



Additional Assessment Materials

Summer 2021

Pearson Edexcel GCE in Chemistry 9CH0

Resource Set 1 – Topic Group 6

Questions based on practical work taken  
from any topic

(Public release version)

## **Pearson: helping people progress, everywhere**

Pearson aspires to be the world's leading learning company. Our aim is to help everyone progress in their lives through education. We believe in every kind of learning, for all kinds of people, wherever they are in the world. We've been involved in education for over 150 years, and by working across 70 countries, in 100 languages, we have built an international reputation for our commitment to high standards and raising achievement through innovation in education. Find out more about how we can help you and your students at: [www.pearson.com/uk](http://www.pearson.com/uk)

Additional Assessment Materials, Summer 2021

All the material in this publication is copyright

© Pearson Education Ltd 2021

## General guidance to Additional Assessment Materials for use in 2021

### Context

- Additional Assessment Materials are being produced for GCSE, AS and A levels (with the exception of Art and Design).
- The Additional Assessment Materials presented in this booklet are an **optional** part of the range of evidence teachers may use when deciding on a candidate's grade.
- 2021 Additional Assessment Materials have been drawn from previous examination materials, namely past papers.
- Additional Assessment Materials have come from past papers both published (those materials available publicly) and unpublished (those currently under padlock to our centres) presented in a different format to allow teachers to adapt them for use with candidate.

### Purpose

- The purpose of this resource to provide qualification-specific sets/groups of questions covering the knowledge, skills and understanding relevant to this Pearson qualification.
- This document should be used in conjunction with the mapping guidance which will map content and/or skills covered within each set of questions.
- These materials are only intended to support the summer 2021 series.

- 4 Compound **C** is a pink crystalline solid containing two cations and one anion.
- (a) Three tests were carried out on **C**. The observation made for each test was recorded in the table.
- (i) Complete the statements in the inference column by writing the names or formulae of the species.

(6)

Test	Observation	Inference
<p><b>Test 1</b></p> <p>Aqueous sodium hydroxide was added to solid <b>C</b> and the mixture warmed</p> <p>The gas evolved was tested with damp red litmus paper</p>	<p>The red litmus paper turned blue</p>	<p>The gas evolved was .....</p> <p>One of the cations in <b>C</b> is .....</p>
<p><b>Test 2</b></p> <p>Concentrated hydrochloric acid was added to an aqueous solution of <b>C</b></p>	<p>The pink solution turned blue</p>	<p>The other cation in <b>C</b> is .....</p> <p>The formula of the complex ion in the blue solution is .....</p>
<p><b>Test 3</b></p> <p>Dilute hydrochloric acid and aqueous barium chloride were added to an aqueous solution of <b>C</b></p>	<p>A white precipitate formed</p>	<p>The white precipitate is .....</p> <p>The anion in <b>C</b> is .....</p>

- (ii) Use the results of the tests in (a)(i) to give a formula of **C**.  
Do not include water of crystallisation.

(1)

(b) Write the **ionic** equation for the reaction between the cation in **C** and sodium hydroxide producing the gas in **Test 1**.  
State symbols are not required.

(1)

(c) State the type of reaction occurring in **Test 2**.

(1)

(d) Give a reason why dilute hydrochloric acid is needed in **Test 3**.

(1)

---

(Total for Question 4 = 10 marks)

---

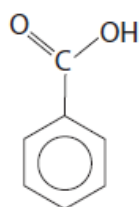
- 5 This question is about extracting benzoic acid from a mixture of benzoic acid,  $C_6H_5COOH$ , and phenol,  $C_6H_5OH$ .

The following steps were carried out.

- Step 1 A suitable mass of the mixture was placed in a separating funnel and some ether added. The funnel was shaken to dissolve the mixture.
- Step 2 Aqueous sodium hydrogencarbonate was added to the separating funnel, and the contents shaken.
- Step 3 Once the reaction was complete, the two layers were allowed to separate.
- Step 4 The lower aqueous layer was removed and placed in a beaker.
- Step 5 The ether layer in the separating funnel was washed with deionised water and the washings added to the beaker.
- Step 6 Hydrochloric acid was added to the aqueous solution in the beaker to precipitate the benzoic acid.
- Step 7 The impure benzoic acid was filtered under reduced pressure.
- Step 8 The impure benzoic acid was purified by recrystallisation.
- Step 9 The melting temperature of the purified benzoic acid was measured and compared with the literature value of  $122^\circ C$ .

- (a) Complete the equation for the reaction between benzoic acid and sodium hydrogencarbonate.

(2)



- (b) In Step 2 there is a pressure build-up in the separating funnel.

Describe how you would lower the pressure.

(1)

.....

.....

.....

(c) State why, in Step 4, the aqueous layer was the lower of the two layers. (1)

.....

(d) Give a reason why, in Step 5, the ether layer was washed with deionised water. (1)

.....

.....

(e) Explain why the addition of hydrochloric acid in Step 6 results in the precipitation of benzoic acid. (2)

.....

.....

.....

.....

(f) Draw a diagram of the apparatus used in Step 7 to filter under reduced pressure. (2)

- (g) Benzoic acid can be purified in Step 8 because of its high solubility in hot water and low solubility in cold water.

Calculate the maximum number of benzoic acid molecules that can dissolve in  $50.0\text{ cm}^3$  of cold water if the solubility is  $1.70\text{ g}$  per  $1000\text{ cm}^3$ .

(3)

- (h) The melting temperature range of the purified benzoic acid in Step 9 was  $116\text{--}121\text{ }^\circ\text{C}$ .

Compare this result with the literature value, giving a reason for any differences.

(2)

.....

.....

.....

.....

.....

---

(Total for Question 5 = 14 marks)



3 This question is about the identification of a Group 2 carbonate.

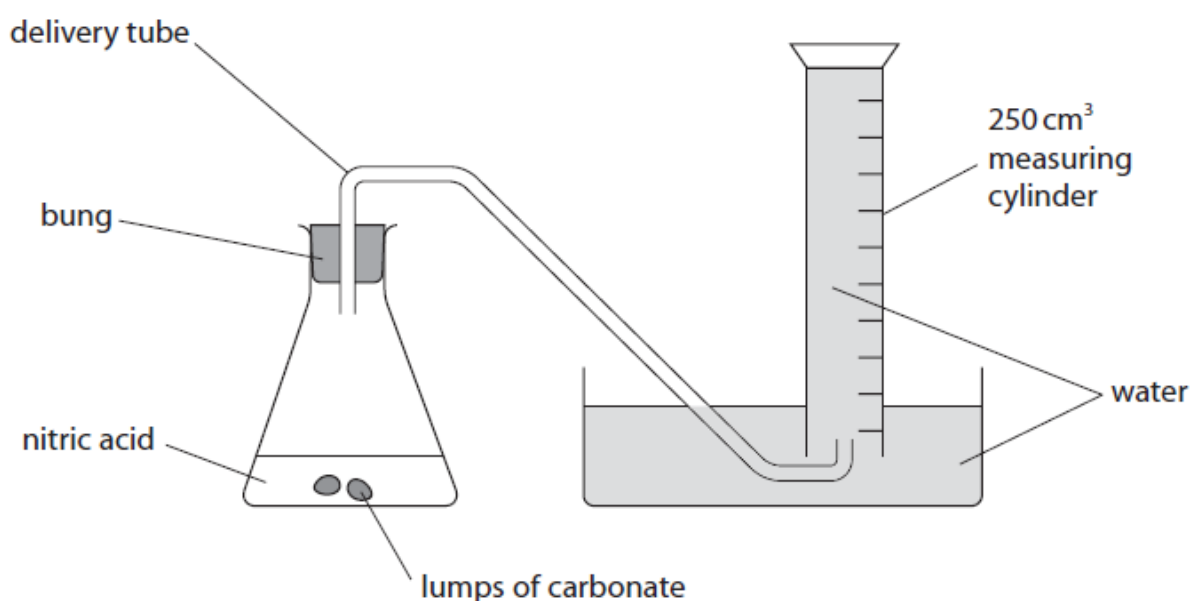
A chemistry teacher found a bottle containing lumps of a white solid. The original label was missing from the bottle. However, someone had written 'Group 2 carbonate' on the bottle. The lumps of the anhydrous white solid were pure and dry.

The chemistry teacher tried to identify the carbonate with the help of three students. The three students worked under identical conditions and shared the same weighing balance.

Student 1 recognised that if an acid is added to a carbonate, carbon dioxide is evolved. The student decided to measure the volume of carbon dioxide evolved when the Group 2 carbonate reacts with excess nitric acid.

The student knew that 1 mol of a Group 2 carbonate produces 1 mol of carbon dioxide.

Student 1 set up the apparatus shown below.



- Student 1 weighed out some of the Group 2 carbonate and added it to a 250 cm<sup>3</sup> conical flask.
- Student 1 then added 100 cm<sup>3</sup> of 0.200 mol dm<sup>-3</sup> nitric acid to the conical flask and replaced the bung.
- Student 1 measured the volume of gas collected in the inverted measuring cylinder at room temperature and pressure (r.t.p.) when all the Group 2 carbonate had reacted.
- Student 1 obtained the results shown in Table 1.

Measurement		Value
Mass of weighing bottle and carbonate	/ g	13.247
Mass of empty weighing bottle	/ g	12.431
Mass of carbonate used	/ g	.....
Volume of acid used	/ cm <sup>3</sup>	100
Volume of gas collected	/ cm <sup>3</sup>	225

**Table 1**

- (a) Complete Table 1 to show the mass of the carbonate used. (1)
- (b) Calculate the amount, in moles, of carbon dioxide collected in the measuring cylinder at r.t.p. (1)
- (c) Calculate the molar mass of the Group 2 carbonate to an appropriate number of significant figures and hence deduce the identity of the Group 2 metal. (4)

(d) Student 2 carried out the same experiment as Student 1, using the same mass of the Group 2 carbonate.

Student 2 made no errors in their measurements or calculations but obtained a value for the molar mass which was  $10 \text{ g mol}^{-1}$  greater than the value obtained by Student 1.

(i) Explain **one** procedural error which could have resulted in Student 2 obtaining a molar mass greater than that of Student 1.

(2)

.....

.....

.....

.....

.....

.....

(ii) It was later discovered that Student 2 had used  $110 \text{ cm}^3$  of  $0.200 \text{ mol dm}^{-3}$  dilute nitric acid, instead of  $100 \text{ cm}^3$  of  $0.200 \text{ mol dm}^{-3}$  dilute nitric acid.

Give a reason why this mistake would **not** have affected Student 2's result.

No calculation is required.

(1)

.....

.....

(iii) The teacher noticed that Student 2 had used the Group 2 carbonate in powdered form rather than in lumps.

Explain how, if at all, this would affect the rate of reaction and the final volume of gas produced in the reaction.

(2)

.....

.....

.....

.....

.....

.....

(e) Student 3 suggested a different experiment.  
Student 3 realised that, by heating the carbonate, carbon dioxide would be lost and an oxide would remain.

Student 3 decided to measure the change in mass of the carbonate and to use this information to calculate its molar mass.

- Student 3 weighed an empty test tube.
- Using a spatula, Student 3 added some of the carbonate to the test tube.
- The test tube containing the carbonate was then weighed.
- The test tube and its contents were heated to constant mass.
- The results obtained by Student 3 are shown in Table 2.

Measurement	Value
Mass of carbonate + test tube / g	20.447
Mass of oxide + test tube / g	20.205
Mass of empty test tube / g	19.996

**Table 2**

(i) Write an equation, including state symbols, for the thermal decomposition of a Group 2 carbonate,  $\text{MCO}_3$ , where M represents the metal.

(1)

(ii) Using Student 3's results, calculate the molar mass of the Group 2 carbonate.

(3)

(f) Student 3 used the same balance as Student 1.

Give a reason why the mass of the carbonate measured by Student 3 has a greater percentage uncertainty than that measured by Student 1.

(1)

---

---

---

---

---

**(Total for Question 3 = 16 marks)**

**Total for Test = 40 marks**