

# Periodic Table, Group 2 & The Halogens AS & A Level

## Question Paper 3

Level	A Level
Subject	Chemistry
Exam Board	OCR
Module	Periodic Table & Energy
Topic	Periodic Table, Group 2 & The Halogens
Paper	AS & A Level
Booklet	Question Paper 3

**Time allowed:** 63 minutes

**Score:** /47

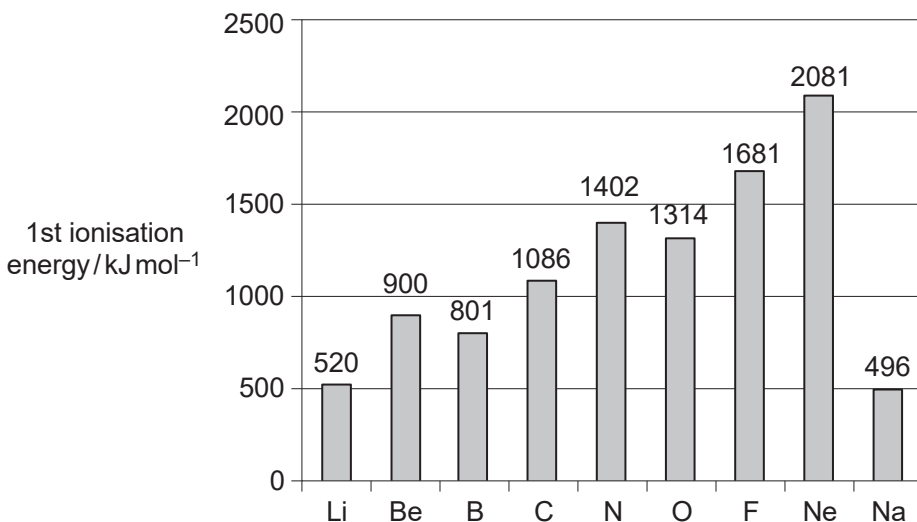
**Percentage:** /100

### Grade Boundaries:

A*	A	B	C	D	E
>85%	73%	60%	47%	34%	21%

Ionisation energies have been used to develop the model of the atom.

The first ionisation energies of the elements Li to Na are shown in the figure below.



(a) Define the term *first ionisation energy*. [3]

(b) (i) Explain why the first ionisation energies show a general increase from Li to Ne. [3]

(ii) Explain the difference between the first ionisation energies of Li and Na.



In your answer, you should use appropriate technical terms, spelt correctly. [3]

(c) The first ionisation energy of oxygen is 1314 kJ mol<sup>-1</sup> and the second ionisation energy of oxygen is 3388 kJ mol<sup>-1</sup>.

(i) Write an equation to represent the **second** ionisation energy of oxygen. [1]

Include state symbols.

(ii) Suggest why the second ionisation energy of oxygen has a greater value than the first ionisation energy of oxygen. [1]

[Total: 11 Marks]

Chlorine and bromine are elements in Group 7 of the Periodic Table.

- (a) Chlorine is used in water treatment.

State **one** advantage and **one** disadvantage of using chlorine in water treatment. [2]

- (b) The electron configuration of bromine contains outermost electrons in the 4th shell.

Using your knowledge of Group 7 elements, complete the electron configuration of bromine.

$1s^2 2s^2 2p^6 3s^2 3p^6$  [1]

- (c) Displacement reactions can be used to detect bromide ions in solution.

A student has a solution that contains bromide ions. The student carries out the following experiment.

**Step 1**

- She bubbles some chlorine gas through a sample of the solution.
- The mixture changes colour.

**Step 2**

- The student then adds an organic solvent, cyclohexane, to the mixture.
- She shakes the contents and allows the layers to separate.

- (i) Write the **ionic** equation for the reaction that takes place in **step 1**. [1]

- (ii) What colour does the cyclohexane layer turn in **step 2**? [1]

(d) Chlorine reacts differently with dilute and concentrated aqueous solutions of sodium hydroxide.

- When chlorine reacts with dilute sodium hydroxide, one of the products is sodium chlorate(I). This is the reaction that is used to manufacture bleach.
- A different reaction takes place when chlorine is reacted with hot concentrated sodium hydroxide. One of the products is  $\text{NaClO}_3$ , used as a weedkiller.

Chlorine has been both oxidised and reduced in each reaction.

(i) What term is used to describe a redox reaction in which an element is both oxidised and reduced? [1]

(ii) Write equations for these two reactions of chlorine with sodium hydroxide:

equation for reaction with **dilute** sodium hydroxide,

equation for reaction with **hot concentrated** sodium hydroxide. [3]

(iii) Chlorine forms another chlorate called sodium chlorate(VII), used in the manufacture of matches.

Suggest the formula of sodium chlorate(VII). [1]

**[Total: 10 Marks]**

### Question 3

Chemists use the Periodic Table to predict the behaviour of elements.

(a) Early attempts at developing a Periodic Table arranged elements in order of increasing atomic mass.

(i) State which two elements from the **first twenty** elements of the modern Periodic Table are not arranged in order of increasing atomic mass. [1]

(ii) Why does the modern Periodic Table **not** arrange some elements, such as those in **a(i)**, in order of increasing atomic mass? [1]

(b) Magnesium and strontium are in Group 2 of the Periodic Table.

(i) Magnesium reacts with oxygen to form a white powder called magnesium oxide.

Write the equation for the reaction of magnesium with oxygen. [1]

(ii) Magnesium reacts with dilute acids.

Describe what you would expect to see when magnesium ribbon is added to an excess of dilute hydrochloric acid. [2]

(iii) Strontium reacts in a similar way to magnesium.

Describe **one** difference you might observe if strontium, instead of magnesium, was reacted with dilute hydrochloric acid. [1]

(c) The third period of the Periodic Table features the elements magnesium and chlorine. The table below shows the melting points of these elements.

element	melting point / °C
magnesium	650
chlorine	-101

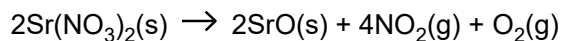
Describe the structure and bonding shown by these elements. Use your answer to explain the difference in melting points.



*In your answer, you should use appropriate technical terms spelt correctly.*

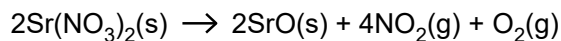
[6]

- (d) The element strontium forms a nitrate,  $\text{Sr}(\text{NO}_3)_2$ , which decomposes on heating as shown below.



- (i) Using oxidation numbers, explain why the reaction involves both oxidation and reduction. [3]

- (ii) A student heats 5.29 g of  $\text{Sr}(\text{NO}_3)_2$  and collects the gas at room temperature and pressure, RTP.



Calculate the volume of gas, in  $\text{dm}^3$ , obtained by the student at RTP.

Molar mass of  $\text{Sr}(\text{NO}_3)_2 = 211.6 \text{ g mol}^{-1}$ . [3]

**[Total: 18 Marks]**

## Question 4

The table below shows the melting points and atomic radii of the elements in Period 3, Na to Cl.

element	Na	Mg	Al	Si	P	S	Cl
melting point/ $^{\circ}\text{C}$	98	639	660	1410	44	113	-101
atomic radius/pm	186	160	143	118	110	102	99

$$1\text{ pm} = 1 \times 10^{-12}\text{ m}$$

(a) (i) Explain the difference in melting point for the elements Na and Mg. [3]

(ii) Sulfur exists as  $\text{S}_8$  molecules and chlorine as  $\text{Cl}_2$  molecules. Use this information to explain the difference in their melting points. [2]

(b) Explain the decrease in the atomic radii across the period from Na to Cl.

In your answer, you should use appropriate technical terms, spelt correctly. [3]



**[Total: 8 Marks]**