# 6.1 Group 1

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## 6.1.1 GROUP 1 (ALKALI METALS)

### Group Classification

- Elements are arranged on the Periodic table in order of **increasing atomic number** where each element has one proton **more** than the element preceding it
- The table is arranged in vertical columns called **groups** numbered I – VIII and in rows called **periods**
- The **period number** tells you the number of **electron shells** an atom has:
  - E.g. elements in period 3 have 3 electron shells
- The **group number** tells you how many **outer electrons** each atom has:
  E.g. group 6 elements have atoms with 6 electrons in the outermost shell
- The periodic table positions elements based on their properties which are linked to their **electronic configurations**
- Elements with the **same** number of electrons in the **outer shell** and hence **similar** chemical properties are placed in the same group
  This allows us to use the table to predict the properties of elements based on their position
- Groups 1, 7 and 0 are elements which have been classified into their respective groups using the periodic table

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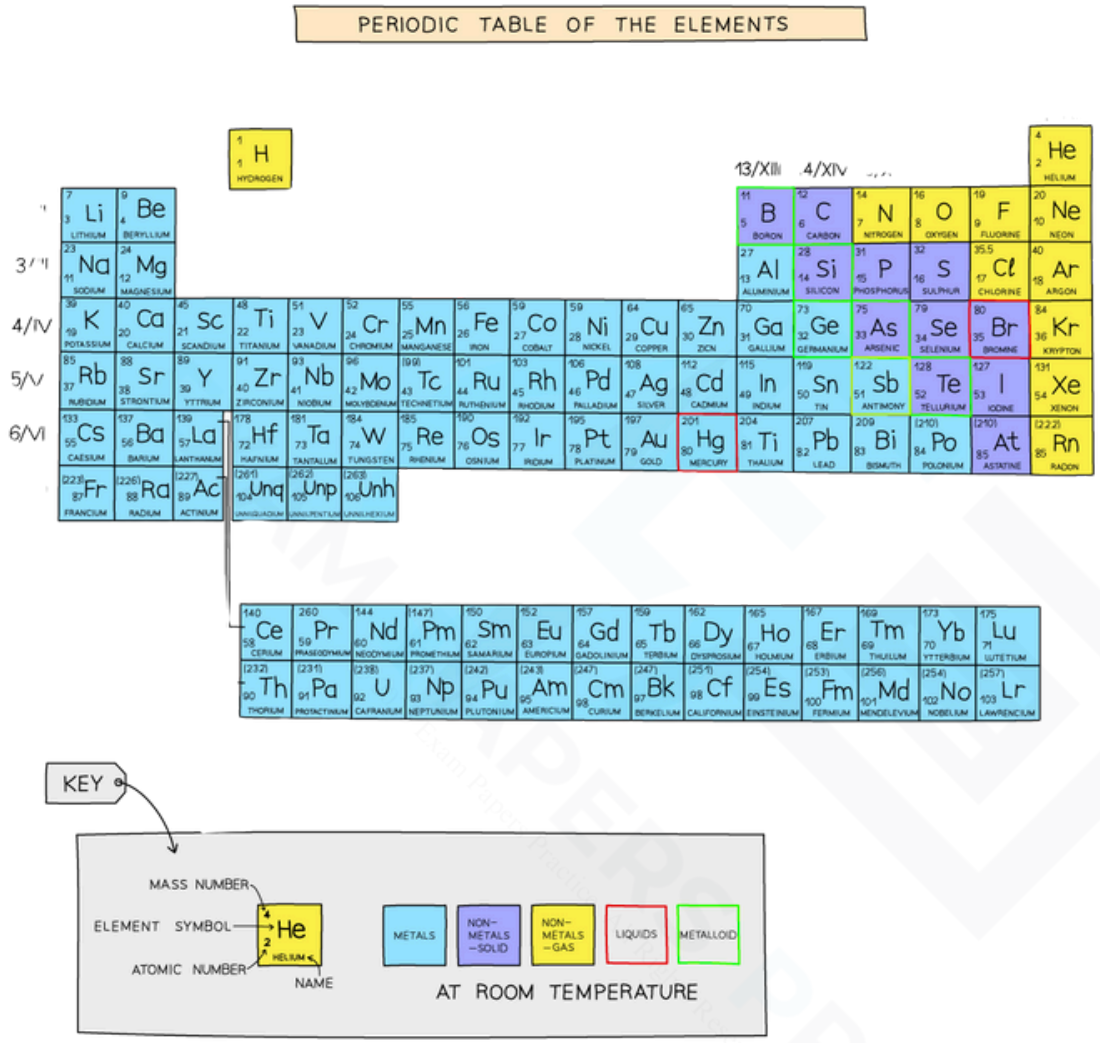


***The periodic table is a road map of all the elements***

## Physical Properties in Group 1

- The group 1 metals are known as the alkali metals
  - They form **alkaline solutions** when they react with water
- The group 1 metals are lithium, sodium, potassium, rubidium, caesium and francium and they are found in the first column of the periodic table

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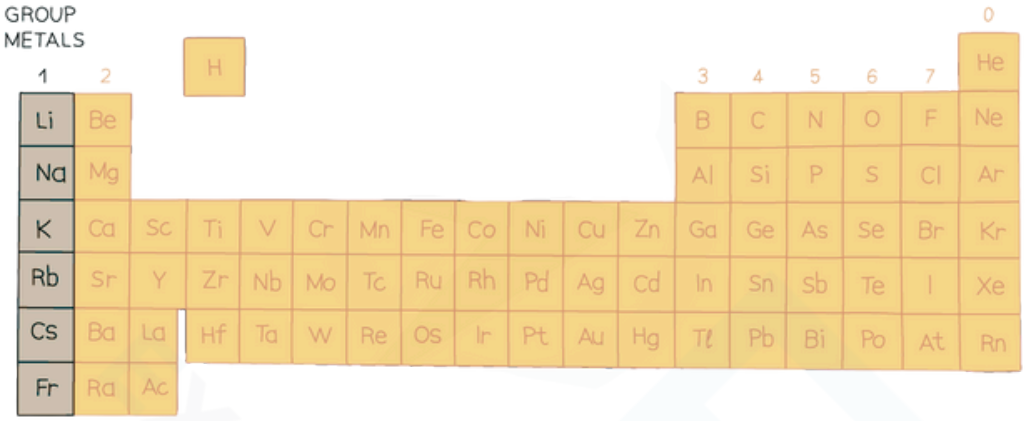


***The alkali metals lie on the far left of the periodic table, in the very first group***

- The alkali metals share similar characteristic physical properties
- Some of these properties are:
  - They are all **soft** metals which can easily be cut with a knife
  - They have relatively **low** densities and **low** melting points
  - They are **very reactive** (they only need to lose one electron to become highly stable)

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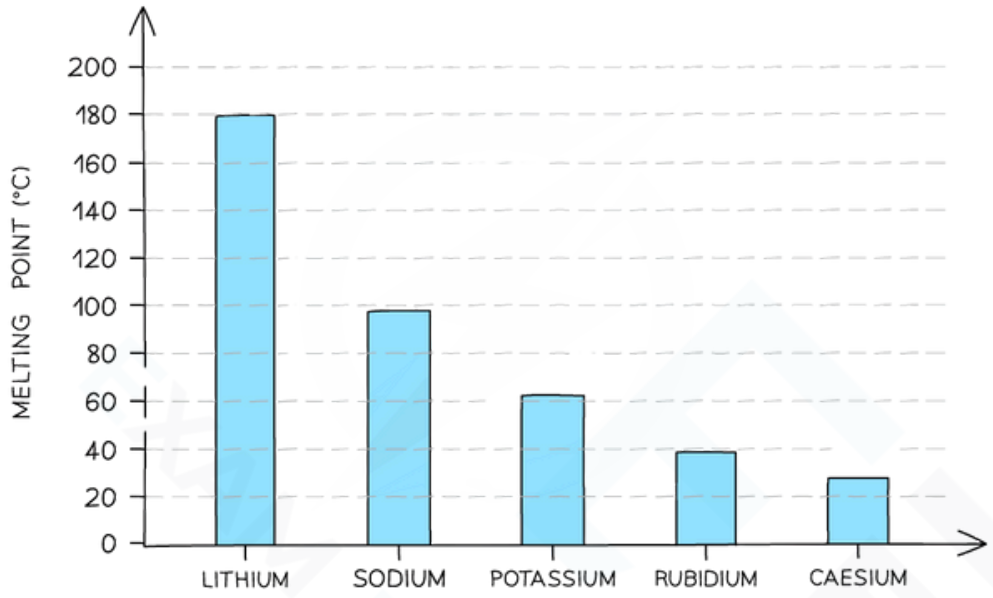


***The melting points of the alkali metals***

## How Alkali Metals React with Water

### Reaction with water

- The reaction of the group 1 metals with water provides evidence for categorising these elements into the same chemical family
- The general pattern shown is:

**group 1 metal + water → metal hydroxide + hydrogen**

**2M (s) + 2H2O (l) → 2MOH (aq) + H2 (g)**

where **M** is Li, Na, K, Rb or Cs

- The hydroxides formed all have the same general formula and are colourless, aqueous solutions
- The metals are so named because they form alkalis in water

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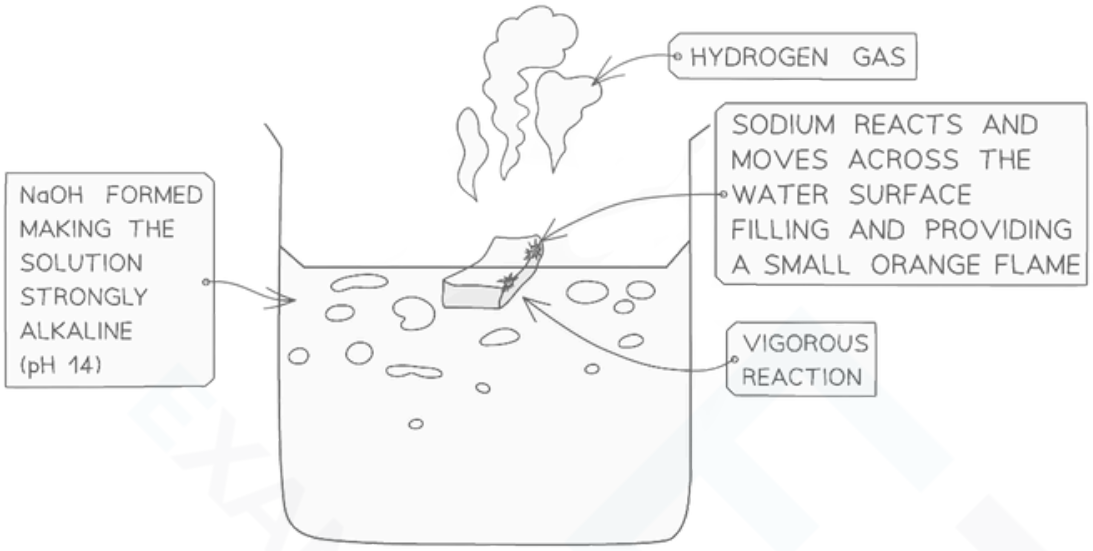


$$2Na\,(s) + 2H_2O\,(l) \longrightarrow 2NaOH\,(aq) + H_2\,(g)$$

***Sodium reacts vigorously with cold water***

Exam Tip

Remember the group 1 metals all produce alkaline solutions (>pH 7) when they react with water.

Lithium will produce a solution of lithium hydroxide; sodium will produce a solution of sodium hydroxide and so on.

Make sure you can give the reaction equations with the correct state symbols to show what is happening during the reactions!

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## Trends in Group 1

- Trends are patterns of behaviour in **physical** or **chemical** properties
- Following these trends seen in lithium, sodium and potassium, we can say that:
  - Rubidium, caesium and francium will react even more vigorously with air and water than the first three alkali metals
- Of the alkali metals, lithium is the **least** reactive (as it is at the top of group 1) and francium would be the **most** reactive (as it's at the bottom of group 1)
- Using the information given in the trends we would predict that **rubidium**:
  - would be a **soft grey solid**
  - would appear **shiny when freshly cut**
  - would be **more dense** than potassium (> 0.86 g cm-3)
  - would have a **lower melting point** than potassium (< 63.5 oC)

### Exam Tip

You could be asked to make predictions about how rubidium would be expected to react with water, knowing that it lies below potassium in group 1. Words like 'explosively' and 'violently' would be good ones to choose when describing the reaction.

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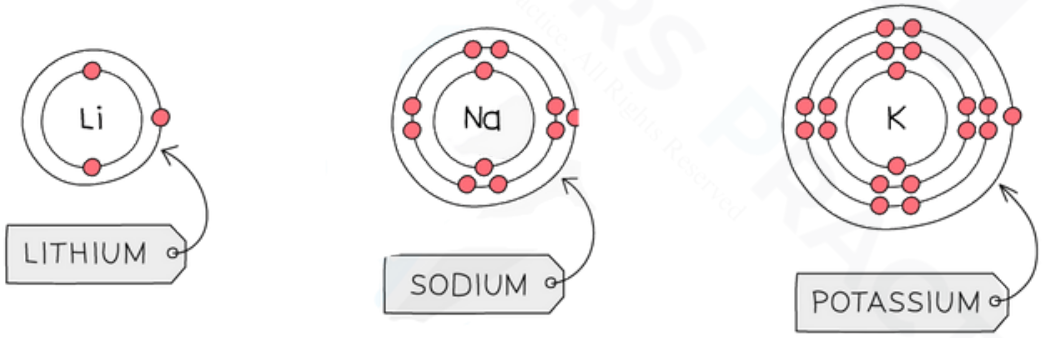
## 6.1.2 GROUP 1: REACTIVITY & ELECTRONIC CONFIGURATIONS

### Group 1: Reactivity & Electronic Configurations

- The reactivity of the group 1 metals **increases** as you go down the group
- When a group 1 element reacts its atoms only need to lose electron, as there is only 1 electron in the outer shell
    - When this happens, 1+ ions are formed
- The next shell down automatically becomes the outermost shell and since it is **already full,** a group 1 ion obtains **noble gas configuration**
- As you go down group 1, the number of shells of electrons increases by 1
    - This means that the outermost electron gets **further** away from the nucleus, so there are **weaker forces of attraction** between the outermost electron and the nucleus
    - **Less energy** is required to overcome the force of attraction as it gets weaker, so the outer electron is lost **more easily**
    - So, the alkali metals get more reactive as you descend the group




***These electron shell diagrams of the first 3 alkali metals show that the group 1 metals have 1 electron in their outer shell***

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Exam Tip

In your exams, you could be asked to explain the trend in reactivity of the alkali metals – make sure you answer this question using their electronic configuration to support your answer.