Science A Controlled Assessment

Unit 1: Chemistry

Exemplar Material of a candidate who scored 40/50 marks

Teachers' Notes

This ISA relates to Science A Unit 2 C1.2 Limestone and Building Materials

Topic of investigation

Evaluate the developments in using limestone, cement and concrete as building materials, and their advantages and disadvantages over other materials.
We need to know how the strength of concrete is affected by varying the proportions of sand, cement, and aggregate.

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 candidate's have researched and written up their own plan in the first part of the ISA they should carry out their investigation providing that this is valid, safe, workable and manageable in the laboratory.

Candidates should be given the hypothesis:

There is a link between the force required to break concrete and the proportions of sand, cement and aggregate present.

Candidates will need to decide 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.

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 Chemistry

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 the need to provide the strongest beam for a road bridge, or an economic mix for garden paths. 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 up to **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 for their research, textbooks or any other appropriate sources of information.

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. 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.

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 will require them 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 for the method they have planned.

Candidates may choose to use technology to draw the table, e.g. a computer spread sheet. **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 notes, 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 part of the investigation 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, e.g. 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.
- 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 part of the investigation candidates must work individually under direct supervision.

Candidates should be given back their table of results, or a table containing the pooled results of the class, 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, e.g. 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 must be printed straight away.

Candidates should not be allowed to take their results and chart or graph away: the teacher must collect them at the end of the lesson and mark them before Stage 5.

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
- the 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 of the Teachers' Notes)

Concrete

Hypothesis: There is a link between the force required to break concrete and the proportions of sand, cement and aggregate present.

You will need to prepare a table for the results.

Equipment:

5 concrete beams of different composition (see below for details)

2 bricks

Wire or rope strap

Several 1kg masses

Method:

1. Support one beam across the two bricks. See diagram
2. Wrap the strap round the middle of the beam.
3. Add masses one at a time until the beam breaks.
4. Repeat the test for the other four beams.

Making your concrete beams

Suitable ratios for the concrete beams are given in the table. Sufficient water should be added to enable a very stiff but workable mixture.

Mix	Cement (g)	Sand (g)	Aggregate (g)
A	100	200	200
B	100	200	300
C	100	200	400
D	100	200	500
E	100	200	600

The concrete should be packed into suitable moulds and left to set.

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 193034 Centre Name Beckfoot High School

Candidate's Name Candidate's Number

Investigation Title Nancy Blackett

ISA number: CONCRETE

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.

Date: _____

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

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Research Notes

Hypothesis

There is a link between the force required to break concrete and the proportions of sand, cement and aggregate present

Research sources

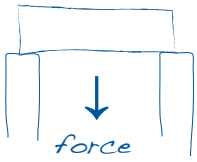
www.RSC.org.uk/alchemy/Limestone
chem. for you Lawrie Ryan.

Method(s)

Suspend beam across 2 stools add 1kg masses to string till beam snaps. Keep gap the same.
Make beams from 100g cement 300g sand plus other masses of aggregate 200g → 600g.

Equipment

2 stools carpet for floor
beams 1kg masses
sand bit of string/wire
cement
aggregate



Risk assessment issues

concrete/cement is alkaline - protect hands + eyes.
Dropping masses on feet - stand back - cushion impact area

Relating the investigation to the context

More aggregate the stronger + cheaper the concrete up to limiting point. Need to find force of car and then concrete mix to support the force.

ISA Section 1

Centre Number						Candidate Number				
Surname	BLACKETT					Other Names	NANCY			

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

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

Candidate Signature		Date	

For Teacher's Use	
Section	Mark
Section 1 (/20)	16
Section 2 (/30)	24
TOTAL (max 50)	40

AQA General Certificate of Secondary Education

June 20xx and January 20xx

Science A

Controlled Assessment ISA CU1.x Concrete Exemplar Section 1

For submission in May 20xx or January 20xx

Time allowed 45 minutes

You will need
- 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 walker Date .....

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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Do not write outside the box

SECTION 1

Hypothesis: *There is a link between the force required to break concrete and the proportions of sand, cement and aggregate present.*

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.

www.RSC.org.uk /alchemy/ limestone

chemistry text book Chemistry for You Laurie Ryan

Which of these sources was the more useful, and why?

Chemistry for you has a really good chapter on cement and concrete. it told me how to make a concrete mix.

2/3

(3 marks)

Mark awarded for the website quoted, and the book is sufficiently detailed. with title and author

The usefulness of only one of the sources has been commented on

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

Write down **one** variable that you will need to control.

the volume of water I use in the beams.

clearly states variable for control

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.

Use a standard mix of sand cement and aggregate eg 100, 200 and 400. Add different volumes of water eg 100, 200, 300 etc until you get a good mix that is neither too runny or too dry to go into your mould. Use the volume of water that gives a good stiff mix to make the concrete bema from I found out in my research that the volume of water is he biggest factor affecting strength.

(3 marks)

3/3

Has clear and detailed method of preliminary work needed. Also clearly states how to use the results to inform the plan.

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

Mixing pot water
stirring rod carpet
moulds
sand,
cement, aggregate
balance
weights of 1 kg
piece of string
two stools

Use 100g of cement, 300g of sand and vary in 100s the mass of aggregate. Mix with 500cm3 of water in the mixing pot stiring until it becomes smooth. pour into the mould, and allow to set.

Take each beam when set, and put the stools about 20 cm apart (enough to allow you to suspend the weights on the beam whilst supporting the edges.) see my picture on the next page. Put the beam across the stools with the piece of string as a loop around it.

Hook a kg mass on the string.
See if the beam breaks. Keep adding mass until your beam breaks. Repeat this for the other beams made.

a good list of equipment.

The description of the method gives a clear order of how to carry out the investigation.

How the equipment is to be used is made clear and is helped by the diagram.

There is little reference to how to make the test fair, the candidate is relying on it being implicit in the method.

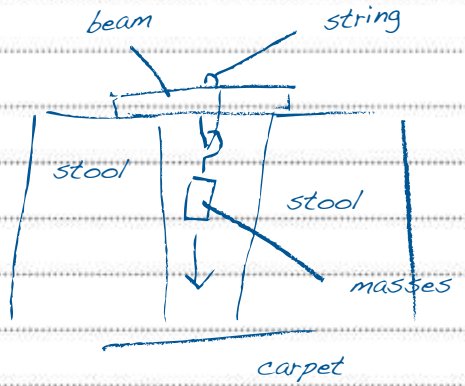
4

I will convert my results into units of force called newtons by multiplying them by 10 before plotting my graph.

Good risk assessment and ideas for controlling the risks.

Risks

There are two big risks here, one is that concrete and cement are alkali, so you should avoid touching them when wet, and the other is dropping the masses on your foot or the floor. Use a piece for carpet to protect the floor and stand well away when adding the masses so your feet are not near the masses when they fall. Be ready to jump.



Clear diagram to help understanding.

8/9

(9 marks)

The spelling, punctuation and grammar are generally good quality and therefore the QWC matches the level of scientific understanding.

diagram.

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

Explain the advantages of sharing your results with others.

As I won't make lots of identical beams to test it can act as my repeats.

1/3

(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.

2/2

(2 marks)

16/20

Clear about need to have data to enable anomalous results to be seen but far too little detail for higher marks.

END OF SECTION 1

Table for Section 1 and 2 of the ISA

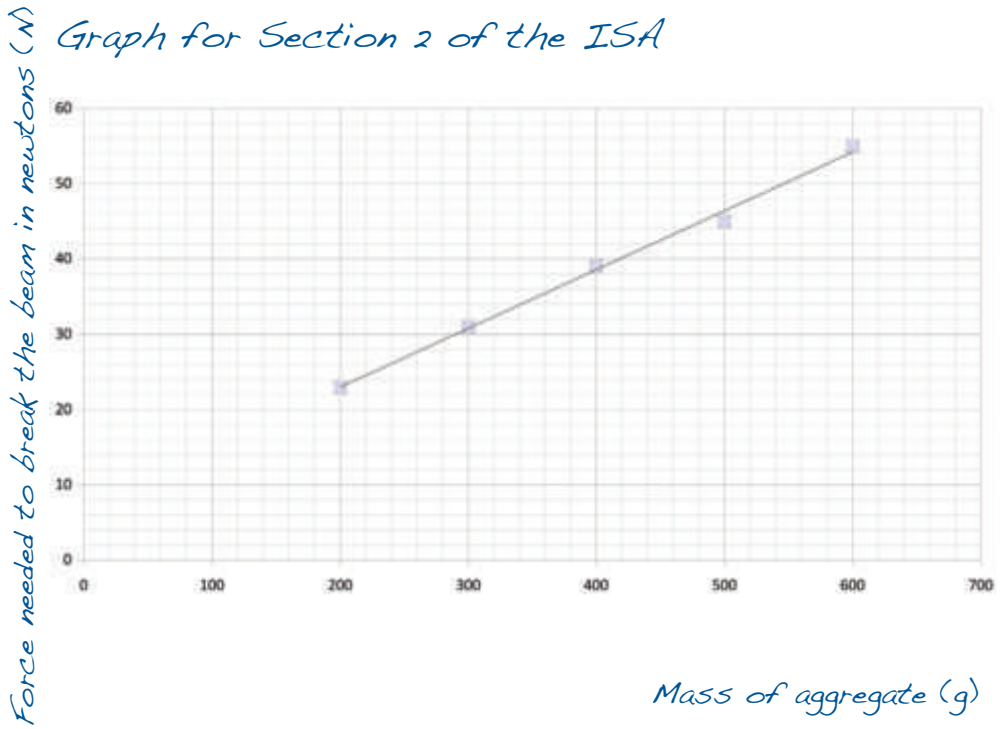
Nancy Blackett Concrete Investigation

Mass of Sand (g)	Mass of cement (g)	Mass of aggregate (g)	mass needed to break the beam in kg				Force (N)
			trial 1	trial 2	trial 3	mean	
300	100	200	2.1	2.5	2.4	2.3	23
300	100	300	3.3	3.1	2.9	3.1	31
300	100	400	4.0	3.8	3.9	3.9	39
300	100	500	4.9	4.3	4.4	4.5	45
300	100	600	5.7	5.4	5.3	5.5	55

2/2

The candidate has provided a blank table for Section 1 which was scored two out of two. The table for the results has both headings and units for the measurements that are to be taken. The candidate has then used their blank table to get their measurements.

Graph for Section 2 of the ISA



ISA Section 2: Higher Candidate Work

Centre Number		Candidate Number	
Surname	BLACKETT	Other Names	NANCY

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

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

Candidate Signature		Date	

For Teacher's Use	
Section	Mark
Section 1 (/20)	16
Section 2 (/30)	24
TOTAL (/50)	40

AQA General Certificate of Secondary Education

June 20xx and January 20xx

Science A

Controlled Assessment ISA CU1.x Concrete Exemplar - Section 2

For submission 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
- a copy of the results of others
- the Secondary Data Sheet
- your Candidate Research notes
- a pencil and ruler

You may use a calculator

Instructions
- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions in 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
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- The maximum mark for the Controlled Assessment Unit is 50
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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 Walker Date .....

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Section 2

Hypothesis: There is a link between *the force required to break concrete and the proportions of sand, cement and aggregate present.*

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

The independent variable was ..... mass of aggregate .....

The dependent variable was ..... the mass added to break the beam .....

One control variable was ..... mass of sand 3/3

(3 marks)

All three variables correctly identified.

1 (b) In your investigation you changed the mass of aggregate used.

What was the range of this variable?

The range was from ..... 200g ..... g to ..... 600g ..... g

If you had been able to use another value of this variable, either within or outside this range, what value would you have chosen?

Give a reason for your answer.

I would use 700g as this would extend the range, as adding more aggregate would eventually run out of the cements stickiness to make it hold together. 3/3

(3 marks)

The range is clearly given and is the same as the candidate's results table has.

Clear additional quantity suggested that extends the range with a clear reason given.

1 (c) Look at your results.

Did you repeat any of the results in your investigation?

Explain why you did or did not repeat any of your results.

Your explanation should include examples from your results.

I did each three times I can see from my results on the graph a clear trend from the calculated averages. All the plots lie close to my best fit line , so I had no anomalous results to affect my line. 2/3

(3 marks)

Answer is consistent with the candidate's results table. There is a clear reference to the unlikeliness of anomalous results, backed up by the reference to the graph. 2 marks is the best fit here.

1 (d) The hypothesis that you were given before you started the investigations was:

There is a link between *the force required to break concrete and the proportions of sand, cement and aggregate present.*

Do **the** results support the hypothesis you were given?

Explain your answer.

yes, my results show that the strength of the concrete does change with the amount of aggregate used. It is directly proportional on my graph. 2/3

(3 marks)

Simple statement verifying the hypothesis is made. The pattern is correctly identified from the graph. There is no reference to any values form the graph.

1 (e) You have been given the results obtained by others in your class, or by your teacher.

Do the results of others show similar patterns to your own results?

Use results to justify your answer.

yes they do, the graph of the class results is also directly proportional showing that increasing the aggregate increases the strength of the beam. 2/3

(3 marks)

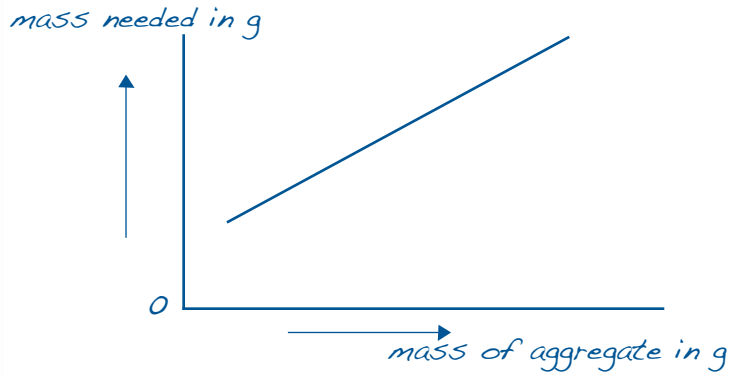
The answer given satisfies the 2 marks, but without quoting some results there is insufficient for the third mark.

Do not write outside the box

2 You have been given a Secondary 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 mass needed to break the beam changes with the mass of aggregate in the concrete beam.



2/2

(2 marks)

2 (b) Look at Case Studies **1**, **2** and **3**.

Do the results in Case studies **1**, **2** and **3** support or not support the 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 supports the hypothesis.

Case study 2 supports the hypothesis but has an anomalous result in trial 2 with a mass of aggregate of 500 grams which has not been excluded from the mean.

Case study 3 also agrees with the results we got

2/3

(3 marks)

A correctly drawn line, with both axes labelled.

Case study 1 is correctly identified as supporting the hypothesis. Case study 2 is also quoted as confirmation, with limited recognition of the anomalous result. Case study 3 is not correctly identified, as the volume of water has changed not the mass of aggregate. Also the candidate has referred to their results which is not required in this question.

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

Describe the relationship between the mass of aggregate and the force needed to break the concrete beam.

at first the graph goes up, then it comes back down. It seems that the beam is strongest with about 2000g of aggregate in the mixture. probably the cement is no longer sticky enough to hold it all together when theirs lots of aggregate present.

2/3

(3 marks)

Identifies the beam gets stronger at 2000g of aggregate. Points out it gets weaker, with some justification, but fails to describe the rapid drop in strength.

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

How could the results from your investigation be useful in the production of concrete for making a household drive?

You may use information from your Candidate Research notes to help you to answer this question.

Different areas need different mixes of concrete according to their use. You could find out how much mass a car has on the drive and then work out how much aggregate would b needed to make the concrete hard enough to withstand that force. Then make the concrete at that amount

2/3

(3 marks)

Information from the Candidate Research Notes is given, and used as well as ideas from the investigation. There is not enough detail to justify awarding three 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 4 marks for your chart or graph.

4/4

(4 marks)

Graph satisfies all the mark guidance points.

END OF QUESTIONS

24/30

Secondary Data Sheet

Data Sheet – Controlled Assessment Chemistry

CU1.x Concrete Exemplar

You will need to use all appropriate data to gain full marks in Section 2 of the ISA on Concrete.

Case study 1

A group of students did an investigation similar to the one you have done to test the hypothesis that the force required to break concrete is related to the proportions of sand, cement and aggregate present. They kept the same mass of cement and sand and changed the mass of aggregate.

They did the investigation three times. These are their results.

Mass of aggregate in the beam in grams	Mean mass in kilograms needed to break the beam.
200	4.3
400	5.3
600	6.7
800	8.0
1000	9.3

Case Study 2

A second group of students did an investigation to test the hypothesis that the force needed to break a concrete beam depended on the mass of aggregate in the beam. They kept the same mass of cement and sand and changed the mass of aggregate.

These are their results.

Mass of aggregate in the beam in grams	Force in newtons needed to break the beam.			
	Trial 1	Trial 2	Trial 3	Mean
200	58	54	56	56
300	82	88	85	85
400	113	117	116	115
500	146	194	149	163
600	177	173	177	176

Case Study 3

A different group of students tested the mass needed to break a beam when the volume of water added to the mixture was varied.

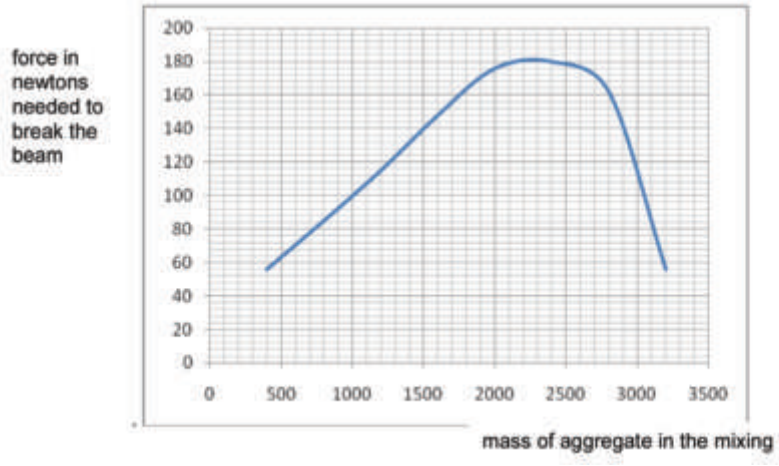
These are their results.

volume of water added in cm^3	Mass of aggregate in the beam in grams	Mean mass in kilograms needed to break the beam.
500	500	5.9
600	500	6.7
700	500	7.5
800	500	7.5
900	500	6.8

Case Study 4

A fourth group of students carried out the investigation into the force needed to break a concrete beam. They increased the mass of aggregate, and then measured the force needed to break the beam. They repeated each test three times and calculated the mean.

They presented their results as a graph.



CU1 Exemplar Mark Guidance

Science ISA – CU1.x Concrete Exemplar 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) 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 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 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 of a question.

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 The dependent variable is stated, but details concerning its measurement are incomplete	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	*A suitable method is likely to involve controlling the mass of sand, cement or volume of water.* *The way in which the results could be used is likely to refer to deciding whether or not there is sufficient (or too much) difference between force needed to break the beams.* *Do **not** give full credit to a candidate who describes how to do the entire investigation at this stage.*			

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 equipment are listed The method described will enable valid results to be collected The measurements to be made are stated at least one control variable is given 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: the alkaline nature of cement products, and the need to wear eye and/or hand protection, and avoidance of inhaling dust.

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 check your results with those of others to see if there are any similarities or differences With more results you are able to calculate a more accurate mean and minimize the effect of random errors	Enables you to check your results with those of others to see if there are any similarities or differences With more results 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 independent is the mass of aggregate.* *The dependent is the force or mass needed to break the beam.* *Examples of control variables are: mass of sand,,cememt, or volume of water, length, cross section of beam.*			

Question 1 (b)	0 marks	1 mark	2 marks	3 marks
	No creditworthy response	At least one end of the range is correctly stated Another value of the independent variable is suggested, although it may not be appropriate	The range is correctly stated, according to the candidate's own results Another appropriate value of the independent variable is suggested	The range is correctly stated, according to the candidate's own results Another appropriate value of the independent variable is suggested The reason given for the choice of the additional reading is appropriate
Additional Guidance	*An appropriate extra reading will usually be one of the following:* • *an intermediate reading to fill in a gap, perhaps where the trend line becomes unclear* • *a reading outside the range already investigated, perhaps to see if the trend continues.*			

Question 1 (c)	0 marks	1 mark	2 marks	3 marks
	No creditworthy response	There is a correct statement regarding whether or not any measurements were repeated There is mention of the presence or absence of anomalous results	There is a correct statement regarding whether or not any measurements were repeated There is reference to either anomalous results or to systematic or random uncertainties	There is a correct statement regarding whether or not any measurements were repeated and a clear indication of which results were repeated There is reference to either anomalous results or to systematic or random uncertainties, and the effects that these would cause
Additional Guidance	*In order to gain maximum marks, the candidate should quote some examples from their results.* *The candidate may refer to a clearly anomalous result that needs repeating, or to the fact that not all the points lie comfortably on a line of best fit (random uncertainties) or to a systematic uncertainty, such as that caused by some experimental issue.*			

SECTION 2

	0 marks	1 mark	2 marks	3 marks
Question 1 (d)	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.*			

	0 marks	1 mark	2 marks	3 marks
Question 1 (e)	No creditworthy response	A simple statement is made as to whether or not the pattern of the other results is similar to the candidate's results	A simple statement is made as to whether or not the pattern of the other results is similar to the candidate's results. and an explanation is provided using either an example from the other results or a correctly identified pattern	A simple statement is made as to whether or not the pattern of the other results is similar to the candidate's results. and a detailed explanation is provided using either; **two** examples from the other results **or** a correctly identified and described pattern in the results
Additional Guidance	*Note that the answer should refer to the other results, and not simply to the expected result.*			

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

SECTION 2				
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 aggregate the greater the mass/force needed to break the beam.* *Further explanation for case study 2 will be that that results support the hypothesis when the anomalous result is excluded (500g and 194N).* *Further explanation for Case study 3 could include reference to the investigation varies the water volume as well as mass of aggregate so it is not relevant.*			
Question 2 (c)	**0 marks**	**1 mark**	**2 marks**	**3 marks**
	No creditworthy response	Increasing the mass of aggregate increases the force needed to break the beam up to a point	Increasing the mass of aggregate increases the force needed to break the beam up to a point beyond 2000g the concrete starts to get weaker	Increasing the mass of aggregate increases the force needed to break the beam up to a point beyond 2000g the concrete starts to get weaker the weakening of strength is at a greater rate than the increase in strength
Additional Guidance				

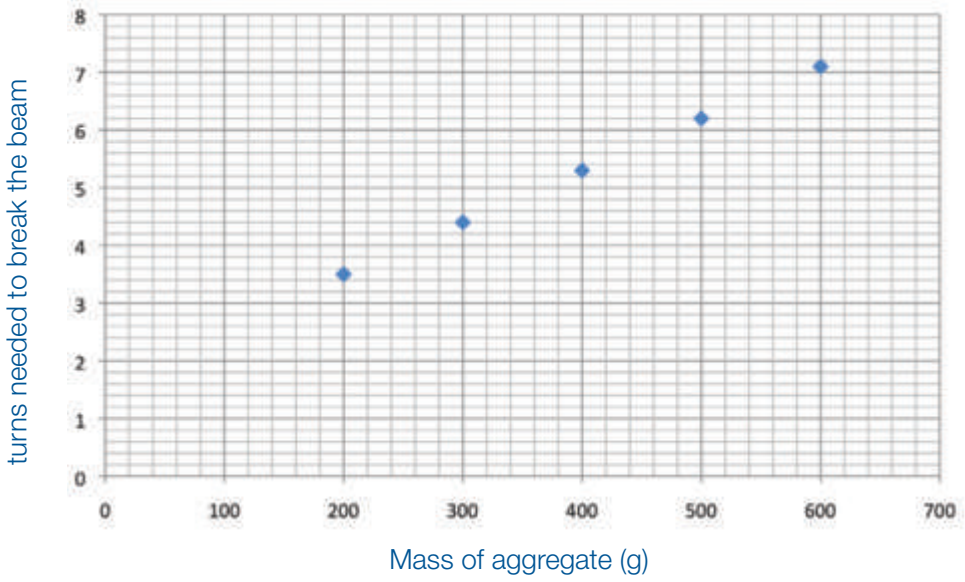
SECTION 2

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 useful 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 useful in the given context
Additional Guidance	*The candidate should attempt to explain, e.g.how the mass of aggregate should be varied to meet the expected force likely on the drive, created buy a vehicle.*			

Question 4	Answer	Additional Guidance	Mark
	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.	**1**
	Y axis: suitable scales chosen and labelled with quantity and units.	It may not always be necessary to show the origin.	**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**

Pooled Result for Class

If you used the clamp method – Graph of mean of pooled results



If you used the kg mass method – Graph of mean of pooled results