

1. This question is about Group 2 and Group 17 (7).

(a) Barium chloride can be prepared from barium hydroxide in a neutralisation reaction.

Write the equation for this reaction. State symbols are **not** required.

..... [1]

(b) The reactivity of the Group 2 elements Mg–Ba increases down the group.

Explain why.

.....
.....
.....
.....
.....
.....
.....
.....
..... [3]

(c) On gently heating, the compound $KClO_3$ reacts as shown in the equation.



This reaction is an example of disproportionation.

(i) State what is meant by *disproportionation* and use oxidation numbers to show that disproportionation has taken place.

.....
.....
.....
.....
.....
..... [3]

(ii) What is the systematic name for $KClO_4$?

..... [1]

(d) Two changes are described below.

For each change,

- write an equation, including state symbols,
- state and explain how the entropy changes.

(i) The reaction of aqueous barium nitrate with aqueous sodium sulfate.

Full equation with state symbols

.....

Explanation of entropy change

.....

.....

..... [2]

(ii) The change that accompanies the standard enthalpy change of atomisation of iodine.

Equation with state symbols

.....

Explanation of entropy change

.....

.....

..... [2]

2. This question is about the halogen group of elements and some of their compounds.

(a) The halogens show trends in their properties down the group.

The boiling points of three halogens are shown below.

Halogen	Boiling point/°C
Chlorine	-35
Bromine	59
Iodine	184

Explain why the halogens show this trend in boiling points.

.....

.....

.....

.....

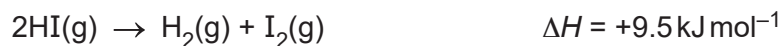
.....

.....

.....

..... [3]

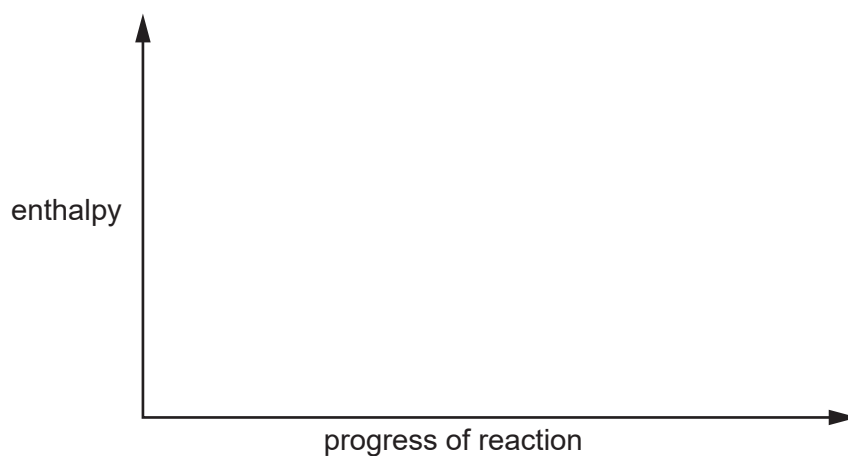
(b) Hydrogen iodide, HI, is decomposed by heat into its elements:



The decomposition is much faster in the presence of a platinum catalyst.

Complete the enthalpy profile diagram for this reaction using formulae for the reactants and products.

- Use E_a to label the activation energy **without** a catalyst.
- Use E_c to label the activation energy **with** a catalyst.
- Use ΔH to label the enthalpy change of reaction.



[3]

- (c) Compound **A** is an oxide of chlorine that is a liquid at room temperature and pressure and has a boiling point of 83 °C.

When 0.4485 g of **A** is heated to 100 °C at 1.00×10^5 Pa, 76.0 cm³ of gas is produced.

Determine the molecular formula of compound **A**.

Show all your working.

molecular formula of **A** = [4]

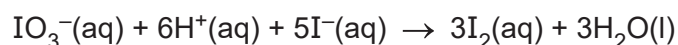
- (d) Compound **B** is an iodate(V) salt of a Group 1 metal.
The iodate(V) ion has the formula IO_3^- .

A student carries out a titration to find the formula of compound **B**.

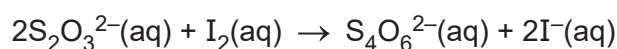
Step 1: The student dissolves 1.55 g of **B** in water and makes up the solution to 250.0 cm^3 in a volumetric flask.

Step 2: The student pipettes 25.00 cm^3 of the solution of **B** into a conical flask, followed by 10 cm^3 of dilute sulfuric acid and an excess of $\text{KI}(\text{aq})$.

The iodate(V) ions are reduced to iodine, as shown below.



Step 3: The resulting mixture is titrated with $0.150 \text{ mol dm}^{-3} \text{ Na}_2\text{S}_2\text{O}_3(\text{aq})$.



The student repeats **step 2** and **step 3** until concordant titres are obtained.

Titration readings

Titration	Trial	1	2	3
Final burette reading/ cm^3	24.00	47.40	23.75	47.05
Initial burette reading/ cm^3	0.00	24.00	0.00	23.20
Titre/ cm^3				

Table 20.1

- (i) Complete **Table 20.1** and calculate the mean titre that the student should use for analysing the results.

mean titre = cm^3 [2]

- (ii) The uncertainty in each burette reading is $\pm 0.05 \text{ cm}^3$.

Calculate the percentage uncertainty in the titre obtained from **titration 1**.

Give your answer to **two** decimal places.

percentage uncertainty = % [1]

- (iii) Describe and explain how the student should determine the end point of this titration accurately.

.....
.....
..... [2]

- (iv) Determine the relative formula mass and formula of the Group 1 iodate(V), **B**.

Show your working.

relative formula mass of **B** =

formula of **B** = [5]

3. Which statement about the reactions of halogens with halide ions is correct?

- A $I_2(aq)$ can oxidise $Br^-(aq)$.
- B $Cl_2(aq)$ can reduce $Br^-(aq)$.
- C $Br^-(aq)$ can reduce $Cl_2(aq)$.
- D $Cl^-(aq)$ can oxidise $I_2(aq)$.

Your answer

[1]

4. 3.528 g of a Group 2 metal, **M**, is reacted with an excess of chlorine. The reaction forms 9.775 g of a chloride.

What is metal **M**?

- A magnesium
- B calcium
- C strontium
- D barium

Your answer

[1]

(b) Chlorine is used in water treatment.

State **one** benefit and **one** risk of using chlorine in water treatment.

Benefit

.....

Risk

.....

[1]

(c) Compound **A** contains bromine and fluorine only, and has a boiling point of 41 °C.

1.26 g of compound **A** is heated to 80 °C.
The volume of gas produced is 0.209 dm³.

Under the conditions used, 1 mol of gas molecules has a volume of 29.0 dm³.

Determine the molecular formula of compound **A**.

molecular formula = [3]