The content on this sheet is assessed on paper 2 only.

Topic 6—Groups in the periodic table

* Indicates that these are some examples only: you could be asked about any substance / reaction.

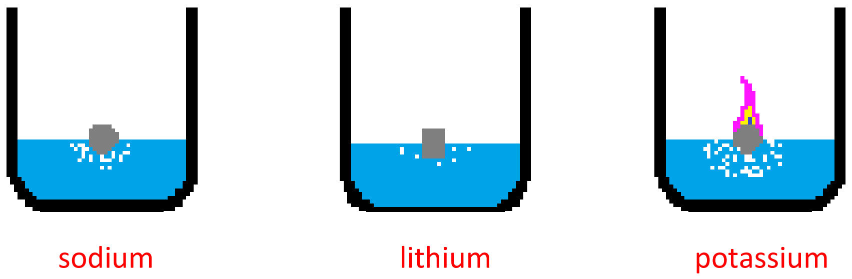
6.1—Elements in the periodic table

The elements in group 1 are known as the alkali metals.
The elements in group 7 are known as the halogens.
The elements in group 0 are known as the noble gases.

6.2—Properties of the alkali metals

The alkali metals are unusual, in that they are quite easy to cut with a knife, due to being quite soft. They also melt at relatively low temperatures.

6.3—Reactions of alkali metals in water

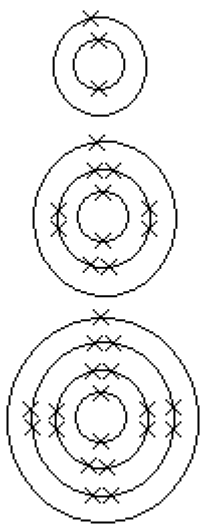


Sodium fizzes, melts to form a ball, and moves quickly on the surface of the water.
Lithium bubbles slowly, and moves slowly around the water.
Potassium melts, produces a lilac flames and then pops/explodes. It also fizzes and moves rapidly across the water.

6.4—Pattern of reactivity of the alkali metals

The order of reactivity of the first three alkali metals is, from least to most reactive, lithium, sodium and potassium. As you go down the group, the metals get more reactive.
Therefore, as you go further down the group, the reactivity increases. This would suggest that the order of reactivity of the alkali metals after potassium is rubidium, caesium and then francium.

6.5—Explaining the reactivity of the alkali metals



All of the alkali metals want to lose 1 electron, in order to get a full outer shell of electrons.
This electron has to get away from the positive charge of the nucleus of the atom.
The further away the electron is from the nucleus, the weaker the attraction between the electron and nucleus.
Therefore, the further down group 1 you go, the more easily the outer electron is lost and so the more reactive the element is.

6.6—Physical appearance of the halogens at room temperature

At room temperature:
Chlorine is a gas, and is pale green in colour.
Bromine is a liquid, and is brown in colour.
Iodine is a solid, and is purple-black in colour.

6.7—Predicting physical properties of the other halogens

As you go down group 7, the elements get darker in colour, and move from being gas to liquid to solid (melting points of the elements increase as you go down the group).
Therefore, it is likely that fluorine would be a pale yellow gas, whilst astatine would be a black solid.

6.8—Chemical test for chlorine

To test for chlorine, hold a piece of damp litmus paper over the gas. It will be bleached, indicating the presence of chlorine.

6.9—Reactions of halogens with metals

All of the halogens react with iron wool to form the iron (III) halide. When chlorine reacts, it reacts very quickly to form iron (III) chloride. Bromine reacts quite slowly with iron wool to form iron (III) bromide. Iodine reacts very slowly to form iron (III) iodide. This pattern suggests that fluorine would react extremely quickly and astatine extremely slowly.

6.10—Reactions of halogens with hydrogen

All of the halogens react with hydrogen gas to form the hydrogen halide. When these dissolve in water, they form acids. Hydrogen chloride dissolves in water to form hydrochloric acid. Hydrogen bromide dissolves in water to form hydrobromic acid. Hydrogen iodide dissolves in water to form hydroiodic acid.

6.11—Displacement reactions of the halogens

A tick in the boxes below indicates that a reaction would occur:

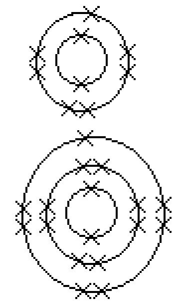
Solutions → Halogen ↓	Potassium bromide (aq)	Potassium chloride (aq)	Potassium iodide (aq)
Bromine	x	✗	✓
Chlorine	✓	x	✓
Iodine	✗	✗	x

The **halogen** that reacts the most times is chlorine, indicating that it is the most reactive.
As you go down the group, the halogens become more reactive. This would suggest that astatine would be less reactive than iodine.

6.12—Displacement reactions & redox (HT only)*

During all displacement reactions, one element is oxidised and the other is reduced.
The more reactive element displaces the less reactive element. In these reactions, the more reactive element is always reduced as it gains 1 electron to become an ion with a –1 charge.
The less reactive element, which starts in the solution, is oxidised as it loses an electron to become a neutrally charged molecule.
E.g. Cl_2 + 2 KBr → Br_2 + 2 KCl
In this example, the chlorine has been oxidised, and the bromine has been reduced (the potassium is unchanged).

6.13—Explaining the reactivity of the halogens



All of the halogens want to gain 1 electron, in order to get a full outer shell of electrons.
This electron has to be attracted to the positive charge in the nucleus of the atom.
The closer the electron can get to the nucleus, the stronger the attraction between the electron and nucleus. Therefore, the further up group 7 you go, the more easily the additional electron is gained and so the more reactive the element is.

6.14—The inertness of the noble gases

All group 0 elements are inert (chemically unreactive) due to the fact that they have a full outer shell of electrons.

6.15—Uses of the noble gases

Helium is used to fill balloons, due ot the fact that it has an extremely low density.
Argon and other noble gases are used to fill light bulbs, due to their property of being inert/unreactive. Argon is also used as a shielding gas in welding for the same reason.

6.16—Patterns in properties of the noble gases

As you go down group 0, although all the elements are gases at room temperature, their melting and boiling points go up.
For example, the boiling point of helium is –269 °C, and the boiling point of neon is –246 °C. The boiling point of krypton is –153 °C. This pattern would indicate that the approximate boiling point of argon, which is between neon & krypton, is –186 °C.