IGCSE CHEMISTRY • EXERCISE SHEET

8.2 Group I properties

Name: _____ Class: _____ Date: _____ **Total: 28 marks**

KEY WORDS sodium 钠 • potassium 钾 • melting point 熔点 • lithium 锂 • density 密度

Objective

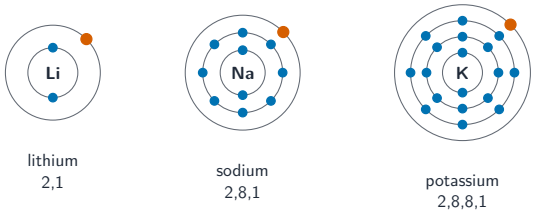
Build the skills to answer exam questions on **Group I** — **the alkali metals** 碱金属 — their properties, **trends** 趋势 down the group, and reaction with water.

You must be able to:

- describe the alkali metals (soft, one outer electron)
- state the trends in melting point, density and reactivity down the group
- predict the properties of an unfamiliar Group I element

1 Worked examples

■ Trends down Group I



Every Group I atom has one outer electron — why they react similarly

Down Group I: melting point decreases, density increases, reactivity increases

- react with water → metal hydroxide + hydrogen (more violent down the group).

■ Group I: the trend, and the reason behind it

The **alkali metals** 碱金属 all have **one electron in the outer shell**, which is why they behave alike: each loses that one electron to form a 1+ ion.

Going DOWN Group I	Trend	Reason
reactivity	**increases**	the outer electron is in a shell further from the nucleus and is shielded by more inner shells, so it is held less strongly and is lost more easily
melting point and density	melting point **decreases**	the metallic bonding weakens as the atoms get larger
atomic radius	increases	one more occupied electron shell each period

Reaction with water, the one the exam asks for. Each metal fizzes, floats and produces hydrogen, and the metal hydroxide formed makes the solution alkaline:

$$2\text{Na} + 2\text{H}_2\text{O} \rightarrow 2\text{NaOH} + \text{H}_2$$

The **observations** are the marks. Lithium: fizzes steadily and moves slowly. Sodium: melts into a ball, moves quickly across the surface, fizzes rapidly. Potassium: melts, moves very fast, and the hydrogen **ignites with a lilac flame**. Adding universal indicator turns the solution purple, showing an alkali.

Worked example. Predict what rubidium would do with water, and explain. Rubidium is below potassium, so it is more reactive: it would react violently, melt, move very rapidly, and the hydrogen would ignite, possibly explosively. The reason is that its outer electron is in an even more distant, more shielded shell, so it is lost still more easily. The equation is $2\text{Rb} + 2\text{H}_2\text{O} \rightarrow 2\text{RbOH} + \text{H}_2$.

2 Practice

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]

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]

3 Exam-style questions

3.1 Going down Group I, the melting point: [1]

A B
C D

A increases
B decreases
C stays the same
D increases then decreases

3.2 Rubidium is below potassium in Group I.

(a) Predict how its reactivity compares with potassium. [1]

(b) Predict how its melting point compares with potassium. [1]

3.3 Sodium reacts with water.

(a) Name the two products. [2]

(b) Explain why potassium reacts more violently than sodium. [1]

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	

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

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

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

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