

Science B Controlled Assessment

Unit 4: Using Practical and Investigative Skills

The effectiveness of antacid remedies

Exemplar material of a candidate who scored
20/48 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 cm³ 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

www.bbc.co.uk/health

One source of information has been given.

I'm going to find out how good calcium carbonate is at neutralising stomach acid. This is what chemists do when they make new antacid remedies.

There is no evidence here that the candidate is working at Level 2 or Level 3.

A simple application has been given.

1/4

2. Planning

Aim

My aim is to see how much different amounts of calcium carbonate neutralise stomach acid.

2.1a
The purpose of the investigation is stated.

Equipment

*goggles - to protect eyes.
measuring cylinders - to measure acid and alkali.
electronic balance - to measure calcium carbonate.
conical flask - to mix acid and calcium carbonate.
universal indicator - to know when its neutral.
hydrochloric acid (0.1M) - our stomach acid.
sodium hydroxide (0.1M) - alkali to neutralise.
spatula - to spoon out calcium carbonate.
calcium carbonate - to neutralise acid.
burette - to add alkali to acid.
clamp and stand - to hold burette.
white tile - to see colour change.*

Variables

My independent variable is the mass of calcium carbonate added to the acid. My dependent variable is the amount of alkali needed to neutralise it.

I think that when I add more calcium carbonate it will neutralise the acid so less alkali will be needed.

*Fair testing**What I will change*

- the mass of calcium carbonate added

What I will keep the same

*- the amount of acid
- the amount of indicator
- the strength of alkali
- all equipment*

Method

Measure out 50ml of acid.

Put in one pipette of universal indicator.

Add sodium hydroxide from burette until neutral.

Record result and repeat 2 more times.

Repeat but this time add 0.2g of calcium carbonate to acid 1st and react before doing titration. Then repeat 2 more times.

Do the same with 0.5, 0.7 and 0.10g of calcium carbonate, repeating each time.

3/6

2.1b

The variables are given.

2.2b/2.3b

A possible relationship between the variables is given, but this is basic. There are no details of the possible quantitative relationship between the variables, so there is not enough to award the Level 3 mark.

2.2a/2.3a

The plan shows some structure but is not clear enough or in sufficiently logical order to ensure it could be followed easily by another person. Level 2 and 3 marks cannot therefore be awarded.

The masses of calcium carbonate given in the plan do not match those on the results table.

3. Assessing and Managing Risk

Equipment/ chemical/ method	Hazard	Risk	Control measures	Source of information
measuring cylinders	could drop	low	take care	own knowledge
electronic balance	electric shock	low	take care	
conical flask	could cut yourself	medium	look for cracks	
universal indicator	stains skin	medium	wear gloves	
hydrochloric acid (0.1M)	burns your skin	medium	wear goggles	
sodium hydroxide (0.1M)	burns	medium	wear goggles	
spatula	nothing	none	nothing	
calcium carbonate	makes you cough	low	take care	
burette	cuts	low	look for cracks	
clamp + stand	heavy falls over	low	stand back	
white tile	cuts	low	take care	
carrying out experiment	falling over	low	look where you are going	

3.1
A basic risk assessment has been completed, with references to health and safety practices.

3.2ai
Most of the hazards have been identified.

3.2aii/3.3aii
The risks are given, although they are not very detailed or scientific. It is not enough just to state that they are at a high or medium level – the candidate should attempt to describe the risk in more detail for the Level 2 mark. There is not enough detail for Level 3.

3.2b/3.3b
The control methods are very basic and based more on common sense than on any scientific understanding or reasoning. Scientific reasoning must be used in order to get into Level 3.

4/8

4. Collecting data

Mass of calcium carbonate added (g)	Volume of alkali needed to neutralise the acid sample				
	Rough titration	1st attempt	2nd attempt	3rd attempt	mean titration
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	29.5	31	30.5
0.07	21	24.3	20.9	20.7	21.96
0.10	10.5	10.2	10.3	10.4	10.3

I worked out the mean by adding my 3 attempts together and dividing the answer by 3.

4.2c/4.3c

Repeats have been carried out but there is no recognition of why repeats were carried out, nor is there any discussion of anomalous results.

The masses of calcium carbonate given in the table do not match those on the plan.

4.1a/4.2a/4.3a

Rational, accurate observations have been made and there is reasonably good concordance on most measurements for each mass. All the observations have not been recorded, as only the final titres have been recorded. Observations would have been made in order to do this, so this mark has (generously) been awarded at Level 2. For Level 3 all of the observations should have been recorded.

4.1b/4.2b/4.3b

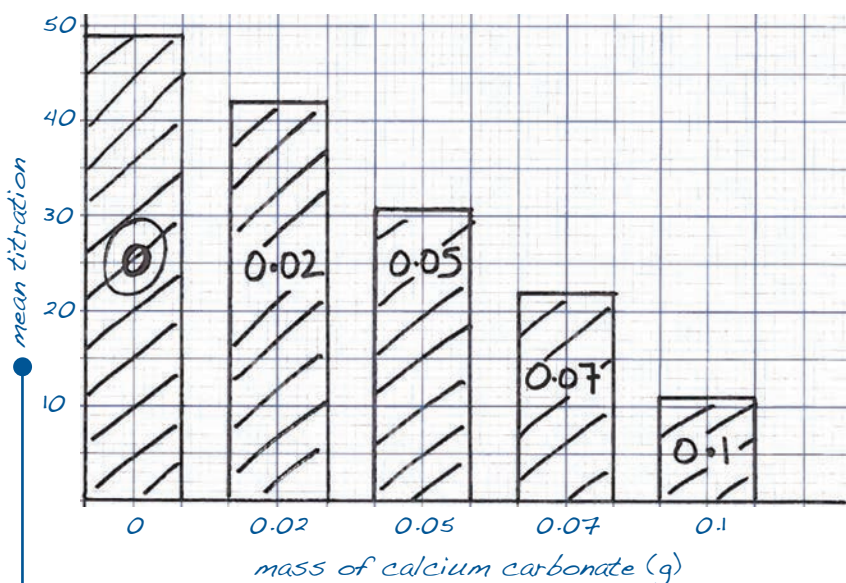
Units of volumes of titres are missing, but the rest of the table is fine for Level 2 marks. For Level 3 all the titres should have been recorded to the same number of significant figures.

5/8

5. Processing data

As I add more calcium carbonate I add less alkali.

I decided to do a bar chart. The teacher helped me with the scales.



5.1b/5.2b/5.3b

The average titre has been calculated for each mass, but not to the appropriate significant figures. This keeps the marks at Level 1.

3/10

6. Analysing data

I found out that when I added more calcium carbonate to the acid I used less alkali to neutralise the acid in the titration.

e.g. 0.02g = 42.8ml
0.10g = 10.3ml - much less

2/6

7. Evaluating the practical activity

My experiment went well and I worked safely.

My results were good too.

I could have used a pH meter to make it better.

2/6

Overall mark 20/48

5.1a/5.2a/5.3a

A very simple pattern has been identified, which is just sufficient for the Level 1 mark. The quantitative pattern has not been identified, so Level 2 and Level 3 marks cannot be awarded.

5.1c/5.2c/5.3c

A bar chart has been drawn, but the candidate did not choose their own scale. This keeps the marks at Level 1.

5.2d

The anomalous result for 0.07 has been used where it should have been ignored. No understanding of the anomalous results is demonstrated.

6.1/6.2a

There is a simple conclusion, which relates to the data obtained, but there is no reference to the secondary data.

There are no suggestions on how to increase the reliability or validity of own data.

7.1i

A very simple evaluation has been given.

7.1ii

A simple improvement is suggested, but there is no reason given, so the mark cannot be awarded out of Level 1.

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 1/4

Strand 2: Planning

2.1a	2.2a	2.3a
✓		
2.1b	2.2b	2.3b
✓	✓	

Marks for Strand 2 3/6

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 4/8

Strand 4: Collecting data

4.1a	4.2a	4.3a
✓	✓	
4.1b	4.2b	4.3b
✓	✓	
	4.2c	4.3c
	✓	

Marks for Strand 4 5/8

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 3/10

Strand 6: Analysing data

6.1	6.2a	6.3i
✓	✓	
	6.2bi	6.3ii
	6.2bii	

Marks for Strand 6 2/6

Strand 7: Evaluating the practical activity

7.1i	7.2i	7.3i
✓		
7.1ii	7.2ii	7.3ii
✓		

Marks for Strand 7 2/6

Total marks for the unit 20/48

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	<p>2.1a The plan is basic, stating the purpose of the investigation but overall lacking a coherent structure (mark point).</p> <p>2.1b There is only a vague idea of the variables to be studied (mark point).</p>	<p>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).</p> <p>2.2b Details of the possible relationship between two variables are given (mark point).</p>	<p>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).</p> <p>2.3b Details of the possible quantitative relationship between two variables are given (mark point).</p>
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	<p>3.1i There is only a basic attempt at risk assessment (mark point)</p> <p>3.1ii and only brief references to health and safety practices. (mark point).</p>	<p>3.2ai Most of the relevant hazards involved with the investigation have been identified (mark point),</p> <p>3.2aii together with associated risks (mark point).</p> <p>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).</p>	<p>3.3ai The relevant hazards involved with the investigation have been identified (mark point),</p> <p>3.3aii together with the appropriate associated risks (mark point).</p> <p>3.3b Control measures that are firmly based on scientific reasoning to reduce the risks identified have been suggested (mark point).</p>
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	<p>4.1a Simple observations have been made from first-hand evidence obtained during the investigation (mark point).</p> <p>4.1b Data is recorded in a simple form, possibly with some errors (eg incorrect/missing headings, units) (mark point).</p> <p>Overall, recording of results has no coherent structure.</p>	<p>4.2a Rational, accurate observations have been made from first-hand evidence obtained during the investigation (mark point).</p> <p>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).</p> <p>4.2c Observations that it would be appropriate to repeat are recognised (mark point).</p> <p>Results are recorded in a structured way, although there may be some errors.</p>	<p>4.3a Rational, accurate, reliable observations have been made from the first-hand evidence gained during the investigation (mark point).</p> <p>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).</p> <p>4.3c Anomalous results are identified and an explanation given why it would be appropriate to repeat certain results (mark point).</p> <p>Results are recorded logically and clearly, with only minor errors.</p>
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	<p>5.1a Simple patterns have been identified within data, with guidance (mark point).</p> <p>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).</p> <p>5.1c A simple bar chart or line graph has been constructed from scales provided (mark point).</p>	<p>5.2a Patterns within data have been identified and the quantitative relationship between two variables has been described (mark point).</p> <p>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).</p> <p>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).</p> <p>5.2d The need to exclude any anomalous readings from the calculation has been recognised (mark point).</p>	<p>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).</p> <p>5.3b Complex calculations involving mathematical formulae have been carried out to an appropriate number of significant figures and with few errors (mark point).</p> <p>5.3c An appropriate chart or graph has been constructed independently, with no guidance given on scales (mark point).</p>
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) . The conclusions show little logical structure or organisation.	6.2a Conclusions are given and relate directly to the data obtained (mark point) . 6.2bi Some comparison with secondary data has been made (mark point) . 6.2bii and some suggestions made on how to increase the validity of their own data (mark point) . Generally the conclusions show some organisation and structure.	6.3i Conclusions are given that relate directly to the data obtained (both primary and secondary), recognising its limitations (mark point) . 6.3ii The conclusions illustrate a comprehensive scientific understanding (mark point) . 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) . 7.1ii and a simple suggestion for improvement (mark point) are given. 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.	7.2i An evaluation of the practical activity is given, describing the effectiveness of working methods (mark point) . 7.2ii and making some justified suggestions for improvement so that more reliable evidence can be obtained (mark point) . 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.	7.3i A reasoned and logical evaluation of the investigation is given, covering both strengths and weaknesses of working methods (mark point) . 7.3ii and including justified suggestions for improvement so that more reliable and valid evidence can be obtained (mark point) . 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				