Controlled Assessment – Additional Science/Chemistry ISA CU2.x

Rates of reaction (Specimen)

For use from May 20xx to April 20xx

Teachers' Notes

This ISA relates to Additional Science / Chemistry Unit 2: **C2.4 Rates of reaction**

Being able to speed up or slow down chemical reactions is important in everyday life and in industry. Changes in temperature, concentration of solution, gas pressure, surface area of solids and the presence of catalysts all affect the rates of reactions.

Overview

Candidates should:

- develop hypotheses and plan practical ways to test them
- make risk assessments and manage risks when carrying out practical work
- collect, process, analyse and interpret primary and secondary data, including the use of appropriate technology to draw evidence-based conclusions
- review methodology to assess fitness for purpose, and review predictions in light of outcomes.

The teacher should describe the context in which the investigation is set and outline the problem that is to be investigated.

Candidates need to develop their **own** hypothesis. They should research **two** possible methods to investigate it, and develop a detailed plan for one of these methods.

Once the candidates have researched and written up their own plan in the first part of the ISA they should carry out their investigation providing that it is workable safe and manageable in the laboratory.

Candidates then take Section 1 of the ISA, which contains questions about their research and their plan.

Candidates then carry out experimental work and process their results.

After this, candidates take Section 2 of the ISA, in which they analyse their results and use data selected from a data sheet of secondary data to comment on the outcomes of their experimental work

Risk Assessment

It is the responsibility of the centre to ensure that a risk assessment is carried out.

Stage 1 – Planning research (Limited control)

Candidates should be given the opportunity to carry out an investigation concerning the rate of a chemical reaction. This should be set in a context by the centre. Examples of suitable contexts could include, eg industrial processes or the rate at which antacid tablets work. Whichever context is chosen, the teacher must take care to present it in such a way that it does not limit the candidates' choice of method for the investigation.

Candidates should then independently research an appropriate plan and decide for themselves factors such as the range, interval and number of repeat readings that they should take, and the variables that need to be controlled.

They will need to undertake independent research to identify **two** different methods that could be used. During this time they may make **one** A4 side of their **own** research notes for use during Section 1 of the ISA. The sheet for making these notes is attached.

Candidates may use technology such as the Internet or CD-ROMs, textbooks or any other appropriate sources of information for their research.

Candidates should also research the context of this investigation to find out how the results of their experiment might be useful in the specified context.

There is no set time allocation for this research, but it is anticipated that it should take no longer than 3 hours of work. This research may be done in the laboratory or elsewhere.

The teacher should check and sign these notes before allowing the candidate to use them during the completion of Section 1 of the ISA. The candidate may use these notes while completing Section 1 and Section 2 of the ISA. When the candidate has completed Section 2, the notes should be stapled to the ISA.

Stage 2 – Reporting on the planning research (High control)

For this stage, candidates must work individually under direct supervision.

After candidates have completed their research they should be given Section 1 of the ISA and should work on their own, under controlled conditions, to answer it. Candidates may take brief notes of up to one A4 side of their **own** research into the formal assessment period. These must be checked to ensure they do not contain plagiarised text, detailed planning grids or a pre-prepared draft.

Section 1 requires candidates to:

- report on their research into how to test the hypothesis they have made
- outline two possible methods from their research to investigate their hypothesis
- give reasons for why one method is preferable to the other
- write a detailed plan of their chosen method
- identify possible hazards and write down how the risks may be minimised
- draw a suitable blank table in which the results could be recorded for the method they have planned.

Candidates may choose to use technology to draw the table, eg a computer spreadsheet. **This must be done under the direct supervision of the teacher**. It should **not** be stored, but should be printed immediately and attached to the ISA paper.

While answering Section 1 of the ISA, candidates must **not** be allowed to use textbooks, the Internet or any other source of help apart from (a maximum of) **one** A4 side of their **own** research notes.

Stage 3 – Practical Work (Limited control)

For this stage, candidates may work individually or in groups.
Candidates may work in groups to carry out their plans, but each candidate must contribute to the collection of data.
Candidates may use appropriate technology during the practical work, eg data loggers or sensors.
If the teacher deems that the plan provided by the candidate is unworkable, unsafe or unmanageable or for any other reason unsuitable, then the teacher may provide a plan. An example of a suitable plan is attached to these notes.
The teacher may also provide a blank table for the results if the table produced by the candidate is inadequate. In such cases the candidate would not be able to score full marks for producing a table.

Stage 4 – Processing primary data (High control)

For this stage, candidates must work individually under direct supervision.
Candidates should be given back their table of results, and be asked to display these on a bar chart or line graph. Candidates must decide for themselves which format is the more appropriate for any particular investigation. Candidates may use appropriate technology to do this, eg a graph-drawing program on a computer.

If a candidate chooses to use a computer, this must be under the direct supervision of the teacher and the bar chart or line graph must be printed straight away.

Candidates must not be allowed to take their results and chart or graph away, the teacher must collect them at the end of the lesson.

Stage 5 – Analysing results (High control)

For this stage, candidates must work individually under direct supervision.

Candidates take Section 2 of the ISA.

They require:
- a copy of the question paper,
- a copy of the AQA supplied Data Sheet,
- their own table of results
- their own chart or graph.
- their A4 sheet of research notes.

The teacher should have recorded the marks for each candidate's table and chart or graph before these are given back. This ensures that a candidate cannot gain an unfair advantage by making any alterations to them at this stage.

AQA provides the Data Sheet of secondary data. In Section 2 of the ISA, candidates are required to select and process data from the sheet.

Candidates' work must not be annotated, either by the teacher or the candidate, with additional information which would give them an unfair advantage during the ISA, eg the use of the terms independent/dependent variable.

Section 2 requires candidates to:
- analyse their own results
- draw a conclusion
- match their results to a hypothesis
- evaluate the method of collection and the quality of the resulting data
- analyse secondary data drawn from the same topic area as their experimental work
- relate their findings to the context set in the ISA.

If the teacher deems that the plan provided by the candidate is unworkable, unsafe or unmanageable or for any other reason unsuitable, then the teacher may provide a plan.
The following is an example of a method that could be supplied by the teacher.

Example of a Method Sheet for Chemistry Controlled Assessment CU2.x

Reaction of sulfuric acid with magnesium

It is the responsibility of the centre to ensure that a risk assessment is carried out.

In this investigation magnesium reacts with different concentrations of sulfuric acid in a conical flask which is connected to an inverted measuring cylinder in a trough of water.
The volume of hydrogen produced is measured over a few minutes and the results are used to plot a graph.

Apparatus list:

Stopclock/stopwatch
Conical flask (100 cm^3)
Delivery tube with a single-holed stopper to fit conical flask
Trough or washing-up bowl
Two measuring cylinders (100 cm^3)
Clamp stand, boss and clamp
3 cm lengths of clean magnesium ribbon
Dilute sulfuric acid: 0.25, 0.50, 0.75, 1.0 and 1.25 mol dm^{-3}

Method:

Use only one acid concentration at a time.

1 Measure 50 cm^3 of 0.25 mol dm^{-3} sulfuric acid using one of the measuring cylinders. Pour the acid into the 100 cm^3 conical flask.

2 Set up the apparatus.
- Half fill the trough/bowl with water.
- Fill the other measuring cylinder with water and place it upside down in the trough/bowl of water. (Make sure that the measuring cylinder stays filled with water.)

3 Add a 3 cm strip of magnesium ribbon to the conical flask, put the stopper into the top of the flask as quickly as you can and start the stopclock/stopwatch.

4 Record the total volume of hydrogen given off every 15 seconds. Continue timing and recording the total volume of hydrogen until no more gas appears to be given off.

Centre-assessed work
Candidate Research Notes

GCSE Science A (4405/ 4406) Additional Science (4408/4409)
Biology (4401) Chemistry (4402) Physics (4403)

SCA4P ☐ AS4P ☐ BL4P ☐ CH4P ☐ PH4P ☐

Centre Number _____ Centre Name _____

Candidate's Name _____ Candidate's Number _____

Investigation Title

_____

ISA number: _____

The notes the candidate takes into the Controlled Assessment task are to be recorded in the spaces on this sheet.

This sheet should be given to the teacher for checking before it is used in Section 1 of the ISA.

When Section 1 of the ISA has been completed, this sheet should be retained by the teacher for subsequent use with Section 2

When Section 2 of the ISA has been completed, this sheet should be stapled to it.

Declaration

I confirm that these are the only preparation notes used in the Controlled Assessment task.

Teacher signature	Candidate signature

Date: _____

This form can be downloaded from Secure Key Materials in e-AQA

Hypothesis
Research sources
Method(s)
Equipment
Risk assessment issues
Relating the investigation to the context

Centre Number						Candidate Number				
Surname						Other Names				

Notice to Candidate. The work you submit for assessment must be your own. If you copy from someone else or allow another candidate to copy from you, or if you cheat in any other way, you may be disqualified.

Candidate Declaration. I have read and understood the Notice to Candidate and can confirm that I have produced the attached work without assistance other than that which is acceptable under the scheme of assessment.

Candidate Signature		Date	

For Teacher's Use	
Section	Mark
Section 1 (/20)	
Section 2 (/30)	
TOTAL (max 50)	

General Certificate of Secondary Education

June 20xx

Additional Science/Chemistry (Specimen)

Controlled Assessment ISA CU2.x Rates of Reaction Section 1

For submission on 7 May 20xx

Time allowed up to 45 minutes

For this paper you must have:
- your research notes
- a pencil and ruler.

You may use a calculator.

Instructions
- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions in **Section 1** in the spaces provided. You may use extra paper.
- Do all rough work in this book.
- Cross through any work you do not want to be marked.

Information
- The marks for questions are shown in brackets.
- The maximum mark for this Section 1 paper is 20.
- The maximum mark for the Controlled Assessment Unit is 50.
- You are reminded of the need for good English and clear presentation in your answers.

Details of additional assistance (if any). Has the candidate received any help or information from anyone other than the subject teacher(s) in the production of this work? If the answer is yes give the details below or on a separate page.

Yes ☐ No ☐

Teacher Declaration:
I confirm that the candidate's work was conducted under the conditions laid out by the specification. I have authenticated the candidate's work and am satisfied that to the best of my knowledge the work produced is solely that of the candidate.

Signature of teacher …… Date ……

Section 1

Your task is to do an investigation on a factor that affects the rate of reaction.

1 Think about the research that you did on this investigation.

Name the **two** most useful sources that you used for your research.

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Explain why these sources were the most useful.

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(*3 marks)*

2 Write a hypothesis about **one** factor that affects the rate of reaction.

Write down your hypothesis.

Hypothesis……

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Use information from your research to explain why you made this hypothesis.

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(*3 marks)*

3 *In this question you will be assessed on using good English, organising information clearly and using scientific words where appropriate.*

From the research that you have done, describe in detail how you are going to do your investigation.

You should include:

- the equipment that you plan to use
- how you will use the equipment
- the measurements that you are going to make
- how you will make it a fair test
- a risk assessment.

You may include a labelled diagram.

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(9 marks)

4 In your research, you will have found other methods that you could have used.

Outline **one other** method that you could have used and explain why you decided **not** to use this method.

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(3 marks)

5 You will need a table for your results.

If you have not already produced a table for all the data that will need to be recorded, you should do so now.

You may use technology such as ICT to do this if you wish.

Attach your table below.

Make sure that you hand in your A4 side of research notes and your blank table for the results with this paper.

You will be awarded up to two marks for your table.

(2 marks)

20

END OF SECTION 1

Centre Number						Candidate Number				
Surname						Other Names				

Notice to Candidate. The work you submit for assessment must be your own. If you copy from someone else or allow another candidate to copy from you, or if you cheat in any other way, you may be disqualified.

Candidate Declaration. I have read and understood the Notice to Candidate and can confirm that I have produced the attached work without assistance other than that which is acceptable under the scheme of assessment.

Candidate Signature		Date	

For Teacher's Use	
Section	Mark
Section 1 (/20)	
Section 2 (/30)	
TOTAL (/50)	

General Certificate of Secondary Education

June 20xx

Additional Science/Chemistry (Specimen)

Controlled Assessment ISA CU2.x Rates of Reaction Section 2

For submission on 7 May 20xx

Time allowed 50 minutes

For this paper you must have:
- results tables and charts or graphs from your investigation
- the Data Sheet(enclosed)
- your research notes
- a pencil and ruler

You may use a calculator.

Instructions
- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions in **Section 2** in the spaces provided.
- Do all rough work in this book.
- Cross through any work you do not want to be marked.

Information
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 30.
- The maximum mark for the Controlled Assessment Unit is 50.
- You are reminded of the need for good English and clear presentation in your answers.

Details of additional assistance (if any). Has the candidate received any help or information from anyone other than the subject teacher(s) in the production of this work? If the answer is yes give the details below or on a separate page.

Yes ☐ No ☐

Teacher Declaration:
I confirm that the candidate's work was conducted under the conditions laid out by the specification. I have authenticated the candidate's work and am satisfied that to the best of my knowledge the work produced is solely that of the candidate.

Signature of teacher …… Date ……

These questions are about the investigation that you were given to test the hypothesis.

1 (a) What conclusion can you make from your investigation about a link between the concentration of the reactants and the rate of reaction?
You should use any pattern that you can see in your results to support your conclusion.
You should quote some figures from your data to support your answer.

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(3 marks)

1 (b) Compare your results with those of others in your class or with your teacher's results.

1 (b) (i) Do you think that your results are **reproducible**?
Explain the reasons for your answer.

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(3 marks)

1 (b) (ii) Explain how you could use the results from the rest of the class to obtain a more **accurate** answer.

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(3 marks)

2 Think about the quality of your results.

Do you think that you got any anomalous results?

Explain your answer by quoting some data from your investigation..

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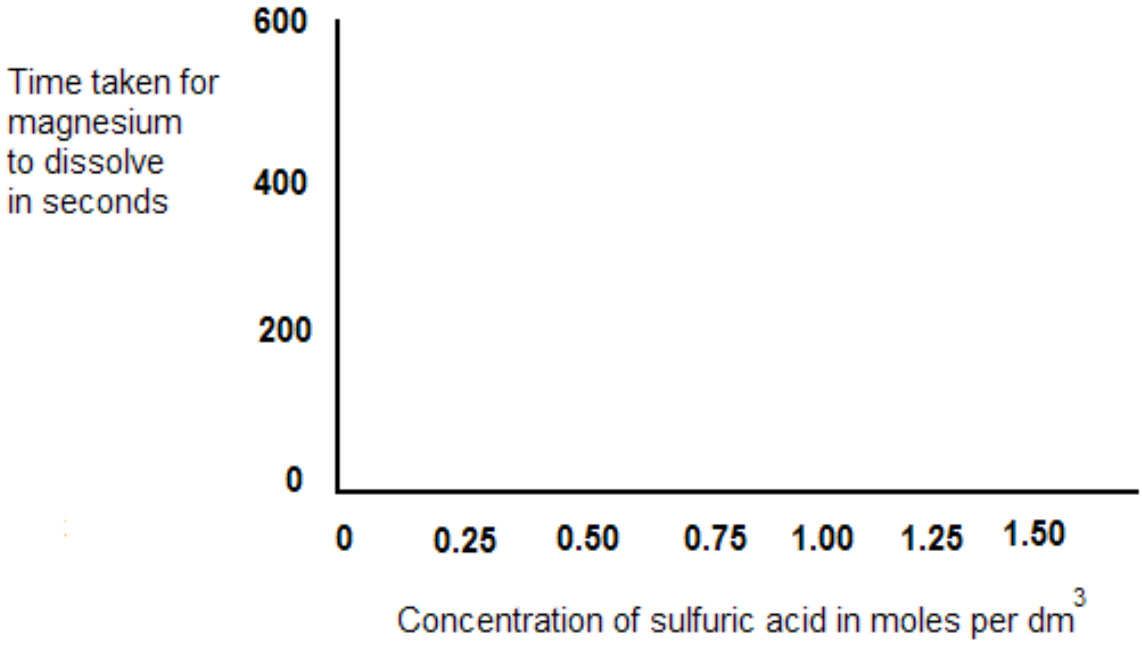
(3 marks)

3 Look at the Case Studies on the Data Sheet.

3 (a) Use results from the table in **Case Study 1** to sketch a graph to show the effect of the concentration of sulfuric acid on the time taken for the magnesium to dissolve.



(2 marks)

3 (b) Look at **Case Studies 1 to 3**.

To what extent does the data in **Case Studies 1 to 3** support or contradict **your** hypothesis for this investigation?

Give the reasons for your answer using data from these Case Studies.

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(3 marks)

4 Offshore wind turbines are made of steel. Sulfur dioxide in the air forms sulfuric acid that makes the steel corrode.

Blocks of magnesium can be fixed to the turbines to protect steel from corrosion.

The magnesium corrodes before the steel as it is more reactive.

A manufacturer of these magnesium blocks has a hypothesis that the concentration of sulfuric acid will affect the rate at which it reacts with magnesium.

4 (a) Do the results from your investigation and the investigations on the Data Sheet support or contradict this hypothesis?

You should quote some figures from the data to support your answer.

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(3 marks)

4 (b) The manufacturers intend to fix a 1 kg block of magnesium to the turbine. They want to find out how long it will take for this block to completely corrode when the turbine is in use.

Describe how the manufacturers could find out how long it will take.

You should include:

- how they could make use of the data on the sheet
- what other information they will need
- any control variables that they will need to consider.

Use ideas from your investigation and the investigations on the Data Sheet to help you.

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(3 marks)

5 Look at **Case Study 4**.

Compare the data from your investigation to the data shown.

Explain how far the data shown supports or contradicts **your** hypothesis.

You should use data from **Case Study 4** and your own investigation in your answer.

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(3 marks)

6 Make sure that you hand in your A4 sheet of notes, results tables, and charts or graphs with this paper.

You will be awarded up to four marks for your chart or graph.

(4 marks)

30

END OF QUESTIONS

Data Sheet for Controlled Assessment: Chemistry – CU2.X Rates of Reaction

The manufacturer's hypothesis is that the concentration of sulfuric acid will affect the rate at which it reacts with magnesium.

Below are four resources showing the results from rates of reaction investigations.

Case Study 1

A group of students carried out an investigation similar to the one that you did.
The 2 tables below show their results.

(a) They measured the time taken for the magnesium to dissolve in the acid.

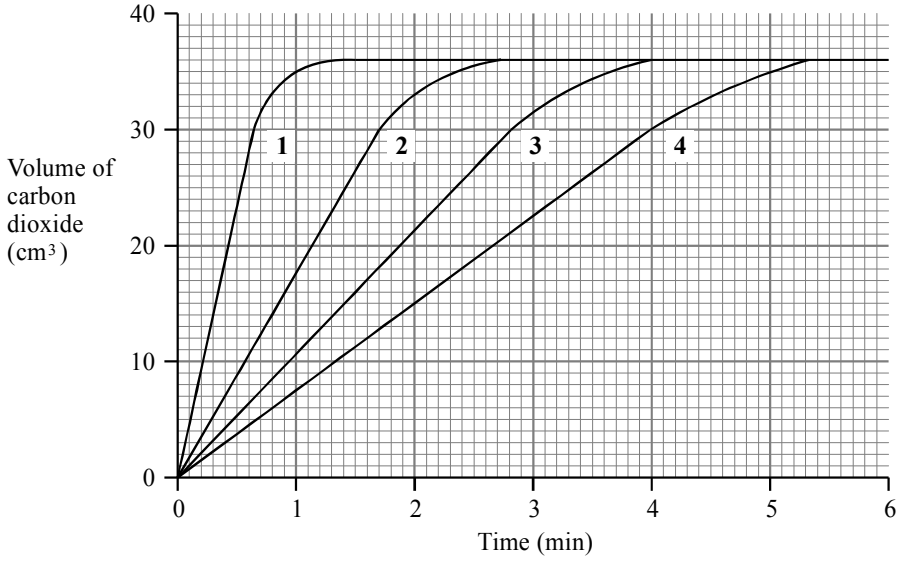
Concentration of sulfuric acid (moles per dm^3)	0.25	0.5	0.75	1.0	1.25	1.5
Time taken for magnesium ribbon to dissolve (s)	600	300	180	90	60	30

(b) Then they measured the volume of gas produced:

Time in seconds	0	10	20	30	40	50	60	70	80
Volume of gas in cm^3 produced using 1 mole per dm^3 sulfuric acid	0	360	550	690	780	830	860	880	900
Volume of gas in cm^3 produced using 1.25 moles per dm^3 sulfuric acid	0	600	750	820	870	900	920	920	920

Case Study 2

The graph below shows the volume of carbon dioxide gas released by marble chips in 4 different concentrations of hydrochloric acid.

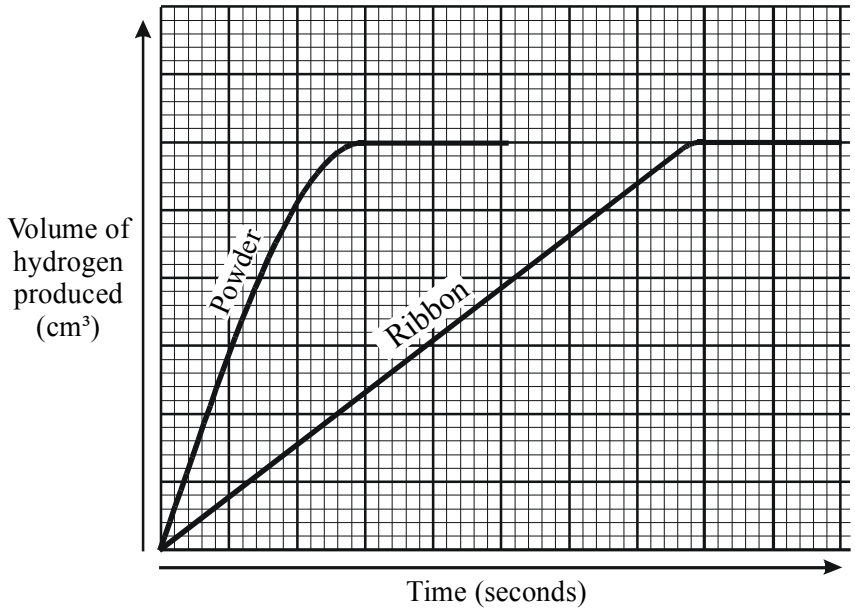


Concentrations of hydrochloric acid:

Line 1 = 2 moles per dm^3
Line 2 = 1 mole per dm^3
Line 3 = 0.5 mole per dm^3
Line 4 = 0.25 mole per dm^3

Case Study 3

This graph shows results from an investigation on the reaction between magnesium and acid.



Case Study 4

The results below are from a group of students who carried out a more extensive investigation to measure the volume of hydrogen gas produced in the reaction between magnesium ribbon and sulfuric acid.

Time (s)	Volume of hydrogen produced (cm^3)					Average volume of hydrogen gas (cm^3)
	test 1	test 2	test 3	test 4	test 5	
0	0	0	0	0	0	0
10	4	3	4	3	4	4
20	103	95	105	99	100	100
30	134	128	132	127	127	130
40	154	157	149	161	154	155
50	179	180	150	184	180	175
60	179	182	190	187	186	185
70	150	220	170	240	194	195
80	202	203	194	202	201	200

GCSE Science – Controlled Assessment ISA – Marking Guidelines

Additional Science/Chemistry ISA – CU2.x Rates of Reaction (Specimen)

For use from 1 May 20xx to 30 April 20xx

Please mark in red ink, and use one tick for one mark. Each part of each question must show some red ink to indicate that it has been seen. Subtotals for each part of each question should be written in the right-hand margin.

Enter the marks for **Section 1 and Section 2** and the **total mark** on the front cover of the answer booklet and fasten them together with the results table(s) and the graphical work and the candidate's research work from Section 1 of the ISA.

The teacher must sign and date the front cover of the ISA.

The papers must be kept in a secure place and must **not** be returned to the candidates.

These Marking Guidelines are largely generic. Teachers will be given additional guidance on how to relate these generic mark schemes to particular investigations.

SECTION 1				
The initial research				
Read through the whole of the candidate's answer and use the Marking Guidelines below to arrive at a 'best-fit' mark. The layout on the ISA has been designed to help the candidate to structure an answer, but it does not matter if the candidate has written part of the answer in what you consider to be the wrong section. Sources need not be identified in great detail, eg the exact URL is not required for an internet source, simply the name of the website.				
	3 marks	**2 marks**	**1 mark**	**0 marks**
Q. No. 1	The candidate identifies **two** relevant sources and explains why these were found to be useful	The candidate identifies at least **one** relevant source and explains why this was found to be useful **OR** The candidate identifies **two** relevant sources but fails to explain why they were useful	The candidate identifies at least **one** source but fails to explain why this was found to be useful **OR** The candidate refers to a poorly defined source (eg 'A physics text book') but explains why it was found to be useful	No relevant content

CU2.x Rates of Reaction -Specimen ISA - Marking Guidelines

The research hypothesis				
Q. No. 2	Read through the whole of the candidate's answer and use the Marking Guidelines below to arrive at a 'best-fit' mark, as candidates may meet some criteria but not others in a level. The layout on the ISA has been designed to help the candidate to structure an answer, but it does not matter if the candidate has written part of the answer in what you consider to be the wrong section.			
	3 marks	**2 marks**	**1 mark**	**0 marks**
	There is a clear hypothesis that identifies both the independent and the dependent variable The hypothesis is justified by information from the candidate's research	There is a clear statement that identifies both the independent and the dependent variable, and includes a plausible qualitative hypothesis, however the justification is unclear	The candidate has made a simple hypothesis that by implication identifies the independent and dependent variables, but there is no justification	No relevant content

Writing the plan				
	Read through the whole of the candidate's answer and use the Marking Guidelines below to arrive at a 'best-fit' mark, as candidates may meet some criteria but not others in a level.			
	9, 8 or 7 marks	**6, 5 or 4 marks**	**3, 2 or 1 marks**	**0 marks**
Q. No. 3	There is a clear and detailed scientific description of how the investigation should be carried out Control variables are clearly identified, with details of how they will be monitored or controlled, so that the method gives valid results Equipment and its use is clearly described and appropriate Most of the major hazards are identified, together with an assessment of the associated risks and corresponding control measures. There is an appropriate and logical sequence of steps A range of appropriate and relevant specialist terms are used accurately The response shows very few errors in spelling, punctuation and grammar	There is a description of how the investigation should be done so that valid results can be collected At least one control variable is identified Most of the necessary equipment required is described The major hazard is identified, together with a corresponding control measure but the risk assessment is weak or absent A sequence of steps is shown Some errors in spelling, punctuation and grammar	The method described is weak but shows some understanding of the sequence of an investigation Equipment is mentioned but is not always appropriate An appropriate hazard is identified, but the corresponding risk assessment and control measure is weak or absent There are frequent errors in spelling, punctuation and grammar	No relevant content

<table>
<tr><th colspan="5">Consequences of the initial research</th></tr>
<tr><td rowspan="3">Q. No. 4</td><td colspan="4">Read through the whole of the candidate's answer and use the Marking Guidelines below to arrive at a 'best-fit' mark, as candidates may meet some criteria but not others in a level.</td></tr>
<tr><td>3 marks</td><td>2 marks</td><td>1 mark</td><td>0 marks</td></tr>
<tr><td>An alternative method is outlined in sufficient detail so that the necessary steps are clear

Sensible explanations are given as to why this alternative method would not have been as good as the one chosen</td><td>An alternative method is outlined briefly although some of the necessary steps may not be clear

A suggestion is given as to why this alternative method would not have been as good as the one chosen</td><td>An alternative method is outlined briefly although some of the necessary steps may not be clear

OR

A suggestion is given as to why this alternative method would not have been as good as the one chosen</td><td>No relevant content</td></tr>
<tr><th colspan="5">Table for Results</th></tr>
<tr><td rowspan="2">Q. No. 5</td><td>2 marks</td><td colspan="2">1 mark</td><td>0 marks</td></tr>
<tr><td>Headings and units all correct for all measured variables</td><td colspan="2">Table with incomplete headings or units for the measured variables.

At least half of the required elements should be present</td><td>No table or a table with incomplete headings or units for the measured variables.

Fewer than half of the required elements are present</td></tr>
</table>

SECTION 2				
Read through the whole of the candidate's answer and use the Marking Guidelines below to arrive at a 'best-fit' mark, as candidates may meet some criteria but not others in a level.				
Analysing results				
	3 marks	**2 marks**	**1 mark**	**0 marks**
Q. No. 1 (a)	The candidate correctly concludes whether or not there is a quantitative relationship between the variables investigated and quotes some data to support this	The candidate correctly concludes whether or not there is a quantitative relationship between the variables investigated but fails to quote any data to support this	The candidate correctly concludes whether or not there is a qualitative relationship between the variables investigated but fails to quote any data to support this	No relevant content
	3 marks	**2 marks**	**1 mark**	**0 marks**
Q. No. 1 (b) (i)	Candidate states whether or not the results are considered reproducible **and** explains the reason:- **Either:** There is a clear description of a pattern in the results Repeated results confirm similar values obtained, with some specific examples given Other members of the class obtained similar results **Or:** There is reference to a wide scatter of results and no emerging pattern Repeated results give widely different values, with some specific examples given Other members of the class obtained very different results	Candidate states whether or not the results are considered reproducible **and** explains the reason:- **Either:** There is reference to a pattern in the results but the description is not clear Repeated results confirm similar values obtained, but no specific examples given Other members of the class obtained similar results **Or:** There is reference to a wide scatter of results and no emerging pattern Repeated results give widely different values, but no specific examples given Other members of the class obtained very different results	Candidate states whether or not the results are considered reproducible **and** explains the reason:- **Either:** There is reference to a pattern in the results, but the nature of the pattern is not made clear. There is reference to either the candidates own repeats or the results of others in the class **Or:** There is reference to a wide scatter of results and no emerging pattern, but no reference to repeated results or to the results of others in the class	No relevant content

Q. No. 1 (b) (ii)	**3 marks**	**2 marks**	**1 mark**	**0 marks**
	Candidate explains that the data should first be inspected for anomalous results and these discarded The remaining results should then be added together and divided by the number of values in order to calculate a mean	Candidate explains that the data should first be inspected for anomalous results and these discarded Candidate states that a mean should be calculated, but does not explain clearly how this should be done	Candidate states that a mean should be calculated but does not explain how to do this	No relevant content
Q. No. 2	**3 marks**	**2 marks**	**1 mark**	**0 marks**
	Candidate correctly states clearly whether there are or are not any anomalous results Candidate explains that anomalous results are ones that do not fit the pattern Candidate quotes some data from the results to support this, eg by specifying results that are considered to be anomalous or by referring to the fact that, eg all results are very close to a line of best fit	Candidate correctly states clearly whether there are or are not any anomalous results. Candidate explains that anomalous results are ones that do not fit the pattern but fails to quote any data from the results to support this	Candidate correctly states clearly whether there are or are not any anomalous results, but fails to explain how the data justifies this statement.	No relevant content
	NB the candidate's response must match the candidate's own data.			

Secondary Research				
Read through the whole of the candidate's answer and use the Marking Guidelines below to arrive at a 'best-fit' mark, as candidates may meet some criteria but not others in a level.				
Q No. 3 (a)	**2 marks**	**1 mark**	**0 marks**	
	Sketch has the general correct shape, starting from time = 600 s	Sketch has the general trend but is either a straight line or the line touches the x-axis	Sketch line does not represent the data	
Q. No. 3 (b)	**3 marks**	**2 marks**	**1 mark**	**0 marks**
	The candidate states that the data strongly supports the original hypothesis, and quotes some data from tables that support this. There is an appreciation that there is some evidence that is not relevant (Case Study 3). There is evidence that the candidate has inspected the data critically, eg by noticing that only two different concentrations were used in Case Study 1(b) or that in Case Study 2, there is not an exact mathematical relationship between rate and concentration (eg by calculating average rates for the four concentrations of by comparing the gradients of the straight portions of the graphs) A statement is made that indicates that the candidate realises that Case Study 3 is inappropriate because the investigation does not involve a change of concentration.	The candidate states that overall the data strongly supports the original hypothesis, although may not quote data to support this. A statement is made that indicates that the candidate realises that Case Study 3 is inappropriate.	A clear statement is made that both Case Studies 1 and 2 support the hypothesis. The point is made that the greater the concentration the faster the reaction	No relevant comment

CU2.x Rates of Reaction -Specimen ISA - Marking Guidelines

Read through the whole of the candidate's answer and use the Marking Guidelines below to arrive at a 'best-fit' mark, as candidates may meet some criteria but not others in a level.

The manufacturer's hypothesis				
	3 marks	**2 marks**	**1 mark**	**0 marks**
Q. No. 4a	The review of the hypothesis is appropriate and valid and correctly states, with reason(s), why the hypothesis is or is not supported Numerical data from the results is quoted to support the assertion	The review of the hypothesis is appropriate and valid and correctly states whether or not the hypothesis is or is not supported but fails to explain clearly the reason for this References to the data are mainly qualitative	There is a review of the hypothesis that is appropriate but there is little clarity and detail	No relevant content

Read through the whole of the candidate's answer and use the Marking Guidelines below to arrive at a 'best-fit' mark, as candidates may meet some criteria but not others in a level.

	3 marks	2 marks	1 mark	0 marks
Q. No. 4b	Candidate realises that the measurement of concentration of sulfuric acid in the rain at the site is important, and suggests how this might be measured Candidate realises the need to research the average rainfall at the site or the likely time that the turbine will be exposed to the acid rain over twelve months Candidate realises that data from Case Study 1 is useful in determining how long it will take for 1 kg of magnesium to dissolve, and suggests how this might be done Candidate realises that the data from Case Study 1 needs to be scaled up by a factor of 1000 Candidate realises that other variables will make a significant difference to the time taken to dissolve, and mentions the most significant ones, There is likely to be an explanation as to why at least one of these factors is important	Candidate realises that the measurement of concentration of sulfuric acid in the rain at the site is important, but may not take account of the need to research the average rainfall at the site or the likely time that the turbine will be exposed to the acid rain over twelve months Candidate realises that data from Case Study 1 is useful in determining how long it will take for 1 kg of magnesium to dissolve, but does not make clear how this might be achieved Candidate realises that the data from Case Study 1 needs to be scaled but does not specify by how much Candidate realises that other variables will make a significant difference to the time taken to dissolve, and mentions at least one significant factor	Candidate realises that the measurement of concentration of sulfuric acid in the rain at the site is important Candidate realises that data from Case Study 1 is useful in determining how long it will take for 1 kg of magnesium to dissolve, but does not make clear how this might be achieved Candidate refers to at least one other variable that will make a significant difference to the time taken to dissolve, but fails to explain in any detail why this factor is important	No relevant content

Read through the whole of the candidate's answer and use the Marking Guidelines below to arrive at a 'best-fit' mark, as candidates may meet some criteria but not others in a level.

	3 marks	2 marks	1 mark	0 marks
Q. No. 5	Comment that this experiment was not directly comparable to the candidate's investigation because it was to find the volume of hydrogen produced over time and any two further relevant comments eg. • This data does give information that the rate of reaction decreases as concentration decreases, because the concentration of acid decreases as it is used up • The data is not quantitative because the concentration of acid is not known at a given time • The concentration of acid at a given time could be calculated from the amount of hydrogen produced (but this is a complicated calculation, or it could be done using a spreadsheet) • A graph would need to be plotted to show how the rate changed with time and therefore concentration • Note several anomalous results at 70 seconds used in average making it unreliable	Comment that the experiment was not comparable to the candidate's investigation, with a correct reason and any one further relevant comment	Simple remark that the experiment is not comparable because it is investigating different variables or that a graph of the data would give an indication of how rate changes with concentration or one other relevant comment	No relevant comment

Graph or chart			
	Answer	**Additional Guidance**	**Mark**
Q. No. 6	X axis: suitable scales chosen and labelled with quantity and units	Scale should be such that the plots occupy at least one third of each axis Accept axes reversed It may not always be necessary to show the origin	**1**
	Y axis: suitable scales chosen and labelled with quantity and units		**1**
	Points or bars plotted correctly to within ± 1 mm	Allow one plotting error out of each 5 points/bars plotted	**1**
	Suitable line drawn on graph or bars correctly labelled on bar chart	Allow error carried forward from incorrect points If wrong type of graph / chart, maximum **3** marks If the independent variable is: • *continuous,* should draw a *best fit line* **NB** If no line possible because there is no correlation, candidates should state this on the graph to gain the mark • *categoric,* should draw a bar chart	**1**