

# EB Education Revision Guide



How to work with Alkali Metals

# Group 1: The Alkali Metals

## The facts

Group 1 metals are known as the Alkali Metals.

All the alkali metals have one electron in their outer shell. This means their **chemical properties** are similar.

They form ionic compounds with non-metals when they lose their outer electron.

## Physical properties:

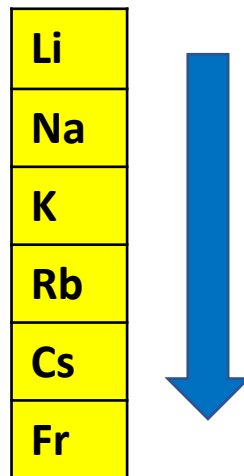
(in comparison to other metals)

- Low melting and boiling points
- Soft - they can be easily cut with a knife
- Shiny when freshly cut but oxidise fast

## Where to find Alkali metals in the Periodic Table

Group →	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18							
↓ Period																									
1	1 H																	2 He							
2	3 Li	4 Be											5 B	6 C	7 N	8 O	9 F	10 Ne							
3	11 Na	12 Mg											13 Al	14 Si	15 P	16 S	17 Cl	18 Ar							
4	19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr							
5	37 Rb	38 Sr	39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe							
6	55 Cs	56 Ba		72 Hf	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg	81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn							
7	87 Fr	88 Ra		104 Rf	105 Db	106 Sg	107 Bh	108 Hs	109 Mt	110 Ds	111 Rg	112 Cn	113 Uut	114 Fl	115 Uup	116 Lv	117 Uus	118 Uuo							
				Lanthanides							57 La	58 Ce	59 Pr	60 Nd	61 Pm	62 Sm	63 Eu	64 Gd	65 Tb	66 Dy	67 Ho	68 Er	69 Tm	70 Yb	71 Lu
				Actinides							89 Ac	90 Th	91 Pa	92 U	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr

GROUP 1



Reactivity  
Increases

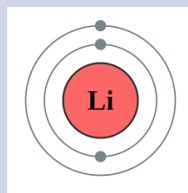
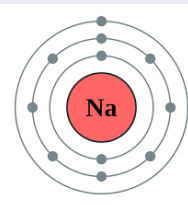
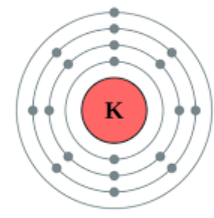
# Reactivity

## Why are they reactive?

Alkali metals are very reactive. This is because they easily lose their one outer electron to form a 1+ ion.

As you go down the group, the metals become more reactive. This is because as the atom gets larger it is easier to lose the outer electron, as it is further away from the nucleus. This happens due to the fact that the electron is not as strongly attracted to the nucleus by electrostatic forces, and so less energy is needed to remove it.

Alkali metals are so reactive they are stored in oil, to stop them reacting with the oxygen in the air and water.

Atomic number	Name	Electronic configuration	Diagram of atom
3	Lithium	2, 1	
11	Sodium	2, 8, 1	
19	Potassium	2, 8, 8, 1	

# Reacting with water

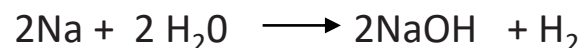
## How do they react?

Alkali metals react vigorously when they are placed in water.

They react to produce a metal hydroxide and hydrogen gas.

metal + water  $\longrightarrow$  metal hydroxide + hydrogen

sodium + water  $\longrightarrow$  sodium hydroxide + hydrogen



You can test for hydrogen by using a lit splint – you will hear a squeaky pop.

If you place Universal Indicator into the water after it has reacted with the alkali metal - it will turn blue or purple. This is because metal hydroxides are alkaline.

**Lithium:** Fizzes around the surface of the water.

**Sodium:** Melts to form a small ball, and then fizzes rapidly.

**Potassium:** Quickly melts to form a ball, burns violently with sparks and a lilac flame, disappearing rapidly, often with a small explosion.

All the alkali metals will float on water, as they are less dense than water.

# Your turn:

1. Lithium, sodium and potassium all react with cold water

a) They are all in group 1 of the periodic table...

Complete the sentence putting a cross next to the correct answer.

...these elements are...

- A halogens
- B noble gases
- C transition metals
- D alkali metals

b) When sodium is added to cold water, it forms a molten ball which floats on the surface of the water.

Why does this happen?

.....  
.....  
.....

c) Write the balanced equation for the reaction of sodium with water.

d) Sodium and potassium react with cold water to give similar products.

The electronic configuration of sodium is 2.8.1

The electronic configuration of potassium is 2.8.8.1

Explain, considering their electronic configurations and reactions, the similarities and differences in the way sodium and potassium react with cold water. (6)

2. Lithium, sodium and potassium are metals in Group 1 of the periodic table. They are all good conductors of heat and electricity. When they are freshly cut the metals are all shiny.

- Write another physical property of all these metals.
- Explain, in terms of their electronic structure why they are all in group 1 of the periodic table.
- Some potassium is added to water. Describe what you would see in this reaction.

## Your turn:

d) Which of these is a balanced equation for the reaction?

- $2\text{K} + 2\text{H}_2\text{O} \longrightarrow \text{K}_2\text{O} + 2\text{H}_2$
- $2\text{K} + \text{H}_2\text{O} \longrightarrow \text{K}_2\text{O} + \text{H}_2$
- $4\text{K} + 3\text{H}_2\text{O} \longrightarrow 4\text{KOH} + \text{H}_2$
- $2\text{K} + 2\text{H}_2\text{O} \longrightarrow 2\text{KOH} + \text{H}_2$

e) Explain the increase in reactivity of the group 1 metals from lithium to potassium.

# Your turn:

3. Group 1 of the periodic table contains the alkali metals lithium, sodium and potassium. They show a pattern in their reactivity with water.

The pattern can be seen when small pieces of lithium, sodium and potassium are added separately to water.

Describe the reactions, what would be seen and explain the pattern in reactivity.

You may include equations as part of your answer. (6)

# Answers:

1. Lithium, sodium and potassium all react with cold water

a) They are all in group 1 of the periodic table.

Complete the sentence putting a cross next to the correct answer.

These elements are

- A halogens
- B noble gases
- C transition metals
- D alkali metals

b) When sodium is added to cold water, it forms a molten ball which floats on the surface of the water.

Why does this happen?

Sodium reacting with water is an exothermic reaction (releases heat). Sodium has a low melting point, so melts and forms a ball. Sodium is less dense than water so it floats.

c) Write the balanced equation for the reaction of sodium with water.



d) Sodium and potassium react with cold water to give similar products.

The electronic configuration of sodium is 2.8.1

The electronic configuration of potassium is 2.8.8.1

Explain, considering their electronic configurations and reactions, the similarities and differences in the way sodium and potassium react with cold water. (6)

**Similarities:**

Both metals are in group 1, so they both have 1 electron in the outer shell. This means they both react in a similar way.

Both fizz and produce hydrogen.

Both produce metal hydroxides (alkaline solution)

**Differences:**

Potassium is more reactive – it will catch fire with a lilac flame.

Sodium is less reactive – it burns with an orange flame.

The outer electron of potassium is further away from the nucleus (there are more shells) - so there is less attraction from the nucleus.

This means it is easier for the outer electron of potassium to be lost.

Remember to write your answer in good English using these points.



# Answers:

2. Lithium, sodium and potassium are metals in Group 1 of the periodic table. They are all good conductors of heat and electricity. When they are freshly cut the metals are all shiny.

a) Write another physical property of all these metals.

Low melting point/low boiling point/soft

b) Explain, in terms of their electronic structure why they are all in group 1 of the periodic table.

They all have 1 electron in the outer shell

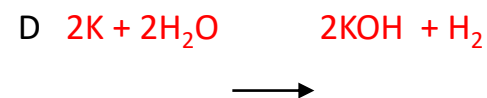
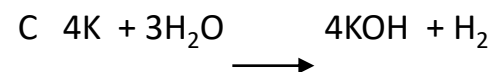
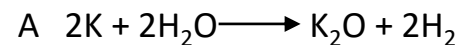
c) Some potassium is added to water. Describe what you would see in this reaction.

Fizzing/bubbles

Potassium floating/moving across the surface of the water

Melts/forms ball/lilac flame

d) Which of these is a balanced equation for the reaction?



e) Explain the increase in reactivity of the group 1 metals from lithium to potassium.

Increase in the number of shells, as the atom gets larger, therefore the outer electron is further away from the nucleus.

So there will be less attraction from the nucleus for the outer electron, so it is easier to lose.

# Answers:

3. Group 1 of the periodic table contains the alkali metals lithium, sodium and potassium. They show a pattern in their reactivity with water. The pattern can be seen when small pieces of lithium, sodium and potassium are added separately to water.

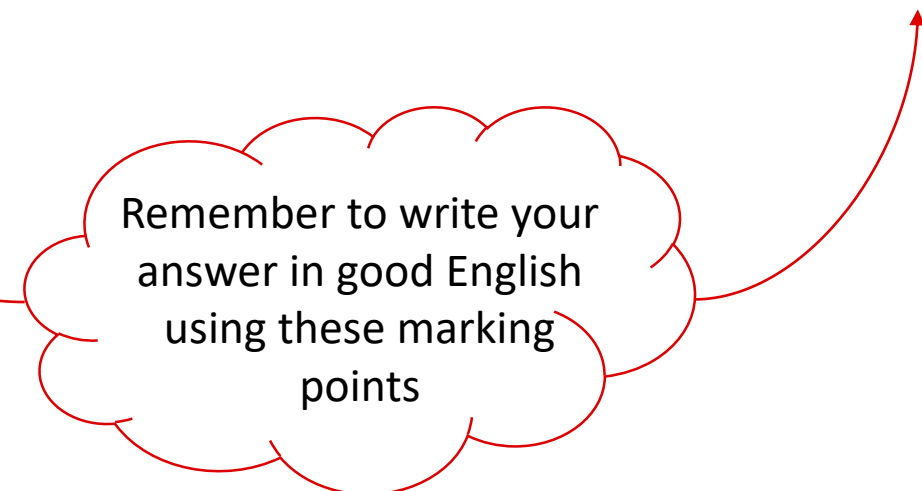
Describe the reactions, what would be seen and explain the pattern in reactivity. You may include equations as part of your answer. (6)

#### Description:

- Fizzing/bubbles
- Float/move on the surface
- Produce hydrogen and a metal hydroxide solution
- Metal gets smaller/disappears
- Reactivity increases as move down the group – potassium reacts more than sodium and lithium
- Sodium and potassium melt, potassium gives a lilac flame
- Universal Indicator turns the water blue/purple

#### Explanation:

- Group 1 metals react by losing one electron
- Electron is more easily lost as you go down the group as the outer electron is further away from the nucleus
- There is less attraction between the nucleus and the outer electron



Remember to write your answer in good English using these marking points

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