OCR
RECOGNISING ACHIEVEMENT

SPECIMEN

GENERAL CERTIFICATE OF SECONDARY EDUCATION

GATEWAY SCIENCE

B743

CHEMISTRY B

Unit B743: Chemistry controlled assessment

Controlled assessment
Teacher guidance

INSTRUCTIONS TO TEACHERS

This document contains:

- Teacher guidance on task preparation, task taking and task marking.
- The marking criteria with exemplification.
- This document consists of **16** pages. Any blank pages are indicated.

Teacher guidance – Green transport

Introduction

Controlled assessment tasks for GCSE Chemistry require candidates to:

- develop hypotheses and plan practical ways to test them including risk assessment
- manage risks when carrying out practical work
- collect, process, analyse and interpret primary and secondary data including the use of appropriate technology to draw evidence-based conclusions
- review methodology to assess fitness for purpose
- review hypotheses in light of outcomes.

This controlled assessment consists of one task divided into three parts. The task is centred on a particular idea, that of the energy provided by potential alternative fuels. This idea is investigated through Parts 1, 2 and 3. The parts should be taken in this order.

Preparing for the assessment

It is expected that before candidates attempt this controlled assessment task they will have received general preparation in their lessons. The details of practical techniques, the development of skills associated with these techniques, and the methods and choice of equipment for the task should be covered when teaching the particular part(s) of the specification which the controlled assessment task relates to, and should be completed prior to setting the task.

Further advice on the conduct of controlled assessment tasks can be found in the Guide to Controlled Assessment for this specification, published on the OCR website.

From their work in Module C3 Chemical Economics candidates should be familiar with the way in which the energy released from burning a sample of alcohol can be used to heat water, either using a spirit burner or a small, fireproof container with ceramic wool (C3f). A comparison of various alcohols as fuels can be made by calculating the quantity of energy transferred to the water.

Teachers may wish to refer to:

http://www.practicalchemistry.org/experiments/measuring-heat-energy-of-fuels,21,EX.html

Candidates should be made aware of the:

- health and safety issues
- need to provide a quantitative evaluation of the data collected
- sources of experimental errors.

Candidates should be familiar with the use and meaning of the terms in the formula:

energy = mass x specific heat capacity x change in temperature

Assessment of the quality of written communication

The quality of written communication is assessed in Parts 2 and 3 of this controlled assessment and indicated by a pencil symbol (✎) for the information of candidates. Candidates should be advised that where the pencil symbol occurs, their quality of written communication will be assessed. Further information about the assessment of quality of written communication may be found in the specification.

Part 1 – Research and collecting secondary data

- Research activities **1.5 – 2 hours**

Candidates are given the Part 1 stimulus material which requires them to carry out research using books/internet/surveys. They will need to plan how they are going to carry out the research and collect their results for use in Part 2 and Part 3. T he research can be carried out during lessons or as a homework exercise.

Candidates complete Part 1 under limited control. The work of individual candidates may be informed by working with others and work may be completed out of the classroom but candidates must provide an individual response. Teachers may give generic, informal feedback while the task is being completed but may not indicate what candidates need to do to improve their work. Candidates should not be given the opportunity to redraft their work, as this is likely to require an input of specific advice. Candidates should be made aware of the time allowed for carrying out this part of the task. Candidates' access to resources is determined by those available to the centre and/or to candidates at home.

The research information should be brought into the classroom. The candidate working individually should use the information to address the issues on the stimulus sheet. The candidate's individual work must be carried out under supervised conditions and retained by the teacher.

All work should be recorded on loose-leaf paper, and may be hand written or word processed.

The candidate's work and research should be available for Parts 2 and 3. They may not redraft the work completed in Part 1.

The information will be used by the candidates to answer specific questions in the answer booklet and should be attached to the answer booklet for Part 3 by treasury tags so that it can be marked.

Part 1 ends with the collection of the candidates' work and research.

Candidates require the Part 1 stimulus material below.

Green transport

Part 1 stimulus material: Research and collecting secondary data

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.

You are going to carry out some research into this problem. You should find out

What alternative fuels could be used by the vehicles we have today?

How much energy do these alternative fuels provide, when compared with petrol?

You will need to

- write a detailed list of all the sources you used
- present the information you have found for use in Part 2 and Part 3.

Part 2 – Planning and collecting primary data

- Planning **1.5 – 2 hours**
- Practical **1 hour**

Candidates are given the Part 2 stimulus material which requires them to formulate a hypothesis, plan and carry out an investigation to collect primary data. Candidates also need access to their individual work and research from Part 1.

Candidates may work in groups of no more than 3 (2 is recommended) and may collaborate in the development of the plan and the conduct of the investigation. During planning candidates may wish to trial procedures they plan to use, at the discretion of the centre. They are required to provide a risk assessment of the procedures they have planned. **Candidates must record their hypothesis, plan and results individually**. The investigation should be planned and conducted in supervised lessons and written work should be collected in and redistributed if more than one lesson is required.

Teachers are responsible for ensuring appropriate health and safety procedures are carried out, including a risk assessment for the task, prior to candidates attempting the practical work. It is the centre's responsibility to ensure the safety of all candidates involved in any investigation.

Candidates complete Part 2 under limited control. The work of individual candidates may be informed by working with others but candidates must provide an individual response. Teachers may give generic, informal feedback while the task is being completed but may not indicate what candidates need to do to improve their work. Candidates should not be given the opportunity to redraft their work, as this is likely to require an input of specific advice. Candidates should be made aware of the time allowed for carrying out this part of the task. Candidates' access to resources is determined by those available to the centre.

All work should be recorded on loose-leaf paper, and may be hand written or word processed. It should be collected in and redistributed for Part 3 and should be attached to the answer booklet for Part 3 by treasury tags so that it can be marked.

In their investigations, candidates may wish to explore ways in which heat losses can be minimised. Depending on the method used, candidates will need to make choices about: the range of fuels used; the resolution of measurements made of mass of fuel and volume of water; the number of replicates; the volume of water used; how long to leave the fuels burning; and whether to replace the water/tube after each trial. **Candidates must not be instructed or advised in these areas** except where they affect safety, use of resources or timescale.

Part 2 ends with the collection of the raw data by the candidate. The work is collected and retained by the teacher. It is processed and analysed in Part 3.

Candidates require the Part 2 stimulus material below.

Green transport

Part 2 stimulus material: Planning and collecting primary data

Bio-diesel and bio-ethanol are renewable fuels.

The formula of bio-ethanol is C_2H_5OH.

Bio-diesel 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	bio-diesel	bio-ethanol
energy released by 1 litre of fuel in kJ	32 000	22 000

Use the information about the molecules of these fuels to suggest a hypothesis to explain these observations. Explain your reasons for suggesting this hypothesis.

Plan an investigation to test your hypothesis. Your teacher will provide a range of different fuels for you to use.

Carry out your investigation and record your results to use in Part 3.

Part 3 – Analysis and evaluation

- Analysis and evaluation **1.5 – 2 hours**

Part 3 is completed independently under supervision. Candidates will process and analyse the results of their research and the investigation. They will evaluate their data and the methods used to collect it. They will then draw and justify a conclusion and review their hypothesis. They will be asked to comment on any issues of safety within the practical work. If more than one lesson is necessary then all booklets must be collected in and given out again for subsequent lessons.

Candidates will need access to their individual responses from Part 1 and Part 2.

Candidates complete Part 3 under high control. Candidates must complete all work independently. Teachers may give generic, informal feedback while the task is being completed but may not indicate what candidates need to do to improve their work. Candidates should not be given the opportunity to redraft their work, as this is likely to require an input of specific advice. Candidates should be made aware of the time allowed for carrying out this part of the task. All work should be recorded on the answer booklet provided or on loose-leaf paper (such as graph paper), and may be hand written or word processed. All loose sheets should be attached to the answer booklet for Part 3 by treasury tags so that it can be marked.

In processing data, candidates will have opportunities to use mathematical and graphical skills: energy value(s) calculated by substituting in the equation; average energy values calculated per gram or cm^3 of fuel tested; average energy values calculated per mole of fuel tested; quantitative treatment provided of spread of data and thus level of uncertainty; graph drawn with correct scales and accurate plotting with line of best fit to show relationship between energy and feature of molecule chosen, eg number of carbon atoms. **Candidates must not be instructed or advised in these areas**.

Candidates require the answer booklet for Part 3.

Materials required:

- Part 1 and Part 2 stimulus materials and answer booklet for Part 3, supplied by OCR
- Marking Criteria supplied by OCR in this booklet
- candidates' work for Parts 1 and 2.

Apparatus suggested:

- Access to top pan balances including one that records to 0.05g, if possible.

For each candidate or group of candidates:

- stand, clamp and boss
- heat proof mat
- boiling tubes and test tubes
- measuring cylinders, including 50 cm^3
- thermometer
- crucible or similar small, fireproof container with supply of ceramic (rocksil) wool, or alternatively a spirit burner
- plastic disposable pipette with graduations
- access to fuels which will burn safely, for example: ethanol, propanol, butanol, pentanol and hexanol.

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

Notes to help teachers and technicians with this controlled assessment

If possible, provide spirit burners which have removable glass caps or, if using crucibles, provide lids. This makes it easier and safer to extinguish the flames.

Fill and label spirit burners or dropper bottles with alcohols in advance of the lesson. Ensure any excess alcohol is wiped off the side of the burners or dropper bottles.

Keep bottles of alcohol well away from flames.

Careful consideration must be given to how the candidates will ignite the alcohols. They could be given matches. Alternatively, a single Bunsen burner could be provided at the front of the lab (well away from the spirit burners or dropper bottles) and the candidates given access to wooden spills.

Candidates should be given the formulae of the fuels they have been provided with, or appropriate reference materials.

Teachers are advised to try out the experiment prior to candidates undertaking the task.

Marking the controlled assessment

The task will be marked by the centre using the **marking criteria** given in the specification. For each skill, mark descriptors are given at each of four levels. Marking is by 'best-fit' to the criteria.

All three parts should be marked together when candidates have completed Part 3. Except for Part 1, candidates should not take work out of the classroom/laboratory.

This Teacher Guidance document contains the marking criteria from the specification with exemplification. The first row for each skill quality shows the marking criteria given in the specification. The second row exemplifies how <u>some</u> aspects of these criteria may be applied in the context of this specific task. These points are for guidance only.

For further information about the award of marks, please see Section 5.4.2 in the specification.

Candidates should not be given access to the additional guidance for the task.

Assessment objectives (AOs)

Each of the skill qualities to be assessed addresses one or more of the assessment objectives and these are shown in the marking criteria. The overall balance is shown in the table below.

Assessment objective	**TOTAL**
AO1: Recall, select and communicate their knowledge and understanding of science	5
AO2: Apply skills, knowledge and understanding of science in practical and other contexts	10
AO3: Analyse and evaluate evidence, make reasoned judgements and draw conclusions based on evidence	33
Total	**48**

Marking Criteria

Skill quality	0	1 – 2 marks	3 – 4 marks	5 – 6 marks	AO
Researching collect secondary data including the use of appropriate technology	*	Some information collected and used from at least two sources.	Relevant information collected from at least three sources; information presented clearly and all sources identified.	Range of relevant sources identified and judgement used to select those appropriate to the task. Information collated and presented clearly in appropriate formats including a full bibliography.	**AO1 – 1** **AO2 – 3** **AO3 – 2**
Additional guidance Research for Part 1		*Information collected could include identification of two alternative fuels; some evidence of understanding provided on renewability or greenhouse gas production.*	*Information collected could include identification of several alternative fuels; some information provided on renewability and greenhouse gas production; some data collected on the energy released from these fuels when compared with petrol.*	*Information collected could include a range of alternative fuels; detailed information provided about each as to whether they are renewable, increase greenhouse gases and are useable in vehicles, data collected on the energy released from these fuels when compared with petrol, with correct units.*	

* No evidence of achievement for this quality, or evidence insufficient for the award of 1 mark.

Skill quality	0	1 – 2 marks	3 – 4 marks	5 – 6 marks	AO
Planning develop hypotheses and plan practical ways to test them	*	Simple hypothesis or prediction relates to the data or information provided but does not identify a trend or pattern to be investigated. Outline plan includes equipment and techniques to be used. Plan provides a 'fair test'. No evidence of modifications of plan during the data collection phase. Plan shows limited structure with errors in spelling and punctuation.	Hypothesis provides a limited scientific explanation of the data or information provided. Plan gives sufficient detail for experiment to be repeated, including choices of: equipment and techniques; range and number of data points for the independent variable; number of replicates; other variables to be controlled, with the aim of collecting quality data. Some consideration given to how errors will be minimised. No evidence of modifications of plan during the data collection phase. Plan structured clearly with occasional errors in spelling and punctuation.	Complex hypothesis provides a complete scientific explanation of the data or information provided and is capable of investigation. Comprehensive plan shows scientific understanding in making appropriate choices of: equipment, including resolution, and techniques; range and number of data points for the independent variable; number of replicates; control of all other variables, with the aim of collecting accurate data. Detailed consideration given to: how errors will be minimised; variables which cannot be controlled. Where appropriate, reasoned modifications made to the plan as evidence is collected. Plan structured coherently with few, if any, errors in grammar, punctuation and spelling.	**AO1 – 1** **AO2 – 3** **AO3 – 2**
Additional guidance Hypothesis Plan		*Prediction such as biodiesel has more energy as it is a mixture.* *Plan includes appropriate measurements of temperature and mass or volume of fuel. At least 2 replicates used.*	*Hypothesis such as energy output higher in biodiesel because of the complexity of the fuel.* *Candidate could include choices about: the range of fuels used; the number of replicates; volume of water used. The method takes account of variation in mass between samples of fuel. Errors could include the significance of heat losses.*	*Hypothesis could link energy output to molecular structure with explanation of bonding.* *Candidate could include choices about: ways in which heat losses can be minimised; the range of fuels used; measurements made of mass (to 0.05g) or volume (to 0.1cm^3)of fuel and volume of water (to 0.1cm^3); the number of replicates; how long to leave the fuels burning (to 1s). Minimising errors could include whether to replace the water/tube after each trial, how to reduce heat losses.*	

* No evidence of achievement for this quality, or evidence insufficient for the award of 1 mark.

Skill quality	0	1 – 2 marks	3 – 4 marks	5 – 6 marks	AO
Collecting data collect primary data including the use of appropriate technology	*	Results recorded clearly but not in an appropriate format.	Results tabulated to include all data expected, though not in the most appropriate format. Headings given but units not always correct.	Results tabulated clearly and logically, including use of correct headings and units; all data expected recorded to appropriate levels of precision.	**AO1 – 2** **AO2 – 4**
Additional guidance Results from Part 2		*Data could include volume of water used, temperatures of water before and after heating, temperature change and mass or volume of each fuel sample.*	*Results could include volume of water used (or indication that the same volume used on each occasion) temperatures of water before and after heating, temperature change and mass or volume of each fuel sample presented in table(s).*	*Results could include volume of water used (or indication that the same volume used on each occasion) temperatures of water before and after heating, temperature change and mass or volume of each fuel sample presented in a single table. Mass of fuel samples measured to the nearest 0.05g (if possible) or volume to 0.1 cm^3, volume of water to the nearest 1 cm^3 and temperature to nearest 0.5^oC. Temperature changes are within 5^oC showing that measurements are precise.*	
Managing risk manage risks when carrying out practical work including risk assessment	*	Limited understanding of risks in procedures with only standard laboratory safety features mentioned. Some teacher intervention required to ensure safety.	Some risks in procedures analysed and some specific responses suggested to reduce risks. Risks managed successfully with no significant incidents or accidents and no requirement for teacher intervention.	All significant risks in the plan evaluated. Reasoned judgments made to reduce risks by use of appropriate specific responses. Risks managed successfully with no incidents or accidents and no requirement for teacher intervention.	**AO3 – 6**
Additional guidance Part 2 risks in plan and in Part 3 evaluation in Q 4		*Risks will be specific to the planned investigation.*	*Risks will be specific to the planned investigation.*	*Risks will be specific to the planned investigation.*	

* No evidence of achievement for this quality, or evidence insufficient for the award of 1 mark.

Skill quality	0	1 – 2 marks	3 – 4 marks	5 – 6 marks	AO
Processing data process primary and secondary data including the use of appropriate technology	*	Some evidence of processing quantitative data: data presented as simple charts or graphs with some errors in scaling or plotting; use of one simple mathematical technique.	Graphical and mathematical techniques used to reveal patterns in the data: charts or graphs used to display data in an appropriate way, allowing some errors in scaling or plotting; correct use of more than one simple mathematical technique.	Appropriate graphical and mathematical techniques used to reveal patterns in the data: type of graph, scales and axes selected and data plotted accurately, including where appropriate a line of best fit; correct use of complex mathematical techniques where appropriate; appropriate quantitative treatment of level of uncertainty of data.	**AO3 – 6**
Additional guidance Results table Questions 1 and 3		*Processing and mathematical techniques could include temperature changes averaged, attempts made at calculating energy values by substituting temperature changes in equation. Presenting data could include simple bar chart showing relationship between energy and number of carbon atoms.*	*Mathematical techniques could include mean temperature changes calculated correctly; energy value(s) calculated by substituting values in equation; calculations of energy values per gram or cm^3 of fuel attempted. Presenting data could include line graph drawn to show relationship between energy and feature of molecule chosen, eg number of carbon atoms.*	*Graphical and mathematical techniques could include mean energy values per gram or cm^3 of fuel tested calculated correctly; quantitative treatment provided of spread of data and thus level of uncertainty; graph drawn with correct scales and accurate plotting with well positioned line of best fit, where appropriate, to show relationship between energy and feature of molecule chosen, eg number of carbon atoms.*	

* No evidence of achievement for this quality, or evidence insufficient for the award of 1 mark.

Skill quality	0	1 – 2 marks	3 – 4 marks	5 – 6 marks	AO
Analysing and interpreting analyse and interpret primary and secondary data	*	At least one trend/pattern identified and outlined correctly; an attempt is made to interpret the information linking primary and secondary data/information.	Main trend(s)/pattern(s) described and interpreted with reference to quantitative data and scientific knowledge and understanding, with some errors; reasoned comparison between primary and secondary data/information; any anomalous results identified correctly and implications discussed.	All trend(s)/pattern(s) described and interpreted correctly with reference to quantitative data and relevant scientific knowledge and understanding; links between primary and secondary data/information evaluated; level of uncertainty of the evidence analysed.	**AO3 – 6**
Additional guidance Part 3 Questions 2 & 3		*An attempt is made to link a feature of the molecules with the energy values, between own data and research information but interpretation confused or incorrect.*	*Some understanding of correlation or absence of correlation between energy values and feature of molecule; uncertainty of evidence appreciated, for example by the identification of anomalous results; some links made between research and experimental data.*	*Correlation or absence of correlation between energy values and feature of molecule identified and interpreted correctly. Range bars on the graph used to assess uncertainty of data on energy values; appropriate comments made when comparing own results and research including an assessment of the uncertainty of experimental results.*	
Evaluating review methodology to assess fitness for purpose	*	Relevant comments made about the quality of the data and the method used. Answer is simplistic with limited use of specialist terms.	Comments made on the quality of the data including accuracy and sources of error, linked to the method of collection; limitations in the method of data collection identified and suggestions for improvement given. Information is relevant and presented in a structured format. Specialist terms are for the most part used appropriately.	Detailed and critical consideration given to the data and methods used to obtain them: sources of error and quality of the data discussed and explained, including accuracy, repeatability and uncertainty; limitations of the method identified and suggestions for improvements justified. Information is relevant, clear, organised and presented in a coherent format. Specialist terms are used appropriately.	**AO1 – 1** **AO3 – 5**
Additional guidance Part 3 Question 4		*Some attempt made to consider energy losses and how to reduce these. Comment made about accuracy of measurements.*	*Energy losses described, and suggestions made for changes to the method to limit these losses. Comments made on accuracy of measurements of mass/volume and temperature.*	*Detailed explanation given of how some energy from the fuels is not transferred to the water and suggestions made to reduce these losses. Inaccuracies in measurements of mass/volume and temperature quantified and discussed.*	

* No evidence of achievement for this quality, or evidence insufficient for the award of 1 mark.

Skill quality	0	1 – 2 marks	3 – 4 marks	5 – 6 marks	AO
Justifying a conclusion draw evidence-based conclusions; review hypotheses in light of outcomes	*	Conclusion given *and hypothesis reviewed* using the data collected. Answers simplistic with little scientific understanding.	Conclusion given and justified *and hypothesis reviewed* based on an analysis of the data and information from research and investigation, demonstrating an understanding of the underpinning science.	Conclusion given and justified *and hypothesis reviewed*, based on a critical analysis of the data and information from research and investigation, and clearly linked to relevant scientific knowledge and understanding.	**AO3 – 6**
Additional guidance Part 3 Questions 5 & 6		*Hypothesis confirmed or rejected and fuel chosen without clear understanding of the science or analysis of the evidence.*	*Review of hypothesis relates energy values to features of the molecules. Fuel chosen on the basis of evidence from research and the experiment.*	*Review of hypothesis includes the need to relate energy values to the overall size of the molecules or to molecular mass. Fuel chosen on the basis of critical evaluation of evidence from research and the experiment.*	

* No evidence of achievement for this quality, or evidence insufficient for the award of 1 mark.

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