Science A Controlled Assessment

Unit 1: Physics

Exemplar Material of a candidate who scored 32/50

PHYSICS

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.

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 valid, safe, workable, and manageable in the laboratory.

Candidates should be given the hypothesis:

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

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

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

Important: In this ISA, candidates will need to be given a table of pooled results from the whole class. If the class is very small, then the teacher may add his or her own results to the table.

Risk Assessment

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

Follow the next 5 stages to complete Science A Controlled Assessment for Physics

Teachers' Notes

stage 1

Planning (Limited control)

Teachers should provide a Candidate Research Notes Form. For Science A, teachers should write the hypothesis and context written on this form. Candidates should be given the opportunity to plan an investigation to test the hypothesis. The investigation should be set in a context by the centre. Examples of suitable contexts could include 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 to test the hypothesis 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 should use at least **two** sources for this research.

They will need to undertake independent research to identify **one** method that could be used. During this time they may make **one** A4 side of their **own** Candidate Research Notes for use during Section 1 of the ISA. The Candidate Research Notes sheet is attached as an appendix.

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 how the results of the investigation 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 at most. This research may be done in the laboratory or elsewhere.

The teacher should check and sign the Candidate Research Notes before allowing the candidate to use them during the completion of Section 1 of the ISA. These must be checked to ensure they do not include plagiarised text, detailed planning grids or a pre-prepared draft. The candidate may use these notes while completing Section 1 and Section 2 of the ISA. When the candidate has completed Section 2, the Candidate Research Notes should be stapled to the ISA.

Teachers' Notes

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, 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
- 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 suitable 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 and may be done at any convenient time between the planning session in Stage 1 and the completion of Section 1 of the ISA.**

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 their **own** Candidate Research Notes.

Teachers' 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 candidate is going to carry out his or her own plan, then the teacher may photocopy the plan from Section 1 of that candidate's ISA. This photocopy may then be given to the candidate to use during the practical session. 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 method. An example of a suitable method 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 which case the candidate would not be able to score full marks for producing a table.
- if the candidate carries out an investigation from a method provided by the teacher, or the teacher prefers that the candidates use a particular format – in which case the candidate would be able to score full marks for producing their own 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.

Teachers' Notes

stage 5

Analysing results (High control)

For this part of the investigation candidates must work individually under direct supervision.

AQA will provide a Secondary Data Sheet.

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 own results.

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

- their own table of results
- a set of results obtained by other people
- their own chart or graph
- Secondary Data Sheet supplied by AQA
- their own Candidate 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.

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.

An example of a Suitable Method

(Refer to Stage 3 Teachers' Notes)

Specific Heat Capacity

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.

Equipment:

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.

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Research Notes

AQA

Centre-assessed work
Candidate Research Notes

GCSE Science (4405) Additional Science (4408) Biology (4401) Chemistry (4402) Physics (4403)

SCYC ☑ ASCC ☐ BLYC ☐ CHYC ☐ PHYC ☐

Centre Number 9 8 7 6 5 Centre Name The New Academy

Candidate's Name WARD, JAMES Candidate's Number 0107

Investigation Title SPECIFIC HEAT CAPACITY

ISA number: PU1.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.

J. Harrison

J. Ward

Date: 25/1/11

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

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Research Notes

Hypothesis

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

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.

ISA Section 1

PHYSICS

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	29/1/11

For Teacher's Use	
Section	Mark
Section 1 (/20)	14
Section 2 (/30)	18
TOTAL (max 50)	32

AQA General Certificate of Secondary Education

June 20xx and January 20xx

Science A (Specimen)

Controlled Assessment ISA PU1.x Specific Heat Capacity Section 1

For moderation in May 20xx or January 20xx

Time allowed up to 45 minutes

For this paper you must have:
- your Candidate 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 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 Physics Science (Archer.al)

The Internet: en.wikipedia.org/wiki/Heat_capacity

Which of these sources was the more useful and why?

Concise Twentieth Century Science. It gave me a complete method with a diagram.

2

(3 marks)

The candidate has clearly identified two relevant sources and has stated why one of them was more useful.

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 preliminary investigation 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.

2

(3 marks)

A suitable control variable has been given (the length of time for which energy is supplied). A suitable range has been given.

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.

3

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 1kg 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 scold someone. So I will

Turn over ▶

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.

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.

The equipment that the candidate proposes to use is clearly described and is appropriate. However, the candidate would also need a balance (or at least a measuring cylinder assuming the he knows the density of water.

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).

The method is described in a logical sequence of steps.

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.

4

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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.

7

(9 marks)

Do not write outside the box

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.

2

(3 marks)

5 Make sure that you hand in your Candidate 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

14/20

1

END OF SECTION 1

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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.

The table is incomplete, as the units for temperature are missing.

ISA Section 2

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)	14
Section 2 (/30)	18
TOTAL (/50)	32

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 moderation in May 20xx or January 20xx

Time allowed 50 minutes

For this paper you must have:
- results tables and charts or graphs from your investigation
- the Secondary Data Sheet
- your Candidate 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 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 Harrison Date 5/2/11

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2

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

1 (a) What were the variables in the investigation you did?

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)

3

All three variables have been correctly identified.

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 temperature?

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 1/10 th degree because it would have been more accurate.

(3 marks)

1

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 (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)

2

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.

Do not write outside the box

1 (d) You have been given the results obtained by other people.
Do these other results show that this investigation is reproducible? Explain your answer using examples from the results.

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)

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 (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, using examples from your results.

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)

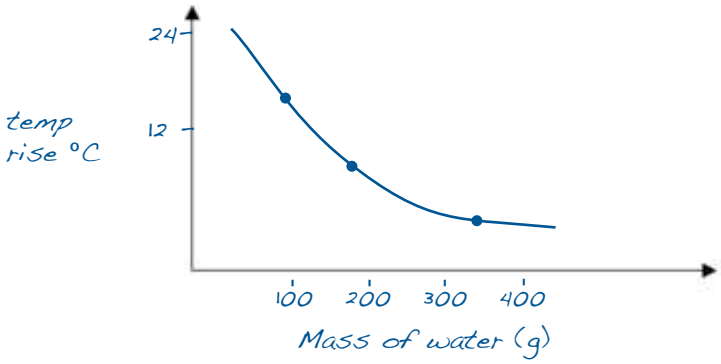
The candidate's answer contains a sensible suggestion which is partly explained, but no examples are quoted from the results

Do not write outside the box

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

2 (a) Label the axes and 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

(2 marks)

Both axes are labelled correctly, and the shape of the line is appropriate.

2 (b) Look at Case Studies 1, 2 and 3. Do the results in Case Studies 1, 2 and 3 support or not support they hypothesis you were given?

To gain full marks your explanation should include appropriate examples from the results in Case Studies **1**, **2** and **3**.

Case Study 1 does cos it gives the same shape graph as mine.

Case Study 2 gives the same pattern as well.

Case Study 3 doesn't help cos they heated the water for different times.

(3 marks)

2

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.

Do not write outside the box

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 information in Case Study **4** 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.

1

(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 Candidate 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.

2

(3 marks)

4 Make sure that you hand in your Candidate Research notes, results tables, and chart or graph with this paper.
You will be awarded up to four marks for your chart or graph.

3

(4 marks)

END OF QUESTIONS

18/30

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The candidate has correctly identified the pattern but has not quoted any numerical data to support this.

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).

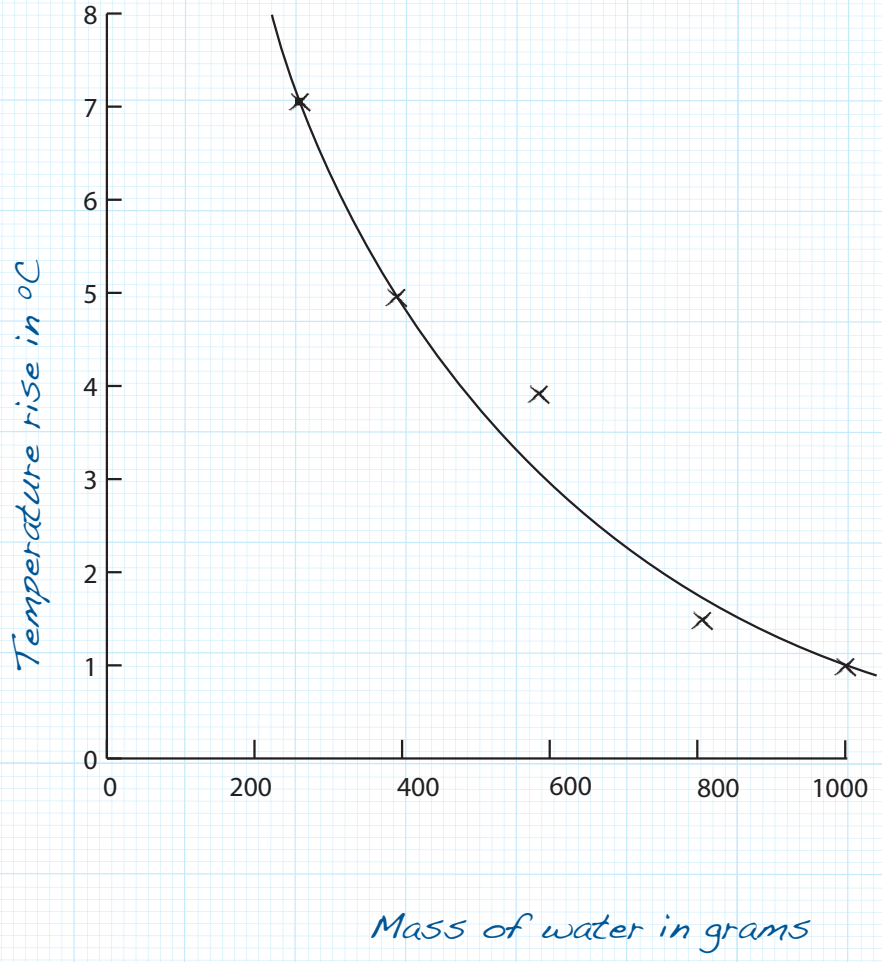
Table for Section 2 of the ISA

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

Graph for Section 2 of the ISA

J WARD 0107



Both axes are appropriately scaled and labelled. However there are two plotting errors, but the line of best fit is suitable.

Secondary Data Sheet

Secondary Data Sheet – Controlled Assessment Science

PU1.x 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. They heated the water for the same length of time in each test.

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	64

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 electric immersion heater to heat the water. They heated the water for the same length of time 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 250 g 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 was 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 250 g 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 Exemplar Mark Guidance

Science ISA – PU1.x Specific Heat Capacity (Specimen) for moderation in May 20xx or 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), 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 marking guidelines to particular investigations.

Read through the whole of the candidate's answer and use the marking guidelines below to arrive at a 'best-fit' mark.

The layout of questions 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.

SECTION 1				
Question 1	**0 marks**	**1 mark**	**2 marks**	**3 marks**
	No creditworthy response	Two relevant sources are identified	Two relevant sources are clearly identified The usefulness of one of the sources is commented on.	Two relevant sources are clearly identified The usefulness of both is explained and a comparison made.
Additional Guidance	*A clearly identified source is referred to by title and author or for websites at least the name of the web site should be quoted.* *A clear comment on only one of the sources may be sufficient to gain 2 marks if the answer implies a comment on the other source* *If candidates have taken part in peer discussion as part of their research, simply stating this is not sufficient to qualify for quoting a source. Similarly reference to their own notes or exercise book alone is insufficient.*			

SECTION 1				
Question 2	**0 marks**	**1 mark**	**2 marks**	**3 marks**
	No creditworthy response	A suitable control variable is stated	A suitable control variable is stated Only one value to be investigated in the preliminary experiment is suggested	A suitable control variable is stated. The limits of the range to be investigated in the preliminary experiment are appropriate A statement concerning how the results could be used to determine the best value has been made
Additional Guidance	*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'.* *The dependent variable will be the temperature rise* ***after a specified time****.* *The preliminary investigation is likely to involve testing two ends of a range to see if there is sufficient variation.*			

SECTION 1

Question 3

In this question candidates are required to produce extended written material in English, and will be assessed on the quality of their written communication as well as the standard of the scientific response.

Candidates will be required to use good English, organise information clearly and use specialist vocabulary where appropriate.

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 within a mark band.

0 marks	1, 2 or 3 marks	4, 5 or 6 marks	7, 8 or 9 marks
No creditworthy response	Most of the necessary equipment is stated The method described is weak but shows some understanding of the sequence of an investigation The measurements to be made are stated An appropriate hazard is identified, but the corresponding risk assessment and control measure is weak or absent The answer is poorly organised, with almost no specialist terms and little or no detail given The spelling, punctuation and grammar is very weak	All of the major items of necessary equipment are listed The method described will enable valid results to be collected The measurements to be made are stated and at least one control variable is identified Any significant hazards are identified, together with a corresponding control measure but the risk assessment is weak or absent The answer has some structure and organisation, use of specialist terms has been attempted but not always correctly, and some detail is given The spelling, punctuation and grammar is reasonable although there may still be some errors	All of the major items of equipment are listed The method described will enable valid results to be collected The measurements to be made are stated and control variables are clearly identified with details of how they will be monitored or controlled Any significant hazards are identified, together with an assessment of the associated risks and corresponding control measures The answer is coherent and written in an organised, logical sequence, containing a range of relevant specialist terms used correctly The answer shows almost faultless spelling, punctuation and grammar

Additional Guidance *Typical hazards with associated risk reduction might include: very hot water, high risk of scalding if beaker knocked over, restrict temperature rise to 40 ºC*

It may be possible to credit a clearly labelled diagram for some of the marks

SECTION 1				
Question 4	**0 marks**	**1 mark**	**2 marks**	**3 marks**
	No creditworthy response	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	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 Enables reproducibility to be confirmed

Table for the results			
Question 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	*The table should be able to accommodate all of the variables 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.*		

SECTION 2

Question 1 (a)	0 marks	1 mark	2 marks	3 marks
	No creditworthy response	Any **one** variable correctly identified	Any **two** variables correctly identified	All **three** variables correctly identified
Additional Guidance	*The variables are likely to be:* *Independent - the mass of water heated* *Dependent - the temperature rise after a set period of time (simply "temperature rise" is insufficient)* *Control - the length of time for which energy was supplied or the amount of energy supplied*			

Question 1 (b)	0 marks	1 mark	2 marks	3 marks
	No creditworthy response	A correct value for the resolution is given or A sensible but incorrect value is given for the resolution, with a correct statement appropriate to the resolution they have given	A correct value for the resolution is given A correct statement as to whether or not the resolution was appropriate is given, but the explanation is not clear	A correct value for the resolution is given A correct statement as to whether or not the resolution was appropriate is given with a clear explanation
Additional Guidance	*Look at the candidate's table of results in order to confirm the resolution.* *A clear explanation will convey that the candidate understands the term resolution.*			

Question 1 (c)	0 marks	1 mark	2 marks	3 marks
	No creditworthy response	A simple correct statement is made as to whether or not the results support the hypothesis with an attempt at an explanation	A simple correct statement is made as to whether or not the results support the hypothesis and an explanation that includes a simple description of a correctly identified pattern or lack of pattern	A simple correct statement is made as to whether or not the results support the hypothesis and an explanation that includes a detailed description of a correctly identified pattern or lack of pattern
Additional Guidance	*Note that the answer should refer to the candidate's own results, and not simply to the expected result.*			

SECTION 2

Question 1 (d)	0 marks	1 mark	2 marks	3 marks
	No creditworthy response	A statement is made as to whether or not the results are reproducible, with a reason stated	A statement is made as to whether or not the results are reproducible, with a reason stated and explained	A statement is made as to whether or not the results reproducible, with a reason stated and explained There is a detailed explanation supported by at least one example from the results
Additional Guidance		*e.g. other people have got the same results*	*e.g. other people have got the same results and they had the same shape of graph*	*e.g. other people have got similar results to mine, and we all got a 2 ºC temperature rise for 1 kg of water and a 4 ºC for 500 g water*

Question 1 (e)	**NOTE:** there is no mark for ticking the 'Yes' or 'No' box			
	0 marks	**1 mark**	**2 marks**	**3 marks**
Yes I would make changes	No creditworthy response	Simple appropriate suggestion given as to why changes would be made	Simple appropriate suggestion given as to why changes would be made together with examples quoted from the results	Simple appropriate suggestion given as to why changes would be made together with examples quoted from the results plus an explanation of why these changes would improve the results
Additional Guidance	*Suggested reasons for changing or nor changing the method are likely to refer to e.g.* • *there is or is not no clear pattern,* • *the range or interval was or was not suitable,* • *the number of repeats was or was not appropriate* • *the choice of measuring instruments was or was not suitable*			
	0 marks	**1 mark**	**2 marks**	**3 marks**
No I would not make changes	No creditworthy response	Simple appropriate suggestion given as to why no changes would be made	Simple appropriate suggestion given as to why no changes would be made together with examples quoted from the results	Simple appropriate suggestion given as to why no changes would be made together with examples quoted from the results plus a detailed explanation of why any change would not necessarily improve the results

SECTION 2

Question 2 (a)	0 marks	1 mark	2 marks
	No creditworthy response	Both axes labelled with the variables and units	Both axes labelled with the variables with units and an appropriate line drawn
Additional Guidance	*Axes should be labelled "mass (of water)" and either "temperature rise)"* *Accept axes drawn either way round (i.e. it doesn't matter which axis the mass is on)* *The line should be a concave curve, sloping from top left to bottom right*		

Question 2 (b)	0 marks	1 mark	2 marks	3 marks
	No creditworthy response	A clear statement is made that Case study **1** supports the hypothesis A simple correct statement is made about one of the other Case studies	A clear statement is made that Case study **1** supports the hypothesis Correct statements are made about both Case studies **2** and **3** supported by a more detailed explanation of one of them.	A clear statement is made that Case study **1** supports the hypothesis Correct statements are made about both Case studies **2** and **3** supported by a more detailed explanation of both of them.
Additional Guidance	*An example of a clear statement for case study 1 is "the greater the mass of water, the smaller the temperature rise"* *Further explanation for case study 2 could include reference to the wider variation in results, or the incorrect calculation of a mean (for 200g) as an anomalous result has been included* *Further explanation for Case study 3 could include reference to the fact that the independent variable is not the same as the other two Case Studies*			

SECTION 2				
Question 2 (c)	**0 marks**	**1 mark**	**2 marks**	**3 marks**
	No creditworthy response	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	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 There is a realisation that any discerned relationship can only be an approximation using the data in the table, as the data contains some anomalies
Additional Guidance	*Data quoted might be eg the specific heat capacity of sesame oil is twice that of brick but the temperature rise produced is only half*			
Question 3	**0 marks**	**1 mark**	**2 marks**	**3 marks**
	No creditworthy response	An idea from the research has been related to the context	An idea from the research has been related to the context There is a simple explanation of how this idea can be applied and used in the given context	An idea from the research has been related to the context There is a detailed explanation of how this idea can be applied in the given context
Additional Guidance	*The candidate should attempt to explain, e.g. how manufacturers of domestic hot water tanks could work out the optimum size for the tank*			

Graph or chart			
	Answer	**Additional Guidance**	**Mark**
Question 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.		**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: • categoric; a bar chart should be drawn • continuous; a best fit line should be drawn **N.B.** If no line is possible because there is no correlation, candidates should state this on the graph to gain the mark	**1**