group I
- A is the opposite; C and D are wrong

Exercise 3.2 (a)

3.2 Rubidium is below potassium in Group I.

(a) Predict how its reactivity compares with potassium.

[1]

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3.2 Rubidium is below potassium in Group I.

(a) Predict how its reactivity compares with potassium.

[1]

(a)

- rubidium is below potassium, so it is **more reactive**

Exercise 3.2 (b)

3.2 Rubidium is below potassium in Group I.

(b) Predict how its melting point compares with potassium.

[1]

Exercise 3.2 (b)

3.2 Rubidium is below potassium in Group I.

(b) Predict how its melting point compares with potassium.

[1]

(b)

- it has a **lower melting point** than potassium

Exercise 3.3 (a)

3.3 Sodium reacts with water.

(a) Name the two products.

[2]

Exercise 3.3 (a)

3.3 Sodium reacts with water.

(a) Name the two products.

[2]

(a)

- sodium hydroxide and hydrogen

Exercise 3.3 (b)

3.3 Sodium reacts with water.

(b) Explain why potassium reacts more violently than sodium.

[1]

Exercise 3.3 (b)

3.3 Sodium reacts with water.

(b) Explain why potassium reacts more violently than sodium.

[1]

(b)

- reactivity increases down the group, so potassium is **more reactive** than sodium

Exercise 3.4 (a)

3.4 A student compares lithium, sodium and potassium by adding a small piece of each to water containing universal indicator.

(a) Complete the table by giving one observation for each metal.

[3]

Metal	Observation
lithium	
sodium	
potassium	

Exercise 3.4 (a)

3.4 A student compares lithium, sodium and potassium by adding a small piece of each to water containing universal indicator.

(a) Complete the table by giving one observation for each metal.

[3]

Metal	Observation
lithium	
sodium	
potassium	

(a)

- lithium: fizzes steadily and moves slowly
- sodium: melts into a ball and fizzes rapidly
- potassium: melts, moves very fast, hydrogen ignites with a **lilac flame**

Exercise 3.4 (b)

3.4 A student compares lithium, sodium and potassium by adding a small piece of each to water containing universal indicator.

(b) State the colour of the universal indicator after each reaction, and name the type of compound that causes it. [2]

Exercise 3.4 (b)

3.4 A student compares lithium, sodium and potassium by adding a small piece of each to water containing universal indicator.

(b) State the colour of the universal indicator after each reaction, and name the type of compound that causes it. [2]

(b)

- indicator goes **purple** (or blue)
- a metal **hydroxide** (an alkali)

Exercise 3.4 (c)

3.4 A student compares lithium, sodium and potassium by adding a small piece of each to water containing universal indicator.

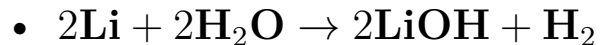
(c) Write the balanced equation for the reaction of lithium with water. [2]

Exercise 3.4 (c)

3.4 A student compares lithium, sodium and potassium by adding a small piece of each to water containing universal indicator.

(c) Write the balanced equation for the reaction of lithium with water. [2]

(c)



Exercise 3.4 (d)

3.4 A student compares lithium, sodium and potassium by adding a small piece of each to water containing universal indicator.

(d) Explain, in terms of the outer electron, why potassium is more reactive than lithium.[3]

Exercise 3.4 (d)

3.4 A student compares lithium, sodium and potassium by adding a small piece of each to water containing universal indicator.

(d) Explain, in terms of the outer electron, why potassium is more reactive than lithium.[3]

(d)

- potassium's outer electron is in a shell **further from the nucleus**
- it is **shielded** by more inner shells
- it is attracted less strongly and **lost more easily**

Exercise 3.4 (e)

3.4 A student compares lithium, sodium and potassium by adding a small piece of each to water containing universal indicator.

(e) Predict two observations when caesium, which is below potassium, is added to water, and justify your prediction. [3]

Exercise 3.4 (e)

3.4 A student compares lithium, sodium and potassium by adding a small piece of each to water containing universal indicator.

(e) Predict two observations when caesium, which is below potassium, is added to water, and justify your prediction. [3]

(e)

- any **two** of: reacts violently / melts / moves extremely fast / hydrogen ignites
- caesium is further down, so its outer electron is even more shielded and **lost most easily**