RECOGNISING ACHIEVEMENT

INSET Training Materials

OCR GCSE Twenty First Century Science (J241): Get started - Managing the Controlled Assessment unit A144

Name:		**Date Attended:**	

Contents/Order of Documents

Course overview

This half day course will:

- Explain the administration procedures for Unit A144
- Provide guidance on how to prepare candidates for Controlled Assessment
- Discuss the preparation and marking of Controlled Assessment units
- Consider the assessment of candidates with the review of sample assessment materials
- Review the support and resources we offer
- Enable delegates to network and share ideas for best practice.

Programme

Morning Courses

9:30	Tea/coffee/registration
10:00	Domestic arrangements for the day
10:05	An introduction to Controlled Assessment
10:20	The Case Study Introducing a Case Study The method of marking Case Studies
10.50	A Case Study marking standardisation exercise
11:30	The Practical Data analysis Why not a complete investigation? The method of marking data tasks
12:00	A Practical Data Analysis marking exercise
12:45	Lunch

Programme

Afternoon Courses

12:45	Lunch followed by registration
1:30	Domestic arrangements for the day
1:35	An introduction to Controlled Assessment
1:50	The Case Study Introducing a Case Study The method of marking Case Studies
2:15	A Case Study marking standardisation exercise
2:55	The Practical Data analysis Why not a complete investigation? The method of marking data tasks
3:20	A Practical Data Analysis marking exercise
4:00	Course ends

Useful documents on the OCR website

The main OCR website is:

www.ocr.org.uk

There you can find and download the specifications for all OCR GCSE Sciences. You can also download the sample assessment materials, brochures describing the specifications (useful for senior management, parents' evenings, open days etc.) and presentations which you can use to introduce the specifications.

On the introductory page, there is a panel at the right hand side which lists quick links.

Click the GCSE Science 2011 link.

Accessing the materials:

Follow the instructions above, or go directly to:

www.gcse-science.com

The page you see has a panel on the right hand side to download specifications. Select the specification you wish to view or download, and click.

You will be presented with a download button for the specification, and a button to 'View all Documents'.

This displays a list including the specification, the Guide to Controlled Assessment, all sample assessment materials, a draft summary brochure and two presentation PowerPoints:

GCSE Sciences for 2011 presentation – describes the structure of the specifications and assessments.

GCSE Sciences rules presentation – gives explanatory notes about the new assessment regulations.

Availability of assessments

Subject	Assessment unit	Content	Jan 2012	June 2012	Jan 2013	June 2013	Jan 2014	June 2014
J241 Science	A141 (1hr exam)	B1, C1, P1	✓	✓	✓	✓	✓	✓
	A142 (1hr exam)	B2, C2, P2	✓	✓	✓	✓	✓	✓
	A143 (1hr exam)	B3, C3, P3		✓	✓	✓	✓	✓
	A144 (CA)	case study + data		✓		✓		✓
J242 Add Science	A151 (1hr exam)	B4, C4, P4		✓	✓	✓	✓	✓
	A152 (1hr exam)	B5, C5, P5		✓	✓	✓	✓	✓
	A153 (1hr exam)	B6, C6, P6				✓	✓	✓
	A154 (CA)	investigation				✓		✓
J243 Biology	A161 (1hr exam)	B1, B2, B3	✓	✓	✓	✓	✓	✓
	A162 (1hr exam)	B4, B5, B6		✓	✓	✓	✓	✓
	A163 (1hr exam)	B7				✓	✓	✓
	A164 (CA)	investigation				✓		✓
J244 Chemistry	A171 (1hr exam)	C1, C2, C3	✓	✓	✓	✓	✓	✓
	A172 (1hr exam)	C4, C5, C6		✓	✓	✓	✓	✓
	A173 (1hr exam)	C7				✓	✓	✓
	A174 (CA)	investigation				✓		✓
J245 Physics	A181 (1hr exam)	P1, P2, P3	✓	✓	✓	✓	✓	✓
	A182 (1hr exam)	P4, P5, P6		✓	✓	✓	✓	✓
	A183 (1hr exam)	P7				✓	✓	✓
	A184 (CA)	investigation				✓		✓

In any one year, for controlled assessment, choice will be available between:

Science: Three case study topics, three data analysis tasks (each candidate to submit marks from any one of these case studies and any one of these data tasks)

Biology: Two investigations (one on a topic from B4, B5 or B6) + one other (each candidate to submit marks from either one of these)

Chemistry: Two investigations (one on a topic from C4, C5 or C6) + one other (each candidate to submit marks from either one of these)

Physics: Two investigations (one on a topic from B4, B5 or B6) + one other (each candidate to submit marks from either one of these)

Additional Science:

Candidates may investigate any of the topics from biology, chemistry or physics

Availability of the controlled assessment tasks

Tasks are available ONLY for presentation in the year stated, i.e. marks for the tasks dated 2014 may only be presented in the summer session of 2014. All marks and a sample of work must be submitted for moderation in May 2014.

The tasks will be made available to centres two years before the presentation date, and may be completed at any time.

Examples of possible strategies for pupils who complete Year 11 in June 2014:

Series model:

Teaching:
Science in Year 10 (Sept 2012 – June 2013), Additional Science in Year 11 (Sept 2013 – June 2014)

Controlled Assessment:
Science candidates must complete 2013 CA tasks and submit in May 2013.
Additional Science candidates complete a 2014 investigation and submit in May 2014.

Theoretically, Additional Science candidates could complete a 2013 investigation during Year 10 and submit that in May 2013 and the mark would then be available for aggregation with exam marks in 2014 (but at least 2 written papers will need to be taken in June 2014 to satisfy the terminal rules).

If Science candidates wanted to repeat the CA by doing 2014 tasks, they would also have to re-sit a written paper in 2014 to meet the 40% terminal assessment requirement.

Parallel model:

Teaching:
Science and Additional Science taught alongside each other, over the full 2 years.

Controlled Assessment:
The same conditions would apply to each of the subjects.

Candidates could take a 2013 task during Year 10 and submit in June 2013 – they would then have to take at least two written papers in June 2014.

These candidates could also do a 2014 task during Year 11 and decide whether they wanted to submit these marks in June 2014 – however, as with a re-sit of a written paper, the best mark would count, unless the 2014 mark was needed as part of the 40% requirement.

or Candidates could complete a 2014 task at any time during their 2-year course, marks to be submitted in May 2014.

or Candidates could complete both a 2013 and a 2014 task during Year 10 and decide which one they would submit (if they score better on the 2013 task, submit in 2013 or, if they score better on the 2014 task, submit in 2014). However, bear in mind that, especially at the start of a new specification, grade threshold boundaries are likely to change from year to year, so there may be some uncertainty as to which piece of work would give the higher UMS (if marks were reasonably close).

These rules should also cover candidates who present the three separate sciences.

Aims and objectives

- Explain the administration procedures for Unit A144
- Provide guidance on how to prepare candidates for Controlled Assessment
- Discuss the preparation and marking of Controlled Assessment units
- Consider the assessment of candidates with the review of Sample Assessment Materials
- Review the support and resources OCR offers
- Enable delegates to network and share ideas for best practice.

Controlled Assessment

The rationale

- provides candidates with an opportunity to demonstrate skills that are more difficult to assess in an examination environment

while at the same time, it

- provides a degree of control to ensure that the process is fair for all candidates.

See also: http://www.ocr.org.uk/download/sm/ocr_53021_sm_gcse_ca.pdf
http://www.ocr.org.uk/download/sm/ocr_61003_sm_gcse_gtca.pdf

GCSE assessment rules have changed

- Each specification will have a maximum of four units, and each unit must carry a minimum weighting of 20%.
- Controlled Assessment replaces coursework.
- Specifications have 25% for Controlled Assessment (60% for Additional Applied Science)

Restrictions on re-sits

- Learners must take at least 40% of the assessment of each specification in the final examination series when they certificate.
- Learners may only re-sit a unit assessment once. The better result for the two attempts at a unit counts.

But –

- If a re-sit is part of the 40% terminal requirement, that mark must count, even if lower than that achieved at a previous sitting.

Restrictions on Controlled Assessment

- Tasks must be defined by the awarding body.
- Controlled Assessments may only be submitted at the Summer assessment in the year for which they are specified.
- Tasks will be released (via Interchange) in June, two years before the submission date.
- The type of tasks for Science (i.e. the Case Study and Data Analysis) are different from Additional Science and Separate Sciences (i.e. candidates for Additional Science and Biology, Chemistry and Physics must all submit marks for an investigation)
- Investigations are defined for either Biology, Chemistry or Physics, so cannot be double entered for other sciences (but all could be used for Additional Science).
- Marks from investigations may not be cross-counted for the data task of Science A (these marks must come from a defined science A data task).

Controlled Assessment

The tasks

Two tasks in Science A:

- a **Case Study [32 marks]** (secondary data).
  researching a topical issue in Science.

- a **Practical Data Analysis [32 marks]** (primary data)
  – a 'stepping stone' towards the wider range of skills required for candidates to carry out a complete investigation.

Controlled Assessment

The tasks

One task in Additional Science A/ Separate Sciences:

- a **Practical Investigation [64 marks]** (primary and secondary data).
  draws together the skills of predicting and planning, and collecting, interpreting, evaluating and reviewing data.

Tasks provided each year

Science A (single science)		Separates	Additional
Case Study	Data task	Investigation	
1 Biology	1 Biology	B(4 – 6) + B(1 – 7)	Either
1 Chemistry	1 Chemistry	C(4 – 6) + C(1 – 7)	Either
1 Physics	1 Physics	P(4 – 6) + P(1 – 7)	Either

Science: any one chosen from three

Biology: either one from two
Chemistry: either one from two
Physics: either one chosen from two

Additional science: any one chosen from six

Levels of control – we are not the first!

- Some subjects have been using controlled assessment for 2 – 3 years.
- Colleagues in English, Geography, History etc., have already devised procedures.
- Attempt to build on established practice in your school, but note that there are differences in administration in Science!

Controlled Assessment

The Case Study

Is based on modules B,C,P1-3.

Candidates:

- are provided with the initial stimulus for the study – the News Sheet. This contains:
  - 'people's views' on a topic (that involves controversy or disagreement), including opposing evidence or/ and opinions, and
  - a section on the background Science involved.
- will decide on a question that interests them for their Case Study.
- will carry out research from text books, the Internet, and other sources of information, considering the information in relation to their own scientific knowledge and understanding and evaluating the quality of information provided and the validity of each information source.
- produce a written report that will also include recommendation(s) for a course of action based on their conclusions.

Controlled Assessment

The Case Study

Research and Planning stage

Approximate timing: 1.5 - 2 hours

Conditions of limited control

- candidates can undertake this part of the task without direct teacher supervision, and can work in collaboration (and can work away from the centre, at the centre's discretion).
- during the research phase, candidates can be given support and guidance: teachers can explain the task, discuss how the task can be approached and advise on resources.
- but candidates must develop an individual response.

Controlled Assessment

Introducing the Case Study

- A news sheet for students to introduce the topic
- Discuss possible questions to research
  - With the whole class - part or whole lesson
- Allow time for initial data searching
  - Limited control – can be outside lesson time
- Check progress
- From the beginning
  - Keep a folder for each candidate
  - Check material collected and store securely

Controlled Assessment

The Case Study

Analysis, evaluation and review stage

Approximate timing: 1.5 - 2 hours

Conditions of high control

- candidates work individually to complete reports under direct teacher supervision.
- candidates refer to and use resources and notes from the planning stages, but *prepared text* based on the analysis, evaluation and review of the topic cannot be incorporated directly into the report.
- if write-ups extend over several sessions, work, including electronic data storage devices, must be collected in.
- teachers must be able to authenticate work.

Controlled Assessment

The Case Study: the marking criteria

- The general style of dividing each task into strands continues
- Within each strand, a series of four criteria (is)
- Used hierarchically to show increasing levels of performance
- The scheme has been simplified to reduce teacher workload
- The number of strands has been reduced by almost 50%

Controlled Assessment

The Case Study: Assessment

Strand A: Finding sources of information

- A(a) – Planning and research to collect information/ data.
- A(b) – Acknowledgement and evaluation of sources.

Strand B: Providing scientific explanations

Strand C: Conclusions and recommendations

- C(a) – Comparing opposing views and evidence.
- C(b) – Conclusions and recommendations.

Controlled Assessment

The Case Study: Time for a marking exercise!

- Scripts: **pages 38 – 58**
- Marking Criteria: **pages 24 – 26**
- Cover sheet to record marks: **use one of the straw coloured sheets in Appendix B**

Strand A: Finding sources of information

	1 mark	2 marks	3 marks	4 marks
A(a)	The content of the report does not go beyond what was given in the initial stimulus material.	The report includes information/data from at least one additional relevant source found by the candidate.	Information/data has been selected from sources which represent conflicting views or opinions.	The information/data selected is relevant and provides balanced coverage of the range of views or opinions.
A(b)	Links to at least some sources are indicated, though these may not be fully detailed (e.g. reference to web-site home page or book by title only).	Most sources found by the candidate are identified, but many lack full details (e.g. reference to web-site home page or book by title only).	Comments are made about the validity of sources. References to nearly all sources used are sufficiently detailed to identify the pages that information has been taken from. Quotations are clearly identified.	Ownership and status of sources are evaluated to justify selection or rejection of information from them. References are fully detailed and link opinions or data to their authors.

Strand B: Providing scientific explanations

	1 – 2 marks	3 – 4 marks	5 – 6 marks	7 – 8 marks
B	Only superficial mentions of any science explanations are given. The response may be simplistic, with frequent errors of spelling, punctuation or grammar and have little or no use of scientific vocabulary.	There is a basic outline of the main scientific ideas which are relevant to the claims and opinions. Some relevant scientific terms are correctly used, but spelling, punctuation and grammar are of variable quality.	There is a review of the evidence and of the scientific knowledge needed to understand the issues studied. Information is effectively organised with generally sound spelling, punctuation and grammar. Specialist terms are used appropriately.	Detailed scientific knowledge is used to analyse and interpret the evidence collected. The report is comprehensive, relevant and logically sequenced, with full and effective use of relevant scientific terminology. There are few, if any, grammatical errors.

Strand C: Conclusions and recommendations

	1 – 2 marks	3 – 4 marks	5 – 6 marks	7 – 8 marks
C(a)	Evidence is unselectively reported without organising it in relation to different views of the issue being studied. The report has very little structure or coherence.	Items of evidence are clearly identified as 'for' or 'against' a particular view. The report has an appropriate sequence with some structure (eg use of subheadings).	The evidence is compared to establish how it supports or refutes different views. Information is organised for effective communication of ideas.	Details of the evidence related to opposing views is evaluated and critically compared to show how the evidence supports or refutes each of the views. Issues are reported clearly with a consistent style.
C(b)	A simple conclusion is stated without linking it to supporting claims or evidence.	A conclusion is given based on the extent to which views or opinions discussed in the report are supported by scientific evidence.	Suggestions for appropriate recommendations are based on a conclusion which is clearly linked to evidence in the report.	Limitations of the conclusion, and alternative recommendations are considered, showing awareness of different interpretations of the evidence.

Controlled Assessment

The Practical Data Analysis

Research and Planning, and Collecting Data stage

Strategy: Research and planning
Approximate timing: 1 hour

Conditions of limited control

- candidates can undertake this part of the task without direct teacher supervision, and can work in collaboration (and can work away from the centre, at the centre's discretion).
- during the research phase, candidates can be given support and guidance: teachers can explain the task, discuss how the task can be approached, along with advising on resources.
- but candidates must develop individual response.

Controlled Assessment

The Practical Data Analysis

Research and Planning, and Collecting Data stage

Collecting Data
Approximate timing: 1 hour

Conditions of limited control

- candidates will carry out practical work under direct supervision.
- collaboration is permissible, but all candidates must be actively involved.
- candidates must develop own response in deciding how best to collect data and record data.

N.B. data collection cannot be based solely on secondary data, computer simulations or demonstrations.

Controlled Assessment

The Practical Data Analysis

Analysis, evaluation and review stage

Approximate timing: 1 hour

Conditions of high control

- candidates work individually to complete their reports under direct supervision.
- if write-ups extend over several sessions, work, including electronic data storage devices, must be collected in.
- teachers must be able to authenticate work.

Controlled Assessment

The Practical Data Analysis: Assessment

Strand D: Choice of method, techniques and equipment

Strand E: Revealing patterns in data

Strand F: Evaluation of data

Strand G: Reviewing confidence in the hypothesis.

Strand D: Choice of methods, techniques and equipment

	1 – 2 marks	3 – 4 marks	5 – 6 marks	7 – 8 marks
D	Describe the method and apparatus selected to collect data. Make an appropriate comment about safe working.	Comment on the techniques and equipment selected to collect data, showing some understanding of the need for repeatability. Correctly identify hazards associated with the procedures used.	Describe the techniques and equipment selected to collect an appropriate range of data, of generally good quality, including regular repeats, or checks for repeatability. Identify any significant risks and suggest some precautions.	Justify the method, range of values, equipment and techniques selected to collect data of high quality. Complete a full and appropriate risk assessment identifying ways of minimising risks associated with the work.

Strand E: Revealing patterns in data

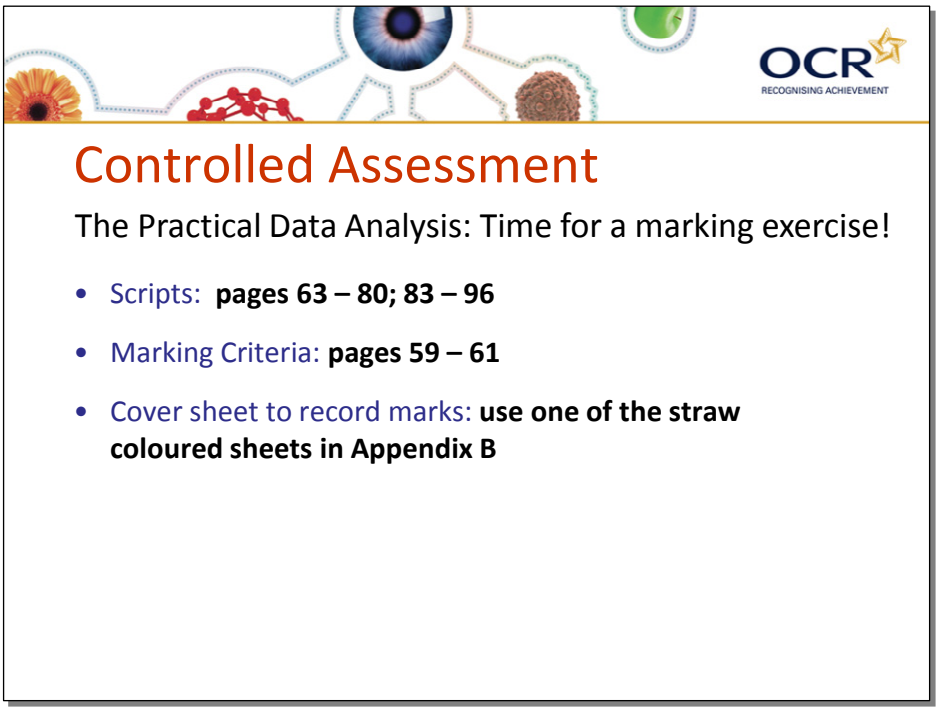
	1 – 2 marks	3 – 4 marks	5 – 6 marks	7 – 8 marks
E	Display limited numbers of results in tables, charts or graphs, using given axes and scales.	Construct simple charts or graphs to display data in an appropriate way, allowing some errors in scaling or plotting.	Correctly select scales and axes and plot data for a graph, including an appropriate line of best fit, or construct complex charts or diagrams e.g. species distribution maps.	Indicate the spread of data (e.g. through scatter graphs or range bars) or give clear keys for displays involving multiple datasets.
	Select individual results as a basis for conclusions.	Carry out simple calculations e.g. correct calculation of averages from repeated readings	Use mathematical comparisons between results to support a conclusion.	Use complex processing to reveal patterns in the data e.g. statistical methods, use of Inverse relationships, or calculation of gradient of graphs.

Strand F: Evaluation of data

	1 – 2 marks	3 – 4 marks	5 – 6 marks	7 – 8 marks
F	Make a claim for accuracy or repeatability, but without appropriate reference to the data.	Correctly identify individual results which are beyond the range of experimental error (are outliers), or justify a claim that there are no outliers.	Use the general pattern of results or degree of scatter between repeats as a basis for assessing accuracy and repeatability and explain how this assessment is made.	Consider critically the repeatability of the evidence, accounting for any outliers.

Strand G: Reviewing confidence in the hypothesis

	1 – 2 marks	3 – 4 marks	5 – 6 marks	7 – 8 marks
G	Correctly state whether or not the original prediction or hypothesis is supported, with reference only to common sense or previous experience. The response is simplistic, with frequent errors in spelling, punctuation or grammar and has little or no use of scientific vocabulary.	Comment on whether trends or correlations in the data support the prediction or hypothesis and suggest why by reference to appropriate science. Some relevant scientific terms are used correctly, but spelling, punctuation and grammar are of variable quality.	Explain the extent to which the hypothesis can account for the pattern(s) shown in the data. Use relevant science knowledge to conclude whether the hypothesis has been supported or to suggest how it should be modified to account for the data more completely. Information is organised effectively with generally sound spelling, punctuation and grammar. Specialist terms are used appropriately.	Give a detailed account of what extra data could be collected to increase confidence in the hypothesis. The report is comprehensive, relevant and logically sequenced, with full and effective use of relevant scientific terminology. There are few, if any, grammatical errors.


OCR
RECOGNISING ACHIEVEMENT
Controlled Assessment
The Practical Data Analysis: Time for a marking exercise!
• Scripts: **pages 63 – 80; 83 – 96**
• Marking Criteria: **pages 59 – 61**
• Cover sheet to record marks: **use one of the straw coloured sheets in Appendix B**

Overview of marking criteria for the Case Study

The three strands in the marking criteria for the Case Study are designed to match different types of performance; two of them are divided into two different aspects. These do not correspond with any particular sequence that candidates are likely to consistently follow in their reports. Positive achievement should therefore be credited in the appropriate strand wherever it is found in the report.

Strand A: **finding sources of information**	This strand depends on understanding of: IaS4: *The scientific community*
Aspect A(a): planning and research to collect information/data	Credit will be given for selection of appropriate sources and materials from those available, rather than indiscriminate copying. Credit will also be given for judgement shown in planning the use of sources which allow comparison of a variety of different opinions or views of the topic.
Aspect A(b): acknowledgement and evaluation of sources	All sources should be referenced and it should be clear where each piece of information has come from. Direct quotations should be acknowledged. Candidates should show that they have considered the validity of sources when making choices of material to include.
Strand B: **science explanations**	This strand depends on understanding of: IaS1: *Data: their importance and limitations* IaS2: *Cause–effect explanations* IaS3: *Developing scientific explanations*
Providing scientific explanations	Candidates should use explanatory scientific theory to help them analyse and interpret the information/data they have collected. Candidates should look beyond the claims or opinions they find in their sources to analyse the evidence which supports them, and the level of agreement between different sources. Quality of written communication is also assessed in B.
Strand C: **conclusions and recommendations**	This strand depends on understanding of: IaS4*: The scientific community* IaS5: *Risk* IaS6: *Making decisions about science and technology*
Aspect C(a): comparing opposing views and evidence	Candidates should compare the evidence they have collected for each different view of the topic. They should evaluate the claims and opinions they have studied, and compare their relative value as guides to future action. Candidates should be encouraged to structure the report clearly. Thinking about a good structure for the contents can help candidates to organise their ideas. Use of tables of contents, and sub-headings between sections of text are valuable in this context.
Aspect C(b): conclusions and recommendations	Candidates should give a conclusion about the issues involved, showing how this is based on their science understanding and their evaluation of the evidence they have collected. They discuss the best course(s) of action based on their conclusion. Credit will be given for discussion of the perceived benefits and associated risks of any proposed actions and an appreciation that different groups may be affected in different ways. Quality of written communication is also assessed in C(b).

Mark Descriptors for the Case Study

Mark descriptors are to be used hierarchically.

Strand	0	1 mark	2 marks	3 marks	4 marks
A(a)	*	The content of the report does not go beyond what was given in the initial stimulus material.	The report includes information/data from at least one additional relevant source found by the candidate.	Information/data has been selected from sources which represent conflicting views or opinions.	The information/data selected is relevant and provides balanced coverage of the range of views or opinions.
A(b)	*	Links to at least some sources are indicated, though these may not be fully detailed (e.g. reference to web-site home page or book by title only).	Most sources found by the candidate are identified, but many lack full details (e.g. reference to web-site home page or book by title only).	Comments are made about the validity of sources. References to nearly all sources used are sufficiently detailed to identify the pages that information has been taken from. Quotations are clearly identified.	Ownership and status of sources are evaluated to justify selection or rejection of information from them. References are fully detailed and link opinions or data to their authors.
		1 – 2 marks	3 – 4 marks	5 – 6 marks	7 – 8 marks
B	*	Only superficial mentions of any science explanations are given. The response may be simplistic, with frequent errors of spelling, punctuation or grammar and have little or no use of scientific vocabulary.	There is a basic outline of the main scientific ideas which are relevant to the claims and opinions. Some relevant scientific terms are correctly used, but spelling, punctuation and grammar are of variable quality.	There is a review of the evidence and of the scientific knowledge needed to understand the issues studied. Information is effectively organised with generally sound spelling, punctuation and grammar. Specialist terms are used appropriately.	Detailed scientific knowledge is used to analyse and interpret the evidence collected. The report is comprehensive, relevant and logically sequenced, with full and effective use of relevant scientific terminology. There are few, if any, grammatical errors.

C(a)	*	Evidence is unselectively reported without organising it in relation to different views of the issue being studied. The report has very little structure or coherence.	Items of evidence are clearly identified as 'for' or 'against' a particular view. The report has an appropriate sequence with some structure (eg use of subheadings).	The evidence is compared to establish how it supports or refutes different views. Information is organised for effective communication of ideas.	Details of the evidence related to opposing views is evaluated and critically compared to show how the evidence supports or refutes each of the views. Issues are reported clearly with a consistent style.
C(b)	*	A simple conclusion is stated without linking it to supporting claims or evidence.	A conclusion is given based on the extent to which views or opinions discussed in the report are supported by scientific evidence.	Suggestions for appropriate recommendations are based on a conclusion which is clearly linked to evidence in the report.	Limitations of the conclusion, and alternative recommendations are considered, showing awareness of different interpretations of the evidence.

How good are your data?

This exercise appears towards the end of module C1: Air Quality. Pupils have been introduced to the idea that small molecules such as carbon dioxide are made and released into the air as a result of human activities, principally burning fuels.

Raise the question of whether these pollutants might affect our health.

Which parts of the body / life activities are most likely to be affected (lungs/ breathing)

Ask the class to suggest health conditions which might be caused by air pollution. Suggestions will usually include colds, flu, pneumonia, bronchitis, asthma. Prompt for suggestions of hay fever. This is a good topic for study: it is common amongst teenagers; it is not life-threatening; it has an unusual seasonal pattern of occurrence.

A show-of-hands poll should reveal several who experience hay fever and they can be asked what time of year their symptoms appear (usually spring or summer)/

This is an example of scientists being interested in what is happening around them and seeking DATA so that they can judge the scale of an issue and begin to look for PATTERNS.

The next stage would be to seek an explanation for the observed pattern. Introduce the idea that eating cold ice-cream might cause a runny nose – a graph can be displayed to show that ice-cream eating occurs more in summer – an example of a CORRELATION.

If we could get better, more detailed data, we might be able to test the ice-cream HYPOTHESIS further.

Provide blank graph axes, and data for hay fever medicine prescriptions (available from the NHS). Pupils plot a graph to show the seasonal occurrence.

Pupils will find that the April figure does not seem to fit the overall pattern of the data and may suggest that this is an outlier, or anomaly. At this point, it can be revealed that different groups had data for different years, but all have the same small peak for the April data.

Thus, the April peak is a reproducible effect. The data is now strong enough to be confident that the true seasonal occurrence of Hay Fever has a double peak – it no longer correlates to the ice-cream sales data, so that hypothesis must be abandoned.

If a graph of pollen count across a year is overlaid on the hay fever data, the same double peak shape is seen. This is now a very strong correlation, but still requires a plausible mechanism to explain how pollen could cause hay fever. The course Student Book gives further evidence, including the use of allergy testing to confirm the link.

This exercise helps to show how the reproducibility and precision of data is important in giving confidence in any explanations and could be linked to discussion of the marking requirements for data tasks or investigations.

Data for Hay Fever exercise

Group C

The table shows how common hay fever is at different times of the year.

It shows the number of people who were given hay fever medicine by their doctor in each month.

The table shows the figures for the year **1993**.

Month	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Number of prescriptions per 1000 of population	77	75	95	270	116	267	582	499	197	114	80	71

To do

Plot the data from the table on the axes provided.

Use a straight line to join each point to the next.

Describe any patterns you can see in the data.

Data for Hay Fever exercise

Group D

The table shows how common hay fever is at different times of the year.

It shows the number of people who were given hay fever medicine by their doctor in each month.

The table shows the figures for the year **1994**.

Month	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Number of prescriptions per 1000 of population	79	83	83	273	106	251	678	404	218	75	78	68

To do

Plot the data from the table on the axes provided..

Use a straight line to join each point to the next.

Describe any patterns you can see in the data.

Here are two articles about possible causes of asthma. Read both articles, then use your knowledge of How Science Works (Ideas about Science) to compare the articles. Say which you think is more reliable, and explain why.

Article A:

Studies confirm the cause of asthma

Asthma affects about one million children in the UK, including one in every three teenagers. Asthma rates have doubled in 20 years (NHS data). Data on the number of vehicles registered (DVLA data) shows a matching increase. Air pollution from traffic is now believed to be the major cause of asthma.

Three recent studies lend weight to claims of a causal link.

Support for a direct link comes from a study of over 600 primary school children, which found that respiratory disorders got worse as air pollution increased. The study spread over 3 years at the University of Groningen in the Netherlands. Results were published in The Lancet, a peer-reviewed medical journal. Children from town and country areas kept diaries of asthma symptoms and tested their lung capacity three times a day. When air pollution was higher, these children were much more likely to suffer breathing problems.

When there were more particulates - bits larger than 10 micrometers - in the air, these children were up to 139% more likely to suffer. And when there were more of the pollutants that make up car exhaust fumes - black smoke, sulphur dioxide and nitrogen dioxide - they were up to 131% more likely to have such symptoms.

Researchers claimed that the length of the study, and its careful links to clinical symptoms, helped to prove a link where other studies could not.

Researchers in Munich studied the health of 4000 children aged between 5 to 11years. Children who lived within 50 metres of very busy roads were almost twice as likely to suffer from asthma as the general population.

A study of 312,000 children aged 12 to 15 in Taiwan compared air pollution data with figures for classic hay fever symptoms – runny nose, itching eyes and sneezing fits. They found a clear connection between these symptoms and exposure to air pollution – with an increased risk of about 17%.

Article B:

Getting in a fog about asthma

It really is about time that the anti-car lobby extremists stopped spreading scare stories about pollution and health.

A hundred years ago, when asthma was an almost unheard of illness, air quality was appalling. Factories making soda for glass and soap making spewed out hydrochloric acid fumes straight into the atmosphere. Lead-acid chambers the size of small cathedrals leaked sulphur fumes in all directions. Every house had a coal fire pumping out carbon dioxide, sulphur dioxide and soot.

People of pensionable age can remember city "smog" when it was impossible to see across the street for the billowing yellowy-grey fumes.

Since then, legislation like the alkali acts has brought commercial premises under control. Gas, oil or electric heating has replaced coal in most homes and the quality of air in both towns and country is now so much better than it was that even the word for "smog" has disappeared from general conversation.

Leading scientists and politicians alike are only too delighted to tell us how much things have improved.

And yet – the number of people suffering from asthma has remorselessly increased to almost terrifying epidemic proportions.

During the past 20 years, asthma rates in England have approximately doubled (NHS figures). During that time, car makers have invented catalytic converters and fitted them to every car exhaust. Dangerous pollutants such as carbon monoxide, and oxides of nitrogen, which used to be given out by every vehicle are now almost totally converted to harmless carbon dioxide and water vapour. Sulfur is stripped out from fuels before they are burned, lean burn engines and diesel technology mean that cars consume fewer gallons of fuel per 100 miles than ever before.

The "rise" in asthma cases is at least partly due to better diagnosis and reporting by doctors and hospitals. Much of the rest is due to the effects of too much time indoors with stuffy atmospheres and little exercise.

It is time that the professional scare-mongers in soft health-ministry jobs laid off the poor, beleaguered motorist and started looking for the real causes of ill-health.

A possible exercise on correlation and cause explanations

People without their own teeth run a greater risk of dying from heart disease than those with a full set of teeth.

" Cardiovascular disease, and in particular coronary heart disease, is closely related to the number of teeth" that a person has left, Anders Holmlund told AFP, explaining the results of a Swedish study to be published in the *Journal of Periodontology*.

"A person with fewer than 10 of their own teeth has a seven times higher risk for death by coronary heart disease than a person of the same age and of the same sex with more than 25 teeth left," Holmlund said.

Although many studies published in the past 15 years have showed a link between oral health and cardiovascular disease, Holmlund's study shows a direct relationship between cardiovascular disease and the number of teeth in a person's mouth.

The study, conducted with colleagues Gunnar Holm and Lars Lind, surveyed 7,674 women and men, most suffering from periodontal disease for an average of 12 years, and examined the cause of death of the 629 people who died during the period.

For 299 of the subjects, the cause of death was cardiovascular disease.

Source: Holmlund S., Holm G. and Lind L. (2010). Number of teeth as a predictor of cardiovascular mortality in a cohort of 7,674 subjects followed for 12 years. *Journal of Periodontology* **81** 870-876.

Dissecting an article

What is the title of the article? .....

.....

Where was the article published? .....

.....

When was the article published? .....

What is the author's name? .....

What is the author's job?
(Are they a scientist? A journalist? A salesman? A marketing person? A government official?)

.....

.....

In the article, use coloured pens or pencils to highlight or underline:

- data and evidence – **in green**
- information about how the study was done – **in blue**
- the author's opinions and ideas – **in red**

Which pages in your textbook have information that helps you to understand the article?

pages .....

.....

.....

Judging a source of information

	The further to the right, the more reliable the source is likely to be				
Publication / source	Website or newsletter of a private individual, 'blog' or forum entry from unknown writer.	'Respectable' pressure group web-site or newsletter.	'Quality' media, e.g., the BBC, The Guardian.	School textbook or science magazine, e.g., New Scientist, Focus, Catalyst.	Peer-reviewed journal or government report.
Nature of the data	Little or no data given.	Data of doubtful reliability, e.g., based on small or unrepresentative sample.	Based on a single study, or little information about sample design or procedures.	Clear indication of valid design e.g. large samples, extended period of study.	Different studies give matching results.
Science explanations	No explanation or data to support claim.	Explanation not yet tested or confirmed.	Can be compared with other possible explanations.	Agreed by most of the scientific community.	Fully agreed by almost everyone.
Status of the author	Individual of unknown background, or known extremist.	Science student or well informed person.	Teacher / professional scientist with expertise in a different field.	Scientist working in this field.	Recognised expert in the field.
Author's affiliation or institution	Non-science related.	Representing a particular view only (e.g., manufacturer or pressure group).	Independent, science related source.	University, medical school, science institute.	Leading research centre / major company / government research centre.

Use this guide when comparing different articles in the media or other sources.
It will help you to decide which articles are most likely to be giving reliable information to support any claims made or opinions given.

Case Study

Specimen Assessment Materials and Exemplars

For Assessment Submission in 201#

GCSE TWENTY FIRST CENTURY SCIENCE

SCIENCE A

A144 Case Study

Possible effects of air pollution on public health

CONTROLLED ASSESSMENT
NEWS SHEET FOR CANDIDATES

This assessment will be changed every year. Please check on OCR Interchange that you have the Controlled Assessment material valid for the appropriate assessment session.

- To be issued to candidates at the start of the task.
- This News Sheet contains some information about: Possible effects of air pollution on public health.
- The articles give information about some of the research which has been done on Possible effects of air pollution on public health, and some of the opinions that have been published. The people who wrote the articles do not all agree.
- Read the articles and then choose a question about Possible effects of air pollution on public health for your Case Study.
- **Your report must show clearly where your information has come from.**
- Your quality of written communication will be assessed.
- The total number of marks for this Controlled Assessment task is **32**.
- This Controlled Assessment task is valid for submission in the June 201# examination series only.

This document consists of 4 **pages. Any blank pages are indicated**

Teachers are responsible for ensuring that assessment is carried out against the Controlled Assessment set for the relevant examination series (detailed above).

Assessment evidence produced that does not reflect the relevant examination series will not be accepted.

Air pollution and public health

Study proves the cause of asthma

BBC News Website

Its hard to avoid pollutants in the air – you can't just stop breathing! Air pollution has been linked with asthma for some time, but proof has always proved elusive. Now support for a direct link comes from a study of over 600 primary school children, which found that respiratory disorders got worse as air pollution increased.

The study spread over 3 years at the University of Groningen in the Netherlands. Results were published in The Lancet medical journal. Children, from town and country areas, kept diaries of asthma symptoms and tested their lung capacity three times a day. When air pollution was higher, these children were much more likely to suffer breathing problems.

When there were more particulates - bits larger than 10 micrometres - in the air, these children were up to 139% more likely to suffer. And when there were more of the pollutants that make up car exhaust fumes - black smoke, sulphur dioxide and nitrogen dioxide - they were up to 131% more likely to have such symptoms.

Researchers claimed that the length of the study, and its careful links to clinical symptoms, helped to prove a link where other studies could not.

Finding ways to reduce air pollution, such as low or zero emission vehicles, must be an important part of public health policy, the researchers said. The Government has tried to increase the use of diesel cars in Britain by lower fuel taxes. This is called a "green" policy because diesels make less carbon dioxide than petrol-powered engines - but they also emit far more of the particulates.

advertisement

Protect your health from urban smog!

Millions die each year across the World from breathing traffic fumes!

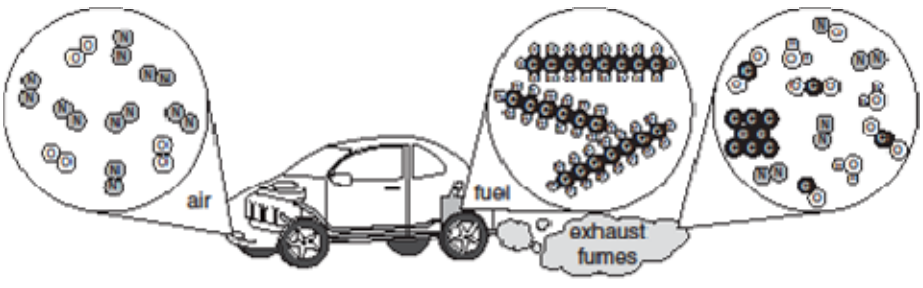
Driver, passenger or pedestrian, you can breathe cleaner air with Twenty-first century personal filters.

© iStockphoto.com / Dane Wirtzfield

© iStockphoto.com / Christy Thompson

Keep your children safe on the way to school – *the fine filter fabric catches particles and soaks up harmful gases.*
Buy now –
www.21filter.com
Big 10% discount!

This appeared in a reader's blog in response to the article:



The chemicals going into and coming out of a car engine

It may be the coffin they carry you off in
but its the car that causes the "coff"!

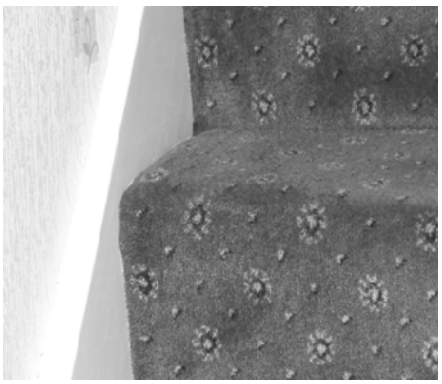
Carpets get the blame for asthma

From a report published in July 2000

A recent report has blamed fitted carpets for a rise in asthma and other allergies.

Almost every house hold in the UK has some fitted carpets, compared to just 16% in France and 2% in Italy.

The report, based on carpet sales and studies of houses in the South, says that this could be one reason why the UK has the worst record in the world for asthma and allergies. "House dust mites like to live in dark and damp environments and we find a lot of them at the base of a carpet. When you consider that each one produces 20 particles of faeces each day, that is an awful lot in a house full of fitted carpets."



The allergen which causes conditions such as asthma is in the faeces. Up to 100,000 dust mites can live in just one square metre of carpet. They are very difficult to remove and can even resist the suction of vacuum cleaners.

The report has many sponsors, including the National Eczema Society, Action Against Allergy and the Women's Environmental Network.

Householders are advised to fit wood, laminate or linoleum floors, rather than carpets. "Where small children are concerned this simple act could save them from a life's suffering with allergies and breathlessness.", said a spokeswoman for the Network.

However, the claims were disputed by experts from the University of Cambridge who said that dust mites in beds were a more likely cause. "The danger with asthma is breathing in the allergen. Particles in a bed are easily spread into the air - just turning over in bed is enough."

School Science As 'Media Slave' Is Condemned

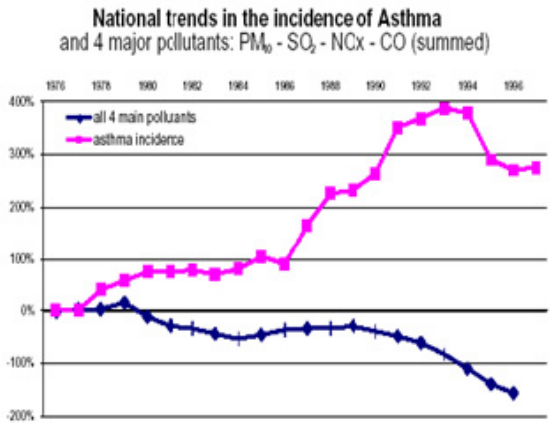
By The Association of British Drivers

Students in future will read newspaper coverage of air quality issues in science lessons which, if they mirror the errors of the past and present, will lead them to conclude that outdoor air quality is getting worse when the opposite is true as it's now better than at any time for hundreds of years and ten times better than the air quality in our homes.

Newspapers and TV news items, if allowed to set the agenda for lessons, will link car emissions with asthma causation, yet asthma cases have increased over a period of time when outdoor air pollution has declined (6). Those with medical knowledge point to the home and enzymes in house dust mite excreta

News flash – November 2004

Researchers in Denver, Colorado compared daily air pollution levels with asthma symptoms for children who were already known to have moderate to severe asthma. Symptoms were monitored over three winters because winter is the season when pollution levels are highest. The numbers of children studied in each year were 41, 63 and 43. They concluded that air pollution seemed to have no effect on asthma flare-ups or lung function.



Should we worry about wheezes?

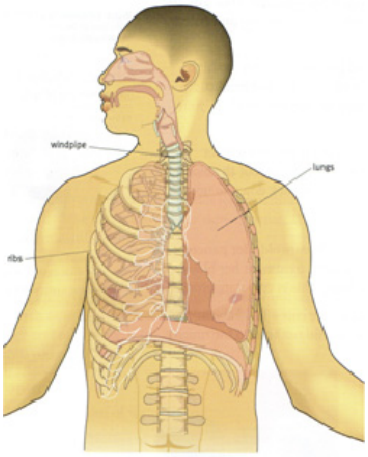
By our health correspondent.

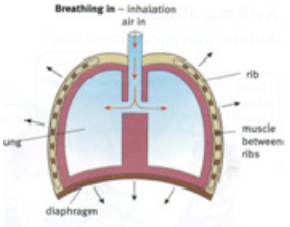
Breathe Easy

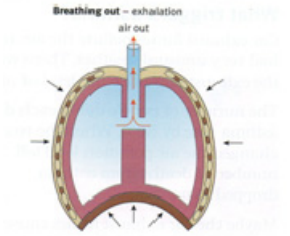
When you breathe in,

- you use muscles between your ribs to lift the ribs up and outwards.
- The diaphragm moves down
- this makes more space in your chest and air moves into your lungs
- Tubes carry air into your lungs. They divide into smaller and smaller tubes.
- At the end of each tube is a tiny air-sac
- blood flows through capillaries round the air sacs,
- oxygen in the air dissolves in the blood and is carried round the body
- carbon dioxide waste from the body passes into the air in the sacs and is breathed out

When you breathe out, the ribs move down and the diaphragm moves up. Air is pushed out of the lungs.







Breathe difficult

Asthma is a long-term health condition in which the tubes in the lungs become inflamed and narrow, making it difficult to breathe.

© iStockphoto.com / Daniel Fascia

A peak-flow meter to measure how well you can breathe

Asthma is one of a group of allergic conditions, including eczema and hay fever, which often occur together. Symptoms are not present all the time, but can suddenly get worse – this is called an asthma attack.

Once somebody has asthma, attacks can be started by various "triggers" which set off the swelling of the air passages.

How big a problem is asthma?

5.4 million people in the UK now need treatment for asthma:

- 1.1 million children (1 in 11 of the child population)
- 4.3 million adults (1 in 12 of the adult population).

There were 1,200 deaths from asthma in the UK in 2006 (40 were children aged 14 years or under). On average, 3 people per day or 1 person every 7 hours dies from asthma

You can see that lots of people suffer from the effects of air pollution, sometimes very seriously. Do you have a question about air pollution and health that you would like to find out more about?

References:
BBC News website', BBC News: Study 'proves' asthma cause, Friday 12 March 1999, http://news.bbc.co.uk/1/hi/health/295067.stm
3 Carpets get the blame for asthma © 'BBC News website', BBC News: Carpets blamed for asthma, Tuesday 11 July 2000, http://news.bbc.co.uk/1/hi/health/828622.stm
Page 3 and 4 School Science As 'Media Slave' Is Condemned © The Association of British Drivers, http://www.abd.org.uk/pr/505.htm
Page 5 Should we worry about wheezes? © "By permission of Oxford University Press", pg28-29, (image) from "Twenty First Century Science: Entry Level textbook – 21st Century Science" by Science Education Group University of York edited by Nuffield Curriculum Centre (2006) Free permission, www.oup.com
Page 6 How big a problem is asthma? © Asthma UK, For journalists: key facts & statistics, http://www.asthma.org.uk/news_media/media_resources/for_journalists_key.html

Candidate 1

Are the rise in asthma attacks caused by the air pollution?

Contents:

Introduction

I have been asked to do a Case Study on the subject of "Air Quality". I was asked to think of a question in relation to the subject and the question I came up with is *"Are the rise in Asthma Attacks Caused by the Air Pollution Levels in the air?"*

Firstly I will be finding out some background information about, what the air is made up of and what Asthma is. I will also be trying to find out whether the pollution levels in the air affects asthmatic patients.

There will be two sides of the argument to whether the pollution levels causes the rise in more ill patients so I will be researching information from the internet, looking in science text books, using scientific knowledge and getting some useful articles and quotes from scientist or doctors to back each side of the argument.

At the end of the Case Study I will conclude by giving me own opinion of what I think causes the rise in Asthma Attacks.

Resources:

www.twentyfirstcenturyscience.com
www.bbc.co.uk
www.abd.ord.uk/asthma
www.news.bbc.co.uk/1/hi/health/1099418.stm
www.airquality.co.uk/archive/what_causes.php
www.yamoa.natural-remedies-clinic.co.uk/airpollution.htm
Twenty first century science, text book.

What is air Pollution?

When people think about air pollution they usually think about smog, acid rain and other forms of outdoor air pollution, but air pollution can also exist inside homes and other buildings. Chemical substances and air pollutants arise from a wide variety of sources, although they are mainly a result of the combustion process. The largest sources include motor vehicles and industry, cars and trucks. They pollute the air during manufacturing; oil refining and distribution, refuelling Motor vehicles cause both primary and secondary pollution. Primary pollution is emitted directly into the atmosphere; secondary pollution results from chemical reactions between pollutants in the atmosphere. The following are the major pollutants from motor vehicles: Ozone (O3), Particulate (PM) Nitrogen Oxides (NOx) Carbon monoxide (CO) Sulfur Dioxide (SO2) Hazardous air pollutants (Toxics)

Pollutant	Source	What effect does it have?
Carbon monoxide A colorless, odourless, tasteless and relatively inet gas which slowly converts to carbon monoxide over a period of about a month.	• Vehicles burning petrol • Domestic Fires	• Interferes with the ability of the blood to absorb and circulate oxygen • Can affect people with heart conditions and can impair co-ordination and attention • Causes headaches and vomiting • Large amounts can kill
Nitrogen dioxide A reddish, brown, pungent, acidic gas	• Vehicles burning diesel petrol • Domestic fires • Power stations burning fossil fuels • Major industry • Lightning	• Can lead to throat and lung infections • Low level exposure can affect growth a cause damage to plants • Contributes to the formation of hazes and smog

There is no clear link between concentrations of air pollutants and people starting to get asthma, however, people who already have asthma have sensitive breathing tubes, so, anything that causes irritation or makes breathing harder, is likely to trigger an attack or make symptoms worse.

Things that can trigger asthma:

- Tree or gas pollen
- Animal skin flakes
- Dust mite droppings
- Air pollution
- Nuts shellfish
- Food additives
- Dusty material

Two people of different ages with asthma are interviewed about how there asthma affects them in their lives.

Elaine (14) – *I use my inhaler before I go swimming, or when it is very cold. When I first noticed my asthma I use to feel very panicky and frightened because I feel as though I couldn't breathe. But now I have an inhaler so it isn't so bad.*

Dave (27) – *I had my first asthma attack when I was cross-country running at school. The doctor gave me an inhaler for more than a year: I gave up sports and was very miserable. Gradually I learnt that the inhaler could control my wheezing and I started to play football again. Now I drive an ambulance rushing round helping other people and my asthma seems to have almost faded away.*

"*The groups most affected by air pollution include children and the elderly. People with chronic diseases such as emphysema, heart disease and asthma are also more susceptible than the general population*." Quoted by Dr Nathan Rabinovitch.

Fors

Many people agree that the main reasons why the increase of asthma attacks are due to the atmospheric pollutants. The UK and Ireland have the highest rates of asthma in the whole of the European, 13% of the UK adult population has asthma, says a new report by the European Respiratory Society. The UK and Ireland has the highest death rate from respiratory diseases in the European Union.

Friends of the Earth Society says that:

One of the most well-known health impacts of air pollution is an increase in asthma attacks. The incidence of asthma appears to have more than doubled in the last 15 years. Some of this increase may be due to changes in how doctors categorize asthma, but it is now widely accepted that the incidence of asthma has increased considerably. Asthma is the most common chronic disease of childhood with around 1 in 7 children affected.

Evidence of a link between pollution and asthma is certainly accumulating, but there is no proof yet of a causal relationship. *What we do know, however, the problem is, is that pollution can aggravate asthma symptoms and can also trigger an asthma attack in people who are already asthmatic*. There is evidence that use of asthma medication and hospital admissions diagnosed as asthma increase during severe pollution episodes.

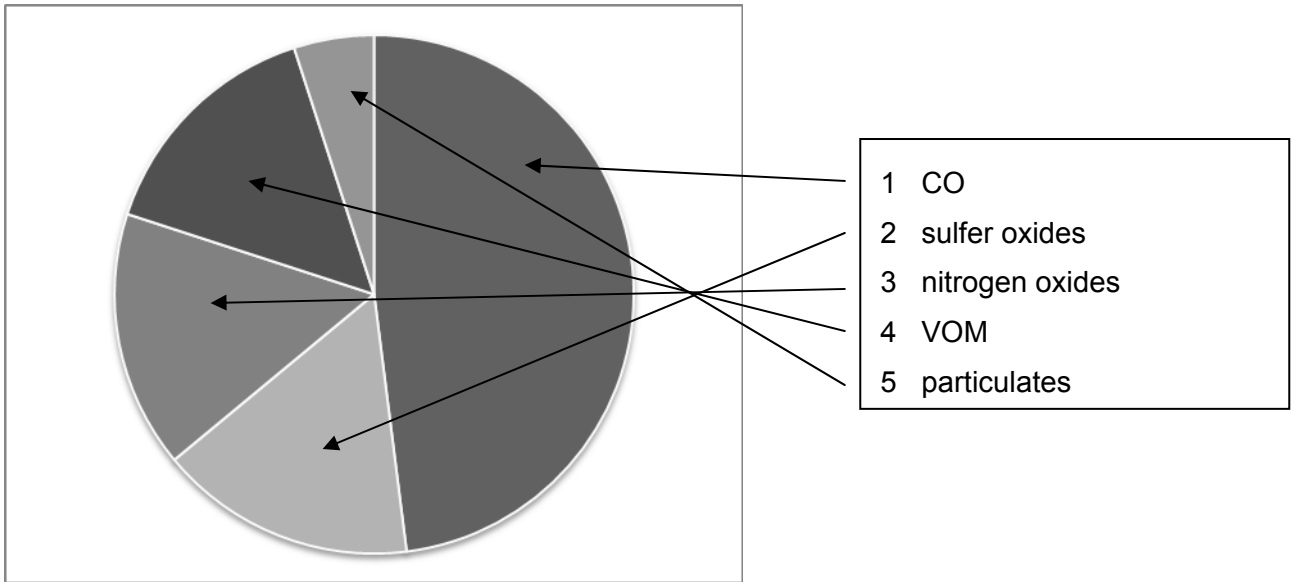
The pollutants, which are of most concern in relation to asthma, are ozone, particulates and nitrogen oxides, (shown in the table on page 3). Mixtures of pollutants (secondary pollutants) may also be particularly damaging.

Particulates: Consistent correlation between particle levels and death rates. High levels of particulates have also been linked with increased hospital admissions and asthma attacks. Smaller particles

can carry carcinogenic particles into the lungs.

Nitrogen dioxide: May aggravate asthma symptoms. Can cause a tightening of the chest and reduced lung function. Can make airways more sensitive to allergens such as house dust mite. By disrupting the body's natural cleansing mechanisms nitrogen dioxide may increase the body's susceptibility to viral infections.

There are several theories on how pollution might trigger asthma attacks. One is that ozone may damage the lining of the airways and allow other allergens, such as pollen or substances from house dust mite etc, to enter and thereby set up the allergic response.



Above is the percentage of each type of pollutant that is released into the atmosphere.

"It's very clear that air pollution can make asthma worse, so if you live in a city with a lot of air pollution, chances are you will have worse asthma than if you lived in a cleaner environment." – Dr Nathan Rabinovitch.

This evidence from the "friends of the earth" society and quotes by Dr. Rabinovitch proves that there is a correlation between the air pollution and the rise in asthma attacks.

Against

Air pollution is not the only one suspected factor in the increased incidence of asthma. Many other factors, such as changes in domestic heating and ventilation, diet and exposure to cigarette smoke, have also been implicated.

Many people disagree that ir pollution is the reason why asthma attacks have risen. Some people believe that air pollution is not responsible and therefore are against the question.

"*Air pollution does not cause asthma*."

"*There is no correlation between levels of vehicle emissions and asthma incidence*"

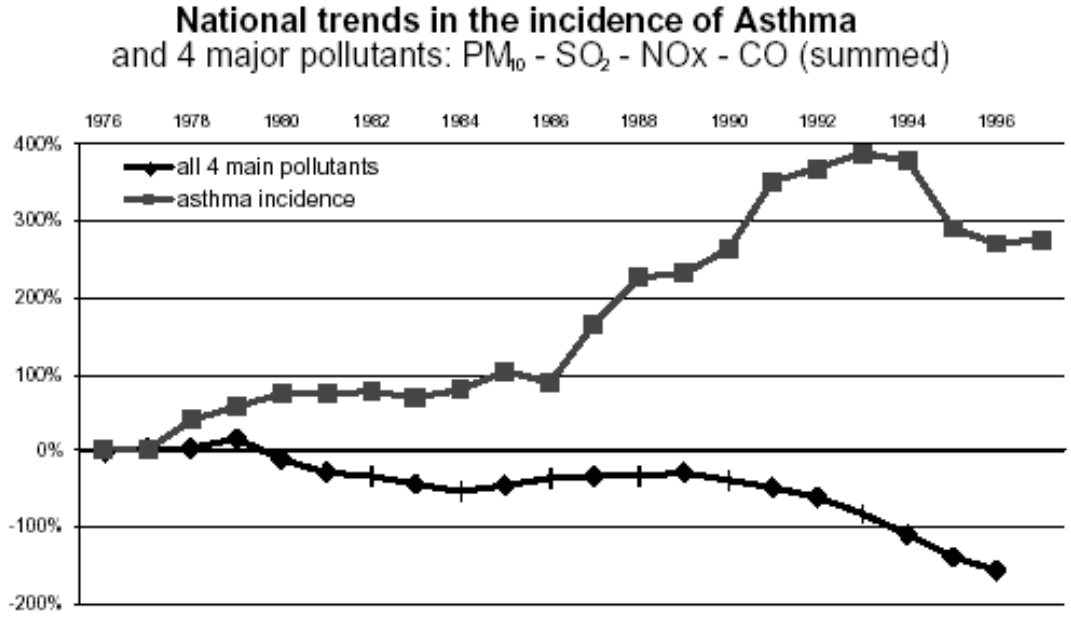
1995 department of Health Study on the causes of asthma – ***Dr Kenneth Calman Government chief Medical Officer.***

Dr Martin Stern of the British Allergy foundation has categorically rejected that asthma is linked to outdoor air pollution. Instead, he links it to the household dust mite and its excreta. Modern living, with central heating, draught-free double-glazing, fitted carpets and poor diet plus lack of exercise provide the ideal environment for the dust mite and its effects on our respiratory system. The proportion of homes with fitted carpets in England, France and Italy is directly proportional to the incidence of asthma in each country.

Allergies are the biggest cause of asthma. Allergies are triggered by reaction of the immune system to allergens, which are materials of biological origin, specifically proteins. Common allergens are:

A	Waste from house dust mites – 23% of American homes have levels sufficient to cause asthma.
B	Particles from bacteria, fungi, plant fragments, pollen, mould, etc.
C	Rubber in latex gloves, the dust from tyres and elsewhere.

This graph shows the national trends in the incidence of asthma



Another quote to back up the argument against pollution causing rise in asthma attacks:

"In the last 40 years the level of (outdoor) air pollution has decreased dramatically"

"Nevertheless the incidence of asthma has risen"

"Pollution does not cause bronchitis or asthma, nor does wearing a so-called anti-pollution mask do anything except identify the wearer as a sucker" – ***medical expert Professor Emeritus Stanley Feldman***

What can we do to improve the air quality?

Air quality is very important for people's health; it is vital that the air quality is clean as it can harm our bodies; people can do many things to improve air quality. When we think about air quality there are 3 main approaches available.

What can scientists and technologists do? Can technological development improve air quality?

What can governments do? Can regulation and taxes help control pollution?

What can individual people do? Are people prepared to change their life style if it improves air quality?

All 3 approaches are needed it we are to have good air quality for ourselves and for the future generations. Air pollution can be reduced in different ways. As vehicles causes the most air pollution it can be reduced by fitting a Catalytic Converter in the engine where it converts Carbon Monoxide + Oxygen produced to a safer gas which is Carbon Dioxide.

The chemical reactions that occur in catalytic converters are:

Carbon Monoxide + Oxygen = Carbon Dioxide

$2CO + O2 = 2CO_2$

Hydrogen fuel cell engines are being developed, using hydrogen as fuel and reducing the amount of CO_2 in the atmosphere.

Scientists can also remove almost all sulphur from power stations and chimney compounds from natural gas before it is used for power stations and domestic heating.

Here are lists of things you can do to reduce air pollution:

- Walk or ride a bike.
- Ride public transit.
- Obey the speed limit.
- Replace your car's air filter.
- Look for the most efficient, lowest polluting model or even a zero-polluting electric car.
- Paint with a brush, not a sprayer.
- Use a push or electric lawn-mower.
- Choose air-friendly products.

There are many more ways to reduce air pollution; the list will go on forever. These are just a few examples.

Conclusion

From all the information I have collected about the causes of asthma, I have come to a conclusion. In my opinion, I think that air pollution is not highly responsible for the increase in asthma attacks because I agree with Dr Nathan Rabinovitch that air pollution makes asthma worse, air pollution is one of the main triggers however I don't think that the death rates of asthma is caused by the air pollution, I also agree with Dr Martin Stern that allergies are the main cause of asthma. I believe that more indoor pollution such as particulates in the air and dust mites are the main reason for the rise in asthma attacks as also said by Dr Martin Stern. The graph showing the trends in the incidence of asthma shows that the 4 main pollutants do not cause more incidence of asthma. On the other hand, I disagree with "The Friends of the Earth Society" because they do not have enough evidence to prove that deaths of asthma are related to air pollution and their resources are slightly biast and are not very reliable as they have just used any information to back there argument. I would rather believe what a doctor or a scientist would say as they are more experienced and have scientific knowledge to support there views. I have also found out that asthmatic people are sensitive to breathing and different people are affected by asthma in different ways, some people are triggered by different things such as grass pollen, dust mite droppings and animal hair, so this tells us that not just air pollution causes the rise in asthma attacks. Scientific evidence such as graphs and quotes by scientists and doctors helps me to make this decision so therefore I am also against the question.

Candidate 2

Can levels of pollution affect a town's tourism?

A case study for GCSE SCience

Can levels of pollution affect a town's tourism?

Towns like York depend on tourists in order for their businesses to survive, that's why it is important for a town to be appealing to visitors.

What does tourism mean?

Noun: the business of providing services to tourists.

This means that towns have to not only make sure it has a varied type of businesses to please the tourists, such as shops and places to work, so that it stands out from other towns, but also to make sure its is a clean and pollutant free place from air pollution.

That is why I have chosen the question "Can levels of pollution affects a towns tourism?" To see weather a town needs a competitive range of shops or a pollution free air to lure tourists to their towns.

Pollutants can damage our health long and short term. People who have asthma can find that their symptoms become worse when there is pollution in the air, by chemicals from car fumes or factories giving off gases.

Pollutants can come in many forms but mostly invisible in exception to smoke which is made up of tiny bits of solid called particulates which can get into sufferers lungs.

Types of pollutants:

Much of air pollution comes from cars, buses and lorries

Sulphur dioxide SO2 – causes acid rain

Carbon monoxide CO – poisonous

Nitrogen dioxide NO2 – acid rain and asthma

Particulates – sort of soot, very small, causes lung problems

Ozone O3 – irritates eyes and nose

Air pollution can consist of smog, acid rain and CFCs plus other outdoor pollution, but air pollution can also be found inside because of chemicals and wear away at rock and brick making it less stable which can lead to the collapse of buildings.

Pollution can be heavily congested in cities such as York. It can spread out as it is in such a small area. That is why pollution is found in cities rather than in the countryside.

Tourism is more in the cities though because of job opportunities and the range of shops. Even though the pollution levels are higher in cities than in the countryside.

Plants can die in the result of over exposure to pollution and can affect its growth.

Towns need beauty to attract tourists and if plants are being killed a town has no attraction to bring tourists to the town.

"Clean" smoke from dirty rubbish

Recycle everything – improve the environment

Pollution can also affect animals. To reduce the pollution levels, some things have been done, such as in Malasia after a forest fire that was caused by air pollution they started to take action in reducing the levels of air pollution and smog by cutting down on rubbish burning.

In the ZOOL newspaper from Malaysia in July 11th 2001

"First we cut down on home burning, this will reduce air pollution, and cut down on forest fires."

In the same article, a Mr Mowaba says:

"Not only does asir pollution affect a countries economy, material and vegetation damage, but it also reduces tourism."

This shows that some people agree that pollution affects a town's tourism; by the way that air pollution can affect a towns beauty by killing plants and animals, and damaging buildings.

So some people agree that with the question **"Can pollution affect a towns tourism?"**

The PDEQ says:
"Air pollution can affect tourism and the ability of businesses and institutions to recruit quality workers to save the problem"

H Josef Hebert, Associated Press writer says: *"The growing problem of polluted air in towns is disappointing tourists and keeping some away."*

Some people that disagree with the question
"Can air pollution affect a towns tourism?"

Francis Sherman – head of Europe's tourist board "Pollution in no way affects a tourist's decision to visit a place, it is clearly down to the level of facilities in a town"

Air quality graphs of Edinburgh London and Oxford all show levels of pollution in the air

In Edinburgh it shows –

Carbon Monoxide	Nitric oxide	Nitrogen oxide	Nitrogen dioxide	Sulphur dioxide	Mean particles
high	low	medium	medium	low	high

London, Westminster pollution levels

Carbon Monoxide	Nitric oxide	Nitrogen oxide	Nitrogen dioxide	Sulphur dioxide	Mean particles
medium	high	medium	low	low	medium

Oxford pollution levels

Carbon Monoxide	Nitric oxide	Nitrogen oxide	Nitrogen dioxide	Sulphur dioxide	Mean particles
low	medium	high	low	medium	low

This shows that pollution may be high in an area of high tourism, but this does not affect how many tourists that visit a town. As there is a high level interest in the town to overcome the level of pollution in the air.

These points shows that pollution takes a big part in the tourism business as it affects how a town is perceived, in how clean and well presented it is, I beauty in plants and structural buildings to attract tourists and if this is affected think that pollution does affect a towns tourism as it shows here that a town needs by pollution, **then this means that it affects a towns tourism**.

www.ask.co.uk/pollution/tourism

www.pdeq.com

www.zool/2001/pollution.com

Candidate 3

Are the Government

doing enough

to reduce air pollution?

Introduction:

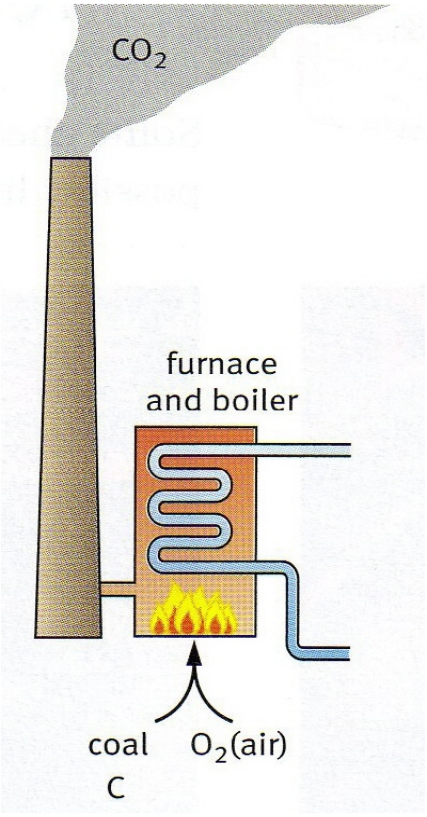
Air pollution is the contamination of air by the discharge of harmful substances.
Ever since primitive people began burning fuels air pollution has been an increasing problem.
In my case study, I shall find out what can be done to reduce this problem, and whether the government should take more responsibility for it.

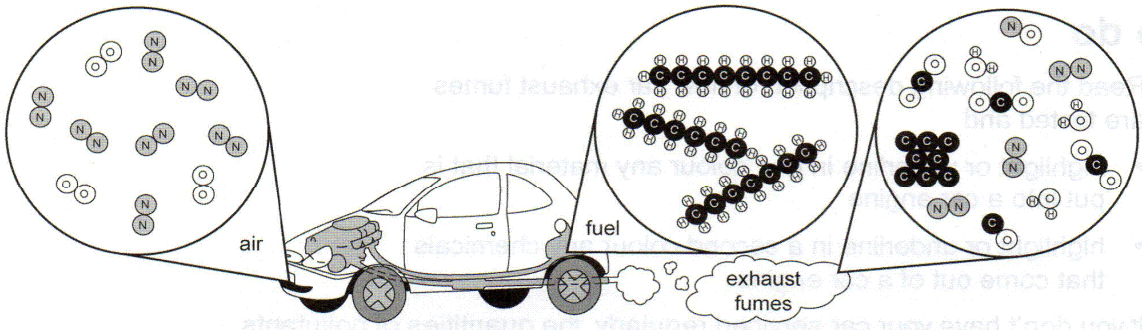
What is air pollution?

Air consists of a mixture of gases –

Gas	Percentage by volume
Nitrogen (N_2)	78
Oxygen (O_2)	21
Argon (Ar)	1
Carbon Dioxide (CO_2)	0.03
Water vapour (H_2O)	Variable 0 - 4

Air can be contaminated naturally, for example by pollen or dust blown up by winds, or by methane from ruminant animals or rotting vegetation. However, these natural pollutants have always been present. It is the extra pollutants added by human actions which are causing increasing concern.
Air pollution can cause health problems including burning eyes and nose, itchy, irritated throat and breathing problems. Air pollution can trigger asthma attacks and may cause the onset of asthma in new patients. Above certain concentrations and exposure times, some air pollutants are extremely dangerous, causing severe injury or even death.
Air pollution can also damage the environment and people's properties. Trees, lakes and animals have been harmed by air pollution. The industrial revolution during the 18th Century began the large-scale burning of fuels as sources of energy. Power stations are huge sources of air pollution, as are road vehicles, ships, trains and aeroplanes.





The chemicals going into and coming out of a car engine

The Major Air Pollutants

Carbon Monoxide (CO)

An odourless, colourless gas.If inhaled, carbon monoxide molecules bind to haemoglobin in red blood cells, making them less able to carry oxygen round the body.

Low concentrations cause dizziness, headaches and fatigue. High concentrations can be fatal. Carbon monoxide is formed by incomplete burning of carbon-based fuels or other organic materials e.g. in internal combustion engines where the supply of air is limited.

Carbon Dioxide (CO_2)

The principal greenhouse gas emitted as a result of human activity. By trapping infra red radiation in the atmosphere, it can cause global warming, resulting in changes in weather patterns which may be disastrous.

Nitrogen oxides (NOx)

During combustion, nitrogen and oxygen in the air react. The oxides formed can react with water and more oxygen to form nitric acid, causing acid rain. They can also react with organic compounds in the air to form photochemical smog.

Particulate matter

Any type of finely divided solid, but mostly tiny specks of carbon (soot) from diesel engines. Can become lodged in lung tissue causing disease and breathlessness.

All of the above are formed from motor vehicle exhausts. Power stations also produce these same pollutants, but also produce –

Sulfur dioxide (SO_2)

Very poisonous. Contributes to acid rain and smog. can cause breathing problems and permanent lung damage.

All of these pollutants continue to be a source of danger and damage to people and the environment. Until fairly recently, lead and chlorofluorocarbons (CFCs) were also very worrying pollutants. However, legislation by governments has almost completely stopped the use of CFCs in fridges and aerosols, and the use of lead in petrol.

So why haven't governments stopped these other pollutants??

I will consider what different groups could do to tackle air pollution problems.

1 Governments (national and local)
2 Industry (e.g. motor industry and power generation)
3 people i.e. you and me!

What can government do?

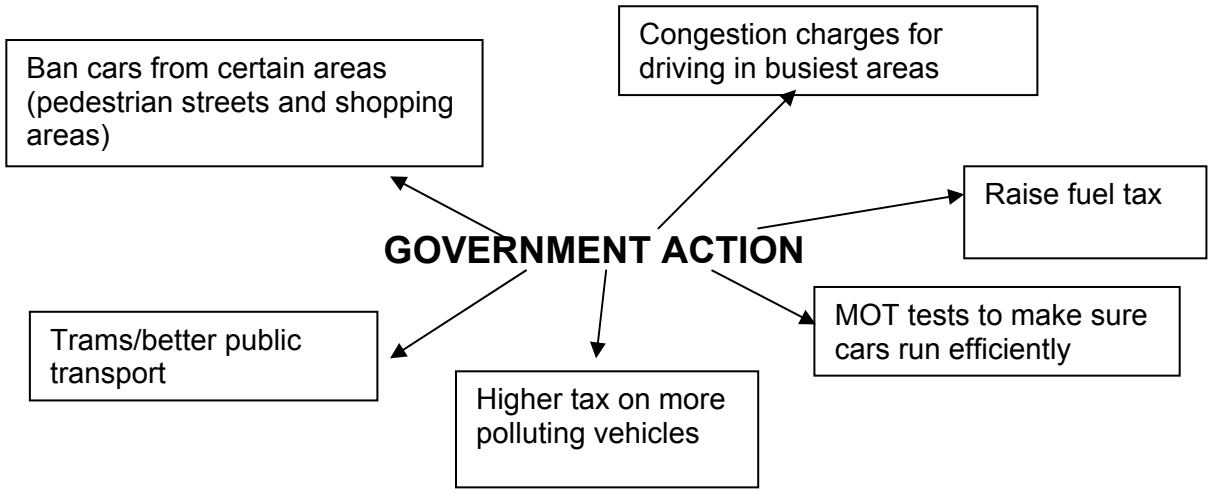
For vehicles to travel on the roads they must pay a Road Fund Licence Tax. The government has decided that the amount of tax will be linked to the amount of pollution caused by each vehicle.

Rating band	Amount of CO2 emitted	Tax per year
A	0 – 100	£0.00
B	101 – 110	£20.00
C	111 – 120	£30.00
D	121 – 130	£90.00
E	131 – 140	£110.00
F	141 – 150	£125.00
G	151 – 165	£155.00
H	166 – 175	£180.00
I	176 – 185	£200.00
J	186 – 200	£235.00
K	201 – 225	£245.00
L	226 – 255	£425.00
M	over 255	£435.00

The idea is that this tax will discourage people from using cars which burn a lot of fuel.
However, the tax does not take notice of the number of miles driven, so it is not directly proportional to the amount of pollution caused.
Also, the money raised does not go to research on ways of reducing pollution even further.

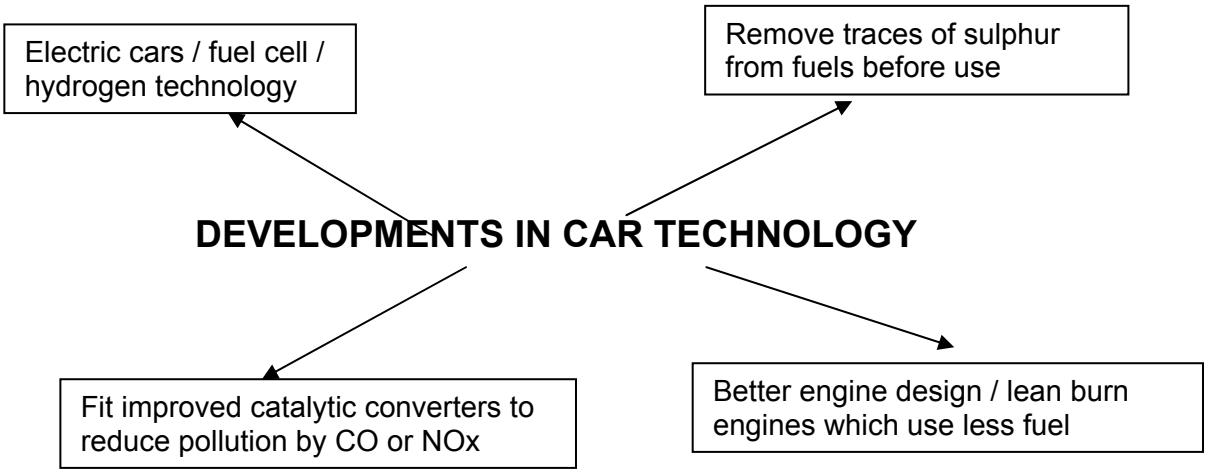
This is a National Government action.

Some local councils have introduced “congestion charges” which make drivers pay to enter the busiest areas. This will reduce the amount of pollution in these areas where very high levels of pollution would otherwise happen.



What can car manufacturers do?

Higher fuel costs, taxes and public awareness have put pressure on car makers to design smaller, lighter, more fuel efficient cars and engines.



Although all of these things are under development, it is interesting to note how many manufacturers now offer “super-cars” designed for high speed, with very large engines that burn enormous amounts of fuel.

In effect, these manufacturers are throwing the responsibility for choice back onto my third group – the consumers!

What can the consumer do?

(In other words, you and me!!)

Some environmental groups want people to make dramatic changes in their life-style to reduce their energy demand (or "carbon footprint"). Since the effects of air pollution are diffuse and un-dramatic on a personal scale, it is unreasonable to expect people to abandon things they have grown used to.
However, in Scotland there is a saying – "Mony a mickle maks a muckle". In other words, a lot of little things added together can add up to a very big effect. If each person can do just a little to use less energy, the effect over the whole country would be very large.

We use lots of energy keeping our homes warm in winter, and much air pollution comes from the power stations that generate this energy. Energy saving in the home reduces pollution (and saves you money!).

- **Use energy saving light bulbs**
- **turn off lights, TV etc when not needed**
- **set your thermostat just a little bit lower**
- **fit double glazing**
- **install better loft insulation**
- **insulate cavity walls**

The government helps with some of these, for example by offering grants to help pay for better loft insulation.

We can also help by small changes in life-style -

- **Walk or ride a bike.**
- **Use public transport.**
- **Drive slower and avoid sudden changes of speed (reduces fuel consumption).**
- **Buy the most efficient, lowest polluting car or even an electric car.**
- **Service your car regularly to keep it efficient.**
- **Use a push-along lawn-mower.**

Conclusion:

All three groups are making efforts to reduce energy demand and air pollution, but all could do more. The changes I have listed in this case study would help a lot – if everyone knew about them and understood how important they are. Air quality in most developed countries is much better than 100 years ago. With better information and education, we could all help to make it better still.

Marking criteria for Controlled Assessment tasks: Practical Data Analysis

The four strands in the marking criteria for the Practical Data Analysis are designed to match the five stages in this controlled assessment task. However, candidates do not always follow this sequence strictly when writing their reports, and positive achievement should be credited in the appropriate strand wherever it is found in the report.

Candidates will draw on their knowledge and understanding of science at all stages of a Practical Data Analysis task. The table shows how they can also draw on their knowledge of 'how science works' through appropriate references to the 'Ideas about Science' in the Science A specification.

Aspect	Content
Strand D: choice of methods, techniques and equipment	Candidates make choices about the methods, techniques and equipment used to collect high quality data. They show awareness of safe working practices and the hazards associated with materials. At the highest level, a full risk assessment is included. Candidates will find it helpful to refer to: IaS5: Risk and IaS1-3.
Strand E: revealing patterns in data	The primary data collected by candidates is analysed to reveal any patterns or relationships. Candidates will find it helpful to refer to IaS2: Cause–effect explanations. To allow access to a wider range of activities, this aspect has two alternative sets of descriptors. One is for the quality of graphical display. The alternative row can be used to award credit for statistical or numerical analysis of data.
Strand F: evaluation of data	Candidates should show awareness of any limitations imposed by the apparatus or techniques used and suggest improvements to the method. Recognition and management of risk should also be taken into account when assessing this strand. Candidates will find it helpful to refer to: IaS1: Data: their importance and limitations and IaS5: Risk.
Strand G: reviewing confidence in the hypothesis	Candidates assess how well the available data supports the hypothesis and explain its scientific basis. Quality of written communication should also be taken into account when assessing this aspect of the work. Candidates will find it helpful to refer to: IaS1: Data: their importance and limitations; IaS2: Cause–effect explanations and IaS3: Developing scientific explanations.

Strand	0	1 – 2 marks	3 – 4 marks	5 – 6 marks	7 – 8 marks	AO
D	*	Describe the method and apparatus selected to collect data. Make an appropriate comment about safe working.	Comment on the techniques and equipment selected to collect data, showing some understanding of the need for repeatability. Correctly identify hazards associated with the procedures used.	Describe the techniques and equipment selected to collect an appropriate range of data, of generally good quality, including regular repeats, or checks for repeatability. Identify any significant risks and suggest some precautions.	Justify the method, range of values, equipment and techniques selected to collect data of high quality. Complete a full and appropriate risk assessment identifying ways of minimising risks associated with the work.	AO2 – 6 AO3 – 2
E	*	Display limited numbers of results in tables, charts or graphs, using given axes and scales.	Construct simple charts or graphs to display data in an appropriate way, allowing some errors in scaling or plotting.	Correctly select scales and axes and plot data for a graph, including an appropriate line of best fit, or construct complex charts or diagrams e.g. species distribution maps.	Indicate the spread of data (e.g. through scatter graphs or range bars) or give clear keys for displays involving multiple data-sets.	AO3 - 8
		Select individual results as a basis for conclusions.	Carry out simple calculations e.g. correct calculation of averages from repeated readings	Use mathematical comparisons between results to support a conclusion.	Use complex processing to reveal patterns in the data e.g. statistical methods, use of inverse relationships, or calculation of gradient of graphs.	

Strand	0	1 – 2 marks	3 – 4 marks	5 – 6 marks	7 – 8 marks	AO
F	*		Correctly identify individual results which are beyond the range of experimental error (are outliers), or justify a claim that there are no outliers.	Use the general pattern of results or degree of scatter between repeats as a basis for assessing accuracy and repeatability and explain how this assessment is made.	Consider critically the repeatability of the evidence, accounting for any outliers.	AO3 - 8
G	*		Comment on whether trends or correlations in the data support the prediction or hypothesis and suggest why by reference to appropriate science. Some relevant scientific terms are used correctly, but spelling, punctuation and grammar are of variable quality.	Explain the extent to which the hypothesis can account for the pattern(s) shown in the data. Use relevant science knowledge to conclude whether the hypothesis has been supported or to suggest how it should be modified to account for the data more completely. Information is organised effectively with generally sound spelling, punctuation and grammar. Specialist terms are used appropriately.	Give a detailed account of what extra data could be collected to increase confidence in the hypothesis. The report is comprehensive, relevant and logically sequenced, with full and effective use of relevant scientific terminology. There are few, if any, grammatical errors.	AO1 - 2 AO3 - 6

* No response or response not sufficient for the award of 1 mark

Practical Data Analysis

Specimen Assessment Materials and Exemplars

OCR
RECOGNISING ACHIEVEMENT

For Assessment Submission in June 201#

GCSE TWENTY FIRST CENTURY SCIENCE

SCIENCE A

A144 Practical Data Analysis
Air bladders on bladder wrack seaweed

CONTROLLED ASSESSMENT
INFORMATION FOR CANDIDATES

This assessment will be changed every year. Please check on OCR Interchange that you have the Controlled Assessment material valid for the appropriate assessment session.

- To be issued to candidates at the start of the task.
- Your quality of written communication will be assessed.
- The total number of marks for this Controlled Assessment task is **32**.
- This Controlled Assessment task is valid for submission in the June 201# examination series only.
- This document consists of **2** pages. Any blank pages are indicated.

Teachers are responsible for ensuring that assessment is carried out against the Controlled Assessment set for the relevant examination series (detailed above).

Assessment evidence produced that does not reflect the relevant examination series will not be accepted.

Turn over

Background information for candidates

Bladder-wrack is a seaweed that clings to rocky surfaces. Bladder wrack lives on seashores in the in the **inter-tidal zone**, so has to spend part of its time under water and part exposed to the air.

It has long, flexible brown fronds and uses energy from sunlight to produce food by photosynthesis.

At intervals along each frond it has air-sacs or 'bladders', which are usually in pairs. These help the fronds to float when the plant is under water.

Scientists observe that the number of bladders varies on different plants.

The hypothesis is that:

The number of air-sacs on a frond of bladder-wrack seaweed is determined by the need to float upwards towards sunlight. There will be more air-sacs on weed at deeper levels.

You are going to plan and carry out experiments to test this hypothesis.

OCR
RECOGNISING ACHIEVEMENT

OCR
RECOGNISING ACHIEVEMENT

For Assessment Submission in June 201#

GCSE TWENTY FIRST CENTURY SCIENCE

SCIENCE A

A144/INST Practical Data Analysis
Air bladders on bladder wrack seaweed
Second task title
Third task title

CONTROLLED ASSESSMENT
INFORMATION FOR TEACHERS

This assessment will be changed every year. Please check on OCR Interchange that you have the Controlled Assessment material valid for the appropriate assessment session.

- This document is confidential to teachers and must not be released to candidates.
- For details of the level of control required for this assessment refer to Section 5 of the specification.
- There is one document provided for candidates for each Practical Data Analysis task: **Information for candidates** provides an introduction to the task and should be issued to candidates at the start of the task.
- The total number of marks for this Controlled Assessment task is **32**.
- Internally assessed marks **must** be submitted by 15 May.
- This Controlled Assessment task is valid for submission in the June 201# examination series only.
- This document consists of **4** pages. Any blank pages are indicated.

Teachers are responsible for ensuring that assessment is carried out against the Controlled Assessment set for the relevant examination series (detailed above).

Assessment evidence produced that does not reflect the relevant examination series will not be accepted.

Introduction

This 'Information for teachers' is confidential and must not be released to candidates.

Three Practical Data Analysis tasks are available as part of the Controlled Assessment of Science A Unit A144 for submission in the June 201# examination series.

These tasks are not valid for submission in any other examination series.

The three Practical Data Analysis tasks which are available for submission in the June 201# examination series are:

- Air bladders on bladder wrack seaweed
- Second task title
- Third task title.

Each candidate for Controlled Assessment in the June 201# examination series must present marks for one of these three Practical Data Analysis tasks, together with marks for one of the three Case Study tasks for the same year. All internally assessed marks must be submitted by 15 May.

The marked work of all candidates must be retained by the centre. Some of the work will be required for moderation.

General guidance for teachers

These notes provide background information for the preparation of candidates for these tasks and advice on the assessment of the Practical Data Analysis report.

Reference should also be made to Section 5 of the specification for Science A and to the *Guide for Controlled Assessment for GCSE Twenty First Century Science*.

Task setting is under high control. Tasks are therefore set by OCR. Where appropriate, tasks may be contextualised by individual centres to take account of local circumstances, including availability of resources and the needs of candidates. However, assessments must be based on the published marking criteria (within Section 5 of the specification). If there is any doubt about whether a contextualised task still sufficiently matches the task and criteria, centres should seek confirmation from OCR that the task is still valid.

Preparation of candidates

It is expected that before candidates attempt a Controlled Assessment task they will have received general preparation in their lessons. Learning activities to develop the relevant skills should have been provided and the broad requirements of the assessment made clear to candidates.

More specific details of practical techniques, the development of skills associated with these techniques, and possible methods and choice of equipment for the task should be covered when teaching the relevant part(s) of the specification, and must be completed prior to setting the task.

In addition, candidates will be expected to be familiar with the concepts and terminology of Ideas about Science. The Ideas about Science are described in detail in Appendix B of the specification.

Air bladders on bladder wrack seaweed

From their work for Module B3: Life on Earth, candidates will be familiar with the adaptation of organisms to their environment.

Second task title

From their work for Module etc…

Assessment of the quality of written communication (QWC)

The quality of written communication is assessed in Strand G of this Controlled Assessment task. Candidates should be advised that the quality of their written communication will be assessed. Further information about the assessment of QWC may be found in the specification.

Risk assessment

It is the centre's responsibility to ensure the safety of all candidates. Teachers are responsible for making their own risk assessment for the task prior to candidates attempting the practical work, and for ensuring that appropriate health and safety procedures are carried out. However, teachers must not provide candidates with a risk assessment since this is included in the marking criteria for Strand D. If candidates require additional guidance on managing safety once the task has started then this will need to be reflected in the marks awarded.

Guidance on assessment

All assessment of the Practical Data Analysis Controlled Assessment is based on the final report submitted by the candidates.

The marking procedure and marking criteria are described in detail within Section 5 of the specification. Marking decisions should be recorded on the respective cover sheets (available to download from www.ocr.org.uk and included in the *Guide for Controlled Assessment for GCSE Twenty First Century Science*). Candidates' reports should be annotated to show how marks have been awarded in relation to the marking criteria.

Additional guidance on marking criteria

Detailed guidance on applying the marking criteria will be found in the *Guide for Controlled Assessment for GCSE Twenty First Century Science.*

The following additional brief notes are applicable to specific Practical Data Analysis tasks and provide some clarification of what may be expected from candidates in some strands. However, all marking decisions must be consistent with the marking criteria.

Air bladders on bladder wrack seaweed

Strand D

Identification of suitable sampling sites, accurate measurement of distances and strategies for consistent counting will be important for success in this task. Considerations of safety will focus on careful observation of tide and wave movements and on care when working on wet and slippery surfaces.

Strand E

Complex processing might involve numerical methods rather than graphical presentation.

Strand G

Reference should be made to the appropriate science in Module 3: Life on Earth.

Quality of written communication is assessed in this strand.

Second task title…

Guidance for technicians and teachers

Candidates plan their own investigations and may therefore require access to other apparatus at the discretion of the centre.

Teachers are advised to check that the range of apparatus provided will enable candidates to plan and carry out appropriate experiments to collect valid data.

Air bladders on bladder wrack seaweed

It is important to follow both national and local authority guidelines for preliminary surveys of chosen sites, obtaining parental permission and insurance cover before deciding whether to use this particular data task. Tide timetables provide information about days when timing will be convenient. Candidates must be carefully instructed on rules for safe behaviour and on the need for suitable clothing, especially footwear. The best seaweed cover will be found on rocky surfaces (sheltered or of medium exposure), which are likely to be wet and slippery.

Candidates should be taught how to recognise the target bladder wrack weed before work begins.

The task should begin at least an hour before low water, to allow time for candidates to select their sites for measurement. The survey should be conducted beginning at or near the low water mark, and moving up the beach to keep well clear of the advancing tide.

Apparatus suggested

A selection of 30 cm rulers, metre rules, long tape reels (e.g. from the PE department) and balls of string which can be knotted at regular intervals should be available.
Clip boards provide a convenient support for recording data.

Notes [if required]

Second task title…

Candidate 1

Does the number of bladders on bladder-wrack seaweed change with depth?

Introduction:

In this assessment, we will look at seaweed in the inter-tidal zone (between high and low water marks, the part of the beach which is sometimes covered by the tide and sometimes not) at Robin Hood's Bay.

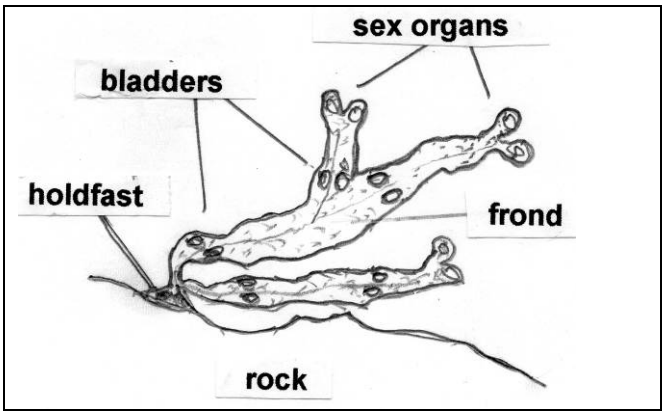
We will count the bladders on bladder wrack seaweed plants to test the hypothesis –

The number of air-sacs on a frond of bladder-wrack seaweed is determined by the need to float upwards towards sunlight. There will be more air-sacs on weed at deeper levels.

Bladder wrack seaweed looks like this –

The holdfast fixes the weed to a rock. The bumps at the tip of each frond are sex organs.

Along the fronds are air-bladders, arranged in pairs. These make the seaweed float upwards so that it can get more light for photosynthesis.



Method:

Bladder wrack does not have deep roots, so on sandy places it would just wash away. Instead, it has a "holdfast" foot which can cling to rocks. So, we need to look at rocky areas of beach rather than sandy ones.

In order to test the theory, we need to measure plants at different depths below the high water mark. The high water mark is the best place to start from as high tide and low tide will vary on different days. We will start when the tide is as low as possible and gradually move up the beach.

The weed grows on rocks but not on sand, so it will be necessary to search along the beach to find an area where it is rocky most of the way from high tide mark to low tide mark. It will be best if it slopes smoothly all the way, because we do not have a way of measuring how high we are, only how far from high tide and low tide. If we find big bumps or hollows, we will move sideways a bit to find a plant at about the right height.

Before we went to the beach, we got our measuring equipment ready. We got a ball of string and tied a knot at every 10 metres. We used a metre ruler to measure out the first 10 metres, then measured the others by folding the string back alongside the first length we had marked. We also used a metre ruler to measure 50 cm lengths of frond on each plant. Where there wasn't much weed, we counted two or three fronds on the same plant. Where there was a lot of weed we did one frond on each of three plants because this gave a sort of average.

At each 10 metres, we found the longest piece of bladder-wrack seaweed we could find. We stretched it from the tip along a ruler and counted the number of bladders along the 50 cm length. We included all the side fronds, but not the receptacles (sex organs) at the ends.

We took our own results, and added results from two other groups, so that we could have an average from three different transects of the beach.

Safety:
We will start at low tide so that we are moving away from the rising water. At the lower levels, rocks will be wet and slippery. Do not move too quickly or jump from rock to rock. Avoid big steps or hollows. Except when stretching the string, stay together. Only go on the section of the beach which is marked out for us, so that there is always a safe route back off the beach. Wear welly boots but remember they can be slippery.

Results of air bladder counts:

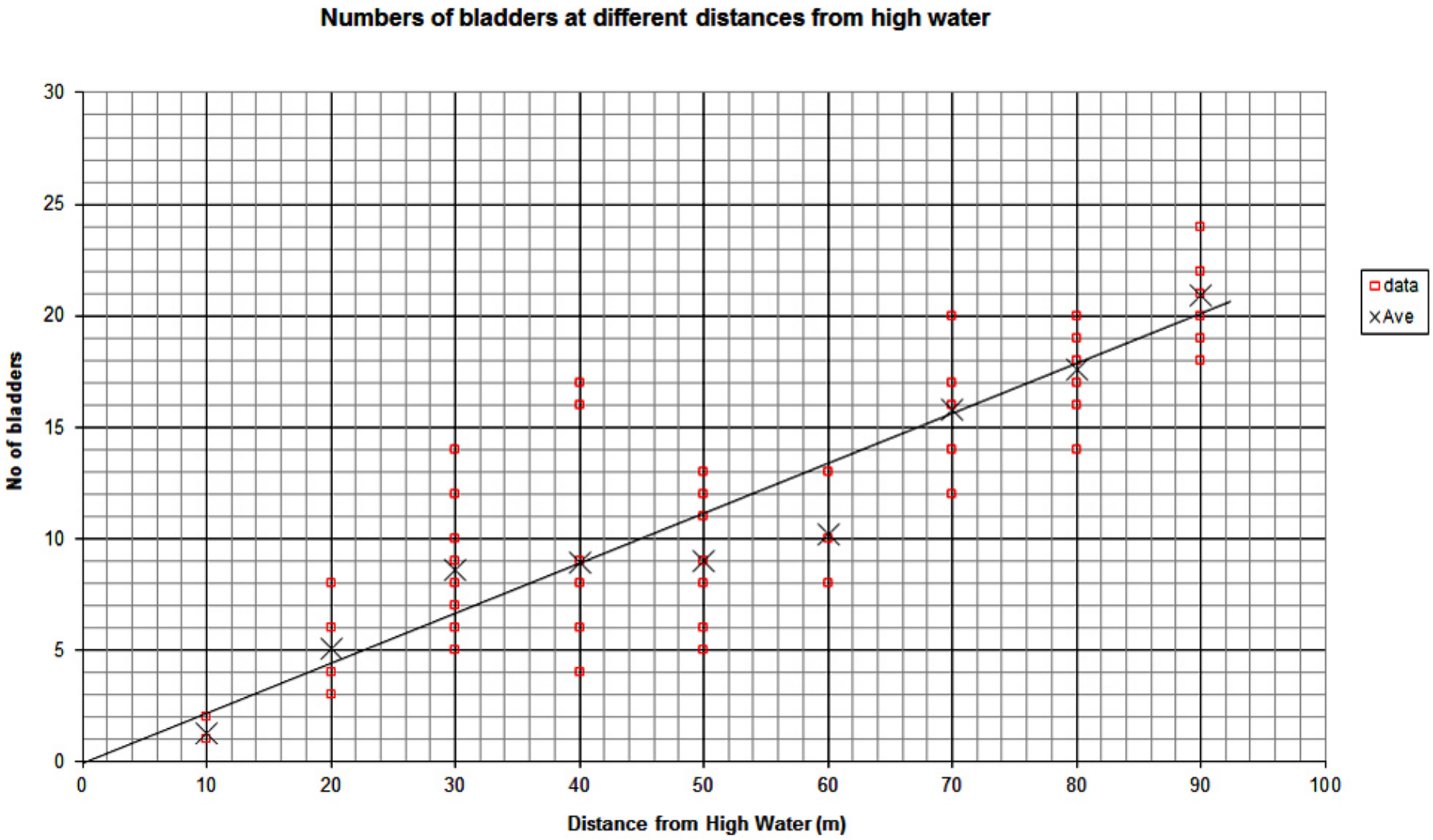
Pupils' results	Number of bladders										
	ours (SM/BG)			PT/DJ			RB/WS			total	ave
Distance from high water mark (m)	1	2	3	1	2	3	1	2	3		
10	2	2	1	2	1	2	2	0*	0*	12	1.3
20	6	8	6	4	4	6	19*	4	3	41	5.1
30	8	7	9	5	6	6	10	14	12	77	8.6
40	6	4	4	8	9	4	16	17	16	80	8.9
50	5	6	6	11	9	11	13	12	8	81	9.0
60	10	13	10	8	10	10	0	0	0	61	10.2
70	14	17	20	16	14	12	16	17	16	142	15.8
80	14	20	19	18	17	16	18	18	18	158	17.6
90	19	24	20	22	21	20	18	22	22	188	20.9

Most of the results are even numbers because the bladders are usually in pairs, one each side of the central rib of the frond.

Some of the results were outliers and were not counted when we calculated the averages. These ones are shaded in the table -
shaded = no weed (sandy patch)
shaded plus star = we think this was counted wrong.

Some of the other results seemed odd, but were included in the averages -
star and underline = might be wrong type of seaweed
underline = there was a ridge of rock across the survey line so these samples were at a higher level than the ones around them

We shared data with these two other pairs because they were nearest to us on the beach so the slope of their beach was nearly the same as ours.


Numbers of bladders at different distances from high water
No of bladders
Distance from High Water (m)
0
5
10
15
20
25
30
0
10
20
30
40
50
60
70
80
90
100
data
Ave

Interpretation of results –

The graph shows all of the results we collected (except the 4 outliers we decided not to count). It also shows the average value for each distance down the beach. I have drawn a best-fit line to show the pattern which I believe is shown by these results.

The best fit line passes through, or very close to the origin of the graph. It is a straight line, which shows that the number of bladders (per 30 cm of plant) is proportional to the distance from the high water line. The slope of my line shows an increase of one extra pair of air-bladder for every 9 metres further down the beach.

Thus, the results do show that on this part of this beach, the number of bladders gets greater as the position of the weed is further down the beach. Results obtained by other groups in our class also showed the same trend. I think (see the evaluation) that it is an even better match to 'the number of bladders is proportional to the **depth** below high water mark.'

We predicted that this might be what happened because the weed needs to be lifted to reach the light. At the upper shore, the bladder-wrack doesn't get covered for water very long, but lower down, the seaweed gets covered with water for long periods of the day, so has to float to get maximum light for photosynthesis. I went on the internet to try to find whether other people had tested this theory.

Several of the web-articles I found confirmed that more bladders are found at greater depths. However, I could not find any site which said this was due to a greater need to float up to the light. Most of the sites gave a different theory to explain this result. The more the weed is exposed to wave action, the more damage it suffers, leaving fewer bladders. Wave action is strongest at or near to the surface. On this theory, the change in number of bladders is explained because the weed at deeper levels is more protected from wave damage.

According to this theory, all bladder wrack grows bladders, but the plants which are exposed by the tides suffer damage which reduces the number of bladders, so the higher up the beach, the fewer the bladders.

Perhaps because of this damage, bladder wrack is not often found near the high tide limit (or the "splash zone" just above high tide). Instead, a species called spiral wrack is found and this does not have bladders. It may be that some of the results at 10 metres happened because they had confused spiral wrack with bladder-wrack by mistake.

Here is information about some of the web-sites I looked at. What is written in *italic print* is a direct quotation cut-and-pasted from the web-site. All the sites were visited on 11th July 2010.

1: A Swedish web-site which refers to bladder –wrack in the Baltic sea. *Aquascope 2000 is a web-site set up by Tjärnö Marine Biological Laboratory, Strömstad, Sweden It provides information about marine topics for use by school pupils and teachers. Aquascope was sponsored by amongst others*, KK-stiftelsen, World Wide Fund For Nature WWF and The Swedish Research Council Formas

http://www.vattenkikaren.gu.se/Fakta/arter/algae/phaeophy/fucuvesi/fucuve4e.html
A quotation from this page: *Bladder wrack that grows in areas that are exposed to powerful wave action can lack bladders. The plants have a tendency to be shorter, more slender and less branched.*

2: ARKive is a web-site based in Bristol. This quote comes from the ARKive site.

http://www.arkive.org/species/ARK/plants_and_algae/Fucus_vesiculosus/

Bladder wrack is a large olive-brown coloured seaweed, which attaches to rocks a small disc. The branching fronds, which grow up to 2m in length, have a midrib, and are covered with air bladders, which tend to occur in pairs on either side of the mid-rib. The appearance of bladder wrack varies depending on the conditions in which it occurs; in more sheltered areas there are many air bladders, whereas there are fewer in more exposed conditions. In very exposed areas, a form of bladder wrack may arise, which completely lacks bladders.

3: The Environmental Literacy Council is an American organisation in Washington DC which provides support materials to teachers who are dealing with environmental topics. This reference gives detailed guidance for how to carry out beach surveys, but doesn't say anything about different types of bladder wrack.
http://www.enviroliteracy.org/article.php?id=1170&print=1

4: A US government sponsored site
The project was funded by the National Oceanic and Atmospheric Administration's Sanctuaries and Reserves Division via a cooperative agreement with Moss Landing Marine Laboratories in the fall of 1994 (completed June 1996), and is the first comprehensive site characterization for a designated national marine sanctuary to be produced for broad dissemination in an electronic format.
This page lists species found at different levels in the inter-tidal zone:
http://montereybay.noaa.gov/sitechar/roctab1.html

Evaluation:

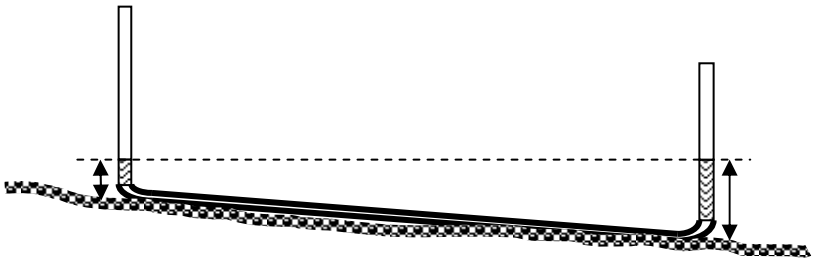
A good deal of the shore is covered with flat rocks, but even so it was difficult to find a place where the slope was quite smooth and steady and where there was weed on all the rocks. We looked at lots of places before we decided where to do our measurements.

Because not all of the rock had seaweed on it, we sometimes had to move up or down or sideways a bit to find something. One set of results (for 60 metre) is missing because they couldn't find any weed near that place.

The results for 40 metres for two of our groups are very low numbers of bladders. We think this was because there was a ridge of higher rock at this part of the shore and so the plants were at a higher level than others around them. It would have been better if we could measure the vertical height rather than the horizontal distance from high tide. We did include these results, and the 40 metre average seems about right, because the third group got their samples where there was a dip and the weed was growing in a rock pool.

The limit on our accuracy was the measuring distances. All our class did it with string from a ball. Each time we moved up the beach, we put one end of the string where we had measured last time, and stretched it up the beach to find the next place. We couldn't always remember exactly where we ended last time, so after two goes, we got a small rock to mark the place each time.

The beach does not slope smoothly, but is quite uneven. We think it would be much better to measure heights. I have found out that this can be done using a long rubber tube with a short glass tube at each end. This is nearly filled with water. When it is stretched out over a long distance, the water



surface at each end will be at the same height. So, if you measure the height above the ground at each end, the difference between the two measurements tells you the difference in level of the ground at each place.

We had noticed that between 40 and 60 metres, there was a fairly flat and level stretch of rock, so all of these readings were at about the same level. There were then a couple of steep drops, so that the next site (70 metres) was quite a lot lower. If we had been able to plot depth against number of bladders, I think we would have got an even better straight line.

The results include ones from three different groups. Each group counted bladders on three weeds at each site. So we have nine results for each distance. Over the full set of nine, there is quite a lot of variation between the readings, as can be seen on the scatter-graph. However, if you look at the three results for any one group, the scatter (range) is usually quite small. This is because the three samples from one group were all growing very close together, but each group was working in a different place, so there was some difference between the environments.

Even with this amount of scatter, it is clear that there is a trend towards greater numbers at greater depth. Remembering the shape of the shore, this would be even more clear if we had plotted depth rather than distance. The line on the graph could be either slightly higher or slightly lower, and it might not go exactly to the origin. Because we are dealing with living material and growth depends on many different factors, we would not expect an exact mathematical pattern, but I am confident that we have definitely shown a trend.

We think that one result (RB/WS first result, 20 metres) was counted wrongly but don't know why.

The two zeroes at 10 metres might be because the wrong species of weed was tested, or might be because the weed there was very exposed to waves and wind. There wasn't much bladder-wrack on this part of the beach. We did include these results in the average.

The results for 40 metres vary more than any others. This was because two of the groups were working on a raised ridge at this site, and the other was in a rock pool in a dip in the rocks.

We were very careful about counting the bladders. We made sure not to include the receptacles at the tip of fronds. Each of us counted the bladders than we compared and if we did not have the same number we counted them again together. I am confident that this data is enough to confirm the trend that we were looking for, although it does not help us to explain why this trend happens.

Conclusion:

The information on the web-sites supports our data because both show that the number of bladders gets greater the further down the beach you go. I am confident that there is a correlation between depth and number of bladders on the wave-exposed open sea shore which we surveyed. From our results I can say that the number of bladders is directly proportional to distance from high water, and this appears to be true across the whole of the inter-tidal zone, which was all that we were able to survey.

We now have two theories to explain why this correlation exists. Firstly, it may be that the need to float upwards towards the light stimulates growth of more bladders. Bladder-wrack at the top of the shore doesn't need these, as it is uncovered and exposed to the light for most of the day. The bladder-wrack that gets covered with water needs to float so that it can photosynthesise. We could extend our investigation by finding out the length of time the

bladder-wrack was uncovered during the day, and plotting the number of bladders against this.

The second theory is that the pounding of waves either inhibits growth of bladders, or might break them off. One web-site said that bladders increase the 'drag' of the waves and so plants with most bladders would be ripped off and lost, leaving only ones with fewer bladders on the exposed rocks.

I don't think that we can decide between these two theories on the evidence we have. It would be very interesting to count the bladders on bladder-wrack seaweed growing in sheltered places (coves, harbours, etc). If this weed in sheltered places shows the same change in number of bladders with depth, then that would support the "floating up to the light" theory. If the effect is NOT found in sheltered places, then that would suggest that the "wave damage" theory was most likely.

Candidate 2

21st Century Science Data Analysis.

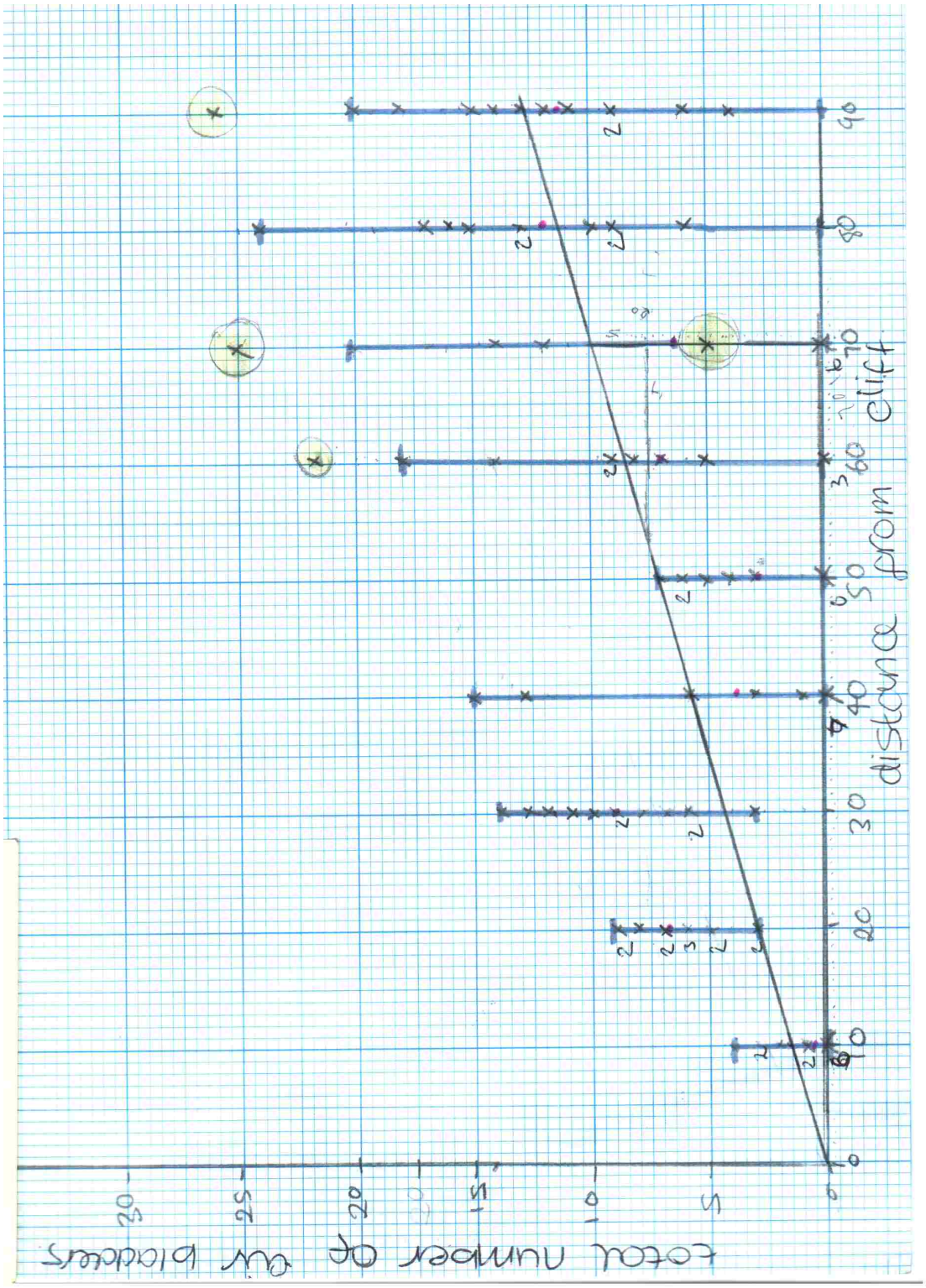
INTRODUCTION: This work was completed on a field trip to Robin Hood's Bay.
Back in school, we were allowed to 'swap and share' data with two other groups.
The first set of results is ours

Planning:
I decided to use a long ball of string to measure across the beach. I made an ink mark on it every 10 metres before we went on the trip. I decided to measure the seaweed for 30 cm long because that is the longest we could measure on our rulers and so would give most air bubbles.

Does the number of air bladders on bladder wrack seaweed change with water depth?

Distance (m)	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
10	2	3	4	1	3	1	0	0	0
20	3	6	3	6	8	5	9	7	6
30	11	12	6	8	7	9	13	14	10
40	13	6	15	0	1	3	0	0	0
50	6	7	5	3	6	4	0	0	0
60	9	7	5	10	18	9	8	7	22
70	5	14	12	25	17	20	0	0	0
80	13	13	15	24	20	19	10	11	16
90	13	14	12	28	18	20	9	11	15

I noticed that the further away from the cliffs the more air bubbles we found on the seaweed.
My gradient of my line was that every 7m away from the cliff there was an increase of 1 air bubble. It showed me a positive correlation.
The reason behind this could be that because the seaweed in the water had more air bladders because it was growing in the sun, so it had energy to photosynthsys. It could also be due to the water preassure as the further down in the water the bigger the preassure, this means that the seaweed has to fight against the water preassure to reach the light for photosynthesis to work so the air bladders keep the seaweed afloat.


distance from cliff
total number of cuy blackers

Evaluation

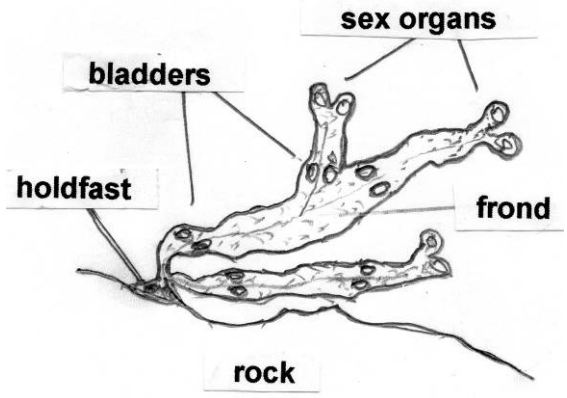
Overall I enjoyed getting our data, however I found that trying to find a piece of seaweed 30 cms long in the 10m radious was very hard. There was a lot of seaweed to get our results from but they weren't long enough to record. If I was to do it again I would gather more results as I found that mine weren't as reliable as I thought they were. I thought that they weren't as reliable because at some distances there wasn't any seaweed so I couldn't get any results. I would do this because I could rely on them more and my graph would be better. I could also get a better line of best fit. We could also go to different beaches and compare the amount of air bladders on the seaweed to the beaches.
The equipment I chose was very fiddley and at some point the string got wet so we couldn't tell where the ink marks were supposed to be. I also found it very slippery as the further we got out to sea the thicker the seaweed was so the more chance there was that we could slip. This is a hazard!
I concluded that my results weren't as reliable as I thought there were but I enjoyed collecting the data.

Candidate 3

Science Data Analysis Assessment

The part of the sea shore which is covered at high tide, but exposed at low tide is called the inter-tidal zone. Anything that lives here has to be able to be covered with salt water for part of the time, and left out in the air to dry the rest of the time.

We are going to study this zone at Robin Hood's Bay. We will look at just one type of specially adapted seaweed, called bladder-wrack.

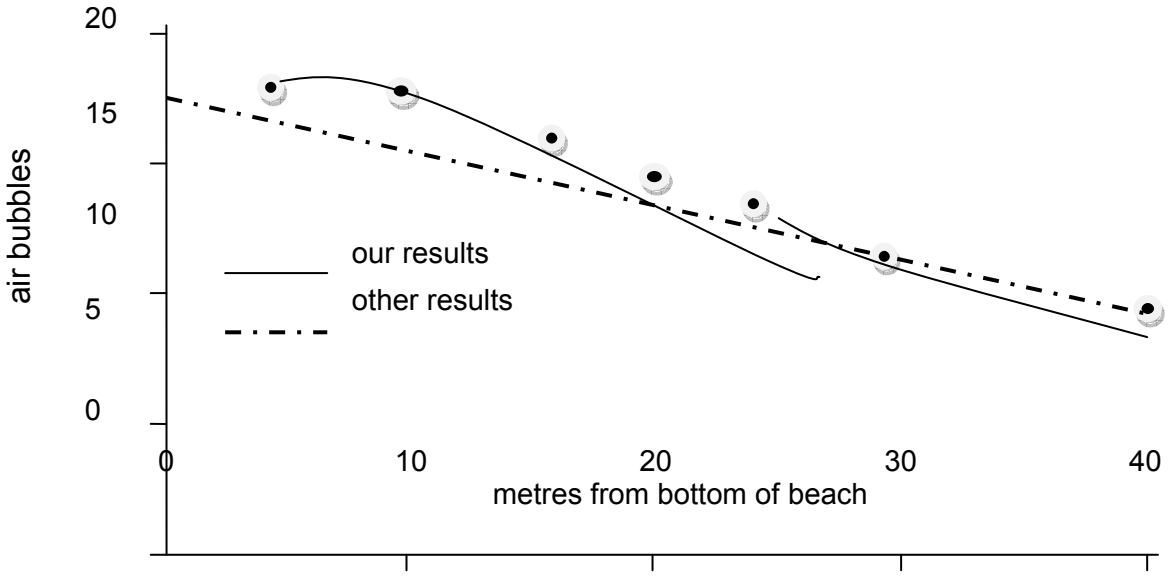
Bladder-wrack clings to rocky surfaces. It has long, flexible brown or green fronds and uses energy from sunlight to photosynthesise its food. At intervals along each frond it has air-sacs or "bladders", usually in pairs. These help the fronds to float upwards towards the light when they are under water.	

Plan of what to do:
We will measure up the beach using string. We marked the string with a piece of red tape round it every 5 metres. The end of the string will be tied to a stick put in the sand at high tide mark (shown by a line of shingle). We will stretch the string down to the bottom of the beach. Then we can walk back one tape at a time and measure the weeds. In the end we can wind up the string because the bottom end is loose.
We can measure the fronds of the weeds with a ruler, then one will count the bubbles and the other will write them down.
We will wear rubber boots and yellow bibs for safety and be careful not to climb up big rocks.

Our results:

How far up beach	bubbles on 1st frond	bubbles on 2nd frond
5m	18	16
10m	18	16
15m	14	14
20m	12	14
25m	12	10
30m	8	10
40m	6	6

We compared our results with people at the other end of the beach and I have put theirs on the graph as well.



Conclusion:

Our results were good and had the same shape as the ones from everybody else. This was because you can count the air-bubbles exactly, you can't have half a bubble. But we couldn't measure the distance so well because the string wasn't really straight, it went up and down a bit over the different height rocks.

In some of the places, e.g. 35 metres, there wasn't any weed to measure, but this didn't spoil the results because we remembered to leave a space on the graph where that number was missing.

We wanted to count for half a metre of frond, but most of the weed wasn't long enough, so we counted for one ruler-length (30cm). This gave us good enough numbers as you can see on the graph.

All of our results give us a good smooth graph, so there are not any outliers, but the one at 5 metres was a bit less than we expected when we looked at the others.

Testing the hypothesis:

We started out to prove that:

The number of air-sacs on a frond of bladder-wrack seaweed is determined by the need to float upwards towards sunlight. There will be more air-sacs on weed at deeper levels.

When the tide is in, the weed which is nearest to the bottom of the beach will be deepest under the water. So our results prove the hypothesis. Weed needs photosynthesis to make its food, so it needs to float up near the daylight, not be at the bottom where the water is darker.

We found that the results showed a steady pattern of more air-bubbles as we went further down the beach, as it says in the hypothesis. We could make bubble counts at other beaches, but everyone in the class got the same answer at different parts of this beach, so we think it is always true.

OCR
RECOGNISING ACHIEVEMENT

For Assessment Submission in June 201#

GCSE TWENTY FIRST CENTURY SCIENCE

SCIENCE A

A144 Practical Data Analysis
Burning fuels

CONTROLLED ASSESSMENT
INFORMATION FOR CANDIDATES

This assessment will be changed every year. Please check on OCR Interchange that you have the Controlled Assessment material valid for the appropriate assessment session.

- To be issued to candidates at the start of the task.
- Your quality of written communication will be assessed.
- The total number of marks for this Controlled Assessment task is **32**.
- This Controlled Assessment task is valid for submission in the June 201# examination series only.
- This document consists of **2** pages. Any blank pages are indicated.

Teachers are responsible for ensuring that assessment is carried out against the Controlled Assessment set for the relevant examination series (detailed above).

Assessment evidence produced that does not reflect the relevant examination series will not be accepted.

Turn over

Background information for candidates

Today most transport in the world uses fossil fuels to provide the energy needed. This is not sustainable because

- fossil fuels are a non-renewable (finite) energy resource
- burning fossil fuels puts 'greenhouse gases' into the atmosphere.

Biodiesel and bioethanol are renewable fuels.

The formula of bioethanol is C_2H_5OH.

Biodiesel is a mixture of compounds. The formula of one compound found in bio-diesel is $C_{17}H_{31}COOCH_3$.

The table below shows that bio-diesel releases more energy per litre than bio-ethanol.

fuel	biodiesel	bioethanol
energy released by 1 litre of fuel in kJ	32 000	22 000

It has been suggested that the difference in the amount of energy released when biodiesel and bioethanol burn is because they have different numbers of carbon atoms in their molecules.

The hypothesis is that:

Different fuels transfer different amounts of energy when they burn because of the different numbers of carbon atoms in the fuel molecules.

You are going to plan and carry out experiments to test this hypothesis.

SAM Controlled assessment: Practical Data Analysis

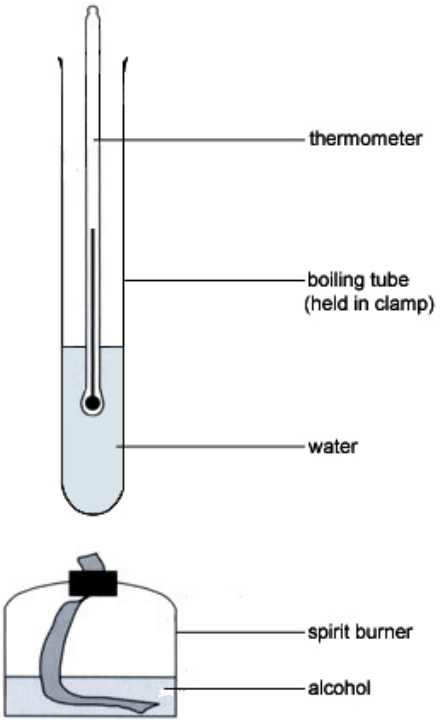
We are planning an investigation to test the hypothesis:

'Different fuels transfer different amounts of energy when they burn because of the different numbers of carbon atoms in the fuel molecules'

To test this hypothesis, we measured the heat of combustion per mole of different fuels when they burnt and heated water. The energy transfer is Chemical energy to heat energy. Energy is also wasted as light energy.

Method
After a group discussion the following method was used:

We weighed the spirit burner without the lid before the practical. The spirit burner contained 10 cm^3 of fuel.



We added 10 cm^3 of water to the boiling tube which we clamped 10 cm above the top of the wick. We us a 10 cm^3 measuring cylinder as this is the smallest which can be used for most accurate results. We also weighed the water as well (10 cm^3 of water should weigh 10 g, but our measuring cylinders are grade B so they may not be very accurate). When measuring the water I also made sure that the meniscus was at eye level and the bottom of the meniscus was at exactly zero.

I then measured the start temperature of the water using the thermometer. We have alcohol glass thermometers but if I had used a digital one it would be more precise.

Then I needed to light the spirit burner so that the flame was directly under the boiling tube. I then let the fuel burn until the temperature of the water rose by about 40 °C. I then put the lid on the spirit burner to put the flame out.

After this I measured the end temperature of the water very quickly so that heat was not lost. It was important not to touch the glass or you will be measuring the heat conducted by the water to the glass.

I weighed the spirit burner without the lid as soon as the flame went out. I can then calculate the heat of combustion of the fuel using the calculations given.

We measured the temperature change and the change in mass of fuel. We repeated each fuel measurement at least three times until there was an insignificant variation between results. These are our dependent variables.

We controlled the volume of water and fuel at the start of the practical. The accuracy of these measurements depends on the accuracy of the equipment used. The measuring cylinders are only B grade. The balance measures to 1 dp. We controlled the distance between the

wick and the bottom of the boiling tube. We changed the boiling tube in between use so that the glass was at the same temperature at the start of each investigation.

Safety
The Health and Safety at work act 1974 gives responsibility to workers for their own safety and the safety of others around them. To follow this we will perform a risk assessment. This also means that we have to look at CLEAPSS on the p drive which tells us what we are allowed to do in school. We also look at HAZCARDS for information about the chemicals we use and what to do if there is an accident. All accidents go in the accident book because accidents can happen even if you do everything that you can to stop them

Our normal lab rules are displayed in the classroom. They include always wear a lab coat, tie your hair back and goggles. The environment is kept clear because all bags and coats are on the window sill. It would be better if we had coat hooks or lockers.

Risk assessment

Hazard	Risk	Reducing risk	Comments
Glass Spirit Burner	May break and cut you. The wick has absorbed fuel which may get on your hands. Some of the fuel may make the outside slippery so you might drop it.	Hold carefully. Wash hands after use. Place firmly in the middle of the table	Clear up breakages using the glass breakage kit in every room seek medical help if you cut yourself. Wash hands after use. Record accident in the accident book.
Glassware (boiling tube measuring cylinder)	When it gets hot you could burn your hand or you could drop it break it and cut yourself.	Use tongs when removing it form the clamp stand. Don't do the clamp stand up too tight.	Make sure the broken glass kit is available. Record accidents and seek medical help.
Lighter fuel	Flammable	Keep away form naked flames when not in use.	
Alcohols	Harmful, flammable. Methanol is toxic leading to blindness if swallowed.	Wear goggles and a lab coat. Wash hands after use. Always check with HAZCARD and CLEAPSS before carrying out an investigation. Make sure there is sufficient ventilation or air conditioning.	Make sure Hazcards are available. This can be on the P drive. Seek medical help if you get burned or ingest any of the fuels.
Clamp stand	Could fall off the table and break your foot.	Clamp the stand to the table or make sure it is in the centre of the table	

Own results
We collected three sets of our own results for one fuel. These were then shared across all the groups that did this investigation so that the final results were as reliable as possible.

I identified any outliers and excluded these when I calculated the mean heat of combustion for each alcohol.

Own results for pentan-1-ol. Formula $C_5H_{11}OH$. RMM = 88.2

	Experiment		
	1st	2nd	3rd
Mass of water, g	9.49	9.89	9.82
Start temperature, °C	22	26	24
End temperature, °C	62	65	63
Temperature rise, °C	40	39	39
Start mass (fuel + burner) g	179.41	179.40	177.79
End mass (fuel + burner) g	177.82	177.83	176.11
Mass of fuel used, g	1.59	1.57	1.68

Calculations
Calculate the heat of combustion for the fuel = Pentanol.

heat of combustion = specific heat capacity of water x mass of water x temperature increase

Where Specific Heat Capacity of water is $4.2\,J\,g^{-1}$

1st results

Moles of fuel burnt = mass of fuel ÷ RMM
= 1.59 ÷ 88.2
= 0.018 moles

heat of combustion = 4.2 x 9.49 x 40
= 1594 J
= $1594 \div 0.018\,J\,mol^{-1}$
= $88.6\,kJ\,mol^{-1}$

2nd results

Moles of fuel burnt = mass of fuel ÷ RMM
= 1.57 ÷ 88.2
= 0.018 moles

heat of combustion = 4.2 x 9.89 x 39
= 1620 J
= $1620 \div 0.018\,J\,mol^{-1}$
= $90.0\,kJ\,mol^{-1}$

3rd results

Moles of fuel burnt	=	mass of fuel ÷ RMM				
	=	1.68 ÷ 88.2				
	=	0.019 moles				
heat of combustion	=	4.2	x	9.82	x	39
	=	1609 J				
	=	1609 ÷ 0.019 $J\,mol^{-1}$				
	=	84.7 $kJ\,mol^{-1}$				

Mean Heat of Combustion = $\frac{88.6 + 90.0 + 84.7}{3}$ = 87.8 $kJ\,mol^{-1}$

Class results

Results for methanol. Formula CH_3OH. RMM = 32.0

	Experiment		
	1st	2nd	3rd
Mass of water, g	11.13	9.43	11.70
Start temperature, °C	22	23	24
End temperature, °C	60	63	64
Temperature rise, °C	38	40	40
Start mass (fuel + burner) g	190.55	190.35	186.73
End mass (fuel + burner) g	188.02	187.53	184.04
Mass of fuel used, g	2.53	2.82	2.69

1st results

Moles of fuel burnt = mass of fuel ÷ RMM
= 2.53 ÷ 32.0
= 0.079 moles

heat of combustion = 4.2 x 11.13 x 38
= 1776 J
= 1776 ÷ 0.079 J mol^{-1}
= 22.5 kJ mol^{-1}

2nd results

Moles of fuel burnt = mass of fuel ÷ RMM
= 2.82 ÷ 32.0
= 0.088 moles

heat of combustion = 4.2 x 9.43 x 40
= 1584 J
= 1584 ÷ 0.088 J mol^{-1}
= 18.0 kJ mol^{-1}

3rd results

Moles of fuel burnt = mass of fuel ÷ RMM
= 2.69 ÷ 32.0
= 0.084 moles

heat of combustion = 4.2 x 11.70 x 40
= 1966 J
= 1966 ÷ 0.084 J mol^{-1}
= 23.4 kJ mol^{-1}

Mean Heat of Combustion = $\frac{22.5 + 18.0 + 23.4}{3}$ = 21.3 kJ mol^{-1}

Results for ethanol. Formula C_2H_5OH. RMM = 46.1

	Experiment		
	1st	2nd	3rd
Mass of water, g	10.09	10.82	9.99
Start temperature, °C	21	22	24
End temperature, °C	61	59	63
Temperature rise, °C	40	37	39
Start mass (fuel + burner) g	190.00	179.37	185.79
End mass (fuel + burner) g	188.02	177.53	184.04
Mass of fuel used, g	1.98	1.84	1.75

1st results

Moles of fuel burnt = mass of fuel ÷ RMM
= 1.98 ÷ 46.1
= 0.043 moles

heat of combustion = 4.2 x 10.09 x 40
= 1483 J
= 1695 ÷ 0.043 J mol^{-1}
= 39.4 kJ mol^{-1}

2nd results

Moles of fuel burnt = mass of fuel ÷ RMM
= 1.84 ÷ 46.1
= 0.040 moles

heat of combustion = 4.2 x 10.82 x 37
= 1681 J
= 1681÷ 0.040 J mol^{-1}
= 42.0 kJ mol^{-1}

3rd results

Moles of fuel burnt = mass of fuel ÷ RMM
= 1.75 ÷ 46.1
= 0.038 moles

heat of combustion = 4.2 x 9.82 x 39
= 1609 J
= 1609 ÷ 0.038 J mol^{-1}
= 42.3 kJ mol^{-1}

Mean Heat of Combustion = $\frac{39.4 + 42.0 + 42.3}{3}$ = 41.2 kJ mol^{-1}

Results for propan-1-ol. Formula C_3H_7OH. RMM = 60.1

	Experiment		
	1st	2nd	3rd
Mass of water, g	10.54	11.12	10.49
Start temperature, °C	22	22	24
End temperature, °C	62	64	49
Temperature rise, °C	40	42	25
Start mass (fuel + burner) g	188.29	190.99	191.78
End mass (fuel + burner) g	186.13	188.71	189.62
Mass of fuel used, g	2.16	2.28	2.16

1st results

Moles of fuel burnt = mass of fuel ÷ RMM
= 2.16 ÷ 60.1
= 0.036 moles

heat of combustion = 4.2 x 10.24 x 40
= 1720 J
= 1720 ÷ 0.036 J mol^{-1}
= 47.8 kJ mol^{-1}

2nd results

Moles of fuel burnt = mass of fuel ÷ RMM
= 2.22 ÷ 60.1
= 0.037 moles

heat of combustion = 4.2 x 11.12 x 42
= 1962 J
= 1962 ÷ 0.037 J mol^{-1}
= 53.0 kJ mol^{-1}

3rd results

Moles of fuel burnt = mass of fuel ÷ RMM
= 2.16 ÷ 60.1
= 0.036 moles

heat of combustion = 4.2 x 10.49 x 25
= 1101 J
= 1101 ÷ 0.036 J mol^{-1}
= 30.6 kJ mol^{-1}

Mean Heat of Combustion = $\frac{47.8 + 53.0}{2}$ = 50.4 kJ mol^{-1}

Results for butan-1-ol. Formula C_4H_9OH. RMM = 74.1

	Experiment		
	1st	2nd	3rd
Mass of water, g	10.22	10.94	10.09
Start temperature, °C	23	23	24
End temperature, °C	62	74	66
Temperature rise, °C	39	51	42
Start mass (fuel + burner) g	188.06	190.71	191.47
End mass (fuel + burner) g	186.13	188.71	189.62
Mass of fuel used, g	1.93	2.00	1.85

1st results

Moles of fuel burnt = mass of fuel ÷ RMM
= 1.93 ÷ 74.1
= 0.026 moles

heat of combustion = 4.2 x 10.22 x 39
= 1674 J
= 1674 ÷ 0.026 J mol^{-1}
= 64.4 kJ mol^{-1}

2nd results

Moles of fuel burnt = mass of fuel ÷ RMM
= 2.00 ÷ 74.1
= 0.027 moles

heat of combustion = 4.2 x 10.94 x 51
= 2343 J
= 2343 ÷ 0.027 J mol^{-1}
= 86.8 kJ mol^{-1}

3rd results

Moles of fuel burnt = mass of fuel ÷ RMM
= 1.85 ÷ 74.1
= 0.025 moles

heat of combustion = 4.2 x 10.09 x 42
= 1780 J
= 1780 ÷ 0.025 J mol^{-1}
= 71.2 kJ mol^{-1}

Mean Heat of Combustion = $\frac{64.4 + 71.2}{2}$ = 67.8 kJ mol^{-1}

Results for octan-1-ol. Formula $C_8H_{17}OH$. RMM = 138.0

	Experiment		
	1st	2nd	3rd
Mass of water, g	10.54	9.95	10.18
Start temperature, °C	22	21	23
End temperature, °C	62	63	63
Temperature rise, °C	40	42	40
Start mass (fuel + burner) g	188.48	191.09	192.01
End mass (fuel + burner) g	186.13	188.71	189.62
Mass of fuel used, g	2.35	2.38	2.39

1st results

Moles of fuel burnt = mass of fuel ÷ RMM
= 2.35 ÷ 138.0
= 0.017 moles

heat of combustion = 4.2 x 10.54 x 40
= 1771 J
= 1771 ÷ 0.017 J mol^{-1}
= 104.2 kJ mol^{-1}

2nd results

Moles of fuel burnt = mass of fuel ÷ RMM
= 2.38 ÷ 138.0
= 0.017 moles

heat of combustion = 4.2 x 9.95 x 42
= 1755 J
= 1755 ÷ 0.017 J mol^{-1}
= 103.2 kJ mol^{-1}

3rd results

Moles of fuel burnt = mass of fuel ÷ RMM
= 2.39 ÷ 138.1
= 0.017 moles

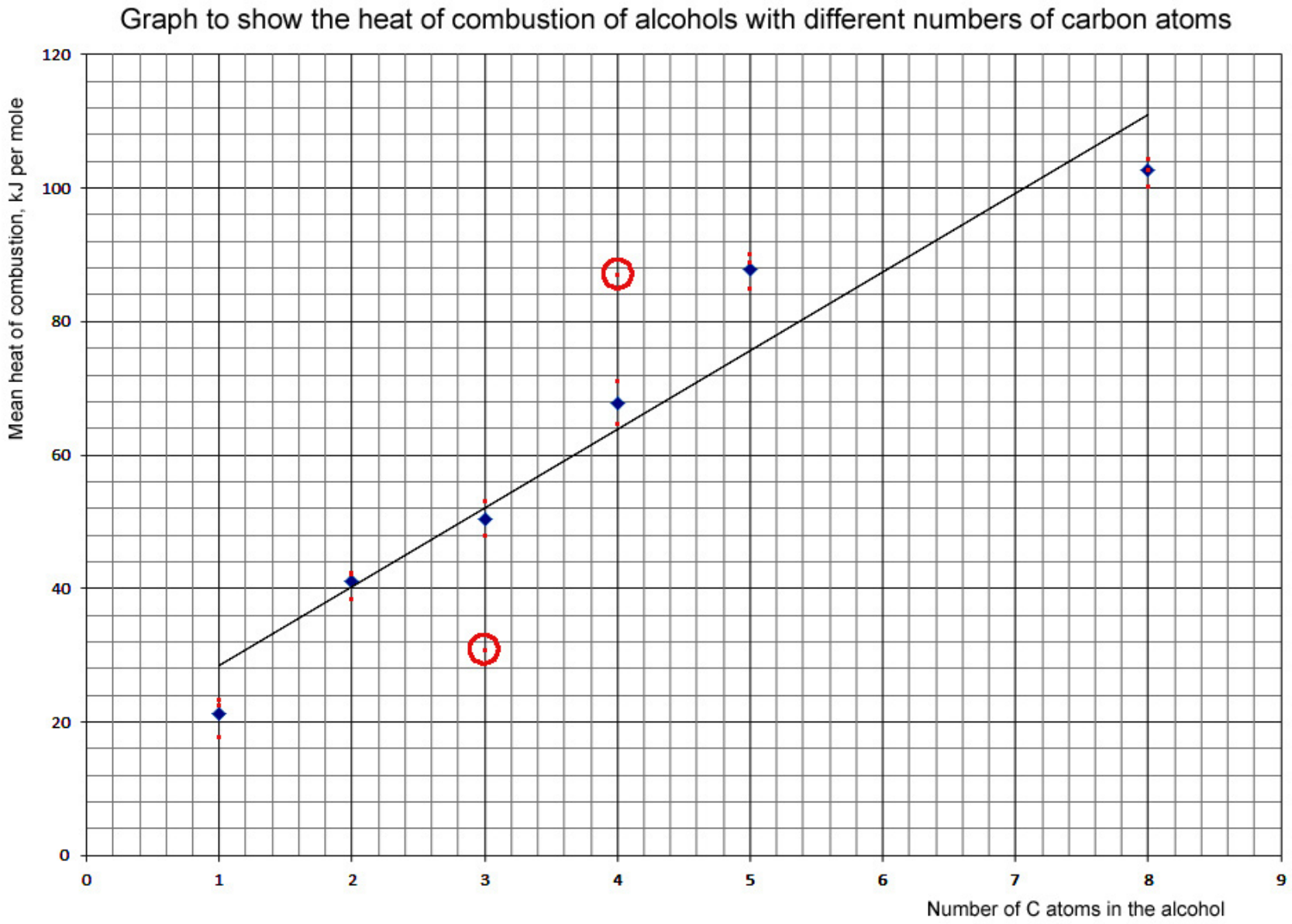
heat of combustion = 4.2 x 10.18 x 40
= 1710 J
= 1710 ÷ 0.017 J mol^{-1}
= 100.6 kJ mol^{-1}

Mean Heat of Combustion = $\frac{104.2 + 103.2 + 100.6}{3}$ = 102.6 kJ mol^{-1}

Summary of class results

Alcohol	Formula	Number of Carbon atoms	RMM	Mean heat combustion, kJ per mole
Methanol	CH_3OH	1	32.0	21.3
Ethanol	C_2H_5OH	2	46.1	41.2
Propan-1-ol	C_3H_7OH	3	60.1	50.4
Butan-1-ol	C_4H_9OH	4	74.1	67.8
Pentan-1-ol	$C_5H_{11}OH$	5	88.2	87.8
Octan-1-ol	$C_8H_{17}OH$	8	138.0	102.6

The graph showing these results is on the next page.


Graph to show the heat of combustion of alcohols with different numbers of carbon atoms
Mean heat of combustion, kJ per mole
120
100
80
60
40
20
0
0
1
2
3
4
5
6
7
8
9
Number of C atoms in the alcohol

Conclusion
In this practical we used many different alcohols. The alcohols we used were octan-1-ol ($C_8H_{17}OH$), pentan-1-ol ($C_5H_{11}OH$), butan-1-ol (C_4H_9OH), ethanol (C_2H_5OH) and methanol (CH_3OH).

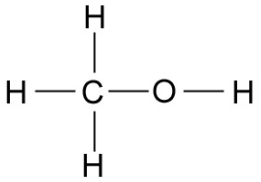
The trends on the graph show that as the number of carbon atoms increase, more energy per mole of fuel is released. We use the energy per mole for comparison instead of energy per gram so that we are comparing the same number of molecules of each fuel.

Combustion is the reaction of fuels with oxygen:

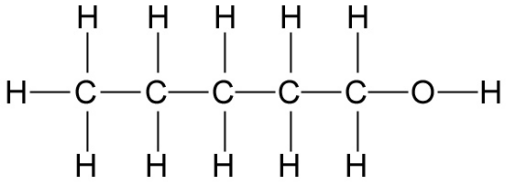
$C_2H_5OH + 3O_2 \rightarrow 2CO_2 + 3H_2O$

Our experimental heat of combustion increases with number of carbon atoms. On the alcohol graph I can also see that as the number of Carbon atoms increases the experimental heat of combustion per mole also increases.

In the alcohols there is covalent bonding. This means that the electrons are shared between the atoms. The alcohols have C-C bonds, C-H bonds and a C-O bond and an O-H bond. The OH bond is very hard to break. More heat energy is needed to break this bond. Energy is used to break the C-C and C-H bonds, but then released as new bonds form between C and O and H and O. Longer chain alcohols release more energy because they have more bonds to break and new ones to form.



methanol



pentan-1-ol
In this molecule, there are more bonds to break and reform

The evidence from our investigation and the discussions about properties of fuels with different numbers of carbon atoms support the hypothesis. The conclusion is that the more the number of carbon atoms then the more energy can be released.

Evaluation
I drew a line of best fit on the graph and added error bars. The error bars were quite short as I had excluded results that were obvious outliers. Some of the groups in the class had results that showed a significant variation within the temperature readings. Some groups had continued till there was less that 5°C variation over the temperature readings. Others (propanol and butanol groups) left their's in. I only included the results I thought weren't outliers in my calculations. The group that did propan-1-ol had a very low reading (25°C). The butan-1-ol group had a high reading. I counted this as an outlier, but I wasn't as sure about this result. I could have included it. It mean with these alcohols I only had two results to calculate the heats of combustion instead of three, so my results would be less reliable.

The main reason for the results varying, and some groups getting outliers was due to the technique used. The energy transfer between the burning fuel and the water wasn't good. We could have made a lid for the boiling tube to stop heat loss. Some of the energy in the

fuel was also transferred to light energy. This practical assumes that **all** the energy is converted to heat.

We might also have got incomplete combustion. This leads to the formation of carbon monoxide which is toxic, and carbon particles. It means that all the energy is not released from the fuel.

Some other reasons for outliers and variation in the results:

Problem	Solution
1. The wick was dirty and not easy to light because it was covered in soot from previous experiments.	New one will allow the wick to absorb fuel evenly and burn evenly and be easier to light.
2. The height of the boiling tube was different for each test.	Measure exactly 50 mm from the top of the wick to the bottom of the tube each time.
3. The direction of the boiling tube had to be altered for each fuel positioning for maximum benefit because the direction of the flame was different once it was lit but this took time and could have affected the results as fuel burned away.	Keep the boiling tube in the same direction but also make sure that the wick is cut directly across rather than at an angle.
4. If at a different direction than vertical the boiling tube glass leaned against the clamp stand. Heat energy was then wasted as heat energy was conducted to the metal of the clamp stand	Position the boiling tube away from the clamp stand so that heat energy is not wasted.
5. The volume of water was not being exactly 10 cm^3, due to incorrect reading of the measuring cylinder caused by a parallax /meniscus.	Make sure that the meniscus is at eye level and that the measuring cylinder is on a level horizontal surface.
6. It was difficult to keep to a 40 °C temperature rise in the water. There was still a variation of the temperature in the water after the flame had been put out.	Use a larger volume of water than 10 cm^3 in a conical flask.
7. General movement of air meant that the flame not constantly on boiling tube due to air flow. Heat energy from the flame was then lost by convection.	Do it by myself in room with just me and keep all the windows and doors shut.
8. Errors in thermometer readings.	Use digital or data logger for more accuracy. The readings on some groups' thermometers varied before we started the investigation (they weren't precise).
9. Errors in thermometer readings.	There might have been some variation in the temperature in different parts of the boiling tube. We could have stirred the water with the thermometer to make sure the temperature was even.

10. Wick not exactly the same size so the volume of fuel would be different as there is a longer wick for more fuel to vaporise along as it reaches the flash point.	Trim wicks exactly 10 mm each.
11. Incomplete combustion of the fuel.	Burn the fuel in pure oxygen.

Overall this was a good study showing clear support for the hypothesis – alcohols with larger number of carbon atoms do transfer more energy.

The results were not accurate as they were shared across the groups. There were limitations by equipment error. Next time we would weigh the water to start with exactly the same volume, use grade A glassware, a digital thermometer and a different boiling tube for each test.

We need to compare our data to secondary sources in order to support conclusion about the hypothesis. Some of the outliers could have been closer to the true figures than ours.

It would be good to extend the investigation. We had no hexanol or heptanol, so there was a gap in the results. We had to base our graph on these figures.

We also have used alcohols with more carbon atoms to see if the relationship carries on after octan-1-ol. But we might have had to modify the experiment to do this. The fuel ignites when it becomes volatile (vaporises) this is called the flash point. There is a link between flash point and the number of carbon atoms. The lower the number of carbon atoms then the lower the flash point. This is because of less intermolecular forces between the molecules with lower numbers of carbon atoms. This suggests that some long chain alcohols will be difficult to light, and they may nor burn properly.

Some alcohols also have slightly different structures. The alcohols we had to choose from included propan-2-ol. This means that the OH group was at a different position in the alcohol. We should test some of these different alcohols to see if our hypothesis still stands.

It may also be difficult to transfer our results to the real world. Fuels are not usually pure chemicals but mixtures (for instance alkane fuels). It is likely that alcohol fuels are mixtures of alcohols and not pure.

Appendix A

Commentaries

Title of the work: **Is the rise in asthma attacks caused by the air pollution?**

Identifying code or candidate name: **Candidate 1**

Marks awarded:

Strand	0	1	2	3	4	5	6	7	8	Mark
A(a) collecting information				✓						3
A(b) evaluation and acknowledgement of sources			✓							2
B science content							✓			6
C(a) comparing views						✓				5
C(b) conclusions and recommendations							✓			6

General summary:
A carefully structured and attractively presented study. There is a review of some of the key gases which contribute towards air pollution, and some information about asthma as a health condition, though both lack the detail required for the highest mark band. A conclusion is given and some suggestions for reducing air pollution are given, though conclusion and suggested actions are not clearly linked. The conclusion is linked to the evidence given, but this is rather limited in amount and sources are not fully acknowledged.

Detailed commentary:

Strand	Commentary	Mark
A(a)	Seven sources are listed and these cover a variety of different views and conflicting opinions. The information selected is relevant to the study, although there is very little supporting evidence for the views given.	3
A(b)	Some of the web references are incomplete (home page only, rather than the pages where information was found) and dates are not given. A few quotations are indicated and linked to their source or author, but much of the information is not identified to any source.	2
B	The basic scientific evidence needed to understand the issues involved is given. There is a fairly good level of detail about pollutant gases, their sources and effects, and the nature of asthma attacks is indicated. However, there is a lack of detail. The appropriate mark is certainly in the 5 – 6 mark band, and there is just	6

Strand	Commentary	Mark
	sufficient to allow a match to 6 marks. Spelling and grammar are generally sound, although there are a number of mistakes. Technical and scientific terms are used correctly.	
C(a)	Evidence and claims that air pollution causes asthma is collected and separated from views that other agents are more important causes. There is some attempt to compare the views, but little evidence is offered about the qualifications or status of the various authors and the amount of supporting evidence for each claim is very limited. Different sources have not been compared for apparent reliability.	5
C(b)	The conclusion is clear and is linked to the evidence given in the study, but is rather one-sided and does not fully consider the possibility that there are multiple causes of asthma. Some ways of reducing air pollution are given, but without any indication of why this might be a good thing, especially since the conclusion is that air pollution is not the major cause of asthma.	6

Total mark for the Case Study = 22/32

OCR RECOGNISING ACHIEVEMENT	Case Study Marking Commentary	INSET 2011-12

Title of the work: **Can levels of pollution affect a town's tourism?**

Identifying code or candidate name: **Candidate 2**

Marks awarded:

Strand	0	1	2	3	4	5	6	7	8	Mark
A(a) collecting information			✓							2
A(b) evaluation and acknowledgement of sources			✓							2
B science content				✓						3
C(a) comparing views				✓						3
C(b) conclusions and recommendations				✓						3

General summary:
This candidate has chosen to look at an aspect of air pollution which is considerably different from the main thrust of the stimulus material in the news-sheet. Candidates should be allowed some freedom in selecting their question to answer, provided that the science core of the topic remains firmly within the field of "effects of air pollution". However, in this case, tourism itself does not easily relate to relevant science within the specification, and the scientific aspects of air pollution are only fairly briefly dealt with, which limits the marks that can be awarded, particularly in strand B.

Detailed commentary:

Strand	Commentary	Mark
A(a)	Only three sources are listed. Very little information is given about how pollution might affect tourism and the pieces of information which have been found are not linked in any coherent way. Little, if any, of the information in the news-sheet has been used.	2
A(b)	Links to sources of information are few, and only at "site home page" level. Some direct quotes are indicated, though the sources and contexts are not given.	2
B	Some major air pollutants are listed, with a brief mention of their principal effects. There is also a mention of effects causing damage to stonework in buildings and to plants, but no details are given. Whilst there is sufficient to merit consideration of the 3-4 mark band, the amount is so limited that 3 marks is the more appropriate award	3

Strand	Commentary	Mark
C(a)	There is some attempt to sort information “for” or “against” the effect of air quality, but the “no effect” argument is not well represented and there is no attempt to compare or evaluate any of the claims.	3
C(b)	There is a conclusion, although it is not clearly identified (it is important to encourage candidates to clearly label key elements in their reports to ensure that they will be recognised and awarded credit). However, it is not clearly linked to the evidence given and there are no suggestions for actions to be taken.	3

Total mark for the Case Study = 13/32

OCR RECOGNISING ACHIEVEMENT	Case Study Marking Commentary	INSET 2011-12

Title of the work: **Is the Government doing enough to reduce air pollution?**

Identifying code or candidate name: **Candidate 3**

Marks awarded:

Strand	0	1	2	3	4	5	6	7	8	Mark
A(a) collecting information				✓						3
A(b) evaluation and acknowledgement of sources	✓									0
B science content					✓					4
C(a) comparing views						✓				5
C(b) conclusions and recommendations								✓		7

General summary:
This case study effectively develops a theme with a clear consistent style and good use of language. However, there are several aspects which cause loss of marks that might easily have been achieved with a clearer understanding of what is required by the mark-scheme.
This case study starts from a view that air pollution is "a bad thing" without much detail of why. It then concentrates on what different groups of people might do to reduce pollution. At first sight, the report covers the topic well, but it does not go beyond listing things which might be done without providing any data or scientific principles to show how each suggestion would work, or how much effect it might have.

Detailed commentary:

Strand	Commentary	Mark
A(a)	There is an appropriate amount of information about some specific pollutants, but only a limited amount about how they are formed, or the scale of problem they pose. The information reported provides a good introductory review of the topic, but the candidate has found very little explanatory science, or data which could be used to prioritise between the different actions which are suggested. Since there are also no references to sources, it is difficult to judge how many sources have been looked at.	3
A(b)	There are no references at all to any sources of information, and nothing to indicate whether any of the content is direct quotation or the candidate's own words. It is essential to make candidates aware of the importance of properly	0

Strand	Commentary	Mark
	identifying and acknowledging sources, if only to avoid accusations of plagiarism.	
B	Some major pollutants are identified with a brief indication of their effects. However, there is nothing which allows a comparison of sources, or the magnitude of their effects. One or two effects of air pollution are mentioned, but with no explanation of how they occur. This is not more than a basic outline of key issues in the topic.	4
C(a)	Because this study is essentially a review of a range of possible actions, rather than a comparison of opposing arguments, it does not easily match to the mark descriptors. However, there is a good deal about pollutants and an outline of some counter measures, so a little more than 4, but not a secure match to 6	5
C(b)	Here the conclusion is that “more needs to be done” and a range of suggested actions is given, linked to different groups in the community.	7

Total mark for the Case Study = 19/32

OCR RECOGNISING ACHIEVEMENT	Data Analysis Marking Commentary	INSET 2011-12

Title of the work: **Does the number of bladders on bladder-wrack seaweed change with depth?**

Identifying code or candidate name: **Candidate 1**

Marks awarded:

Strand	0	1	2	3	4	5	6	7	8	Mark
D choice of methods, techniques and equipment								✓		7
E revealing patterns in data									✓	8
F evaluation of data								✓		7
G reviewing confidence in the hypothesis								✓		7

General summary:
A carefully structured and well-presented study. Appropriate methods were used to collect the data, with careful consideration of factors that could affect measurements.
The data were displayed appropriately, and conclusions drawn which were supported by background science. Internet research revealed another possible explanation for fewer bladders towards the upper shore, and suggestions were made for both extending the original investigation and testing the alternative explanation that the number of bladders is related to degree of exposure.

Detailed commentary:

Strand	Commentary	Mark
D	Techniques used to collect data are described. Repeats are made, and data are compared with those of other groups to consider reliability. There is some justification of the techniques used (in particular where distribution of seaweed meant the technique required modification) and equipment required, but this does not quite represent eight marks. The inclusion of a detailed risk assessment, with ways of minimising risk, takes the work into the 7-8 range, and means that seven marks were awarded.	7
E	The data collected have been displayed appropriately in a graph, and the spread indicated clearly using range bars.	8
F	Repeatability of results has been discussed, by comparisons of data within the group (and reproducibility across other groups), and outliers identified in data. Some reasons are suggested for outliers and inconsistent data (for which there is some scientific justification), along with reasons for the inclusion or exclusion of data. The level of response is just short of eight marks.	7

Strand	Commentary	Mark
G	The extent to which data support the hypothesis has been explained using relevant scientific knowledge. An alternative explanation for the data collected is provided (an effect of the degree of exposure of the shore on the numbers of bladders). Suggestions are made for both extending the original investigation (by exploring the relationship of immersion time against numbers of bladders), and further investigation, of numbers of bladders in seaweed on shores with differing degrees of exposure. The report is comprehensive, relevant and logically sequenced. Scientific terminology has been used effectively, and there are few grammatical errors.	7

Total mark for the Data Analysis = 29/32

OCR RECOGNISING ACHIEVEMENT	Data Analysis Marking Commentary	INSET 2011-12

Title of the work: **21st Century Science Data Analysis**

Identifying code or candidate name: **Candidate 2**

Marks awarded:

Strand	0	1	2	3	4	5	6	7	8	Mark
D choice of methods, techniques and equipment			✓							**2**
E revealing patterns in data					✓					**4**
F evaluation of data				✓						**3**
G reviewing confidence in the hypothesis				✓						**3**

General summary:
The data analysis has been written up appropriately, with all aspects represented in the report, but there are major omissions in each.
An outline of the experimental technique and equipment used are provided, with a limited comment on safe working.

The data collected show some inconsistencies, and it is unclear from the script what the data displayed graphically represent. An attempt is made to relate the trends described by the candidate with the hypothesis provided (which has not been reproduced at the beginning of the report. There is limited scientific terminology, and spelling, in particular, is variable.

Detailed commentary:

Strand	Commentary	Mark
D	The description of the method and apparatus used is limited, and in fact, does not state that air bladders are to be counted. A comment is made on a pertinent hazard, but this is made as part of the evaluation. The best match with the mark descriptors indicates the 1-2 mark band range (although aspects of the 3-4 mark range, i.e., repeats, have been carried out).	2
E	The graph has been drawn with appropriate scales and labelling. Points have been mis-plotted, however (the nature of the data recorded in the graph is unclear; Moderator calculations suggest they are neither a mean of the nine values recorded, or of the first three (which may represent the candidate's group's data.	4

Strand	Commentary	Mark
	Error bars have been drawn, but inaccurately. A maximum of four marks can therefore be awarded.	
F	The candidate comments on the lack of reliability but with no reference to the data, or specific data. Shaded areas in the table of data appear to relate to the identification of outliers, though these are not designated as such. There is enough, however, to put the candidate in the 3-4 mark band range. The emphasis in this strand is on the effects of limitations of techniques and equipment, and several references have been made to aspects of these.	3
G	Comments are made on how the data collected relate to the hypothesis provided, using some reference to the appropriate science. There is little use of scientific terminology, and there are occasional errors in spelling, grammar and punctuation.	3

Total mark for the Data Analysis = 12/32

OCR RECOGNISING ACHIEVEMENT	Data Analysis Marking Commentary	INSET 2011-12

Title of the work: **Science Data Analysis Assessment**

Identifying code or candidate name: **Candidate 3**

Marks awarded:

Strand	0	1	2	3	4	5	6	7	8	Mark
D choice of methods, techniques and equipment					✓					4
E revealing patterns in data						✓				5
F evaluation of data				✓						3
G reviewing confidence in the hypothesis					✓					4

General summary:
A concisely written report, covering many of the pertinent points, but opportunities have been missed by the candidate to markedly improve their report.

The data are based on one set of repeats, and other groups' results have been displayed in a table and a graph, but these could have been improved upon, e.g. by drawing an appropriate line of best fit and adding error bars for their own data, and indicating data points for the line of best fit drawn with 'other results'. Note that there is a marked difference in the distance from high to low water compared with other groups' practical data tasks.

A concise evaluation of the data has been provided. Comments on the extent to which data support the hypothesis have been made, using relevant scientific knowledge, but the candidate sees limited requirement for the collection of further data.

Detailed commentary:

Strand	Commentary	Mark
D	Techniques and equipment used to collect data are described succinctly. One repeat has been carried out. Only limited reference to health and safety on the rocky shore has been made. This strand is borderline, between 3 and 4 marks. Four marks could be awarded, though this is not representative of a 'good' 4.	4
E	The graph has not been drawn on an appropriate grid. Means calculated from the data collected have been displayed in a graph, though a line of best fit could have been used to indicate the trend in data.	5

Strand	Commentary	Mark
	'Other results' are also displayed as a separate line, though individual data points have not been shown. The independent variable, 'how far up the beach' is not a useful parameter to use as the position of low water mark varies with the time of day and at low tide, at spring and neap tides.	
F	The general pattern of results across the candidate's and 'other' groups are cited as reasons for their accuracy, and the candidate comments on a lack of outliers (though has excluded data from the results that could have collected at 35 m, where there 'wasn't any weed to measure' and referred to inconsistent results at the 5 m mark).	3
G	The extent to which data support the hypothesis has been explained using relevant scientific knowledge (but perhaps the lesser requirement for air bladders on seaweed higher up the beach could have been explained). The suggestion of possible further investigation being carried out at other beaches has been made, but then negated by the fact that other groups observed similar trends, so 'we think it is always true.' The report is concise, relevant and logically sequenced. There is some use of scientific terminology, and there are few spelling, punctuation and grammatical errors. Note, however, that it is the science that is the limiting factor in the award of the marks in this strand.	4

Total mark for the Data Analysis = 16/32

SAM Practical Data Analysis Marking Commentary

Title of the work: Different fuels transfer different amounts of energy when they burn because of the different numbers of carbon atoms in the fuel molecules.

Marks awarded:

Strand	0	1	2	3	4	5	6	7	8	Mark
D choice of methods, techniques and equipment								✓		7
E revealing patterns in data									✓	8
F evaluation of data								✓		7
G reviewing confidence in the hypothesis								✓		7

General summary:
This Practical Data Task is very good indeed.

An appropriate technique was used to collect the data, along with some justification of why this method was used.

The data were displayed appropriately and meticulously, and careful calculations made for all the alcohols investigated. Conclusions drawn were supported by background science. Appropriate suggestions were made for extending the original investigation along with limitations of the technique used to do this.

Detailed commentary:

Strand	Commentary	Mark
D	Techniques used to collect data are described, with *some* justification provided of the equipment used. Repeats are made, and only those deemed reliable were used for the calculation of means and for the analysis. The detailed Risk Assessment, with ways of minimising risk, is exemplary. The work is in the 7-8 range, and seven marks were awarded.	7
E	The data collected have been displayed appropriately in a graph. A line of best fit has been drawn. The spread of data used to construct the graph has been indicated clearly on the graph, and outliers circled (though not labelled as such). Complex calculations of heats of combustion have also been made.	8
F	Outliers have been excluded in the calculation of mean heats of combustion (but perhaps could have been recorded). Reasons for specific outliers and inconsistent data have been discussed in detail. The level of response is just short of eight marks.	7
G	The extent to which data support the hypothesis has been explained using relevant scientific knowledge. Suggestions are made (but not discussed in detail) about the limitations of the experiment, ways in which it can be extended, along with some of the practical difficulties associated with this. The report is comprehensive, relevant and logically sequenced. Scientific terminology has been used effectively, and there are just one or two grammatical errors.	7

Total mark for the Practical Data Analysis = 29/32

Appendix B

Controlled Assessment Cover Sheets

OCR

RECOGNISING ACHIEVEMENT

GCSE

Science A

OCR GCSE J241 **Twenty First Century Science Unit A144**

Controlled Assessment Cover Sheet for Case Study and Data Analysis

Examination Series: **June** | | | | |

Centre No: | | | | | | Centre Name:

Candidate No: | | | | | Candidate Name:

Put ticks in the boxes (one per row) to indicate the standard matched by the candidate's work for each aspect of performance. Record the mark awarded for each strand and the final total mark. The right hand column may be used to record any annotations, additional to those on the candidate's scripts, to explain and support marking decisions.

Case Study Title (as on the work):

Strand and aspect		0	1	2	3	4	5	6	7	8	Strand Mark	Annotations to support the marks
A	(a) Selecting information											
	(b) Referencing sources											
B	Science explanations											
C	(a) Comparison and evaluation											
	(b) Conclusions and recommendations											
Total Mark for the Case Study [max = 32]												

Data Analysis Title (as shown on work):

Aspect of performance		0	1	2	3	4	5	6	7	8	Strand Mark	Annotations to support the marks
D	Planning to collect data safely											
E	Graph work											
	Data analysis											
F	Evaluating data											
G	Conclusions											
Total Mark for the Data Analysis [max = 32]												
Total Mark for the whole assessment [max = 64]												A completed copy of this form must be attached to the work of each candidate in the sample requested by the moderator

OCR

RECOGNISING ACHIEVEMENT

GCSE

Science A

OCR GCSE J241 **Twenty First Century Science Unit A144**

Controlled Assessment Cover Sheet for Case Study and Data Analysis

Examination Series: **June** | | | | |

Centre No: | | | | | | Centre Name:

Candidate No: | | | | | Candidate Name:

Put ticks in the boxes (one per row) to indicate the standard matched by the candidate's work for each aspect of performance. Record the mark awarded for each strand and the final total mark. The right hand column may be used to record any annotations, additional to those on the candidate's scripts, to explain and support marking decisions.

Case Study Title (as on the work):

Strand and aspect		0	1	2	3	4	5	6	7	8	Strand Mark	Annotations to support the marks
A	(a) Selecting information											
	(b) Referencing sources											
B	Science explanations											
C	(a) Comparison and evaluation											
	(b) Conclusions and recommendations											
Total Mark for the Case Study [max = 32]												

Data Analysis Title (as shown on work):

Aspect of performance		0	1	2	3	4	5	6	7	8	Strand Mark	Annotations to support the marks
D	Planning to collect data safely											
E	Graph work											
	Data analysis											
F	Evaluating data											
G	Conclusions											
Total Mark for the Data Analysis [max = 32]												
Total Mark for the whole assessment [max = 64]												A completed copy of this form must be attached to the work of each candidate in the sample requested by the moderator

OCR

RECOGNISING ACHIEVEMENT

GCSE

Science A

OCR GCSE J241 **Twenty First Century Science Unit A144**

Controlled Assessment Cover Sheet for Case Study and Data Analysis

Examination Series: **June** | | | | |

Centre No: | | | | | | Centre Name:

Candidate No: | | | | | Candidate Name:

Put ticks in the boxes (one per row) to indicate the standard matched by the candidate's work for each aspect of performance. Record the mark awarded for each strand and the final total mark. The right hand column may be used to record any annotations, additional to those on the candidate's scripts, to explain and support marking decisions.

Case Study Title (as on the work):

Strand and aspect		0	1	2	3	4	5	6	7	8	Strand Mark	Annotations to support the marks
A	(a) Selecting information											
	(b) Referencing sources											
B	Science explanations											
C	(a) Comparison and evaluation											
	(b) Conclusions and recommendations											
Total Mark for the Case Study [max = 32]												

Data Analysis Title (as shown on work):

Aspect of performance		0	1	2	3	4	5	6	7	8	Strand Mark	Annotations to support the marks
D	Planning to collect data safely											
E	Graph work											
	Data analysis											
F	Evaluating data											
G	Conclusions											
Total Mark for the Data Analysis [max = 32]												
Total Mark for the whole assessment [max = 64]												A completed copy of this form must be attached to the work of each candidate in the sample requested by the moderator

OCR

RECOGNISING ACHIEVEMENT

GCSE

Science A

OCR GCSE J241 **Twenty First Century Science Unit A144**

Controlled Assessment Cover Sheet for Case Study and Data Analysis

Examination Series: **June** | | | | |

Centre No: | | | | | | Centre Name:

Candidate No: | | | | | Candidate Name:

Put ticks in the boxes (one per row) to indicate the standard matched by the candidate's work for each aspect of performance. Record the mark awarded for each strand and the final total mark. The right hand column may be used to record any annotations, additional to those on the candidate's scripts, to explain and support marking decisions.

Case Study Title (as on the work):

Strand and aspect		0	1	2	3	4	5	6	7	8	Strand Mark	Annotations to support the marks
A	(a) Selecting information											
	(b) Referencing sources											
B	Science explanations											
C	(a) Comparison and evaluation											
	(b) Conclusions and recommendations											
Total Mark for the Case Study [max = 32]												

Data Analysis Title (as shown on work):

Aspect of performance		0	1	2	3	4	5	6	7	8	Strand Mark	Annotations to support the marks
D	Planning to collect data safely											
E	Graph work											
	Data analysis											
F	Evaluating data											
G	Conclusions											
Total Mark for the Data Analysis [max = 32]												
Total Mark for the whole assessment [max = 64]												A completed copy of this form must be attached to the work of each candidate in the sample requested by the moderator

OCR

RECOGNISING ACHIEVEMENT

GCSE

Science A

OCR GCSE J241 **Twenty First Century Science Unit A144**

Controlled Assessment Cover Sheet for Case Study and Data Analysis

Examination Series: **June** | | | | |

Centre No: | | | | | | Centre Name:

Candidate No: | | | | | Candidate Name:

Put ticks in the boxes (one per row) to indicate the standard matched by the candidate's work for each aspect of performance. Record the mark awarded for each strand and the final total mark. The right hand column may be used to record any annotations, additional to those on the candidate's scripts, to explain and support marking decisions.

Case Study Title (as on the work):

Strand and aspect		0	1	2	3	4	5	6	7	8	Strand Mark	Annotations to support the marks
A	(a) Selecting information											
	(b) Referencing sources											
B	Science explanations											
C	(a) Comparison and evaluation											
	(b) Conclusions and recommendations											
Total Mark for the Case Study [max = 32]												

Data Analysis Title (as shown on work):

Aspect of performance		0	1	2	3	4	5	6	7	8	Strand Mark	Annotations to support the marks
D	Planning to collect data safely											
E	Graph work											
	Data analysis											
F	Evaluating data											
G	Conclusions											
Total Mark for the Data Analysis [max = 32]												
Total Mark for the whole assessment [max = 64]												A completed copy of this form must be attached to the work of each candidate in the sample requested by the moderator