

1 The Periodic Table is arranged in periods and groups.

(a) Elements in the Periodic Table show a periodic trend in atomic radius.

State and explain the trend in atomic radius from Li to F.



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

trend

explanation

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[3]

(b) (i) Complete the electron configuration of a bromide **ion**.

1s² **[1]**

(ii) A student adds a small volume of aqueous silver nitrate to an aqueous solution of bromide ions in a test-tube. The student then adds a similar volume of dilute aqueous ammonia to the same test-tube.

Describe what the student would see in the test-tube after the addition of aqueous ammonia.

..... **[1]**

(iii) Write an ionic equation for any precipitation reaction which occurs in the student's tests.

Include state symbols.

..... **[1]**

(c) The Group 7 element chlorine reacts with sodium hydroxide, NaOH, under different conditions to give different products.

(i) Chlorine reacts with aqueous sodium hydroxide to form bleach.

Write the equation and state the conditions for this reaction.

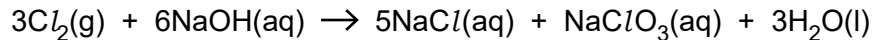
equation

conditions

[2]

(ii) Under different conditions, chlorine reacts differently with aqueous sodium hydroxide.

A disproportionation reaction takes place as shown below.



State what is meant by disproportionation and show that disproportionation has taken place in this reaction.

Use oxidation numbers in your answer.

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..... [3]

[Total: 11]

2 This question is about Group 2 elements and compounds.

(a) Group 2 carbonates undergo thermal decomposition.

(i) Write the equation for the thermal decomposition of calcium carbonate.

Include state symbols.

..... [1]

(ii) Write the formula of the Group 2 carbonate which decomposes at the highest temperature.

..... [1]

(b) Hydrated strontium chloride, $\text{SrCl}_2 \cdot 6\text{H}_2\text{O}$, has a molar mass of 266.6 g mol^{-1} .

A student heats 5.332 g of $\text{SrCl}_2 \cdot 6\text{H}_2\text{O}$.

The $\text{SrCl}_2 \cdot 6\text{H}_2\text{O}$ loses some of its water of crystallisation forming 3.892 g of a solid product.

Use the information above to determine the formula of the solid product.

Show your working.

formula of solid product = [3]

(c) A chemist carries out reactions of barium and barium nitride, Ba_3N_2 .

Reaction 1 Barium is reacted with water.

Reaction 2 Barium nitride is reacted with water, forming an alkaline solution and an alkaline gas.

Reaction 3 Barium is reacted with an excess of oxygen at 500°C , forming barium peroxide, BaO_2 .

(i) Write equations for **Reaction 1** and **Reaction 2**.

Ignore state symbols.

Reaction 1:

Reaction 2:

[3]

(ii) Predict the structure and bonding of Ba_3N_2 .

..... [1]

(iii) BaO_2 formed in **Reaction 3** contains barium and peroxide ions. The peroxide ion has the structure $[\text{O}-\text{O}]^{2-}$.

Suggest a 'dot-and-cross' diagram for BaO_2 .

Show outer shell electrons only.

[1]

[Total: 10]

(b) A student was provided with an aqueous solution of calcium iodide.

The student carried out a chemical test to show that the solution contained iodide ions. In this test, a precipitation reaction took place.

(i) State the reagent that the student would need to add to the solution of calcium iodide.

..... [1]

(ii) What observation would show that the solution contained iodide ions?

..... [1]

(iii) Write an ionic equation, including state symbols, for the reaction that took place.

..... [1]

(iv) The student is provided with an aqueous solution of calcium bromide that is contaminated with calcium iodide.

The student carries out the same chemical test but this time needs to add a second reagent to show that iodide ions are present.

State the second reagent that the student would need to add.

..... [1]

[Total: 9]

4 Periodicity is a repeating pattern across different periods.

(a) First ionisation energy shows a trend across Period 2.

The first ionisation energies of lithium, carbon and fluorine are shown in **Table 5.1** below.

Element	Lithium	Carbon	Fluorine
First ionisation energy / kJ mol^{-1}	520	1086	1681

Table 5.1

(i) Explain the trend across Period 2 shown in **Table 5.1**.



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

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..... [3]

(ii) Solid carbon exists in two forms, diamond and graphite.

Explain why it is unnecessary to refer to carbon as either diamond or graphite in **Table 5.1**.

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..... [1]

(b) Lithium, carbon (in the form of diamond) and fluorine have very different melting points.

These differences in melting points are the result of different types of structure and different forces or bonds between the particles in the structures.

Part of the table below has been filled in.

Complete the table below.

	Lithium	Carbon (diamond)	Fluorine
Melting point/°C	181	3550	-220
Structure	Giant		Simple
Force or bond overcome on melting	Metallic bond		
Particles between which the force or bond is acting			

[6]

[Total: 10]

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

(a) What is the name of the term used to describe the repeating patterns in the Periodic Table?

..... [1]

(b) Melting points show a trend across a period.

The table below shows the melting points of three elements in Period 3 of the Periodic Table.

element	aluminium	silicon	phosphorus
melting point / °C	660	1410	44

Explain the trend shown in terms of bonding and structure.



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

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(c) Scientists use 'sketch graphs' to show trends.

(i) Draw a sketch graph to show the general trend in **ionisation energy** across Period 3.



[1]

(ii) Draw a sketch graph to show the general trend in **atomic radius** across Period 3.



[1]

[Total: 9]

6 Magnesium and strontium are typical Group 2 metals.

(a) Complete the electron configuration of a magnesium atom.

1s² [1]

(b) The second ionisation energy of magnesium is 1064 kJ mol⁻¹.

(i) Write an equation to represent the second ionisation energy of magnesium.
Include state symbols.

..... [2]

(ii) Magnesium has a greater second ionisation energy than strontium.

Explain why.



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

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..... [3]

(c) A student watches a demonstration in which strontium is added to water.

The equation for the reaction is shown below.



(i) Write the formulae of the aqueous ions formed when this reaction takes place.

..... [2]

(ii) In terms of electron transfer, explain why strontium has been oxidised.

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..... [1]

(iii) Suggest two **compounds** which could be reacted together to produce Sr(OH)_2 .

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..... [1]

(d) Sr(OH)_2 can react with an acid to form SrSO_3 .

(i) The systematic name for SrSO_3 is strontium sulfate(IV).

Why does the number (IV) have to be used here rather than simply naming this compound as strontium sulfate?

..... [1]

(ii) Suggest the formula of the acid used to form SrSO_3 .

..... [1]

[Total: 12]