This is a **suggested** practical activity that can be used as part of teaching the GCE Chemistry A and B (Salters) specifications, and in part helps to fulfil the requirements of the Practical Endorsement. These are **not coursework tasks**, and there is **no requirement to use these activities**. You may modify these activities to suit your learners and centre. Alternative activities are available from, for example, RSC LearnChemistry, CLEAPSS and publishing companies. **Support for mapping activities to the requirements of the Practical Endorsement is available from OCR – see** [**https://www.ocr.org.uk/positiveaboutpractical**](https://www.ocr.org.uk/positiveaboutpractical) **or email us at** **PASS@ocr.org.uk****.**

**OCR recommendations:**

* **Before carrying out any experiment or demonstration based on this guidance, it is the responsibility of teachers to ensure that they have undertaken a risk assessment in accordance with their employer’s requirement, making use of up-to-date information and taking account of their own particular circumstances. Any local rules or restrictions issued by the employer must always be followed.**
* **Use CLEAPSS resources (**[**http://www.cleapss.org.uk**](http://www.cleapss.org.uk)**) when carrying out risk-assessments.**
* **Centres should trial experiments in advance of giving it to learners. Centres may choose to make adaptations to this practical, but should be aware that may affect the criteria covered. It is always possible to split tasks to suit your centre.**
* **Centres should retain their trial results along with their other documentation records.**

**1.1 Determination of the composition of copper(II) carbonate basic TEACHER/TECHNICIAN**

**Introduction**

Learners will react a known mass of copper(II) carbonate basic, CuCO3⋅Cu(OH)2(s), with an excess of sulfuric acid, H2SO4(aq), collecting the evolved CO2(g). They will measure the volume of the CO2(g) and determine the percentageby mass of CuCO3 in CuCO3⋅Cu(OH)2(s).

**Aims and *Skills***

* to determine the percentage by mass of CuCO3 in a sample of copper(II) carbonate basic
* *to accurately measure mass and gas volume, and record in an appropriate format*
* *to carry out calculations involving amounts of substance*

**Intended class time**

* 1 hour

**Practical Skills**

* 1.2.1(b) safely and correctly use a range of practical equipment and materials
* 1.2.1(c) follow written instructions
* 1.2.1(d) make and record observations/measurements
* 1.2.1(e) keep appropriate records of experimental activities
* 1.2.1(f) present information and data in a scientific way
* 1.2.1(j) use a wide range of experimental and practical instruments, equipment and techniques appropriate to the knowledge and understanding included in the specification.
* 1.2.2(a) use of appropriate apparatus to record a range of measurements (to include mass, time, volume of liquids and gases, temperature)
* 1.2.2(k) safely and carefully handling solids and liquids, including corrosive, irritant, flammable and toxic substances

**CPAC**

(1) Follows written procedures

(3) Safely uses a range of practical equipment and materials

(4) Makes and records observations

**Links to Specifications**

**Chemistry A**

* 2.1.3(a) explanation and use of the terms: amount of substance, mole (symbol ‘mol’), as the unit for amount of substance, the Avogadro constant, *NA* (the number of particles per mole, 6.02 × 1023 mol–1) molar mass (mass per mole, units g mol–1), molar gas volume (gas volume per mole, units dm3 mol–1)
* 2.1.3(e) calculations, using amount of substance in mol, involving: mass, gas volume, solution, volume and concentration
* 2.1.3(g) use of stoichiometric relationships in calculations
* 2.1.3(i) the techniques and procedures required during experiments requiring the measurement of mass, volumes of solutions and gas volumes

**Chemistry B**

* EL(b)(i) the concept of amount of substance (moles) and its use to perform calculations involving: masses of substances, empirical and molecular formulae, percentage composition, percentage yields, water of crystallisation
* EL(b)(ii) the techniques and procedures used in experiments to measure masses of solids.
* DF(a) the concept of amount of substance in performing calculations involving: volumes of gases (including the ideal gas equation *pV* = *nRT*), balanced chemical equations, enthalpy changes; the techniques and procedures used in experiments to measure volumes of gases

**Mathematical Skills**

* Mathematical skills must be applied in the recording of the data and calculations, and in analysing the data. These steps require the appropriate application of the following mathematical skills:
* M0.0 Recognise and make use of appropriate units in calculations
* M0.1 Recognise and use expressions in decimal and ordinary form
* M0.2 Use ratios, fractions and percentages
* M0.4 Use calculators to find and use power, exponential and logarithmic functions
* M1.1 Use an appropriate number of significant figures
* M2.1 Understand and use the symbols: =, <, <<, >>, >, ∝, ~, ⇌
* M2.2 Change the subject of an equation

**Chemicals**

| **Label** | **Identity** | **Hazard information** |
| --- | --- | --- |
| CuCO3$·$Cu(OH)2(s) | copper(II) carbonate basic solid, CuCO3$·$Cu(OH)2(s)Each learner or group will require approximately 1.5 g | Caution (exclamation mark) | Harmful if swallowed |
| H2SO4(aq) | 1.0 mol dm–3 aqueous sulfuric(VI) acid, H2SO4(aq) Each learner or group will require 50 cm3 | Caution (exclamation mark) | WARNINGCauses skin irritation and serious eye irritation |

**Equipment**

Each learner or group will require:

* eye protection
* access to a balance reading to at least two decimal places
* weighing boat or filter paper
* spatula
* dropping pipette
* conical flask (250 cm3)
* bung with delivery tube *(see note below)*
* measuring cylinder (250 cm3)
* measuring cylinder (50 cm3)
* clamp stand, boss and clamp
* trough *(small washing up bowls or ice creams tubs are suitable alternatives)*

The delivery tube should be made up so that it fits the apparatus as shown on the learner sheet. If the part of the tube which fits into the bung is made sufficiently long, then it is possible to slide the tube carefully so that it fits into the trough of water. It is suggested that a template is drawn onto paper first. A number 31 bung with one hole usually fits into wide-necked conical flasks. The learner may wish to clamp the flask neck as well.

Alternatively, a Buchner flask can be used with a rubber tube in place of glass delivery tube and rubber bung for the top. This is easier to handle, less likely to fall over and removes need for a glass delivery tube.

**Health and Safety**

* Health and safety should always be considered by a centre before undertaking any practical work. A full risk assessment of any activity should always be undertaken.
* It is advisable to check the CLEAPSS website (<http://www.cleapss.org.uk>) in advance of undertaking the practical tasks.
* Learners should wear eye protection throughout.

**Notes**

This activity can also be conducted using a gas syringe, rather than a measuring cylinder, to collect the gas evolved in the reaction. However, as most gas syringes are 100 cm3, you may need to scale the masses down. This does not affect the eligibility of this activity to count for PAG 1 of the Practical Endorsement. However, learners will then not be able to complete all of the ‘Extension Opportunity’ questions. If learners attempt ‘Extension Opportunity’ question 9, this could count towards CPAC (5).

**Trial results**

OCR recommends that this practical is trialled by the centre in advance of giving it to learners. We advise that the trail results are kept as part of centre records for assessing the Practical Endorsement.

OCR Trial data:

|  |  |
| --- | --- |
| Mass of copper(II) carbonate basic + weighing boat / g  | 2.61  |
| Mass of weighing boat / g  | 1.10  |
| Mass of copper(II) carbonate basic added to flask / g  | 1.51  |
| Volume of gas collected / cm3  | 140  |

**Analysis of results – using trial data**

1. *n*(CO2) = = = 5.83 × 10−3 mol

(it is advised that learners carry through their calculator value rather than rounding at this point)

1. According to the reaction equation given, 1 mol CuCO3 produces 1 mol CO2, therefore the amount of CuCO3reacted is also 5.83 × 10−3 mol.

*m*(CuCO3) = *n*(CuCO3) x *M*(CuCO3) = 5.83 × 10−3 × 123.5 = 0.720 g

1. The percentage by mass of CuCO3 in the sample of CuCO3·Cu(OH)2(s) is then:

%(CuCO3) = × 100 = 47.7%

Learners should be advised to keep intermediate answers in their calculator and use these in subsequent steps, rather than rounding answers at each step. This will minimise rounding errors in the final answer.

The measurements given here were recorded to at least three significant figures. Therefore, the final answer should be given to this same number of significant figures.

**Answers to Extension Opportunities**

Answers to the extension questions on the student sheet are available on Interchange in the Science Coordinator Materials area.

**Records**

As evidence for the Practical Endorsement, learners:

* should not need to re-draft their work, but rather keep all of their notes as a continuing record of their practical work, **dating their work clearly**,
* should record any observations made in full detail, clearly identifying what was observed,
* should record any measurements taken to the number of decimal places (resolution) appropriate for the apparatus used. This should be recorded clearly in a table format, or clearly identified with appropriate units,
* should record any modifications to supplied procedures, including their own risk assessments and methods where appropriate.

In preparation for assessment of practical work in the written examinations, and to help learners develop their understanding of the underlying chemical theory, learners:

* should answer all ‘Analysis’ and ‘Extension Opportunities’ questions,
* should show full workings in calculations, and final answers to the appropriate number of significant figures.

This work can be incorporated into learners’ practical work records.

**Document updates**

 v1.0 1 September 2015 Original version.

 v2.0 24 September 2015 Reviewed – minor clarifications and standardisation of formatting/terminology etc.

 v2.1 15 January 2016 Corrections to answers to Extension Question 2, and update to Question 3 in line with updated guidance on uncertainties in digital mass balance (see Practical Skills Handbook). Update to ‘Records’ section.

 v2.2 31 August 2016 Correction of value of *M* for CuCO3.
Minor changes to ordering. Removal of reference to use of gloves & goggles.

 v2.3 14 June 2017 Corrected ± value in Answers to Extension Opportunities Q2

 v3.0 17 February 2020 Answers removed from teacher document and added to separate file on Interchange. No other changes have been made.