

Surname	Centre Number	Candidate Number
First name(s)		2



## GCE A LEVEL

1410U50-1A



**TUESDAY, 17 MAY 2022**

## CHEMISTRY – A2 unit 5

### Practical Examination

### Experimental Task

### TEST 1

3 hours

For Teacher's use only	
Award a mark of 0 or 1 for each of the following	
Efficient use of time	
Working safely	

For Examiner's use only	
Mark Awarded	
Total	

### ADDITIONAL MATERIALS

In addition to this examination paper, you will need a:

- calculator, pencil and ruler;
- **Data Booklet** supplied by WJEC.

### INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen. Pencil may be used to draw tables and graphs.  
Write your name, centre number and candidate number in the spaces at the top of this page.  
Write your answers in the spaces provided in this booklet.

### INFORMATION FOR CANDIDATES

The total number of marks available for this task is 30.  
Your teacher will directly assess your practical skills in **Parts A and B**.  
The number of marks is given in brackets at the end of each question or part-question.  
You are reminded of the necessity for orderly presentation in your answers.

**This practical examination is in two parts:**

**Part A – To find the enthalpy change for the thermal decomposition of potassium hydrogencarbonate**

To find the enthalpy change for the thermal decomposition of potassium hydrogencarbonate indirectly you will carry out two successive enthalpy experiments – reacting potassium hydrogencarbonate and potassium carbonate with excess hydrochloric acid.

**Part B – Qualitative analysis of an unknown s-block metal carbonate**

A series of tests to identify the unknown s-block metal cation in the sample provided.

The apparatus and chemicals required are listed on the following pages.

You should record all observations in the spaces provided and then use the results in the analysis section later in this paper.

**Part A – To find the enthalpy change for the thermal decomposition of potassium hydrogencarbonate****Apparatus**

You will need eye protection and the following apparatus:

- 1 × weighing bottle + lid containing approximately 3.5 g of potassium hydrogencarbonate ( $\text{KHCO}_3$ )
- 1 × weighing bottle + lid containing approximately 3.0 g of potassium carbonate ( $\text{K}_2\text{CO}_3$ )
- 1 × 50 cm<sup>3</sup> burette
- 1 × burette stand
- 1 × funnel
- 1 × polystyrene cup
- 1 × 250 cm<sup>3</sup> beaker
- 1 × thermometer ( $\pm 0.1/0.2^\circ\text{C}$ )
- 1 × stopwatch

Ready access to a weighing balance

**Chemicals**

You will need:

approximately 100 cm<sup>3</sup> of 2 mol dm<sup>-3</sup> hydrochloric acid solution (HCl)

**Part B – Qualitative analysis of an unknown s-block metal carbonate****Apparatus**

You will need eye protection and the following apparatus:

- 1 × sample bottle containing approximately 2.5 g of unknown s-block metal carbonate
- 4 × test tube
- 1 × test tube rack
- 1 × rubber bung for test tube
- 1 × boiling tube
- 1 × wooden splint
- 1 × Bunsen burner
- 1 × spatula
- 1 × wash bottle (deionised water)
- 1 × 10 cm<sup>3</sup> measuring cylinder
- 4 × graduated plastic pipette

**Chemicals**

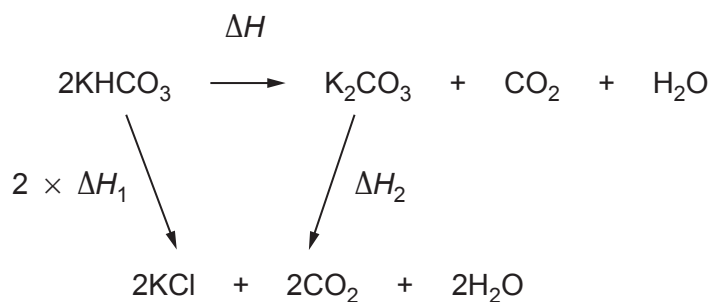
You will need:

- approximately 10 cm<sup>3</sup> of 1 mol dm<sup>-3</sup> nitric acid solution (HNO<sub>3</sub>)
- approximately 2 cm<sup>3</sup> of 1 mol dm<sup>-3</sup> sodium sulfate solution (Na<sub>2</sub>SO<sub>4</sub>)
- approximately 2 cm<sup>3</sup> of 1 mol dm<sup>-3</sup> sodium hydroxide solution (NaOH)

**Part A – To find the enthalpy change for the thermal decomposition of potassium hydrogencarbonate**

Potassium hydrogencarbonate is used as a fire suppression agent in some dry chemical fire extinguishers and in some applications of condensed aerosol fire suppression. It is the only dry chemical fire suppression agent recognized for firefighting at airport crash rescue sites. It is about twice as effective in fire suppression as sodium hydrogencarbonate. However, it can thermally decompose to potassium carbonate, therefore knowledge of the enthalpy change for this reaction is of importance with regards to storage temperatures.

To find the enthalpy change,  $\Delta H$ , for the thermal decomposition of potassium hydrogencarbonate **indirectly** you will carry out two successive enthalpy experiments. You will react potassium hydrogencarbonate and then potassium carbonate with excess hydrochloric acid to determine  $\Delta H_1$  and  $\Delta H_2$  respectively. You will use these values to find  $\Delta H$  using Hess's law.



**You will record your data on pages 7 and 8.**

**Procedure**

- **Wear eye protection at all times.**
  - **Assume that all substances are toxic and corrosive.**
1. Accurately weigh the sample of potassium hydrogencarbonate and the weighing bottle and lid. Record the mass.
  2. Stand the polystyrene cup inside the 250 cm<sup>3</sup> beaker for stability.
  3. Use the burette to add 30 cm<sup>3</sup> of 2 mol dm<sup>-3</sup> hydrochloric acid solution to the polystyrene cup.
  4. Record the temperature of the acid every 30 s for 2 minutes.
  5. At 2½ minutes add the contents of the weighing bottle to the polystyrene cup. Stir carefully with the thermometer. Do **not** record the temperature at this point.
  6. Record the temperature at 3 minutes and again every 30 s for a further 4 minutes.
  7. Reweigh the weighing bottle and lid. Record the mass and hence calculate the exact mass of potassium hydrogencarbonate added to the cup. Record this value.
  8. Wash and dry the polystyrene cup and repeat steps 1-7 using the potassium carbonate sample.

**Use your results in the Analysis of Results section after you have completed Part B of this experimental task.**

**Results Sheet****Part A – To find the enthalpy change for the thermal decomposition of potassium hydrogencarbonate****Potassium hydrogencarbonate****Weighing data**

Mass of sample of potassium hydrogencarbonate and weighing bottle and lid	g
Mass of empty weighing bottle and lid	g
Mass of potassium hydrogencarbonate added	g

**Temperature data**

Circle the resolution of your thermometer.

 $\pm 0.1^{\circ}\text{C}$  $\pm 0.2^{\circ}\text{C}$ 

Draw a table to record your temperature readings.

**Potassium carbonate****Weighing data**

Mass of sample of potassium carbonate and weighing bottle and lid	g
Mass of empty weighing bottle and lid	g
Mass of potassium carbonate added	g

**Temperature data**

Draw a table to record your temperature readings.

**Examiner only****[4]**

<b>Mark awarded</b>	
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## Part B – Qualitative analysis of an unknown s-block metal carbonate

You will carry out a series of tests to identify the unknown s-block metal cation in the sample provided.

**Record your observations in the table on page 11.**

For each of the tests, if there is no apparent change you should write 'no observable change'.

You are **not** required to identify the metal ion present until the **Analysis of Results** section.

### Procedure

- **Wear eye protection at all times.**
- **Assume that all substances are toxic and corrosive.**

### Solubility

1. Place half a spatula of solid from the sample bottle in a test tube.
2. Add approximately 5 cm<sup>3</sup> of deionised water.
3. Place a rubber bung in the tube and shake.
4. Record your observation(s).

### Add nitric acid solution

1. Place half a spatula of solid from the sample bottle in a boiling tube.
2. Add approximately 10 cm<sup>3</sup> of nitric acid solution.
3. Record your observation(s) and allow the boiling tube to stand for a few minutes.
4. Pour one third of the solution into one test tube and one third into another, leaving one third in the boiling tube.

### Flame test

1. Place a wooden splint into the solution remaining in the boiling tube.
2. Hold the splint in a roaring blue Bunsen burner flame.
3. Record any flame colour seen.

**Add sodium sulfate solution**

1. Add approximately  $2\text{ cm}^3$  of sodium sulfate solution to one of the test tubes.
2. Record your observation(s).

**Add sodium hydroxide solution**

1. Add approximately  $2\text{ cm}^3$  of sodium hydroxide solution to the other test tube.
2. Record your observation(s).

**Results Sheet****Part B – Qualitative analysis of an unknown s-block metal carbonate**

Record your observations in the table.

<b>Test</b>	<b>Observation(s)</b>
<b>solubility</b>	
<b>add nitric acid solution</b>	
<b>flame test</b>	
<b>add sodium sulfate solution</b>	
<b>add sodium hydroxide solution</b>	

Use these observations in the **Analysis of Results** section.

**Examiner only**

[4]

<b>Mark awarded</b>	
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**Analysis of Results****Part A – To find the enthalpy change for the thermal decomposition of potassium hydrogencarbonate**

- (i) Use the results from the reactions of potassium hydrogencarbonate and potassium carbonate with hydrochloric acid to construct two graphs on the grids provided.

From the graphs, find the maximum temperature change in both reactions.

**Potassium hydrogencarbonate**

Maximum temperature change = ..... °C

[3]

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**Potassium carbonate**

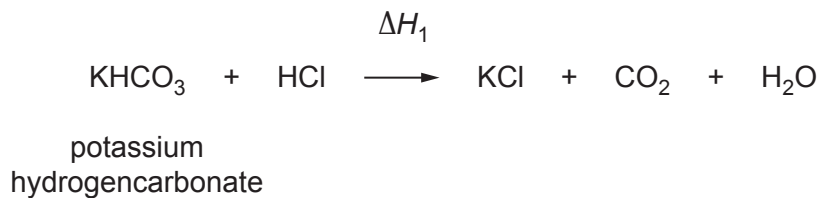
Maximum temperature change = ..... °C

[3]

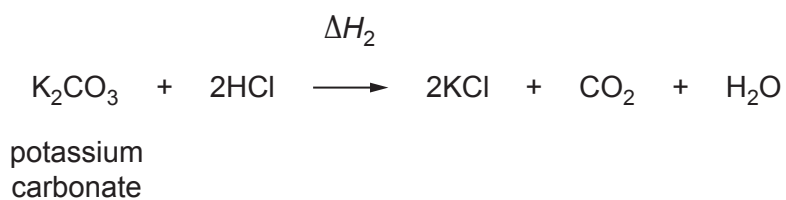
(ii) Use the following equation to calculate the enthalpy change (in  $\text{kJ mol}^{-1}$ ) for both reactions.

[6]

$$\Delta H = - \frac{mc\Delta T}{n}$$



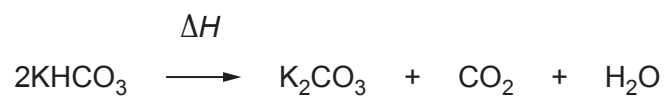
$$\Delta H_1 = \dots\dots\dots \text{kJ mol}^{-1}$$



$$\Delta H_2 = \dots\dots\dots \text{kJ mol}^{-1}$$



- (iii) Use the answers to part (ii) to calculate the enthalpy change for the thermal decomposition of potassium hydrogencarbonate. [2]

Examiner  
only $\Delta H = \dots\dots\dots \text{kJ mol}^{-1}$

**Part B – Qualitative analysis of an unknown s-block metal carbonate**

- (iv) 2.500 g of the unknown anhydrous s-block metal carbonate was heated to constant mass and the mass of the corresponding anhydrous oxide produced was found to be 1.400 g.

Use this information and your qualitative results to confirm the identity of the unknown s-block metal in the carbonate provided.

Show your working and state the conclusions that can be drawn from **each** of the qualitative tests.

[6]

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**END OF PAPER**

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