



**REAL
SCIENCE
READY**

GCSE Science Specification A

Controlled Assessment Exemplar

Unit 1 - Physics

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Controlled Assessment – Science A ISA PU1.x
Specific Heat Capacity (Specimen)
For use from May 20xx to April 20xx

Teachers' Notes

This ISA relates to Science A Unit 3: P1.1

The transfer of energy by heating processes and the factors that affect the rate at which that energy is transferred

Topic of investigation

Energy can be transferred from one place to another by work or by heating processes. We need to know how this energy is transferred and which heating processes are most important in a particular situation.

Overview

Candidates should:

- plan practical ways to answer scientific questions and test hypotheses
- devise appropriate methods for the collection of numerical and other data
- assess and manage risks when carrying out practical work
- collect, process, analyse and interpret primary and secondary data including the use of appropriate technology
- draw evidence-based conclusions
- evaluate methods of data collection and the quality of the resulting data.

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

Candidates should be **given** the hypothesis:

There is a link between the mass of water being heated and the temperature rise.

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 will need to decide on which variables need to be controlled and research a method that could be used, with particular reference to hazards and risk assessment.

Candidates will be required, in Section 1 of the ISA, to provide a full plan of the method that they have chosen to use.

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 specific heat capacity. This should be set in a context by the centre. Examples of suitable contexts could include, eg electric storage heaters, oil-filled radiators or hot water tanks. 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 a method 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 the Stage 1 planning session, candidates 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 include plagiarised text, detailed planning grids or a pre-prepared draft.

Section 1 requires candidates to:

- consider the variables (independent, dependent and control) that they will need to manage during the investigation
- report on their research into how to test the hypothesis they have been given
- outline one possible method from their research to investigate the hypothesis
- 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 produced by the candidate is invalid, unworkable, unsafe, 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 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 done 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.

The candidates should also be given a table of results from other candidates in the class, or the teacher's results. Candidates should use the results of others to analyse the validity of their results.

Candidates should be given Section 2 of the ISA and should also be given:

- a copy of the question paper
- their own table of results
- a copy of the results of other candidates in the class
- a reminder of the context in which the investigation was set, this may be printed on the class results table.
- their own chart or graph
- the AQA supplied Data Sheet
- their A4 sheet of research notes.

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

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

Section 2 will require candidates to:

- analyse their own results
- draw a conclusion
- match their achieved results to the original hypothesis that was given to them
- evaluate the method of collection and the quality of the resulting data
- analyse further secondary data drawn from the same topic area as their original investigation
- 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 Physics Controlled Assessment PU1.x

Specific Heat Capacity

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

Hypothesis: There is a link between the mass of water being heated and the temperature rise.

You will need to prepare a table for the results.

Apparatus List:

Large beakers

Measuring cylinder

Low voltage immersion heater + power supply **or** a Bunsen burner

Thermometer

Stopwatch

Method:

1. Measure out 1 kg of cold water into a large beaker.
2. Measure and record the initial temperature of the water.
3. Put an immersion heater into the water and switch on for a fixed period of time, eg 10 minutes.
4. Measure and record the temperature at the end.
5. Work out the change in temperature.
6. Repeat for several other masses of water.

NOTE:

If you are using a Bunsen burner instead of an electric immersion heater, make sure that you do not change the setting on the burner during the experiment.

GCSE Science (xxxx) Additional Science (xxxx) Biology (xxxx) Chemistry (xxxx) Physics (xxxx)

SCYC

ASCC

BLYC

CHYC

PHYC

Centre Number _____ Centre Name _____

Candidate's Name _____ Candidate's Number _____

Task 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 aqa.org.uk/candidatenotes

Research sources

Method(s)

Equipment

Risk assessment issues

Relating the investigation to the context

Centre Number	9	8	7	6	5	Candidate Number	0	1	0	7	For Teacher's Use		
Surname	WARD					Other Names	JAMES						
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.											Section	Mark	
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.											Section 1 (/20)		
Candidate Signature	J Ward					Date	29/1/11					Section 2 (/30)	
											TOTAL (max 50)		



General Certificate of Secondary Education

June 20xx and January 20xx

Science A (Specimen)

Controlled Assessment ISA PU1.x Specific Heat Capacity Section 1

For submission on 7 May 20xx and 10 January 20xx

Time allowed up to 45 minutes

For this paper you must have:

- your research notes
 - a pencil and a 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 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 J. Harrison Date 1/2/11

As part of AQA's commitment to assist students, AQA may make your CAU available on a strictly anonymous basis to teachers, examining staff and students in paper form or electronically, through the Internet or other means, for the purpose of indicating a typical mark or for other educational purposes. In the unlikely event that your CAU is made available for the purposes stated above, you may object to this at any time and we will remove the work on reasonable notice. If you have any concerns please contact AQA

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Section 1

Hypothesis: There is a link between the mass of water being heated and the temperature rise.

1 Think about the research that you did to find out how to test this hypothesis.

Name two sources that you used for your research.

Concise Twentieth Century Physical Science. (Archer et al)

The Internet.

Which of these sources did you find the more useful?

Concise Twentieth Century Science.

Why was this source the more useful?

It gave me a complete method with a diagram.

(3 marks)

2 In this investigation, you will need to control some of the variables.

Write down one variable that will need to be controlled.

The length of time I switched the heater on for.

Describe briefly how you would carry out a preliminary investigation to find a suitable value to use for this variable.

You should also explain how the results of this work will help you to decide on the best value for this variable.

I would put the heater in the water and leave

it switched on for 30 seconds. Then I would

put it in for 5 minutes. In each case I would

measure the temperature rise and see if

this gave a good difference.

(3 marks)

3

In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.

Describe how you plan to do your investigation to test the hypothesis given.

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

Equipment

- 12 volt immersion heater.
- 1 litre beaker.
- Thermometer
- Stopwatch.

Method

- Put 1 kg of water in the beaker and measure the temperature.
- Put the immersion heater in and switch on for 2 minutes.
- Measure the temperature after 2 minutes.
- Repeat for 800g, 600g, 400g and 200g.

Fair test

The water should start at the same temperature each time, and the heater should be switched on for the same amount of time each time.

Risk Assessment

If the water gets very hot and the

beaker gets knocked over, it could scald
someone. So I will make sure that the
books, bags etc. are well away from it.
Also I will make sure that the water
does not get too hot.

(9 marks)

- 4 When you have completed your experimental work, you will be asked to share your results with others.

Explain the advantages of sharing your results with others.

You can compare your results with other people and see if you have made any mistakes. Also with more results you can calculate a mean and get a better answer.

(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)

Mass of water in g	Temp. at start	Temp. at end

20

END OF SECTION 1

Centre Number	9	8	7	6	5	Candidate Number	0	1	0	7	
Surname	WARD					Other Names	JAMES.				
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	J Ward.					Date	27/1/11				

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

AQA General Certificate of Secondary Education
June 20xx and January 20xx

Science A (Specimen)

Controlled Assessment ISA PU1.x Specific Heat Capacity Section 2

For submission on 7 May 20xx and 10 January 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 a 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 J. Harman Date 5/2/11

As part of AQA's commitment to assist students, AQA may make your CAU available on a strictly anonymous basis to teachers, examining staff and students in paper form or electronically, through the Internet or other means, for the purpose of indicating a typical mark or for other educational purposes. In the unlikely event that your CAU is made available for the purposes stated above, you may object to this at any time and we will remove the work on reasonable notice. If you have any concerns please contact cfg@aqa.org.uk

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

Hypothesis: There is a link between the mass of water being heated and the temperature rise.

1 (a) What were the variables in your investigation?

The independent variable was *The mass of water.*

The dependent variable was *The temperature rise after 2 mins.*

One control variable was *The length of time the water was heated for.* (3 marks)

1 (b) Think about the way in which you took your measurements.

Resolution means the smallest scale division on the measuring instrument that you were using.

What was the **resolution** of your measurement of the dependent variable?

1°C

Do you think that this resolution was appropriate for this investigation?

Explain your answer.

No, it would have been better if I had a thermometer that measured to 1/10th degree because it would have been more accurate.

(3 marks)

1 (c) The hypothesis that you were given before you started your investigation is printed above.

Do **your** results support this hypothesis? Explain your answer.

Yes, because the more water I used, the lower the temperature rise. There was a pattern.

(3 marks)

1 (d) You have been given the results obtained by other people in your class or by your teacher.

Do these other results show that this investigation is reproducible?

Explain your answer using data.

We all got the same pattern - more water meant a smaller temperature rise, but they weren't exactly the same as mine because some of them started at different temperatures.

(3 marks)

1 (e) If you were to repeat your experiment, would you make any changes to your method?

Tick the box beside your answer.

Yes, I would make changes to my method

No, I would not make changes to my method.

Explain why you would or would not make any changes.

I would insulate the beaker and put a lid on it. This would stop any heat escaping through the walls of the beaker or any heat being lost by the water evaporating.

(3 marks)

2 You have been given a **Data Sheet** which provides data from similar investigations.

2 (a) Draw a **sketch graph** of the results in **Case Study 1**.

The graph should show how the mean temperature rise varies with the mass of water being heated.



(2 marks)

2 (b) Does the data on the **Data Sheet** support the hypothesis you were given at the start of your investigation?

To gain full marks you should use all of the **appropriate** data from **Case Studies 1, 2, and 3** to explain the extent to which the data supports or contradicts the hypothesis.

Case study 1 does so it gives the same shape graph as mine.

Case study 2 gives the same pattern as well.

Case study 3 doesn't help so they heated the water for different times.

(3 marks)

2 (c) Use Case Study 4 to answer this question.

What is the relationship between the specific heat capacity of a substance and the mean temperature rise of that substance?

Explain how well the data supports your answer.

Light oil has the highest specific heat
but the smallest temp. rise.

Brick has the lowest specific heat and
the highest temp. rise.

So the bigger the specific heat, the
smaller the temp. rise.

(3 marks)

3 Think about the context that you were given for this investigation.

How could the results of your investigation be useful in this context?

You may use information from your A4 sheet of research notes to help you to answer this question.

In a domestic hot water tank, the bigger
the volume or mass of water you have,
the smaller the temp. rise you will get,
when you heat it up. When you fill a
kettle for a cup of tea, you shouldn't put
too much water in or it will take too long
to boil and you will waste energy.

(3 marks)

4 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)

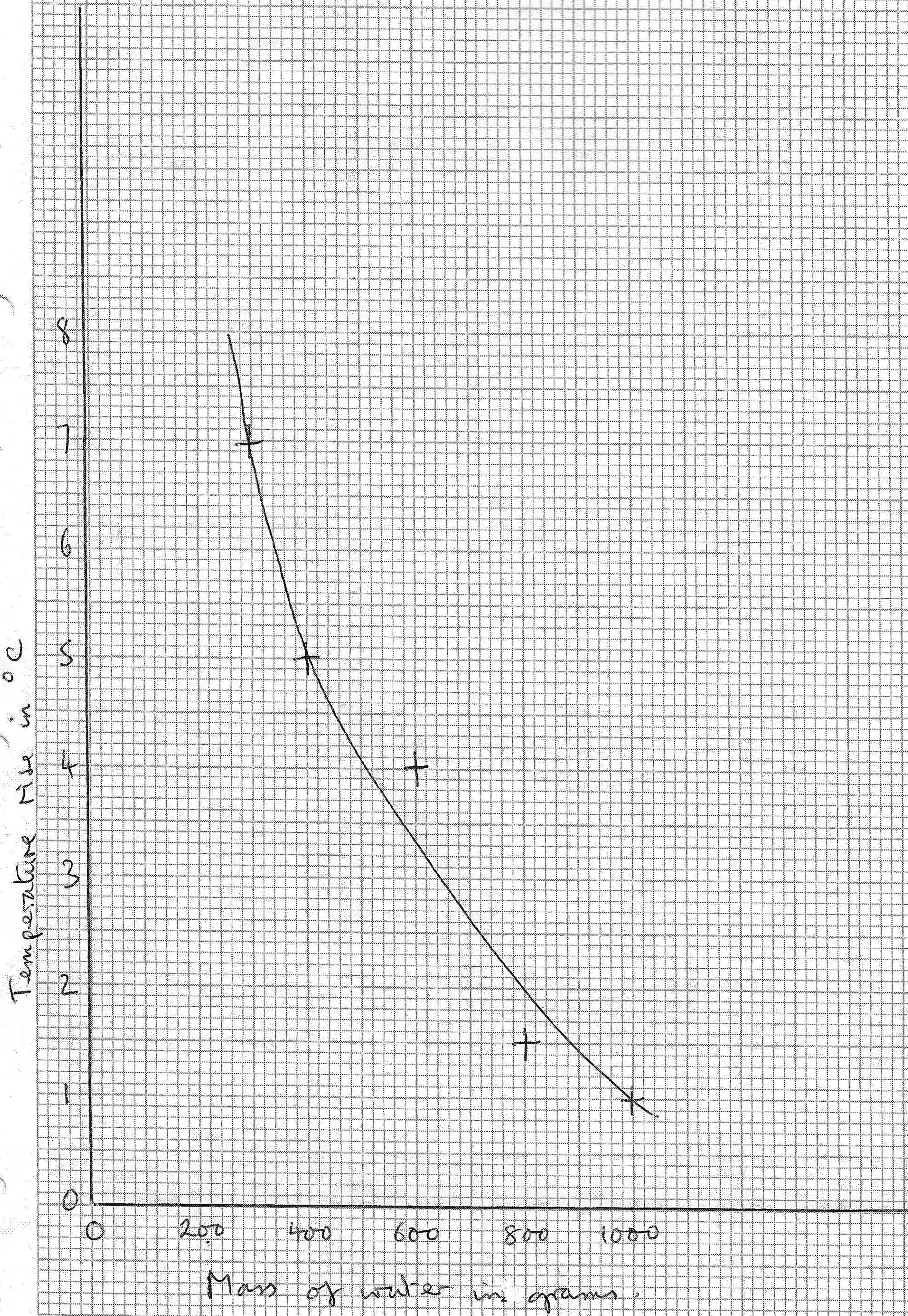
END OF QUESTIONS

J WARD

0107

Mass of water in grams.	Temp. at start in °C	Temp. at end in °C	Temp. rise in °C.
1000	15	16	1
800	15	17	2
600	15	19	4
400	16	21	5
200	15	22	7

J. WARD 0107



GCSE Science (xxxx) Additional Science (xxxx) Biology (xxxx) Chemistry (xxxx) Physics (xxxx)

SCYC ASCC BLYC CHYC PHYC Centre Number 98765 Centre Name The New AcademyCandidate's Name WARD, JAMES Candidate's Number 0107Task Title SPECIFIC HEAT CAPACITYISA number: P01.x

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

J. Harrison

Candidate signature

J. WardDate: 25/1/11

This form can be downloaded from aqa.org.uk/candidatenotes

Research sources

Concise Twentieth Century Science - by Archer etc.
The Internet.

Method(s)

- Electric immersion heater or Bunsen.
- Heat different masses of water for the same length of time.
- Measure temperature at start and end.

Equipment

- Immersion heater + power supply.
- Beaker
- Thermometer
- Stopwatch

Risk assessment issues

- Hot water

Relating the investigation to the context

Boiling water in a kettle - only fill the amount needed otherwise it takes too long and wastes energy.

Data Sheet – Controlled Assessment Physics

PU1.x Specific Heat Capacity

You will need to use all appropriate data to gain full marks in question 1(d) of the ISA on specific heat capacity.

Case Study 1

A group of students carried out an investigation similar to the one you did to test the hypothesis that there is a link between the mass of water being heated and the temperature rise.

The students carried out the investigation three times. They used the same spirit burner to heat the water and heated the water for 15 minutes in each test.

Diagram of the spirit burner and water being heated

These are their results.

Mass of water being heated in grams	Temperature rise of water in degrees C			
	Test 1	Test 2	Test 3	Mean temperature rise in °C
100	24	26	23	24
200	13	14	13	13
300	7	9	7	8
400	4	4	5	4

Case Study 2

A second group of students carried out an investigation similar to the one you did to test the hypothesis that there is a link between the mass of water being heated and the temperature rise.

They carried out the investigation three times. They used the same spirit burner to heat the water and heated the water for 15 minutes in each test.

These are their results.

Mass of water being heated in grams	Temperature rise of the water in degrees C			
	Test 1	Test 2	Test 3	Mean temperature rise in °C
100	46	51	48	48
200	21	14	21	18
300	17	15	16	16
400	8	7	9	8

Case study 3

Students in a laboratory carried out tests to find out the temperature rise in 250g of water when heated for different lengths of time. They used the same spirit burner for all tests. These are their results.

Length of time water heated in minutes	Temperature rise of the water in °C
5	37
10	62
15	74
20	85
25	94
30	100

Case study 4

Tests are being carried out in a building research laboratory. The scientists are testing four different oils and bricks.

They will use their results to find out which oil might be best for an oil filled radiator and whether night storage heaters, containing bricks, might be more cost effective for heating a room in a house.

Material	Specific heat capacity in J/kg °C
Fuel oil	1900
Light oil	2300
Olive oil	2000
Sesame oil	1600
Brick	800

The scientists heated 250g of each of the test materials for 20 minutes. They did this by using an electric heater.

These are their results.

Material being tested	Temperature rise in degrees C			
	Test 1	Test 2	Test 3	Mean temperature rise in °C
Fuel oil	49	31	47	48
Light oil	41	39	42	41
Olive oil	47	47	49	46
Sesame oil	50	52	54	52
Brick	108	100	107	105

PU1.x Specific Heat Capacity - Specimen ISA - Marking Guidelines
GCSE Science – Controlled Assessment ISA – Marking Guidelines
Additional Science / Physics ISA – PU1.x Specific Heat Capacity (Specimen)

For use from May 20xx to January 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			
Q. No. 1	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	The candidate identifies two relevant sources and explains why one of these was found to be the more useful
		2 marks	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 one is more useful
		1 mark	The candidate identifies at least one source but fails to explain why this was found to be useful OR a poorly defined source eg 'Physics text book' but explains why it was found to be useful
Additional Guidance	<i>An identified source is referred to by title and author or for websites at least the name of the web site should be quoted</i>		

PU1.x Specific Heat Capacity - Specimen ISA - Marking Guidelines

Preliminary work

<p>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.</p> <p>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.</p>		3 marks	
		2 marks	
Q. No. 2	0 marks	1 mark	2 marks
	No relevant content	<p>A variable is stated, but it is not an appropriate control variable</p> <p>Only one value to be investigated in the preliminary experiment is suggested</p> <p>The dependent variable is stated, but there are no details concerning its measurement</p> <p>No suitable statement concerning how the results could be used to determine the best value has been made</p>	<p>A suitable control variable is stated</p> <p>Values to be investigated in the preliminary experiment are suggested but may not all be appropriate</p> <p>The dependent variable is stated, but details concerning its measurement are incomplete</p> <p>A statement concerning how the results could be used has been made, but is vague and unclear</p>
			<p>A suitable control variable is stated.</p> <p>The limits of the range to be investigated in the preliminary experiment are appropriate</p> <p>Measurement of the dependent variable is correctly described</p> <p>A statement concerning how the results could be used to determine the best value has been made</p>
Additional Guidance		<p><i>Suitable control variables are likely to be eg the length of time for which the water is heated. Do not accept suggestions such as 'always use the same thermometer'.</i></p> <p><i>The dependent variable will be the temperature rise after a specified time.</i></p> <p><i>The preliminary investigation is likely to involve testing two ends of a range to see if there is sufficient variation.</i></p>	

PU1.x Specific Heat Capacity - Specimen ISA - Marking Guidelines

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.	
0 marks	7, 8 or 9 marks
No relevant content	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
1, 2 or 3 marks	4, 5 or 6 marks
The method described is weak but shows some understanding of the sequence of an investigation Control variables may not be mentioned 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. Steps may be missing or not in the correct sequence Specialist terms may be missing or used inappropriately There are frequent 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 Few specialist terms are used Some errors in spelling, punctuation and grammar
Q. No. 3	
Additional Guidance	<i>In this investigation, candidates should be able to identify at list one hazard, show that they have understood the risk associated with this, and have mentioned on control measure to reduce the risk. Typical hazards with associated risk reduction might include, e.g.: very hot water, high risk of scalding if beaker knocked over, restrict temperature rise to 40 °C It may be possible to credit a clearly labelled diagram for some of the marks</i>

PU1.x Specific Heat Capacity - Specimen ISA - Marking Guidelines

Consequences of the initial research			
Q. No. 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.		
	0 marks	1 mark	2 marks
	No relevant content	Allows you to check your results or calculate a more accurate mean	Enables you to compare your results with those of others to see if there are any similarities or differences. With more data you are able to calculate a more accurate mean and minimize the effect of random errors
Table for Results			
Q. No. 5	0 marks	1 mark	2 marks
	No table or a table with incomplete headings or units for the measured variables Fewer than half of the required elements are present	A table with incomplete headings or units for the measured variables At least half of the required elements should be present	Correct headings and units present for all measured variables
Additional Guidance	<i>The table should be able to accommodate all the quantities that the candidate is going to measure or record during the investigation. There is no need for the candidate to include columns for repeats, means or derived values. Teachers may wish to encourage candidates to include these columns, but they will not lose any marks if they fail to do so as there are no marks allocated for this.</i>		

PU1.x Specific Heat Capacity - Specimen ISA - Marking Guidelines

SECTION 2

Analysing and researching own results and the results of others

		0 marks	1 mark	2 marks	3 marks
Q. No. 1 (a)		No relevant content	Any one variable correctly identified	Any two variables correctly identified	All three variables correctly identified
Additional Guidance	<p><i>The variables are likely to be:</i></p> <p><i>Independent - the mass of water heated</i></p> <p><i>Dependent - the temperature rise after a set period of time (simply "temperature rise" is insufficient)</i></p> <p><i>Control - the length of time for which energy was supplied or the amount of energy supplied</i></p>				
Q No. 1 (b)	0 marks	No relevant content			
	1 mark	Candidate correctly states the resolution of the measurement of the dependent variable, but fails to give a suitable explanation as to why this was or was not appropriate			
	2 marks	Candidate correctly states the resolution of the measurement of the dependent variable		Candidate correctly states the resolution of the measurement of the dependent variable	
	3 marks	Candidate correctly states whether or not the resolution was appropriate but the explanation as to the reason is not clear		Candidate correctly states whether or not the resolution was appropriate and gives a clear explanation as to the reason	

PU1.x Specific Heat Capacity - Specimen ISA - Marking Guidelines

	0 marks	1 mark	2 marks	3 marks
Q No. 1 (c)	No relevant comment	The candidate correctly states whether the results support the hypothesis or not with a simple statement.	The candidate correctly states whether or not the results support the hypothesis and provides an explanation using either one piece of quantitative data or a correctly identified pattern	The candidate correctly states whether or not the results support the hypothesis and provides detailed explanation using either at least 2 pieces of quantitative data or clearly identified patterns in the data

	0 marks	1 mark	2 marks	3 marks
Q No. 1 (d)	No relevant content	Correctly states whether or not the results are reproducible and supports this with a simple statement	Correctly states whether or not the results are reproducible Writes a simple explanation supported by an example from the data (this may be a qualitative example referring to a pattern in the data)	Correctly states whether or not the results are reproducible Writes a detailed explanation supported by at least two examples from the data
Additional Guidance		<i>e.g. other people have got the same results</i>	<i>e.g. other people have got the same results and they had the same shape of graph</i>	<i>e.g. other people have got similar results to mine, and we all got a 2 °C temperature rise for 1 kg of water and a 4 °C for 500 g water</i>

PU1.x Specific Heat Capacity - Specimen ISA - Marking Guidelines

NOTE: there is no mark for ticking the 'Yes' or 'No' box			
Q. No. 1 (e)	0 marks	1 mark	2 marks
Yes, I would make changes	No relevant content	<p>Sensible suggestion made as to why changes would be made, e.g. there is no clear pattern, the range or interval was unsuitable, or reference to the number of repeats, or the choice of suitable measuring instruments, but none of these fully explained.</p> <p>OR</p> <p>Appropriate suggestion(s) made regarding how to improve the results if the experiment were repeated, e.g. wider range, more repeats, but with little or no explanation given as to why this course of action might improve the results</p>	<p>Sensible suggestion made as to why changes would be made, e.g. there is no clear pattern, the range or interval was unsuitable, or reference to the number of repeats, or the choice of suitable measuring instruments, but none of these fully explained.</p> <p>Appropriate suggestion(s) made regarding how to improve the results if the experiment were repeated, e.g. wider range, more repeats</p>
		<p>Sensible suggestion made as to why changes would be made, e.g. there is no clear pattern, the range or interval was unsuitable, or reference to the number of repeats, or the choice of suitable measuring instruments, but none of these fully explained.</p> <p>Appropriate suggestion(s) made regarding how to improve the results if the experiment were repeated, e.g. wider range, more repeats</p>	<p>Sensible suggestion made as to why changes would be made, e.g. there is no clear pattern, the range or interval was unsuitable, or reference to the number of repeats, or the choice of suitable measuring instruments, but none of these fully explained.</p> <p>Appropriate suggestion(s) made regarding how to improve the results if the experiment were repeated, e.g. wider range, more repeats</p>
			<p>Little or no explanation given as to why this course of action might reduce the size of the uncertainty,</p>

PU1.x Specific Heat Capacity - Specimen ISA - Marking Guidelines

No, I would not make changes	0 marks	Sensible suggestion made as to why no changes would be made, e.g. there is a clear pattern, a suitable range or interval was chosen, or reference to the number of repeats, or the choice of suitable measuring instruments, but none of these fully explained.	2 marks	3 marks	
	1 mark		Sensible suggestion made as to why no changes would be made, e.g. there is a clear pattern, a suitable range or interval was chosen, or reference to the number of repeats, or the choice of suitable measuring instruments	Sensible suggestion made as to why no changes would be made, e.g. there is a clear pattern, a suitable range or interval was chosen, or reference to the number of repeats, or the choice of suitable measuring instruments	
			Reference made to the number of repeats but little in the way of how this can be used to calculate a mean	Reference made to the number of repeats and/or calculation of a mean	
			Reference made to the use of equipment, but the reasons, e.g. better resolution, not fully explained	Reference made to the use of equipment, e.g. the resolution on measuring instruments	

Secondary Data			
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. 2 (a)	0 marks	1 mark	2 marks
	No worthwhile attempt	Either: both axes labelled (units not essential) with either some numbers inserted or an arrow on the axis that indicates the direction of increase or a suitable line, ie a concave curve	Both axes labelled (units not essential) with either some numbers inserted or an arrow on the axis that indicates the direction of increase plus a suitable line, ie a concave curve

PU1.x Specific Heat Capacity - Specimen ISA - Marking Guidelines

<p align="center">Q. No. 2 (b)</p>	<p align="center">0 marks</p>	<p>No relevant comment</p>	<p align="center">1 mark</p>	<p>A clear statement is made that Case Study 1 supports the hypothesis that the temperature rise of the water is linked to the mass of water heated</p> <p>The point is made that the greater the volume of water heated the smaller the temperature rise if the same energy is supplied</p>	<p align="center">2 marks</p>	<p>The candidate states that overall the data strongly supports the original hypothesis, although may not quote data that supports this</p> <p>There is an indication that there is conflicting evidence in Case Study 2 with 200g of water</p> <p>There is a statement that the mean for the result at 200g has been calculated incorrectly</p> <p>The candidate realises that Case Study 3 is inappropriate because the hypothesis concerns the effect of changing the mass of the water, and Case Study 3 deals with a fixed mass of water</p>	<p align="center">3 marks</p>	<p>The candidate states that overall the data strongly supports the original hypothesis, and quotes some data from tables that supports this.</p> <p>There is an appreciation that there is some conflicting evidence</p> <p>There is evidence that the candidate has inspected the data critically, eg by noticing the anomalous result in Case Study 2</p> <p>A statement is made that the result for 200g of water in Case Study 2 is anomalous and should not have been included in the mean as it should either have been omitted or repeated</p> <p>A statement is made that indicates that the candidate realises that Case Study 3 is inappropriate</p> <p>The candidate realises that Case Study 3 is inappropriate because the hypothesis concerns the effect of changing the mass of the water, and Case Study 3 deals with a fixed mass of water</p>
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PU1.x Specific Heat Capacity - Specimen ISA - Marking Guidelines

	0 marks	1 mark	2 marks	3 marks
Q. No. 2 (c)	No relevant comment	There is a statement that the higher the specific heat capacity the smaller the temperature rise produced in the substance	There is a statement that the higher the specific heat capacity the smaller the temperature rise produced in the substance, and some data is quoted to support this	<p>The candidate states that the temperature rise is inversely proportional to the specific heat capacity, and quotes some data to support this, eg the specific heat capacity of sesame oil is twice that of brick but the temperature rise produced is only half</p> <p>There is a realisation that this can only be an approximation using the data in the table</p> <p>The candidate realises that the data contains some anomalies</p>

Further work				
	0 marks	1 mark	2 marks	3 marks
Q. No. 3	No relevant content	The candidate has related an idea from the investigation or the research to the context but how this idea could be applied is unclear	<p>The candidate has related an idea from the investigation or the research into the given context</p> <p>There is a brief explanation of how this idea can be applied and used in the given context</p>	<p>The candidate has related ideas from the investigation and the research to the context set by the centre</p> <p>There is a clear explanation of how these ideas can be applied and used in the given context</p>

PU1.x Specific Heat Capacity - Specimen ISA - Marking Guidelines

Graph or chart			Mark
Q. No.	Answer	Additional Guidance	Mark
4	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		
	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: <ul style="list-style-type: none"> • <i>continuous</i>, should draw a <i>best fit line</i> NB If no line possible because there is no correlation, candidates should state this on the graph to gain the mark <ul style="list-style-type: none"> • <i>categorical</i>, should draw a bar chart 	1

GCSE SCIENCE COURSEWORK (new spec)

Commentary on Exemplar ISA

Physics PU1.x – Specific Heat Capacity

Q. No.	Comment	Mark
	Section 1	
1	<p>The candidate has clearly identified one relevant source (the book) and has explained why this was the more useful.</p> <p>Simply saying "The Internet" is too vague</p>	2
2	<p>A suitable control variable has been given (the length of time for which energy is supplied). A suitable range has been given.</p> <p>The candidate has not mentioned how the temperature rise should be obtained (it is actually calculated rather than measured) and the way in which the results could be used ("see if this gave a good difference") is too vague.</p>	2
3	<p>Apart from stating how the temperature rise should be calculated from the initial and final temperatures, the method is clear and another person should be able to follow this method and obtain valid results.</p> <p>The candidate has clearly stated control variables that should be kept the same in order to make the test fair. However, there is no indication as to how these variables will be controlled or monitored.</p> <p>The equipment that the candidate proposes to use is clearly described and is appropriate.</p> <p>The risk assessment contains an identification of the hazard (hot water), the associated risk (being scalded if the water is spilt) and two control measures (keeping book etc away and not overheating the water)</p> <p>The method is described in a logical sequence of steps.</p> <p>Even though the candidate has used bullet points in some places, the spelling, punctuation, grammar and the correct use of technical terms are sufficient to meet all the relevant criteria.</p>	7
4	<p>The candidate has the idea of being able to compare the results in order to check them, and has also referred to the idea of calculating a mean. However, the advantage of calculating a mean is not mentioned, nor is there any reference to reproducibility.</p>	2
5	<p>The table is incomplete, as the units for temperature are missing</p>	1
	Total for Section 1	14

Q. No.	Comment	Mark
Section 2		
1(a)	All three variables have been correctly identified	3
1(b)	The candidate has correctly stated the resolution. However, there is no reason given as to why measuring to 1/10th of a degree would be better. Also the mention of accuracy suggests that the candidate does not fully understand the meaning of the term resolution	1
1(c)	The candidate's results do support the hypothesis, and the candidate has stated this. There is reference to a pattern, but the candidate has failed to quote any numerical evidence to support this.	2
1(d)	The candidate has not quoted any numerical data. Although the candidate has suggested a possible reason as to why the results of others may have been different, there is no explanation of this.	1
1(e)	The candidate's answer implies the reason for the suggested change, but is not fully explained.	1
2(a)	Both axes are labelled correctly, and the mark guidance states that units are not essential. The shape of the line is appropriate	2
2(b)	The candidate has recognised that Case study 1 and case study 2 both support the hypothesis, and has realised that case study three is not appropriate. There is no recognition of the fact that there is some conflicting evidence or that one of the means has been incorrectly calculated. Overall, using a "best fit" approach, this answer is just worth 2 marks	2
2(c)	The candidate has correctly identified the pattern but has not quoted any numerical data to support this.	1
3	The candidate has attempted to apply the results of the investigation to the context set by the teacher, and has also related this work to another context (boiling water in a kettle)	2
4	Both axes are appropriately scaled and labelled, the plotting is correct, and the line of best fit is suitable	4
Total for Section 2		19

Total for both sections	33/50
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