


THE ALKALI METALS

The **periodic table** contains all the known elements.

The **alkali metals** are in the first column, **group 1**, of the periodic table.



hydrogen 1 H 1.0079																			helium 2 He 4.0026
lithium 3 Li 6.941	beryllium 4 Be 9.0122											boron 5 B 10.811	carbon 6 C 12.011	nitrogen 7 N 14.007	oxygen 8 O 15.999	fluorine 9 F 18.998	neon 10 Ne 20.180		
sodium 11 Na 22.990	magnesium 12 Mg 24.305											aluminium 13 Al 26.982	silicon 14 Si 28.086	phosphorus 15 P 30.974	sulfur 16 S 32.065	chlorine 17 Cl 35.453	argon 18 Ar 39.948		
potassium 19 K 39.098	calcium 20 Ca 40.078	scandium 21 Sc 44.956	titanium 22 Ti 47.867	vanadium 23 V 50.942	chromium 24 Cr 51.996	manganese 25 Mn 54.938	iron 26 Fe 55.845	cobalt 27 Co 58.933	nickel 28 Ni 58.693	copper 29 Cu 63.546	zinc 30 Zn 65.39	gallium 31 Ga 69.723	germanium 32 Ge 72.61	arsenic 33 As 74.922	selenium 34 Se 78.96	bromine 35 Br 79.904	krypton 36 Kr 83.80		
rubidium 37 Rb 85.468	strontium 38 Sr 87.62	yttrium 39 Y 88.906	zirconium 40 Zr 91.224	niobium 41 Nb 92.906	molybdenum 42 Mo 95.94	technetium 43 Tc [98]	ruthenium 44 Ru 101.07	rhodium 45 Rh 102.91	palladium 46 Pd 106.42	silver 47 Ag 107.87	cadmium 48 Cd 112.41	indium 49 In 114.82	tin 50 Sn 118.71	antimony 51 Sb 121.76	tellurium 52 Te 127.60	iodine 53 I 126.90	xenon 54 Xe 131.29		
caesium 55 Cs 132.91	barium 56 Ba 137.33	57-70 * lanthanum 57 La 138.905	lutetium 71 Lu 174.97	hafnium 72 Hf 178.49	tantalum 73 Ta 180.95	tungsten 74 W 183.84	rhenium 75 Re 186.21	osmium 76 Os 190.23	iridium 77 Ir 192.22	platinum 78 Pt 195.08	gold 79 Au 196.97	mercury 80 Hg 200.59	thallium 81 Tl 204.38	lead 82 Pb 207.2	bismuth 83 Bi 208.98	polonium 84 Po [209]	astatine 85 At [210]	radon 86 Rn [222]	
francium 87 Fr [223]	radium 88 Ra [226]	89-102 * * actinium 89 Ac [227]	lawrencium 103 Lr [262]	rutherfordium 104 Rf [261]	dubnium 105 Db [262]	seaborgium 106 Sg [266]	bohrium 107 Bh [264]	hassium 108 Hs [269]	meitnerium 109 Mt [268]	ununnium 110 Uun [271]	ununium 111 Uuu [272]	ununbium 112 Uub [277]	ununquadium 114 Uuq [289]						



Cutting into sodium

Potassium reacting with water



DEMO: REACTION OF THE ALKALI METALS WITH WATER

Name of alkali metal	Appearance before reaction	Observations for reaction with water
Lithium	<i>Dull dark grey on outside, but shiny and silver when cut.</i>	<i>Floats and moves around, fizzing. The solution turns blue when universal indicator is added.</i>
Sodium	<i>Dull light grey, but shiny silver when cut.</i>	<i>Floats and moves around. Fizzes and melts into a sphere. Solution turns blue when UI solution is added.</i>
Potassium	<i>Dull dark grey, but shiny inside. Tarnishes very quickly.</i>	<i>Floats and moves around quickly, fizzing and crackling. Gives off a lilac flame as it reacts. Solution turns blue when UI solution is added.</i>

1 Can you spot a pattern in the reactions? *The reaction is more vigorous going down the column/group, but they all react in a similar way and react quite violently with water.*

2 Why are they called the “alkali metals”? *They produce an alkali when they react with water, shown by the blue colour when universal indicator solution is added.*

Conclusion

Elements in the same group of the periodic table react in a similar way.

The alkali metals are **all very reactive**, and react quickly with oxygen in the air and with water.

REACTION WITH OXYGEN IN THE AIR:

The shiny metal quickly **tarnishes** (goes dull) as it reacts with **oxygen in the air** when it is cut. The dull layer is the **metal oxide** formed. This is an **oxidation** reaction.

metal + oxygen → metal oxide

eg. lithium + oxygen → lithium oxide

sodium + oxygen → sodium oxide

REACTION WITH WATER:

The metal react quickly with water producing **hydrogen gas** and a **metal hydroxide** (an alkali).

metal + water → metal hydroxide + hydrogen

eg. *lithium + water → lithium hydroxide + hydrogen*
sodium + water → sodium hydroxide + hydrogen
potassium + water → potassium hydroxide + hydrogen

THE ALKALINE EARTH METALS

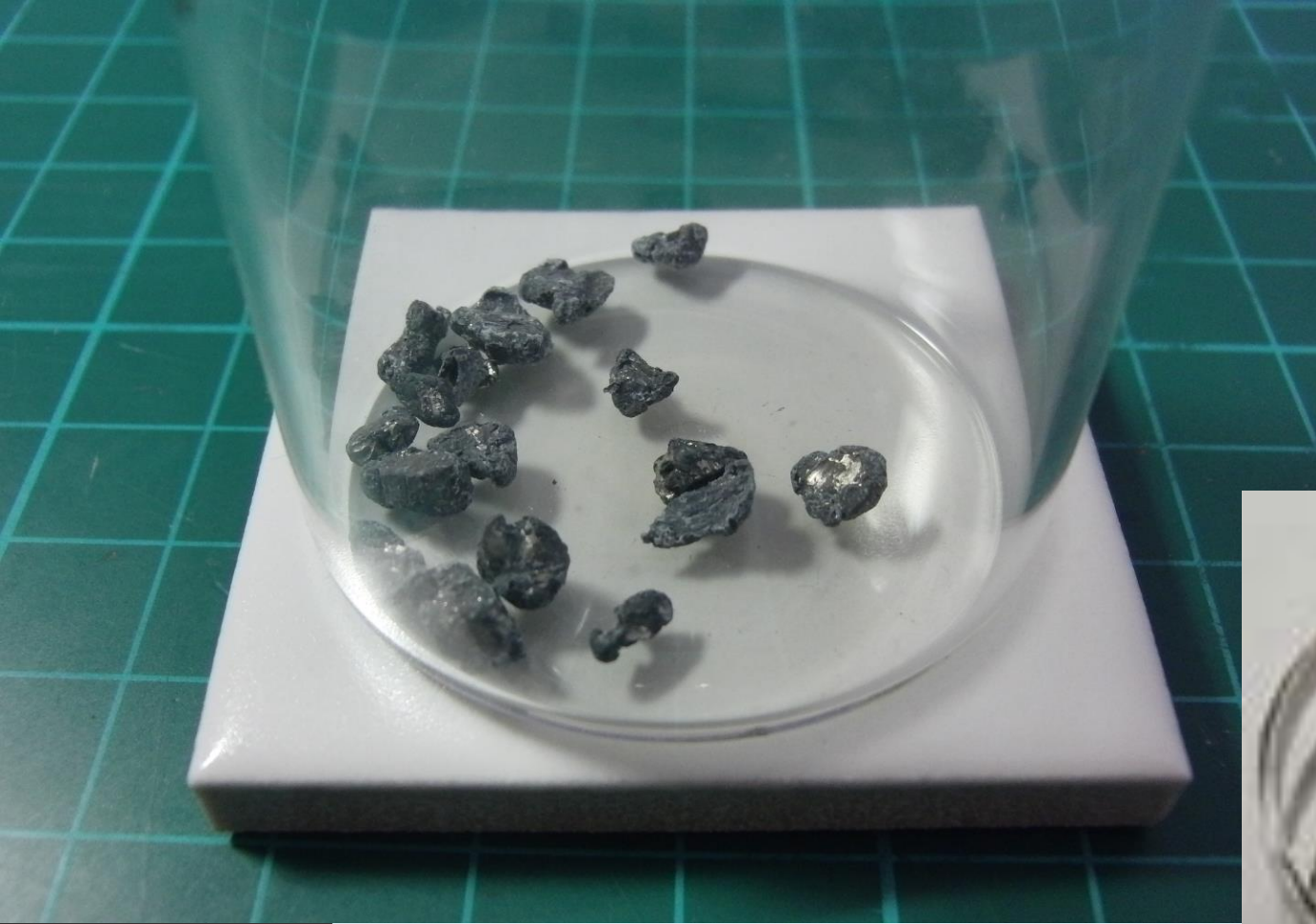
Group 2 (column 2) of the periodic table contains the **alkaline earth metals**.



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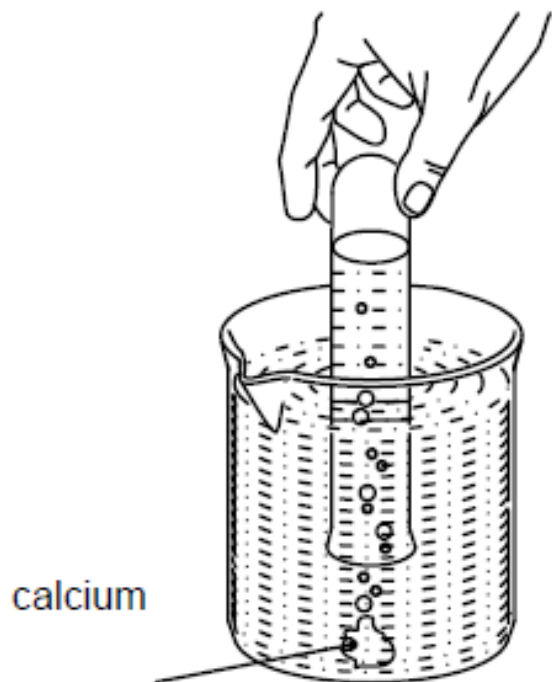
We only need to know about calcium and magnesium at this stage.

magnesium ribbon



PRACTICAL: REACTING CALCIUM WITH WATER

A lump of calcium is added to water and a test tube full of water is held above the reaction.



Observations

The calcium sinks to the bottom and bubbles of gas are produced and fill the test tube. The solution gradually turns white and cloudy.

When a lit splint is held above the mouth of the test tube, a squeaky pop is heard.

When the solution is tested with universal indicator solution, it turns blue.

Conclusion

Calcium reacts with water in a similar way to the alkali metals, but more gently. **Hydrogen** gas and an **alkali** is produced.

calcium + water → calcium hydroxide + hydrogen

The calcium hydroxide produced is not very soluble and causes the solution to turn white and cloudy.

OTHER METALS:

Some other metals react with water too, but much more slowly than the alkali metals or calcium. Some only react when the water is heated or even turned to steam. Magnesium is an example of a metal that only reacts with steam and not cold water.

Metals only react with water if they are more **reactive than hydrogen**.



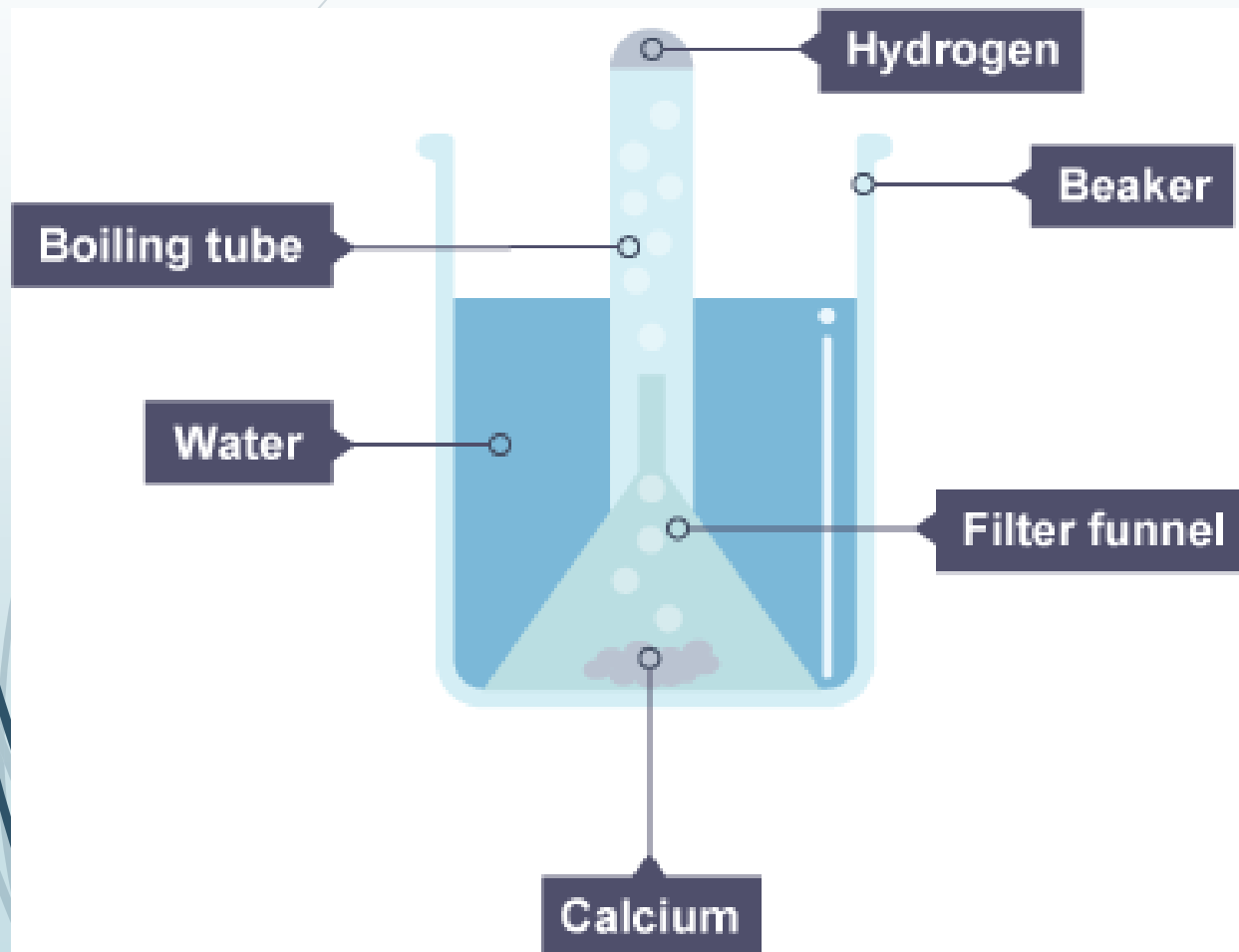
Task: write a word equation for the following reaction

When reacting calcium with water, it will form a hydroxide group and hydrogen gas.

Practical aims:

- ▶ Safely react calcium with water
- ▶ Collect and test for the presence of hydrogen gas

Reacting calcium with water



1. Fill your beaker half-way with water,
2. Place several granules of calcium to the beaker.
3. Place a funnel upside down over the calcium.
4. Lift the funnel up slightly to suction to the bottom of the beaker.
5. Fill two test tubes with water. Invert one and place over the top of the funnel.
6. When all of the water has left the test tube, remove the tube and secure the gas with a bung.

A dark grey arrow points to the right from the top left corner. Below it, several thin, curved lines in shades of blue and grey sweep across the left side of the slide.

PRACTICE TIME –ASSESS YOURSELF
.....WHAT DO U KNOW?

1. Sodium is:

- A compound
- An element
- A gas

2. The formula for sodium hydroxide is:

- NaOH
- NaO
- SOH

3. The chemical symbol for potassium is:

- P
- Pt
- K

4. Which of the following is not a hydroxide?

- LiOH
- NaOH
- Ca(OH)₂
- Na₂CO₃

5. Fill in the blanks using the words provided:

hydroxide purple hydrogen alkaline squeaky-pop splint

When group 1 metals react with water they produce _____ gas and a metal _____. We can test for the gas by holding a lit _____ to it. If the gas is hydrogen it will make a _____ - _____ sound. The metal hydroxide dissolves in the water to make the solution _____. Alkaline solutions turn blue or _____ when Universal Indicator is added.

6. All group 1 metals react with water to produce a metal hydroxide and hydrogen. Complete the following word equations for metal hydroxides reacting with water.

Example: lithium + water → lithium hydroxide + hydrogen

sodium + water → sodium hydroxide + _____

potassium + water → _____ hydroxide + _____

rubidium + _____ → _____ + _____

7. Potassium in the school science lab is handled by the teacher behind a safety screen. Suggest why Rubidium and Caesium are not used in school science lessons.

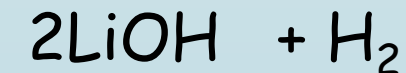
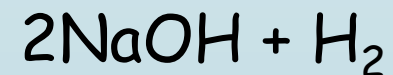
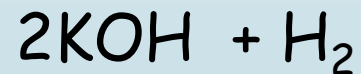
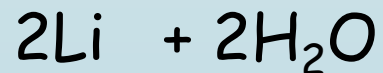
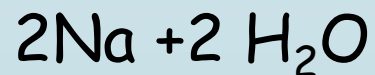
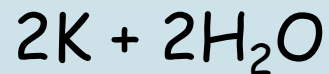
Write the word equations below:

Potassium + Water \rightarrow Potassium hydroxide + Hydrogen

Lithium + Water \rightarrow Lithium hydroxide + Hydrogen

Sodium + Water \rightarrow Sodium hydroxide + Hydrogen

EXT: Balance the following equations:



Word equations

When you react a metal with a non-metal in cold water it forms a hydroxide group (OH) and hydrogen gas

For example:

Lithium + water \rightarrow lithium hydroxide + hydrogen

Complete the word equations given below:

Potassium + ? → Potassium hydroxide + Hydrogen

Lithium + Water → ? + Hydrogen

? + Water → Sodium hydroxide + Hydrogen

EXT: Balance the following equations:

