

Reactivity trends

Name _____ Class _____ Mark _____ / 17

What you are practising

I can use electron arrangements to explain why reactivity increases down group 1.

Worked example: why does potassium react faster than lithium?

1 Arrangement. Lithium is 2, 1 and potassium is 2, 8, 8, 1. Both have one outer electron, but potassium has four occupied shells and lithium has two, so the potassium atom is bigger.

2 Distance. Potassium's outer electron is further from the nucleus.

3 Attraction. The nucleus is positive and the electron is negative, so they attract (electrostatic attraction). Further away, the attraction is weaker.

4 Result. Potassium loses its outer electron more easily, so its reaction with water is faster and more violent.

The rule

A group 1 atom loses its one outer electron when it reacts with water.
Down group 1: more occupied shells
→ bigger atom → outer electron further from the nucleus → weaker attraction → lost more easily → faster reaction.



Reactions and trends

1 Complete the word equations. Metal + water gives a metal hydroxide and a gas. [3]

a lithium(s) + water(l) → _____(aq) + _____(g)

b sodium(s) + water(l) → _____(aq) + _____(g)

c potassium(s) + water(l) → _____(aq) + _____(g)

2 Complete the table. Atomic numbers: Li 3, Na 11, K 19. Write arrangements like 2, 8, 1. [3]

	lithium, Li	sodium, Na	potassium, K
Electron arrangement			
Occupied shells			

Reactions and trends (continued)

3 Circle the correct word in each bracket.

[6]

Going down...	group 1	group 2	group 7 (group 17)
a Reactivity	(increases / decreases)	(increases / decreases)	(increases / decreases)
b Melting point	(increases / decreases)	—	—

c A group 1 atom has (one / two) electron(s) in its outer shell.

d Universal indicator in the solution left after an alkali metal reacts with water turns (purple / red).

Explain

4 Rubidium is below potassium in group 1. Explain why rubidium reacts more violently with water than sodium does.

[3]

Who is right?

5 Sodium fizzes in water, giving off a gas.

Maya: "It is oxygen, because water contains oxygen."

Sami: "It is hydrogen."

Who is right, and why?

[2]

Answers**Reactions and trends****[12]****1** One mark per equation, both products needed.**a** lithium(s) + water(l) → **lithium hydroxide(aq) + hydrogen(g)****b** sodium(s) + water(l) → **sodium hydroxide(aq) + hydrogen(g)****c** potassium(s) + water(l) → **potassium hydroxide(aq) + hydrogen(g)****2** One mark per element, both cells needed.

	lithium, Li	sodium, Na	potassium, K
Electron arrangement	2, 1	2, 8, 1	2, 8, 8, 1
Occupied shells	2	3	4

Each has one outer electron. One more occupied shell each step down, so the atoms get bigger.

3 One mark each.

Going down...	group 1	group 2	group 7 (group 17)
a Reactivity	increases	increases	decreases: fluorine is the most reactive
b Melting point	decreases: lithium 180 °C, caesium 28 °C	—	—

c one **d** purple: the metal hydroxide makes an alkaline solution.**Explain****[3]****4** Rubidium atoms are bigger, with more occupied shells, so the outer electron is further from the nucleus **(1)**. The electrostatic attraction between the positive nucleus and the negative outer electron is weaker **(1)**. So rubidium loses its outer electron more easily and reacts faster **(1)**.**Who is right?****[2]****5** Sami **(1)**. Sodium + water → sodium hydroxide + hydrogen. The oxygen from the water stays in the sodium hydroxide; the gas given off is hydrogen, which burns with a squeaky pop **(1)**.**How to revise this**

Look at the four steps in the worked example: arrangement, distance, attraction, result. Cover them. Write them out for sodium and potassium from memory. Check against page 1. Repeat only the steps you missed.