Pearson Edexcel

# INTERNATIONAL GCSE

## Chemistry (9-1)

### EXEMPLARS WITH EXAMINER COMMENTARIES

### PAPER 1

Pearson Edexcel International GCSE in Chemistry (4CH1)

Pearson Edexcel International GCSE in Science (Double Award) (4SD0)

# Contents

# Introduction

## 1.1 About this booklet

This booklet has been produced to support teachers delivering the Pearson Edexcel International GCSE in Science (Double Award) specification. The Paper 1C exemplar materials will enable teachers to guide their students in the application of knowledge and skills required to successfully complete this course. The booklet looks at questions from the June 2019 examination series, showing real candidate responses to questions and how examiners have applied the mark schemes to demonstrate how student responses should be marked.

## 1.2 How to use this booklet

Each example covered in this booklet contains:

- Question
- Mark scheme
- Example responses for the selected question
- Example of the marker grading decision based on the mark scheme, accompanied by examiner commentary including the explanation for the decision and guidance on how the answer can be improved to earn more marks.

The examples highlight the achievement of the assessment objectives at lower to higher levels of candidate responses.

Centres should use the commentaries on the exemplification of marker decisions to support their internal assessment of students and incorporate examination skills into the delivery of the specification.

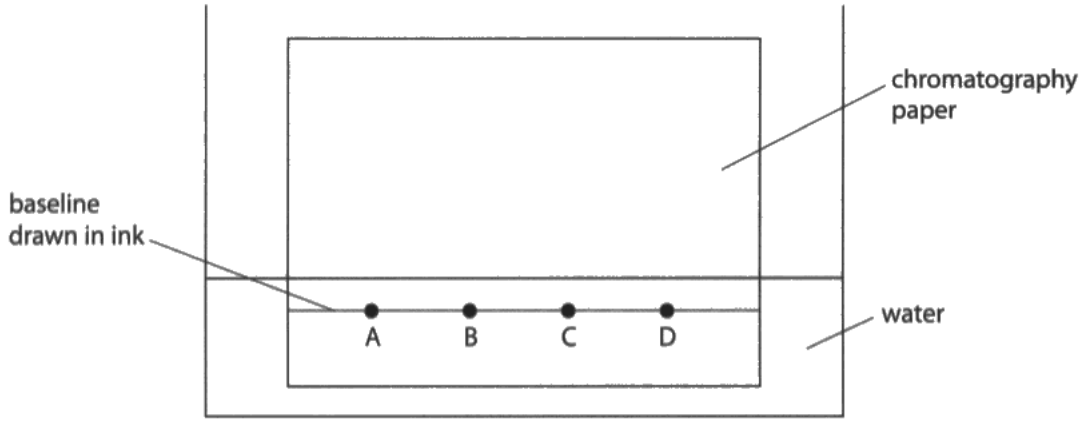
## 1.3 Further support

A range of materials are available from the Pearson qualifications website to support you in planning and delivering this specification.

Centres may find it beneficial to review this document in conjunction with the Examiner's Report and other assessment and support materials available on the Pearson Qualifications website.

# Question 4(a)

**4** A student uses this apparatus to investigate the colours in four different inks, A, B, C and D.




(a) Explain two mistakes the student made when setting up his experiment.

## Mark scheme

| | | | |
|---|---|---|---|
| 4a | Explanations that link together the following two pairs of points:<br><br>**M1** baseline has been drawn in ink<br><br>**M2** and therefore it will interfere with /contaminate the results<br><br>**M3** the water level is above the ink spots<br><br>**M4** and therefore the inks will mix with the water | **ACCEPT** not drawn in pencil<br><br>**ACCEPT** will produce other colours/will move up the paper/will get mixed up with the ink samples<br><br>**ALLOW** pencil will not interfere with the results/ pencil will not dissolve<br><br>**ACCEPT** too high/above the baseline<br><br>**ACCEPT** the spots are under water<br><br>**ACCEPT** the inks will dissolve in the water / the inks will wash off the paper | **4** |

## Exemplar response A

1 The water is above the baseline.
This will make the inks dissolve in the water and not travel up the paper

2 The baseline is drawn in ink which is soluble and will therefore confuse results because it would travel up the paper as well

**Examiner's comments:**

**This response was given 4 marks.**

This is a clear and concise answer.

The response stated that the water is above the baseline which scores marking point 3 and explained that this means the inks will dissolve in the water which scores marking point 4.

It has also said that the baseline is drawn in ink which scores mark point 1 and that this will confuse the results as it will travel up the paper as well which scores marking point 2.

The command word here is '**explain'**; in order to gain full marks, candidates need to identify the two mistakes and for each mistake explain why this will prevent the experiment from giving clear results.

## Exemplar response B

1 The chromatography paper has not been held at the top hence not putting it in a fixed position.

2 The baseline for the inks should be above the solvent. The students is inside the solvent meaning the ink will be ~~sh~~ washed off.

**Examiner's comments:**

**This response was given 2 marks.**

The first paragraph in this response is not creditworthy, as the obvious mistakes in the diagram are the baseline being drawn in ink and the water level being above the inks, so these were the only two answers that were credited.

The second paragraph scores marking point 3 for the inks being above the solvent and marking point 4 for saying that the ink will be washed off.

When answering a question of this nature, candidates will only be credited for answers which will prevent the experiment from giving clear results. Diagrams showing how a chromatogram is set up do not always show the paper being supported at the top, so this is not considered as a mistake here, so cannot be credited.

# Question 6(c)

(c) A displacement reaction can also be used to decide the order of reactivity of two metals.

State two observations made when an excess of magnesium powder is added to an aqueous solution of copper(II) sulfate.

## Mark scheme

| | | | |
|---|---|---|---|
| c | **M1** brown/pink/pink-brown solid forms<br><br>**M2** solution turns colourless | **ALLOW** red-brown /orange-brown<br><br>**IGNORE** red or orange alone<br><br>**ALLOW** precipitate for solid<br><br>**ALLOW** solution becomes paler<br><br>**IGNORE** clear<br><br>**IGNORE** incorrect initial colour of solution<br><br>**IGNORE** references to magnesium disappearing<br><br>**IGNORE** references to heat | **2** |

## Exemplar response A

1 A The blue ~~blue~~ colour of the solution fades as colourless $MgSO_4$ solution is formed

2 A pink - brown deposit of copper will be formed.

**Examiner's comments:**

**This response was given 2 marks.**

This response has scored marking point 2 for the solution becoming colourless and marking point 1 for the pink-brown deposit of copper. Deposit is an acceptable alternative to solid or precipitate.

When giving observations in order to gain full marks, candidates must state both the colour and the physical state of the products formed. If this response had just stated that pink-brown copper was formed, the marking point would not have been awarded as it needs to say that copper is a solid. Similarly It also need to mention the solution when referring to the colour change of the solution.

Candidates need to revise practical chemistry more thoroughly including any observations made, as every exam paper will test practical chemistry as well as theoretical chemistry.

## Exemplar response B

1 A magnesium will displace copper, and therefore a brown solution will be formed

2 Effervescence

**Examiner's comments:**

**This response was given 0 marks.**

This response has unfortunately stated that a brown solution will be formed instead of a brown solid so cannot be awarded marking point 1. Saying that magnesium will displace copper is correct but this is not an observation so is not creditworthy.

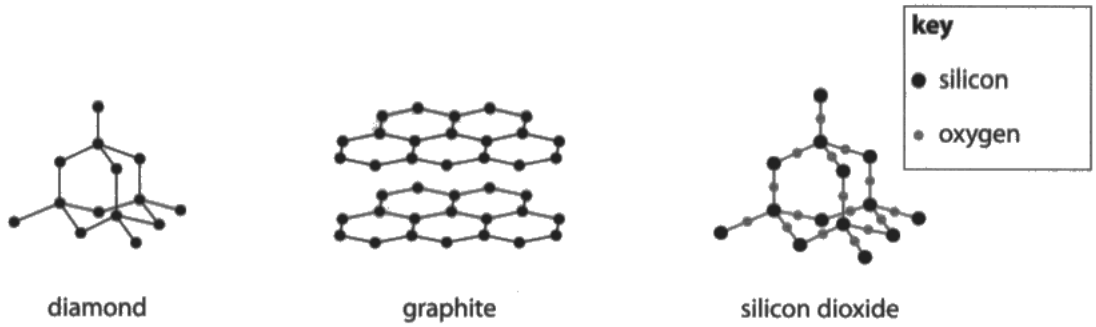
Effervescence was a common response to this question but as there is no gas evolved in this reaction no credit can be given for this answer.

Reference to magnesium disappearing was also a common response but was not creditworthy as the question states that excess magnesium was used. Candidates need to read the questions more carefully as substances that are in excess will not have disappeared even when the reaction has finished.

# Question 7(c)

**7** Diamond, graphite and silicon dioxide all have giant covalent structures.

The diagram shows the structures of these three substances.




(c) State why diamond is hard but graphite is soft.

## Mark scheme

| | | | |
|---|---|---|---|
| c | **M1** (diamond is hard because) it has a 3D lattice/rigid lattice /tetrahedral lattice /every carbon is bonded to four other carbons<br><br>**M2** (graphite is soft because) the layers can slide over one another | **ALLOW** 3D/ rigid/ tetrahedral structure<br><br>**REJECT** mention of intermolecular forces in diamond<br><br>**IGNORE** mention of intermolecular forces between layers in graphite | **2** |

## Exemplar response A

Diamond has a giant 3D lattice tetrahedron structure, with strong covalent bonds between all carbon atoms, while graphite has a hexagonal structure with weak inter-molecular forces between its sheets (this allows graphite to act as a lubricant, when sheets slide over one another).

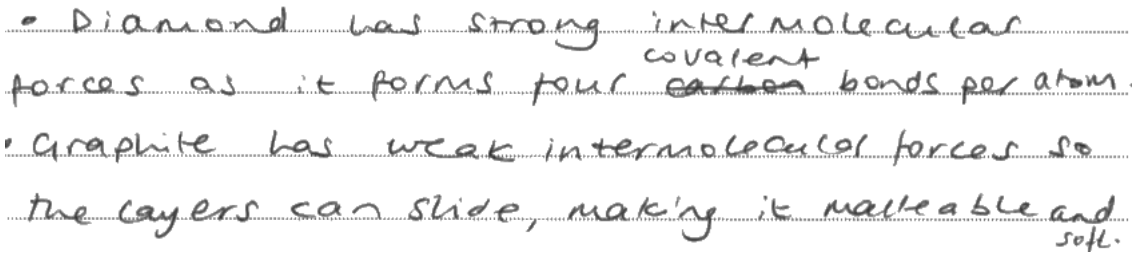
**Examiner's comments:**

**This response was given 2 marks.**

This response has stated that diamond has a 3D lattice and a tetrahedron structure. Both statements score marking point 1. It has talked about the sheets in graphite sliding over one another. Sheets is an acceptable alternative for layers so marking point 2 can be awarded.

In order to gain full marks, candidates need to focus on the differences between the two structures, which give the substances their different properties. The command word here is '**state'** so two statements need to made, one for each substance. It is not enough to say that diamond has strong bonds between atoms, as graphite also has strong bonds between atoms within the layers. There must be some reference to the overall tetrahedral or 3D lattice or the idea of every carbon atom being bonded to 4 others, as these statements are only applicable to diamond.

## Exemplar response B




**Examiner's comments:**

**This response was given 1 mark.**

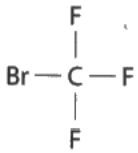
This response has mentioned intermolecular forces in diamond so cannot be awarded marking point 1 as diamond is a giant covalent structure and only simple molecular structures have intermolecular forces. Four covalent bonds per atom is not quite enough for marking point 1 even if intermolecular forces had not been mentioned, as they need to state that every carbon atom is bonded to 4 others to gain the marking point.

Marking point 2 however can be awarded for layers sliding, as mention of intermolecular forces in graphite, although not strictly correct, is ignored as the forces between the layers are weak.

Candidates will always be penalised for mentioning intermolecular forces in giant covalent, ionic or metallic structures or for referring to the breaking of covalent bonds in simple molecular structures. Teachers need to stress the importance of referring to the correct type of forces or bonds in the different types of structures.

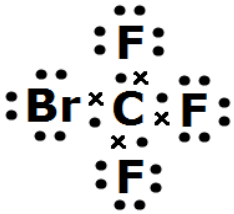
# Question 9(b)

(b) The diagram shows the displayed formula of a molecule of Halon 1301.

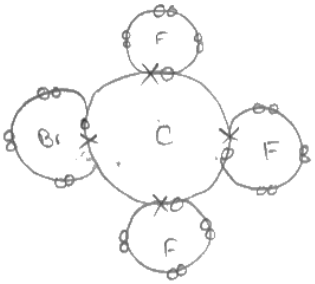



Draw a dot-and-cross diagram to show all the outer electrons in this molecule.

## Mark scheme

| | | | |
|---|---|---|---|
| b |  <br><br>**M1** all four bonding pairs correct **M2** rest of electrons correct | **ACCEPT** any combination of dots and crosses<br><br>**IGNORE** inner shell electrons even if incorrect<br><br>**M2** DEP on **M1** | **2** |

## Exemplar response A



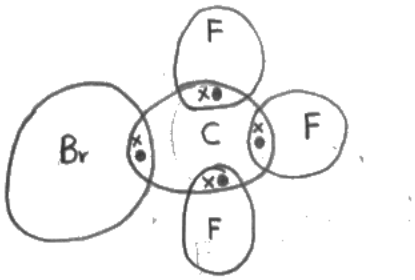

**Examiner's comments:**

**This response was given 2 marks.**

A clear fully correct dot and cross diagram, so both marking points can be awarded.

When drawing a dot and cross diagram, in order to gain full marks and avoid making careless mistakes, start by drawing the bonding pairs of electrons. Next complete the diagram by drawing electrons in pairs around each atom making sure there are eight electrons in total around every atom, except for hydrogen, which just needs two electrons. Circles round the atoms are not necessary. The diagram shown in the mark scheme is the best way to draw a dot and cross diagram.

## Exemplar response B




**Examiner's comments:**

**This response was given 1 mark.**

This response has correctly shown four bonding pairs of electrons so can be awarded marking point 1, however it has failed to draw the lone pairs around the F and Br atoms so marking point 2 is not awarded. All outer shell electrons must be shown to score full marks for a dot and cross diagram.

# Question 11(b)(ii)

(ii) Describe how anhydrous copper(II) sulfate is used to test for water.

## Mark scheme

ii A description that links together the following two points:

| Question number | Answer | Notes | Marks |
|---|---|---|---|
| ii | A description that links together the following two points:<br><br>**M1** white (anhydrous copper(II) sulfate)<br><br>**M2** turns blue (in the presence of water) | | **2** |

## Exemplar response A

anhydrous copper (II) sulphate is white and when water is added it turns blue. This can be used to test ~~a~~ for water.

**Examiner's comments:**

**This response was given 2 marks.**

This is a clear concise answer which describes the appearance of the copper(II) sulfate both before and after adding water, so both marking points can be awarded. The command word here is '**describe**'; when describing a test candidates should state what reagent they are using in the test and also give the result of the test, including any colour changes which occur.

## Exemplar response B

Reacting anhydrous copper (II) sulfate with water will shows a ~~colour~~ colour change to blue.

**Examiner's comments:**

**This response was given 1 mark.**

This response knows that reacting water with anhydrous copper(II) sulfate results in a colour change to blue so scores marking point 2. However in order to score both marks in this question, candidates need to describe the test fully giving the colour both before and after adding the water.

# Question 13(e)

(e) The ionic equation for the reaction between magnesium and hydrochloric acid is

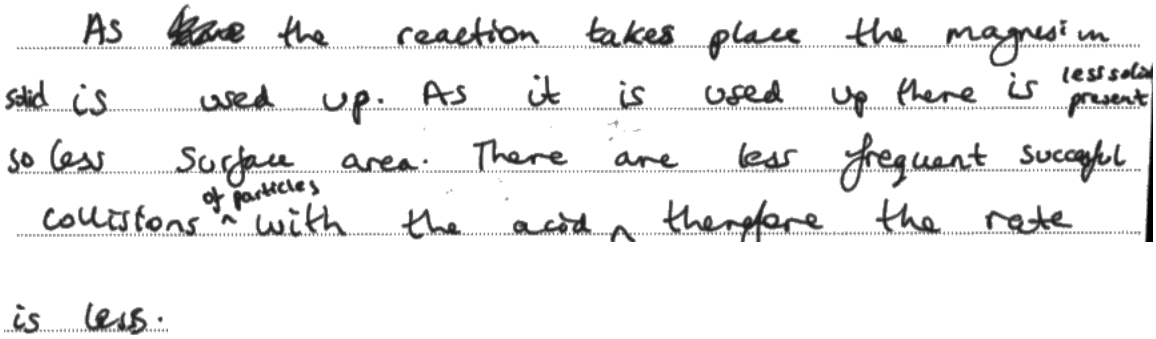
$$Mg(s) + 2H^+(aq) \rightarrow Mg^{2+}(aq) + H_2(g)$$

Use the information in this equation, and the particle collision theory, to explain why the rate of reaction decreases during each of the experiments.

## Mark scheme

| | | | |
|---|---|---|---|
| 13 e | An explanation that links the following points:<br><br>**M1** the concentration of the acid/hydrogen ions/$H^+$ (ions) decreases<br><br>**M2** therefore there are fewer (successful) collisions (between the hydrogen ions/$H^+$ ions and the magnesium atoms)<br><br>**M3** per second/per unit time | **ALLOW** there are fewer hydrogen ions/$H^+$ (ions) in the same volume<br><br>**ALLOW** the surface area of the magnesium decreases<br><br>less frequent collisions/ slower collision rate scores **M2** and **M3**<br><br>**M3** dep on **M2**<br><br>**IGNORE** less chance of collision<br><br>**MAX 1** if reference to energy of particles changing | **3** |

## Exemplar response A




**Examiner's comments:**

**This response was given 3 marks.**

This response has explained that as the reaction takes place the magnesium is used up so there is less surface area. This is an allowable answer for marking point 1. It has gone on to say that there are less frequent successful collisions which scores marking point 2 and marking point 3.

The command word here is '**explain'**. To gain full marks, candidates need to refer to the decrease in concentration of the acid as the reaction progresses or the reduction in surface area of the magnesium ribbon. Candidates then need to go on to use particle collision theory to explain that this results in less collisions per unit time.

## Exemplar response B

As there is a decrease in concentration of hydrochloric acid meaning there are likely to be fewer collision leading to a decrease in rate of reaction.

**Examiner's comments:**

**This response was given 2 marks.**

This response has stated that there is a decrease in concentration of hydrochloric acid which scores marking point 1. It has gone on to explain that there are likely to be fewer collisions which scores marking point 2, but as there is no reference to per unit time or frequency marking point 3 cannot be awarded here.

Candidates need to be aware that any mention of a decrease in energy of the particles in this question would limit them to a maximum of 1 marking point, as the energy of the particles will only change if the temperature is changed.

# Question 14(e)

(e) Describe how the student could obtain a pure, dry sample of hydrated copper(II) sulfate crystals from the filtrate in stage 6.

## Mark scheme

| | | | |
|---|---|---|---|
| 14 e | **M1** heat/boil the filtrate<br><br>**M2** until crystals form in a cooled sample/ on a glass rod<br><br>**M3** leave the solution to cool/crystallise<br><br>**M4** filter (to remove the crystals)<br><br>**M5** dry the crystals on filter paper/on paper towel/in a warm oven /in a desiccator /leave to dry | **NOTE:** If the solution is heated to remove all the water then only **M1** can be awarded<br><br>**NOTE** If the solution is left to evaporate all the water without heating only 1 mark can be awarded<br><br>**ACCEPT** to crystallisation point /to form a saturated solution<br>/until crystals start to form /to remove some of the water<br><br>**M2** dep on **M1**<br><br>**NOTE**: If the solution is left to completely evaporate after heating then award MAX 3<br><br>**ACCEPT** decant the (excess) solution<br><br>**IGNORE** references to washing the crystals<br><br>**REJECT** hot oven or any method of direct heating e.g. Bunsen burner<br><br>No **M5** if crystals washed after drying | 5 |

## Exemplar response A

The filterate is transferred to an evaporating basin. It is then heated until crystallisation point using a bunsen flame. It is left to cool. The crystals are seperated by filteration. The A little amount of cold distilled (deionised) water is added to lower the solubility. The crystals are left to dry, within a filter paper.

**Examiner's comments:**

**This response was given 5 marks.**

This is a clear and concise description which covers all 5 marking points. Marking point 1 and marking point 2 are awarded for heating the filtrate to crystallization point, marking point 3 for leaving to cool and marking point 4 for separating the crystals by filtration. Adding a little water is irrelevant and can be ignored but marking point 5 can be awarded for leaving the crystals to dry on a filter paper.

This question requires a description of a practical chemistry task. In order to gain full marks, clear steps needed must be given. An answer using bullet points would be appropriate here, showing the 5 steps to gain the 5 marking points. Candidates should avoid wasting time by referring to anything that is done before stage 6 of the preparation as these steps have already been covered earlier in the question.

## Exemplar response B

- First place the filtrate over a bunsen burner and heat till ⅓ of the solution has evaporated / heat until it is boiling.
- then leave to dry for a week between two pieces of filter paper in a drying cupboard
- remove after a week and blue crystals should have formed around filtrate
- wash crystals with deionised water to clear any impurities

**Examiner's comments:**

**This response was given 2 marks.**

This response can be awarded marking point 1 and marking point 2 for heating the filtrate until one third of the solution has evaporated. Marking point 5 could have been awarded for leaving the crystals to dry but unfortunately, they have gone on to wash the crystals with deionized water so the crystals will not be dry. Adding an unnecessary step here has lost this candidate a mark. Marking point 3 and marking point 4 have not been awarded as there is no mention of leaving the solution to cool or crystallise or of filtering to obtain the crystals.

# Question 14(f)(i)

(f) The overall equation for the formation of hydrated copper(II) sulfate crystals from copper(II) oxide is

$$CuO(s) + H_2SO_4(aq) + 4H_2O(l) \rightarrow CuSO_4.5H_2O(s)$$

(i) In an experiment, a student completely reacts 9.54 g copper(II) oxide.

Show that the maximum possible mass of $CuSO_4.5H_2O$ crystals that can be obtained is about 30 g.

[$M_r$ of CuO = 79.5 $M_r$ of $CuSO_4.5H_2O$ = 249.5]

Give your answer to an appropriate number of significant figures.

## Mark scheme

| | | | |
|---|---|---|---|
| 14 f i | • • calculate the moles of CuO<br>• • calculate the mass of CuSO4.5H2O<br>• • give the answer to an appropriate number of significant figures<br><br>Example calculation<br><br>**M1** *n*[CuO] = 9.54 ÷ 79.5 OR 0.120 (mol)<br><br>**M2** mass of CuSO4.5H2O = 0.120 × 249.5 **OR** 29.94 (g)<br><br>**M3** = 29.9<br><br>**OR**<br><br>1. **M1** 79.5(g) gives 249.5(g)<br>2. **M2** 9.94(g) gives (249.5÷79.5)×9.54(g) **OR** 29.94 (g)<br><br>**M3** = 29.9 | Final answer must be to 3 sig figs<br><br>29.94 with no working scores 2<br><br>29.9 with no working scores 3 | 3 |

## Exemplar response A

$m(CuO) = \frac{9.54}{79.5} = 0.12$.

(3)

$0.12 \times 249.5 = 29.94$
$= 29.9$
$= 30g$

$\frac{9.54}{79.5} = 0.12$

mass = 29.9 g

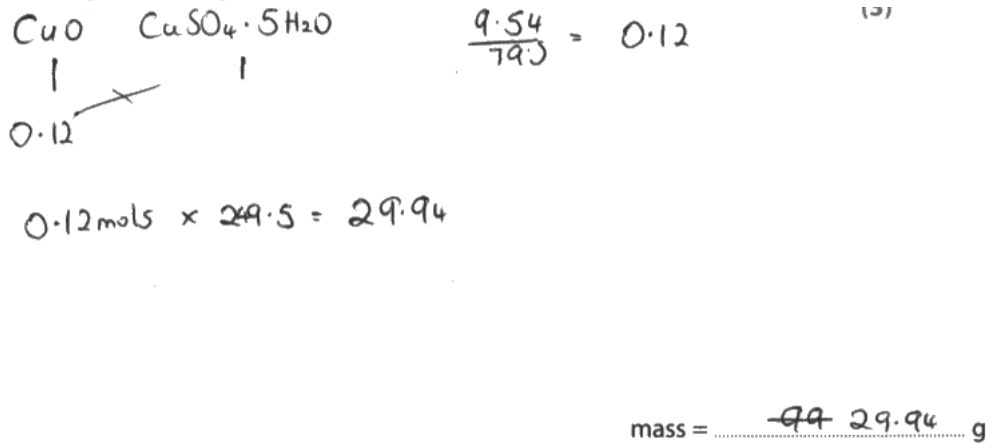
**Examiner's comments:**

**This response was given 3 marks.**

This is a fully correct calculation. Marking point 1 is awarded for finding the moles of CuO and marking point 2 for multiplying the moles by 249.5. The answer has been given to 3 significant figures, which is the appropriate number, because the mass and Mr of CuO have also been given to 3 significant figures.

This question is a '**show that'** calculation. Clear working should be shown in order to gain full marks. When asked to give an answer to an appropriate number of significant figures candidates need to refer to the data in the question. As most of the data is given to 3 significant figures here an answer to 2 or 4 significant figures is not appropriate. When a question states that the answer should be about 30g the calculated answer will not be 30g but will be close to 30g. If candidates obtain an answer that is not close to 30g they have obviously made a mistake, so they should go back and check their working.

## Exemplar response B




**Examiner's comments:**

**This response was given 2 marks.**

This response has shown the working clearly and can be awarded marking point 1 for finding the moles and marking point 2 for finding the mass. Unfortunately, '4 significant figures' is not appropriate for the final answer, so marking point 3 cannot be awarded.

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