Science B Controlled Assessment

Unit 4: Using Practical and Investigative Skills

The effectiveness of antacid remedies

Exemplar material of a candidate who scored 38/48 marks

Notes for Teachers

This task relates to Unit 2 context 3.4.1.2 – Chemistry in action in the body.

Method

Methods and techniques in the Controlled Assessment are not necessarily restricted to those mentioned in the specification. Candidates should be encouraged to use appropriate technology when completing the task.

Candidates should be given the opportunity to carry out an investigation concerning the effectiveness of an antacid on stomach acid, and must write a report on their findings.

Candidates should be given the opportunity to practice the techniques of titration before completing this investigation. They should, however, plan and make decisions on equipment and readings to be taken for themselves.

Candidates should carry out some preliminary research concerning an application for their investigation. They will need to decide on their research method, which could include the use of books, internet sources and surveys. Candidates should bring the information they collect into the supervised sessions to use as part of their final report.

In the practical stage, candidates may work singly or in groups to obtain their data. However, each candidate must record and process the data individually, and must identify the data collected under their own direction.

In addition to the secondary data given in the Notes for Candidates, candidates should be given group or teacher data to analyse and compare with their own in order to comment on the validity of their own work.

Area of Investigation

This work should be carried out during the teaching of the section relating to Unit 2, section 3.4.1.2 – Chemistry in action in the body.

- Our stomach contains hydrochloric acid. Sometimes excess acid can make us feel very uncomfortable and may cause heartburn and nausea.
- Pharmacologists use their knowledge of neutralisation reactions to monitor and control stomach acid using antacids. They test the effectiveness of antacids in terms of how effectively they neutralise excess stomach acids before they are sold to the consumer.
- Name some hazards of acids and bases and some control measures that can be put in place to minimise risks from them.
- Understand that the stomach works most effectively in acid conditions by helping to break down food.
- Explain how an antacid neutralises excess stomach acid to help to treat heartburn and nausea.

Notes for Teachers

Contextualisation of task

The task should be put into a context, so that candidates understand the reason for the investigation that they are carrying out. An example context is given below.

Biochemists working for pharmaceutical companies test a variety of medicines in order to find fast, effective relief from heartburn or acid reflux. Doctors may need to prescribe drugs to help patients with indigestion. These medicines work by neutralising the excess acid within the stomach which helps break down food. When developing new antacid remedies it is important, for both scientific and commercial reasons, to know what amount of antacid is best in neutralising particular acid conditions. You are researching the effectiveness of an antacid preparation in neutralising an acid, to compare the results with known antacids.

Suggested approaches

Candidates could test either a known amount of an antacid compound or an appropriate commercial preparation.

1. Candidates could add a known amount of hydrochloric acid (volume and concentration) to an antacid, calcium carbonate. Alternatively, a commercial antacid preparation could be used. If a commercial preparation is used, it is recommended that one based on calcium carbonate is chosen.
2. The excess acid can be found by titration against a standard sodium hydroxide solution. By difference, the amount of hydrochloric acid that reacted with the antacid can be calculated.

Working safely in the laboratory

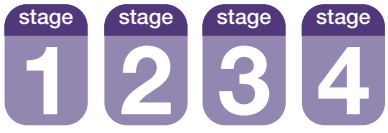
It is the responsibility of the centre to be aware of any health and safety implications of the investigation and ensure that a risk assessment for the practical is carried out. Teachers should remind candidates about safe working when carrying out laboratory procedures.

Analysing secondary data

As part of the task, candidates are required to verify their data by comparing it with secondary data. These data could be the results obtained by other groups within the class, and / or results for the investigation that have been obtained by the teacher or technician before the candidates do the practical themselves.

Candidates should also use the data given in the Notes for Candidates.

Follow the next 4 stages to complete the Controlled Assessment for The effectiveness of anatacid remedies



Notes for Teachers

stage 1 Planning and research (Limited control)

The teacher should lead a discussion with the candidates to outline the technique that is to be used. This might include demonstrating the technique and illustrating the variety of equipment available.

Candidates should be shown the technique to be used, and should be given the opportunity to have hands-on experience of the technique. Candidates should then be left to themselves to decide factors such as the independent variable to be investigated, the range, interval and number of repeat readings they should take.

Candidates also need to carry out research into an application of the investigation they are carrying out. This research could take different forms such as internet searches, book and journal searches, or questionnaires and surveys. Candidates should decide for themselves an appropriate method of research for their investigation.

stage 2 Reporting on the planning and research (High control)

At the end of the planning session, candidates must work on their own, under direct supervision, to write their plan and risk assessment for the practical. Teachers must collect all work in at the end of the session and keep it securely for marking and submission with the final report for moderation.

Notes for Teachers

stage 3

Practical work (Limited control)

For this part of the investigation candidates may work individually or in groups.

The teacher may provide a method, after the candidate has produced their own plan, if the candidate's plan is unworkable, unsafe or unmanageable in the laboratory. For plans that are otherwise good, but unworkable for a good reason (ie logistical) candidates should not lose any marks. However, where the plan is dangerous or unworkable (from a scientific perspective) this will be reflected in the marking.

The method suggested above could be used, but this should not preclude centres from adapting the method to suit their own needs.

Candidates may be given instructions of a general nature, but these should not be so prescriptive as to preclude candidates from making their own decisions.

Each candidate must contribute to the collection of data.

Once the candidates have completed their investigation, their results should be made available to others in their group for data analysis and evaluation. Candidates should use the results of others (possibly other groups in their class or teacher-obtained results), and the secondary data given in the Notes for Candidates, to analyse the validity of their own results.

Notes for Teachers

stage 4

Data processing, analysis and evaluation (High control)

For this part of the investigation candidates must work on their own, under direct supervision to write up their findings, analyse their own and the secondary data and present their evaluations and conclusions.

The data given in the Notes for Candidates are based on taking 0.125g of calcium carbonate, adding 50 cm^3 of 0.1 M HCl, and titrating the excess with 0.1 M NaOH.

Understanding how the exemplar Controlled Assessment is marked

The marking criteria on pages 25–29 have been arranged to aid teachers in understanding how each marking point may be awarded. The numbers in the annotations on the exemplar work refer to these marking points.

The marking checklist on page 24 shows which of the marking points have been awarded to the exemplar.

Notes for Candidates

This task relates to Unit 2 context 3.4.1.2 – Chemistry in action in the body.

Area of Investigation

Antacids neutralise excess stomach acid.

Task

You must design, plan and carry out an experiment to compare the effectiveness of a given antacid with known products.

You will be given the opportunity to:

- research some applications of the investigation you will be doing
- investigate the effectiveness of an antacid in neutralising an acid
- compare your results with those of other people and with those obtained from known products in order to comment on the validity of your data and effectiveness of your techniques.

You will be expected to:

- research applications of the investigation you will be doing
- practice techniques that you will use during your investigation
- work on your own to write a plan for your investigation
- write a risk assessment for your investigation.

When you write up your plan you must work on your own, without talking to your classmates or teacher.

You will be shown the equipment available for you to do the investigation.

You will have to decide on things such as:

- the most appropriate sources of research to use
- the equipment you will use
- how to do the investigation
- appropriate readings and measurements to take
- how you will make your investigation a fair test
- which readings to repeat.

You will then do practical work to obtain data on the neutralising effects of antacids. When doing the practical work you may work in a group with classmates, but you **must** record the data obtained yourself, and you **must** identify the data that you have obtained.

After the practical, you will be given some secondary data (data obtained by other people) to use in your analysis. The secondary data given in the box is obtained from some known products, and you should also use this in your analysis.

Make sure that you consider the questions below the table when you write up your report.

You must write a report on your investigation, which should contain:

- your research, explaining an application of your investigation
- your plan
- your risk assessment
- the results that you have obtained, presented in an appropriate manner
- an analysis of your own results and of the data from the known products
- your conclusions, including a comparison of your results with all the secondary data
- an evaluation of your investigation.

When you write up your report, you **must** work on your own, without talking to your classmates or teacher.

Data from known products

Dilute hydrochloric acid was added to five antacid products, **A**, **B**, **C**, **D** and **E**, all containing calcium carbonate.

After the reaction had completed the acid left over was titrated with dilute sodium hydroxide (0.1M). The following burette readings were obtained. Each antacid was titrated three times.

Antacid	Initial reading (cm^3)	Final reading (cm^3)
A	0.00	21.00
	0.00	19.00
	0.00	20.00
B	10.50	22.80
	5.50	18.65
	4.60	17.10
C	0.00	22.65
	22.65	45.10
	1.25	23.75
D	1.25	17.80
	0.00	16.70
	11.55	38.25
E	0.00	24.60
	24.60	49.20
	1.20	25.80

- Which antacid in the table could have been used in your investigation? Give a reason for your choice.
- Which product in the table was most effective? Give the reasons for your choice.

Candidate work: The effectiveness of antacid remedies

The effectiveness of antacid remedies.

1. Research

I'm going to investigate how effective antacids are on stomach acid. Sometimes people take antacids if they get indigestion or heartburn.

On www.bbc.co.uk/health it says that if you get indigestion you might feel pain in your stomach or think you're having a heart attack. You might feel bloated or get wind or nausea. Sometimes excess acid is linked with ulcers and drugs like aspirin can make it worse. Antacids are alkalis so neutralise the acid. When chemists make new antacids they have to be tested to check they work and that they are safe to use. A chemist might do an investigation like mine when testing new antacid remedies. They would use alkalis to neutralise the acids. Research and development sections of pharmaceutical companies have the role of producing and testing new remedies.

I researched the ingredients of some remedies on http://heartburn/about.com and found that Tums contain famotidine 10mg, calcium carbonate 800mg and magnesium hydroxide 165mg. Maalox contains just calcium carbonate. I know we have this in school so I want to use calcium carbonate in my experiment.

On www.ehow.com it said that stomach acid is 0.16M hydrochloric acid so I think I'll use the same in my experiment so it's similar to real stomach acid. I found a method for investigating ant acids on www.practicalchemistry.org which said that burettes allow you to measure the acid accurately so I want to try to use one in my experiment. I could use some maths to work out how strong the alkali and remaining acid are.

4/4

1.1/1.2/1.3a
A scientific application has been given, discussing acid and alkali neutralisation. Sources of research have been mentioned.

1.3b
Three research sources have been given and the research has been used as a basis for the investigation into the effect of antacids.

2. Planning

Aim

The purpose of my experiment is to investigate how effective calcium carbonate is as an antacid treatment by using different amounts to neutralise a known amount of hydrochloric acid and then titrating this against sodium hydroxide.

2.1a
The purpose of the investigation is stated.

Equipment

Equipment	Why used
Goggles	To protect our eyes
50ml measuring cylinders	To measure out the acid and alkali.
0.1M hydrochloric acid	To react with the alkali.
Calcium carbonate powder	To neutralise the acid. (Antacid)
0.1M sodium hydroxide	To titrate with the acid.
Electronic balance	To weigh the calcium carbonate.
Clamp and stand	To hold the burette.
White tile	To see the colour change easier.
Burette	To titrate the alkali with acid.
Filter funnel	To fill the burette.
Conical flask	To mix the acid and alkali.
Universal indicator	To show when it's neutral
Spatula	To measure out the calcium carbonate.

Fair testing

What I'll keep the same	What I'll change
The volume and concentration of hydrochloric acid and sodium hydroxide used. The same equipment throughout.	The mass of calcium carbonate added to the hydrochloric acid each time.

2.1b
The variables are given here, and in the variables table on page 12.

Method

1. Fill the burette with 50ml of 0.1M sodium hydroxide.
2. Use a measuring cylinder to measure out 50ml of 0.1M hydrochloric acid and put it in a conical flask.
3. Add a pipette of universal indicator and it should turn red.
4. Place a white tile and the conical flask under the burette.
5. Add the alkali to the acid using the tap to control the flow. Stop when the universal indicator turns green and record the volume of sodium hydroxide added to the acid. This is the rough titration which will give me an idea of when the colour change occurs so
   I can do the rest of the results very carefully.
6. Repeat 3 times but adding the alkali slowly to get an accurate reading of the volume added.
7. Now measure out 0.02g of calcium carbonate and add to 50ml of hydrochloric acid in the conical flask. Mix well and wait for all fizzing to stop.
8. Titrate the remaining acid to see what volume of sodium hydroxide is needed to neutralise it. Record the result and repeat 3 times to check reliability.
9. Repeat this for 0.05, 0.07 and 0.10g of calcium carbonate and repeat each one three times.
10. Calculate mean volumes of sodium hydroxide needed to neutralise the remaining stomach acid by adding the three results together
    and dividing it by three.

2.2a/2.3a
The plan is organised and could be followed by another person.

However, there are some steps that are unclear. Step 6 could be improved by stating that the alkali should be added dropwise while swirling the conical flask. The candidate has also not explained that titrations should be repeated until there is concordance in the results.

If this was all present then the Level 3 mark could be awarded.

Variables	
Independent	Dependent
Mass of calcium carbonate added to the acid (g)	Amount of sodium hydroxide (0.1M) added to neutralise the acid (ml)

I think that when more calcium carbonate is added we will use less sodium hydroxide to neutralise the acid because the calcium carbonate reacts with the hydrochloric acid to give carbon dioxide, calcium chloride and water. The water will dilute the remaining acid so less alkali is needed to neutralise it.

4/6

2.2b/2.3b
The variables have been given and a possible relationship between the variables shown. The candidate has recognised that the investigation is a back titration.

However, the candidate has shown a lack of understanding when stating that the water produced will dilute the acid, causing less alkali to be needed to neutralise it. The relationship between the variables is not presented as a quantitative relationship. The candidate should suggest, for example, what might happen when the amount of calcium carbonate is doubled. The understanding of why the amount of alkali needed decreases when the amount of calcium carbonate added increases is confused, and so the Level 3 mark cannot be awarded.

3. Assessing and Managing Risk

Equipment/ procedure/ chemical used	Hazard	Risk	Control measure	Source of information
Glassware	You could cut yourself.	Medium risk to anyone using them. They are very easy to break.	Visually check for cracks or chips before picking up. Keep away from edge of bench. Know the 1st aid for cuts.	Own knowledge. Use British red cross website for 1st aid for cuts.
Electronic balance	Electric shock.	Low as they are designed to be safe to use in labs and use a low voltage.	Visually check wires and plug have intact insulation before plugging in. Ensure that bench is dry and no taps are used nearby. Know the 1st aid for electric shock.	Own knowledge. Use British red cross website for 1st aid for electric shock.
Universal indicator	Flammable and could cause skin allergy. Slips or falls if spilt	Medium risk could be spilt on your skin very easily	No Bunsen flames on in room. Use pipette to measure out solution so it doesn't come in skin contact. Wash hands carefully if you get it on you. Clear up all spillages with paper towels.	Cleapss hazcards.

3.1/3.2ai/3.3ai
All the hazards have been identified.

3.2aii/3.3aii
All the risks with the identified hazards have been clearly given.

3.2b/3.3b
Control measures have been suggested. Most control measures are based on scientific reasoning.

Even though some control measures are based on common sense this is only where appropriate.

Equipment/ procedure/ chemical used	Hazard	Risk	Control measure	Source of information
hydrochloric acid (0.1M)	Irritant can damage the skin and eyes. Slips or falls if spilt	Medium as it can be spilt very easily and looks like water so you might forget to wash it off.	Clear up any spillages immediately using paper towels. Wash hands well after the practical just in case. Wear goggles at all times. Know the first aid for chemicals in the eyes or on the skin. Make sure there's no metals left lying around as acid react with them.	Cleapss hazcards. Use British red cross website for information on 1st aid for chemical burns.
Sodium hydroxide (0.1M)	Irritant can damage eyes and skin. Slips or falls if spilt	Medium as it can be spilt very easily and looks like water so you might forget to wash it off.	Clear up any spillages immediately using paper towels. Wash hands well after the practical just in case. Wear goggles at all times. Know the first aid for chemicals in the eyes or on the skin. If your hands feel soapy wash with lots of water.	Cleapss hazcards. Use British red cross website for information on 1st aid for chemical burns.
Calcium carbonate	Low hazard could cause coughing if breathed in	Low - its used in lots of everyday things like toothpaste	Keep the lid on and don't shake container to keep the dust down. Any asthmatics should have their inhaler on them at all times.	Cleapss hazcards.

Equipment/ procedure/ chemical used	Hazard	Risk	Control measure	Source of information
Carrying out the experiment	Chemicals in the eyes or skin could be irritant	Medium unless you fill and use the burette very carefully	Put the clamp and stand down on the floor to fill up the burette so it is well below eye level. Keep goggles on at all times. Know the 1st aid for chemicals in eyes or on skin.	Own knowledge, practical chemistry website. Use British red cross website for 1st aid for chemicals in eyes or on skin.
Carbon dioxide	Suffocation	Very low as only small amounts will be produced by the reaction	Keep the lab well ventilated by opening up the windows.	Own knowledge and cleapss hazcards

8/8

4. Collecting data

Mass of calcium carbonate added to 50ml of 0.1M hydrochloric acid (g)	Volume of 0.1M sodium hydroxide added to neutralise the remaining acid (ml)				
	Rough titration	1st attempt	2nd attempt	3rd attempt	mean
0	50	50.0	49.8	50.0	49.9
0.02	43	42.6	43.1	42.8	42.8
0.05	31	31.0	29.5	31.0	30.5
0.07	21	24.3	20.9	20.7	20.8
0.10	10.5	10.2	10.3	10.4	10.3

The 1st attempt using 0.07g gave a high result so wasn't used in my mean. If I had more time I would have repeated this one again.

7/8

4.1a/4.2a/4.3a
Titrations have been carried out and the results recorded, so observations have been made. The observations are accurate. However, the candidate needs to have recorded all the measurements or observations made in order to gain the Level 3 mark. This could have been done with a table showing initial and final volumes for the titres.

4.1b/4.2b/4.3b
The data has been recorded with no errors. Even though the rough titrations have not been recorded to 1 decimal place, the rest of the data is recorded with consistent significant figures and with correct headings and units, which is acceptable for the Level 3 mark.

4.2c/4.3c
The candidate has recognised that one of the results for this mass should be repeated, and would have repeated it if possible, so Level 3 mark is awarded here.

5. Processing data

My graph is negatively proportional as it's a straight line. It shows a negative correlation as it goes down. It shows that as I used more calcium carbonate the remaining hydrochloric acid was reduced so the volume of sodium hydroxide needed to neutralise it was also reduced. I calculated the moles of hydrochloric acid remaining by taking each mean titration and dividing it by 1000 and multiplying it by 0.1. My graph shows that if I added 0.126g of calcium carbonate to the acid it would be completely neutralised.

I plotted these figures onto the graph and it clearly shows that the amount of acid is greatly reduced by the calcium carbonate being added. My teacher suggested that I should do a line graph but told me to do my own scales. I didn't use the 1st attempt for 0.07g in my mean as this was an anomalous result compared to the other two. The other two results were quite close so I think my work will still be reliable.

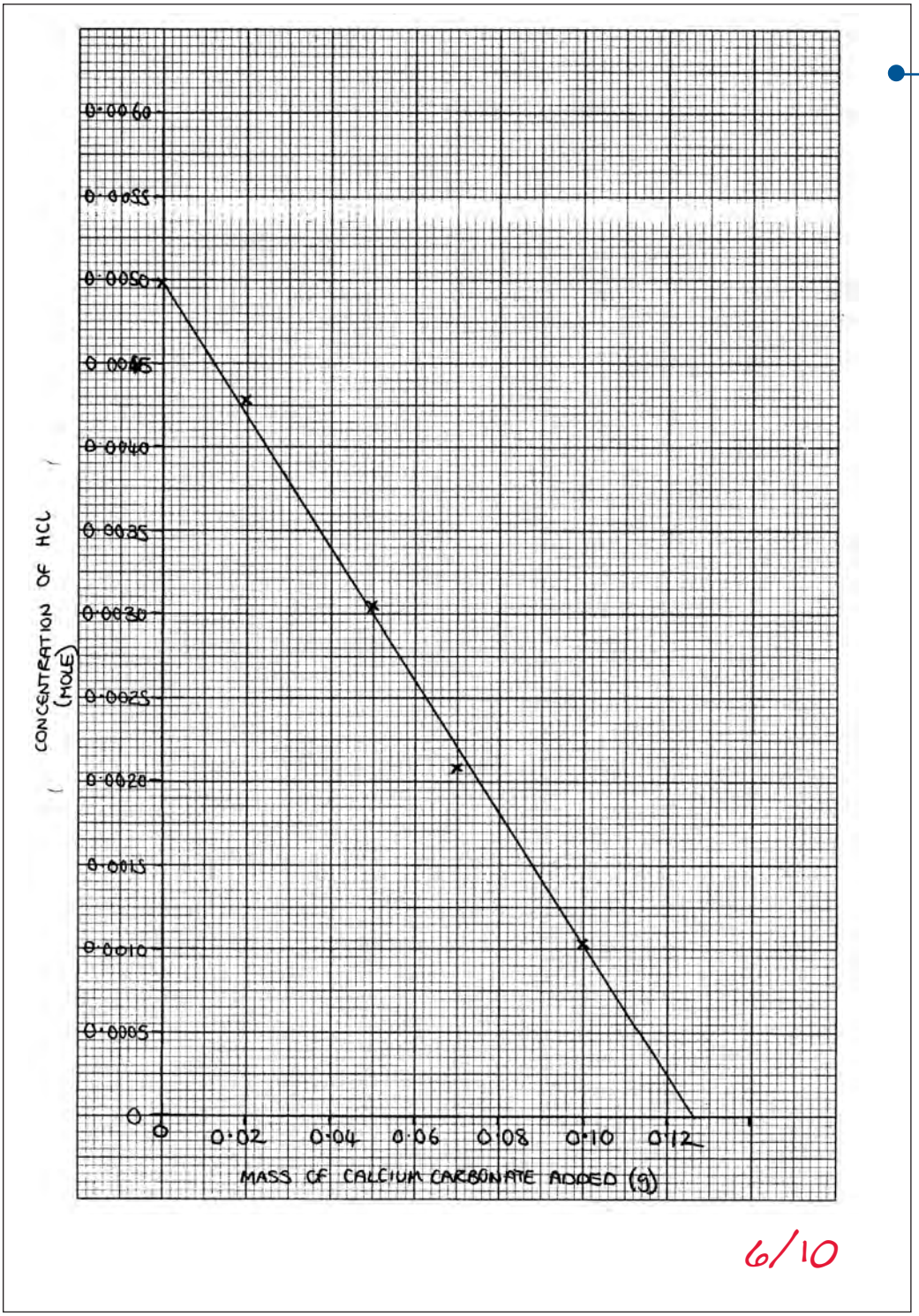
5.1a/5.2a
A pattern has been identified. However, the quantitative relationship between the variables has not been identified, so the Level 2 mark cannot be awarded. The candidate should describe, for example, what has happened when the amount of calcium carbonate has been doubled.

5.3a
The candidate has identified that the line is negatively proportional. However, this doesn't clearly explain the relationship between the amount of calcium carbonate and the volume of alkali used to neutralise the acid, so the Level 3 mark cannot be awarded.

5.1b/5.2b/5.3b
The candidate has calculated the average mass for each titre, using appropriate significant figures for the data obtained. However, to achieve the Level 3 calculation mark the candidate should show the mathematical formula used and give at least one worked example.

5.3c
The candidate was given guidance on what sort of graph to draw, so the Level 3 mark cannot be awarded.

5.2d
The candidate has recognised that the anomalous result shouldn't be used.



5.1c/5.2c
A line graph has been drawn and the candidate chose their own scales for the graph.

6. Analysing data

I found out that calcium carbonate is a good chemical to use as an antacid as the number of moles of hydrochloric acid remaining after the reaction was greatly reduced. For example when 0.02g was added the HCl was 0.0043M but when 0.10g was added it was only 0.00103M. If you double the amount of calcium carbonate you half the amount of acid left.

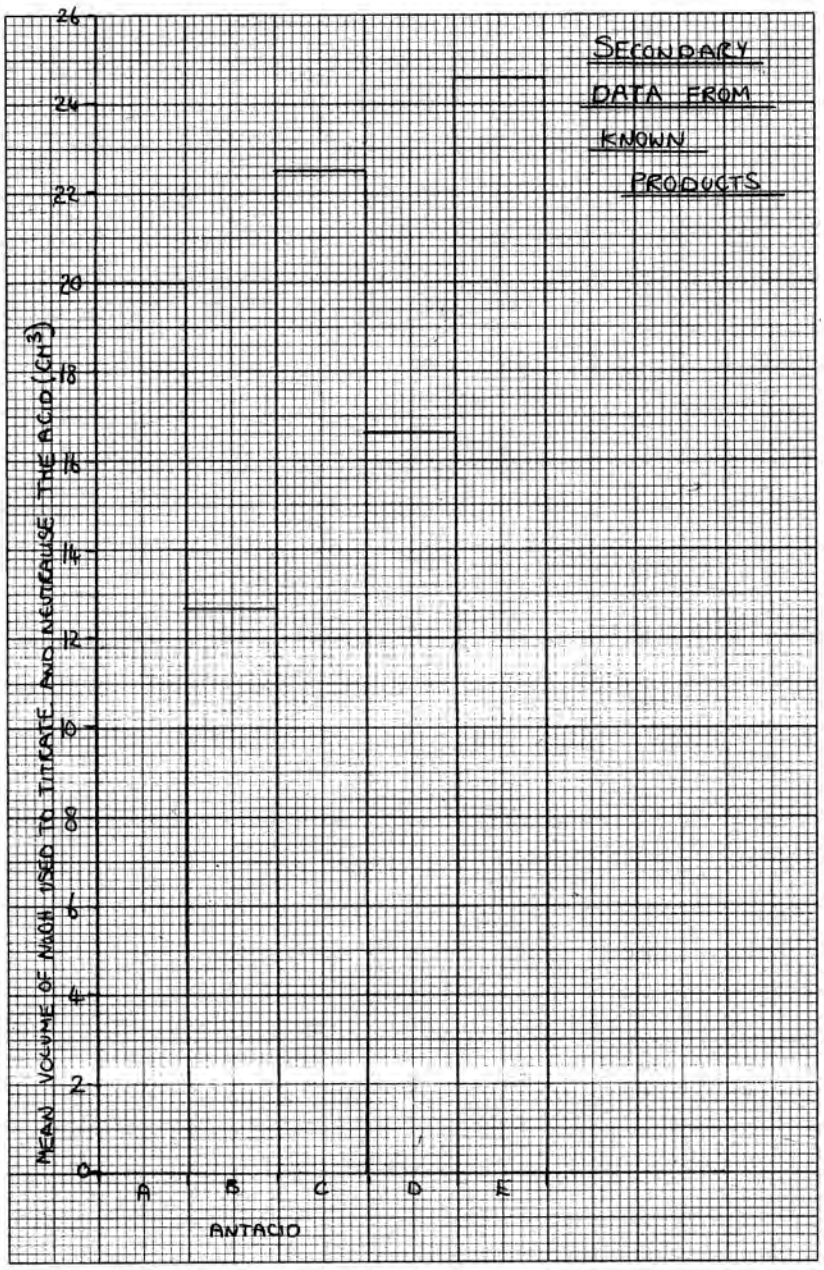
I used the secondary data provided to work out the mean volume of sodium hydroxide needed to neutralise dilute hydrochloric acid for antacids A-E. My means are in the table below. I didn't include the third result for sample D in the mean as it looks like an anomalous result.

Antacid	Volume of sodium hydroxide (ml) needed to neutralise dilute hydrochloric acid	Volume of sodium hydroxide (ml) needed to neutralise dilute hydrochloric acid
A	21	20
	19	
	20	
B	12.5	12.65
	13.15	
	12.5	
C	22.65	22.5
	22.45	
	22.5	
D	16.5	16.62
	16.70	
	26.7	
E	24.60	24.6
	24.6	
	24.6	

6.1/6.2a/6.3i
A conclusion has been given. However, the candidate has got confused on how to use their data and so the conclusion given does not relate directly to their primary data. The example given using data does not support their conclusion even through the conclusion is correct. Level 2 or 3 marks cannot be awarded.

6.2bi
The candidate has compared their results with the secondary data.

I used the means to draw this graph.



Looking at the secondary data provided I think that the ant acid E must have between 0.05 and 0.07g of calcium carbonate in it as the titration value was 24.6ml. My results were between 30.5 and 20.8ml for the same amounts. Antacids A, B, C and D must have between 0.07 and 0.1g of calcium carbonate in them as the titration values were 20, 12.65, 22.5 and 16.62ml. My results were between 20.8 and 10.3ml for these amounts. To make my results even more reliable I should have repeated the anomalous result for the 1st attempt at 0.07g and not just left it out of my mean. I could have kept on repeating each experiment until I got 3 repeats all within 0.5ml of each other. To make my data more valid I should have found out more about antacids A-E and tried to use the same amount of chemicals in my experiment so I could compare my results with those more or I could have borrowed some results from someone else in the class to check them. The most effective antacid in the table was also antacid B as only 12.65ml of sodium hydroxide to neutralise the dilute acid whereas antacid E needed 24.6ml.

6.3i
There are some correct conclusions here regarding the secondary data, but no further secondary data (eg group data) has been used.

6.3ii
There is no evidence of a comprehensive scientific understanding here. The candidate should discuss that the acid is neutralised by the calcium carbonate and that this is whey less alkali is needed when more calcium carbonate is used. They should then relate this to the initial question of how effective antacids are on stomach acid.

6.2bi
The candidate has suggested repeating the anomalous result to improve reliability and has given simple suggestions to improve validity.

The conclusions have been well structured and are clearly presented.

3/6

7. Evaluating the practical activity

Most of my results were good apart from the 1st attempt with 0.07g which was too high – I should have repeated this one again. I think the rest of my results are good as all of the points on the graph are close to the line that I did.

The evaluation is clearly expressed, technical terms have been used correctly and there are few errors in spelling, punctuation or grammar.

7.1i/7.2i
The method and its effectiveness have been evaluated.

Strengths	Weaknesses
Working safely and in an organised way	I used powdered marble instead of pure calcium carbonate
Didn't have to ask for lots of help in the experiment	I put the sodium hydroxide in the burette which blocked up the tap a bit
I did lots of repeats	It was hard to tell when the acid was neutralised because the colour change was hard to see
I tidied up my working area after the experiment	It was hard to mix the conical flask at the same time as adding the alkali from the burette

7.3i
Strengths and weaknesses clearly described.

Improvements to be made	Reasons
Use pure calcium carbonate instead of powdered marble	There was some marble left at the end which could have been impurities which might have affected the reliability of my results.
Change the experiment so that the acid was in the burette and not the sodium hydroxide	Sodium hydroxide can form crystals in it if left around too long. This could block up the tap on the burette so affect the results.
Use a pH meter instead of the universal indicator	It was difficult to get the exact colour change as it sometimes looked yellow/green and sometimes looked blue/green. With a pH meter I would only have to look for a number 7 for neutral on the screen.
Use a magnetic stirrer instead of mixing the conical flask by hand	It was hard to swirl the conical flask and open the tap on the burette at the same time. By using a magnetic stirrer it would be much easier.
Use a glass pipette and filler to measure out the hydrochloric acid	I think I might have not measured the acid correctly in the measuring cylinder I think a pipette would give a more accurate result.
Make sure there are three repeats all within 0.5ml of each other	This way my results will be very reliable.
Check my results with three other people in the class	This way my results will be more valid 6/6 Overall mark 38/48

7.1ii/7.2ii/7.3ii
Sensible and justified improvements have been given.

GCSE Science B Controlled Assessment Marking Checklist

Candidate Name: .....

Candidate Number: .....

Assessment criteria achieved in each strand (tick as appropriate)

Strand 1: Research

1.1	1.2	1.3a
✔	✔	✔
		1.3b
		✔

Marks for Strand 1 4/4

Strand 2: Planning

2.1a	2.2a	2.3a
✔	✔	
2.1b	**2.2b**	**2.3b**
✔	✔	

Marks for Strand 2 4/6

Strand 3: Assessing and managing risk

3.1i	3.2ai	3.3ai
✔	✔	✔
3.1ii	**3.2aii**	**3.3aii**
✔	✔	✔
	3.2b	**3.3b**
	✔	✔

Marks for Strand 3 8/8

Strand 4: Collecting data

4.1a	4.2a	4.3a
✔	✔	
4.1b	**4.2b**	**4.3b**
✔	✔	✔
	4.2c	**4.3c**
	✔	✔

Marks for Strand 4 7/8

Strand 5: Processing data

5.1a	5.2a	5.3a
✔		
5.1b	**5.2b**	**5.3b**
✔	✔	
5.1c	**5.2c**	**5.3c**
✔	✔	
	5.2d	
	✔	

Marks for Strand 5 6/10

Strand 6: Analysing data

6.1	6.2a	6.3i
✔		
	6.2bi	**6.3ii**
	✔	
	6.2bii	
	✔	

Marks for Strand 6 3/6

Strand 7: Evaluating the practical activity

7.1i	7.2i	7.3i
✔	✔	✔
7.1ii	**7.2ii**	**7.3ii**
✔	✔	✔

Marks for Strand 7 6/6

Total marks for the unit 38/48

Science B – Applying the marking criteria

Marking information

Work should be marked in **red**.

Whenever you give a mark, put the appropriate mark on the page next to the place where the candidate has gained that mark. Annotate the work to explain the marking.

It will help moderation if you attach the assessment grid, or the Marking Checklist, to each candidate's work, with the criteria awarded indicated with a tick.

Take a holistic view when deciding on the mark to award each strand. To do this, first review the work to see if it fits the criteria for Level 2:

- If the work **does** fit the criteria for Level 2 then look at the Level 3 criteria and award marks accordingly.
- If the work does **not** fit the Level 2 criteria then look at and award the appropriate Level 1 marks.

Marking should be completed using a 'best fit approach'. There is no compensatory marking or rules on the completion of one box before moving to another etc.

In strands where the Quality of Written Communication is specifically reviewed (4, 6 and 7), if the work does not match the criteria given in a level then the maximum mark for that level must **not** be given, even if all the mark points have been matched.

Put the final marks on the Candidate Record form.

Strand	0 marks	Level 1	Level 2	Level 3
1. Research	No evidence of research having been undertaken	**1.1** A simple application of the investigation is given. No evidence from the research has been used to provide a basis for the investigation. A source of research has been mentioned **(mark point)**.	**1.2** An application of the investigation has been described. There is a limited use of the research to provide a basis for the investigation. One or two research sources have been given **(mark point)**.	**1.3a** An application of the investigation has been given from the research, with a scientific explanation **(mark point)**. **1.3b** Evidence found from the research has been used to provide a basis for the investigation and at least three research sources have been given **(mark point)**.
				Maximum marks for Strand 1 (Research): 4 marks

Strand	0 marks	Level 1	Level 2	Level 3
2. Planning	No plan presented	**2.1a** The plan is basic, stating the purpose of the investigation but overall lacking a coherent structure **(mark point)**. **2.1b** There is only a vague idea of the variables to be studied **(mark point)**.	**2.2a** The plan states the purpose of the investigation, shows some organisation and structure, and is clear enough for another person to follow to collect appropriate data, although there may be some errors **(mark point)**. **2.2b** Details of the possible relationship between two variables are given **(mark point)**.	**2.3a** The plan clearly states the purpose of the investigation, is logically organised, clearly written and well structured in a series of well ordered steps that could easily be followed by another person **(mark point).** **2.3b** Details of the possible quantitative relationship between two variables are given **(mark point).**
				Maximum marks for Strand 2 (Planning): 6 marks

Strand	0 marks	Level 1	Level 2	Level 3
3. Assessing and managing risk	No evidence of risks having been identified	**3.1i** There is only a basic attempt at risk assessment **(mark point)** **3.1ii** and only brief references to health and safety practices. **(mark point)**.	**3.2ai** Most of the relevant hazards involved with the investigation have been identified **(mark point)**, **3.2aii** together with associated risks **(mark point)**. **3.2b** Control measures to reduce the risks identified have been suggested, although these may be based on a common-sense approach rather than on any scientific reasoning **(mark point)**.	**3.3ai** The relevant hazards involved with the investigation have been identified **(mark point)**, **3.3aii** together with the appropriate associated risks **(mark point)**. **3.3b** Control measures that are firmly based on scientific reasoning to reduce the risks identified have been suggested **(mark point)**.
				Maximum marks for Strand 3 (Assessing and managing risk): 8 marks

Strand	0 marks	Level 1	Level 2	Level 3
4. Collecting data	No data collected or results presented	**4.1a** Simple observations have been made from first-hand evidence obtained during the investigation **(mark point)**. **4.1b** Data is recorded in a simple form, possibly with some errors (eg incorrect/ missing headings, units) **(mark point)**. Overall, recording of results has no coherent structure.	**4.2a** Rational, accurate observations have been made from first-hand evidence obtained during the investigation **(mark point)**. **4.2b** Data is recorded in a table with three or more columns with few errors that adequately represents the data obtained. There may be some inconsistency in recording of data in terms of number of significant figures **(mark point)**. **4.2c** Observations that it would be appropriate to repeat are recognised **(mark point)**. Results are recorded in a structured way, although there may be some errors.	**4.3a** Rational, accurate, reliable observations have been made from the first-hand evidence gained during the investigation **(mark point)**. **4.3b** Data is recorded in a table, with correct units and headings, that appropriately represents the data obtained. There is consistency in recording data in terms of using an appropriate number of significant figures throughout **(mark point)**. **4.3c** Anomalous results are identified and an explanation given why it would be appropriate to repeat certain results **(mark point)**. Results are recorded logically and clearly, with only minor errors.
				Maximum marks for Strand 4 (Collecting data): 8 marks

Strand	0 marks	Level 1	Level 2	Level 3
5. Processing data	No attempt made to identify patterns or manipulate data	**5.1a** Simple patterns have been identified within data, with guidance **(mark point)**. **5.1b** Simple calculations (such as calculation of a mean from three results) have been carried out. Calculations are poorly organised, lack coherent structure and may contain errors **(mark point)**. **5.1c** A simple bar chart or line graph has been constructed from scales provided **(mark point)**.	**5.2a** Patterns within data have been identified and the quantitative relationship between two variables has been described **(mark point)**. **5.2b** Calculations (such as a mean from a set of at least three results) have been carried out to an appropriate number of significant figures **(mark point)**. **5.2c** An appropriate graph or chart is constructed, choosing own scale, but with some guidance on the type of chart or graph **(mark point)**. **5.2d** The need to exclude any anomalous readings from the calculation has been recognised **(mark point)**.	**5.3a** Patterns within data have been identified and clearly explained using, for example, linear, directly proportional or by describing a complex relationship **(mark point)**. **5.3b** Complex calculations involving mathematical formulae have been carried out to an appropriate number of significant figures and with few errors **(mark point)**. **5.3c** An appropriate chart or graph has been constructed independently, with no guidance given on scales **(mark point)**.
				Maximum marks for Strand 5 (Processing data): 10 marks

Strand	0 marks	Level 1	Level 2	Level 3
6. Analysing data	No attempt to draw any conclusions from the data	**6.1** Conclusions containing a simple statement of what the findings show are given. There is no reference to the secondary data **(mark point)**.	**6.2a** Conclusions are given and relate directly to the data obtained **(mark point)**.	**6.3i** Conclusions are given that relate directly to the data obtained (both primary and secondary), recognising its limitations **(mark point)**.
			6.2bi Some comparison with secondary data has been made **(mark point)**.	**6.3ii** The conclusions illustrate a comprehensive scientific understanding **(mark point)**.
			6.2bii and some suggestions made on how to increase the validity of their own data **(mark point)**.	
		The conclusions show little logical structure or organisation.	Generally the conclusions show some organisation and structure.	The conclusions are well structured, clear and logical.
Maximum marks for Strand 6 (Analysing data): 6 marks				

Strand	0 marks	Level 1	Level 2	Level 3
7. Evaluating the practical activity	No evaluation evident	**7.1i** A simple evaluation of the practical activity **(mark point)**.	**7.2i** An evaluation of the practical activity is given, describing the effectiveness of working methods **(mark point)**.	**7.3i** A reasoned and logical evaluation of the investigation is given, covering both strengths and weaknesses of working methods **(mark point)**.
		7.1ii and a simple suggestion for improvement **(mark point)** are given.	**7.2ii** and making some justified suggestions for improvement so that more reliable evidence can be obtained **(mark point)**.	**7.3ii** and including justified suggestions for improvement so that more reliable and valid evidence can be obtained **(mark point)**.
		Although there may be some valid points, there are significant errors and/or omissions in the use of technical terms, spelling, punctuation and grammar, leading to an overall lack of clarity.	The evaluation contains a range of technical terms, although not all are used correctly and there are omissions and errors in spelling, punctuation and grammar, leading to inconsistency and some lack of clarity.	The evaluation is clearly expressed, using technical terms correctly, and with few errors in spelling, punctuation or grammar.
Maximum marks for Strand 7 (Evaluating the practical activity): 6 marks				
Total maximum marks: 48				