

**A level Chemistry A**

**H432/01** Periodic table, elements and physical chemistry

**Question Set 13**

1. (a) This question is about the halogen group of elements and some of their compounds.

The halogens show trends in their properties down the group.

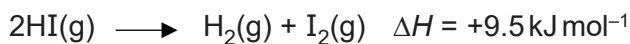
The boiling points of three halogens are shown below.

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

Explain why the halogens show this trend in boiling points.

[3]

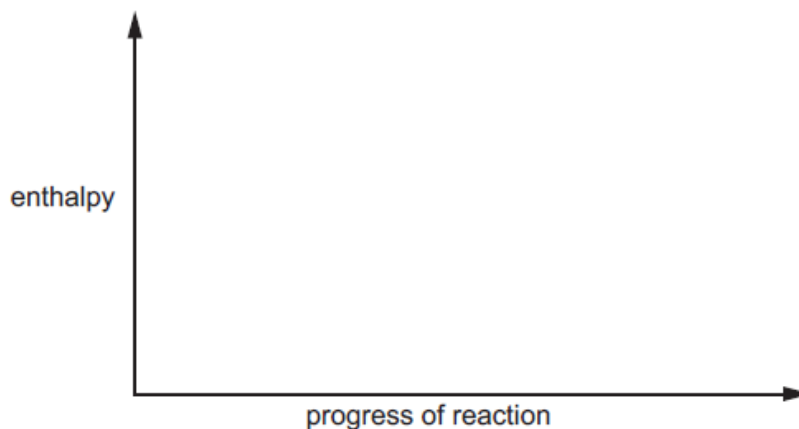
- (b) Hydrogen iodide, HI, is decomposed by heat into its elements:



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  $\Delta H$  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  $1.00 \times 10^5$  Pa, 76.0 cm<sup>3</sup> of gas is produced. Determine the molecular formula of compound **A**.

Show all your working.

molecular formula of **A** =

[4]

- (d) (i) Compound **B** is an iodate(V) salt of a Group 1 metal.

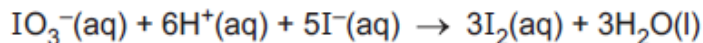
The iodate(V) ion has the formula IO<sub>3</sub><sup>-</sup>.

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

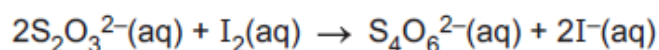
**Step 1:** The student dissolves 1.55 g of **B** in water and makes up the solution to 250.0 cm<sup>3</sup> in a volumetric flask.

**Step 2:** The student pipettes 25.00 cm<sup>3</sup> of the solution of **B** into a conical flask, followed by 10 cm<sup>3</sup> of dilute sulfuric acid and an excess of KI(aq).

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



**Step 3:** The resulting mixture is titrated with 0.150 mol dm<sup>-3</sup> Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub>(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 <sup>3</sup>	24.00	47.40	23.75	47.05
Initial burette reading / cm <sup>3</sup>	0.00	24.00	0.00	23.20
Titre / cm <sup>3</sup>				

**Table 1.1**

Complete **Table 1.1** and calculate the mean titre that the student should use for analysing the results.

mean titre = ..... cm<sup>3</sup>

[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** = ..... [5]

formula of **B** = .....

**Total Marks for Question Set 13: 20**

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