

GCSE Chemistry

Paper 1 | Topic 1

Atomic Structure and the Periodic Table

Extended Response Questions



KayScience



Topic 1: Atomic Structure and the Periodic Table



**Describe how pure, dry salt crystals
can be obtained from a filtrate (3)**



- heat the solution until salt crystals appear on edge/concentrated/saturated solution
- leave solution on window sill for a few days/in warm place/for salt to crystallise
- pat dry crystals using filter paper



Describe the process used to separate liquids with different boiling points (3)



- use the process (fractional) distillation
- heat/boil (the liquid)
- liquid with lowest boiling point boils/evaporates first



Describe how nitrogen gas and oxygen gas can be separated from air (3)



- cool/liquefy air until a liquid
- use fractional distillation
- heat the mixture of liquids
- liquid with lower boiling point evaporates/boils first



Explain how paper chromatography is able to separate mixtures (3)



- solvent/water/mobile phase moves through paper/stationary phase
- substances/dyes/spots travel different distances
- distances travelled are different due to attraction between paper and solvent/dyes / different solubilities OR different forces of attraction for stationary phase/paper and dyes/solvent



Explain why Mendeleev's periodic table was accepted by other scientists compared to previous versions of the periodic table (3)



- predicted properties of elements not yet discovered
- predicted elements were later discovered filling the gaps
- properties of predicted elements were the same as predictions / atomic weights of these predicted elements fitted in the spaces / gaps



Describe the structure of a nitrogen atom (6)

relative atomic mass = 14

atomic number = 7



- there are 7 protons (as atomic number 7)
- there are 7 electrons (as atomic number 7) / electron configuration is 2.5
- there are 7 neutrons (as mass number 14 and atomic number 7) / $14 - 7 = 7$
- the protons are located in the nucleus
- the electrons are located in the shells/energy levels
- the neutrons found in the nucleus
- 5 electrons in outer shell because in group 5
- 2 shells because in period 2



**Explain why carbon-14 and carbon-12
are isotopes (3)**



- same number of protons / both isotopes have 6 protons
- carbon-12 has 6 neutrons
- carbon-14 has 8 neutrons



**Chlorine gas is made up of 75% chlorine-35
and 25% chlorine-37**

**Explain why the relative atomic mass of
chlorine is 35.5 in the periodic table (6)**



- chlorine-35 has 17 protons, 17 electrons and 18 neutrons
- chlorine-37 has 17 protons, 17 electrons and 20 neutrons
- chlorine-35.5 has two isotopes
- 35.5 is the weighted mean of both isotopes
- isotopes have the same number of protons **AND** a different number of neutrons
- higher abundance (more) of chlorine-35 than chlorine-37
- so relative atomic mass closer to 35 than 37
- 2 marks for correct working out:
 - $(75 \times 35) + (25 \times 37) = 3550$
 - $3550 / 100 = 35.5$



Describe what you see when lithium, sodium and potassium react with cold water and describe how these reactions could be safely demonstrated (6)



What is seen: (maximum 3 marks)

- all produce hydrogen gas
- lithium fizzes/effervescence
- sodium melts into ball
- potassium lilac flame
- potassium most vigorous reaction AND lithium least vigorous reaction
- potassium moves the fastest

How to safely demonstrate: (maximum 3 marks)

- safety goggles worn by teacher and students
- place safety screen in front of glass trough
- students standing away from safety screen
- water in trough must have same volume for each experiment
- use tweezers to take out metal from oil
- use filter paper to remove/dry oil from metal
- cut the metal to make smaller
- place metal into water using tweezers



Describe what is seen when a bit of rubidium is placed in water (3)



- fizzing / bubbling / effervescence
- dissolves / smaller / disappears
- flame / fire / ignites / sparks / explosion / moves quickly / melts



Explain why lithium is less reactive than sodium (4)



- lithium has less shells / less energy levels than sodium
- outer electron closer to nucleus / outer electron is less shielded
- more attraction between the nucleus and outer electron/shell in lithium
- harder to lose outer electron in lithium / more energy to lose electron



**Explain how the reactivity
increases down group 1 from
lithium to potassium (4)**



- going down the group atoms become larger
- distance between outer electron and nucleus increases / atomic radii becomes larger / shielding effect increases
- lower force of attraction between nucleus and electron in outer shell
- easier to lose outer electron / lower amount of energy required to lose outer electron



What is seen when hot sodium reacts with chlorine gas – say what you see before, during and after the reaction (3)



- before: liquid / metal or green gas / silver solid
- during: yellow flame / white smoke / green colour fades / disappears
- after: white solid / powder



Describe what you see when a solution of chlorine water is mixed with a solution of sodium bromide (2)



- colourless sodium bromide solution
- solution/mixture becomes red/brown/orange/yellow/red-brown/red-orange/yellow-orange



It is possible that fluorine can react with sodium iodide to produce sodium fluoride and iodine

Explain how fluorine has been reduced (2)



- fluorine gains an electron / gains electrons
- forming fluoride ion/anion/ F^- /negative ion



**Explain why fluorine is
more reactive than bromine (3)**



- fluorine is a smaller atom / less energy levels / outer shell more close to nucleus
- fluorine has a larger attraction between the nucleus and the outermost shell / less shielding
- fluorine is able to gain an electron more easily



The colour of iodine solution is brown, bromine solution is orange and chlorine solution is pale green.

Explain why when adding sodium iodide solution to iodine, bromine and chlorine solutions, the final colour of the mixtures are always brown (4)



- iodine cannot displace iodine from sodium iodide / no reaction with iodine and sodium iodide
- iodine is least reactive / chlorine is most reactive
- chlorine displaces iodine
- bromine displaces iodine
- iodine causes brown colour



**Explain the reactivity of the
halogens going down the group (6)**



- 7 electrons in the outer shell
- each atom gains an electron to form ions with a -1 charge
- each atom needs to gain one electron to have noble gas electronic configuration
- reactivity decreases down the group / fluorine is the most reactive
- because more shells/size of atom increases down the group
- more shells means more shielding
- this causes the attraction between the nucleus and the electron to be weaker
- the larger the atom means harder to gain an electron so less reactive
- the smaller the atom means easier to gain an electron so more reactive