OCR
RECOGNISING ACHIEVEMENT

SPECIMEN

GENERAL CERTIFICATE OF SECONDARY EDUCATION

GATEWAY SCIENCE

B733

BIOLOGY B

Unit B733: Biology 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 – Useful enzymes

Introduction

Controlled assessment tasks for GCSE Biology 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 activity of pectinase enzymes. 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 B3 Living and Growing candidates should be familiar with the principles of enzyme action, such as the way in which pectinase can be mixed with apple to produce juice and the volume of the juice measured, and the factors which can affect the rate of reaction, and how rates of reaction can be measured and compared (B3b).

Teachers may wish to refer to:

http://www-saps.plantsci.cam.ac.uk/worksheets/scotland/fruit.htm

http://www.ncbe.reading.ac.uk/NCBE/PROTOCOLS/INAJAM/PDF/JAM03.pdf

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.

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. The 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.

Useful enzymes

Part 1 stimulus material: Research and collecting secondary data

You have just started work in the labs of a biotechnology firm called Juicee-Co. The company wants to use enzymes to make juices from fruits.

Enzymes such as pectinase can be used to speed up the breakdown of larger molecules into simple sugars. This makes the fruit softer and juicier. Fruit juice companies use a variety of different treatments and enzymes to increase the amount of juice produced.

You are going to carry out some research to help the company. You should find out:

How can Juicee-Co use enzymes to make the maximum amount of juice from fruit?

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 the amount of juice produced from the apple can be measured. Candidates will need to make choices about: the accuracy of measurements made of mass of apple and amount of juice produced; how long to leave the enzyme to react and juice to collect; the number and range of temperatures trialled; the concentration of enzyme; the number of replicates. **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.

Useful enzymes

Part 2 stimulus material: Planning and collecting primary data

Juicee-Co want to produce apple juice. They carry out trials using pectinase enzyme at different temperatures. They notice that at 60^{o}C they get less apple juice than at 30^{o}C.

Suggest a hypothesis to explain these observations and explain your reasons for suggesting this hypothesis.

Plan an investigation to test your hypothesis.

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 for example: average volume of juice produced in unit time; calculation of rate of fruit juice production over time at different temperatures; quantifying the effect of raising temperature on total juice production; quantitative treatment of spread of data and thus level of uncertainty; graph(s) drawn with correct scales and accurate plotting to show relationship between temperature and enzyme activity; calculation of percentage yield. **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:

For each candidate or group of candidates:

- apples or apple 'mash' or apple sauce
- sharp knife for cutting apple
- balance for weighing out quantities
- pectinase
- paper coffee filters
- plastic wrap
- disposable plastic spoons for stirring
- syringes or pipettes, including those measuring 1 cm^3
- funnel
- 30cm rule
- boiling tubes and test tubes
- thermometer
- water baths (electrical water baths which can be set at 'standard' temperatures may be provided and beakers of water heated over a Bunsen burner can be used)
- distilled water
- timer or clock.

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

Apples can be cut up prior to the class practical or candidates provided with apple 'mash' produced from a blender. Apple sauce is an alternative.

Pectinase (Pectinex) can be obtained from NCBE, Science and Technology Centre, Earley Gate, University of Reading, Whiteknights, READING, RG6 6BZ. Tel: 0118 987 3743 Fax: 0118 975 0140. Enzyme data sheets are automatically supplied with the order.

 CARE!: Avoid direct skin and eye contact, wear eye protection and gloves. Enzyme powder can cause allergies. Do not allow any spillages to dry up. Wipe up spillages immediately and rinse cloth thoroughly with water.

Candidates should be instructed not to drink the juice produced in this experiment. The concentration of pectinase used will be much higher than is used in commercial juice production and the fruit and enzyme will not have been handled aseptically.

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 some 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 enzymes identified; some evidence of understanding that conditions affect the rate of reaction.*	*Information collected could include identification of pectinase and cellulase enzymes and their reactions outlined; some data on the effects of temperature and pH on enzyme activity.*	*Information collected could include identification of pectinase and cellulase enzymes and their reactions described, including names of reactants and products; how these reactions increase the amount of juice produced explained; data collected on the effects of temperature and pH on enzyme activity which enables identification of optimum conditions.*	

***** 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 pectinase works best at lower temperatures.* *Plan includes appropriate measurements of temperature and volume of juice collected. At least 2 replicates used.*	*Hypothesis such as pectinase does not produce as much juice at higher temperatures because it is denatured.* *Candidate could include choices about: ways in which the amount of juice can be measured; how long to leave the enzyme to react and juice to collect; the number and range of temperatures trialled; the number of replicates.*	*Hypothesis could link rate of pectinase activity to enzyme structure and optimum temperature.* *Candidate could include choices about: ways in which the amount of juice can be measured (to 1.0cm^3); the accuracy of measurements made of mass of apple (to 1.0g) and amount of juice produced (to 1.0cm^3); how long to leave the enzyme to react and juice to collect (to 1s); the number and range of temperatures trialled (to 0.5^{0}C); explanation of resolution chosen (will relate to available equipment); the concentration of enzyme; the number of replicates.*	

***** 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 temperatures and volume of juice collected.*	*Results could include temperature, volume of juice collected, quantity of apple and enzyme used (or indication that same on each occasion) presented in table(s).*	*Single table of results provided showing temperature, volume of juice collected, quantity of apple and enzyme used, time taken. Mass of apple samples measured to the nearest 1g, volume of juice to the nearest 1 cm^3, temperature to nearest 0.5^oC, time to the nearest 1s; (will relate to available equipment).*	
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		*Only standard laboratory safety procedures such as eye protection and heat mats required for this practical. Mention of not drinking fruit juice.*	*Only standard laboratory safety procedures such as eye protection and heat mats required for this practical. Mention of hand washing after handling enzymes.*	*Only standard laboratory safety procedures such as eye protection and heat mats required for this practical. Allergy risk for skin contact with enzymes and requirement for hand washing included.*	

* 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 Question 1 and 3		*Processing and mathematical techniques could include mean volume of juice produced.* *Presenting data could include simple bar chart showing relationship between temperature and enzyme activity.*	*Mathematical techniques could include mean volume of juice; calculation of mean rate of juice production.* *Presenting data could include line graph drawn to show relationship between temperature and enzyme activity with few errors in scaling or plotting or line of best fit.*	*Graphical and mathematical techniques could include quantitative comparison of rate of juice production at different temperatures, quantifying the effect on juice production of raising temperature (prior to denaturating).* *Range bars used to show uncertainty of data; graph drawn with correct scales and accurate plotting and line of best fit, to show relationship between temperature and enzyme activity.*	

* 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 and 3		*An attempt is made to link temperature with juice production and reduction in rate at higher temperatures recognised.*	*Link identified between temperature and juice production. Optimum temperature identified. Comments made relating own results with those from research.*	*Correlation identified between temperature and juice production, to optimum value and then decline at higher temperatures. Appreciation shown that amount of juice produced depends on rate of enzyme reaction. Range bars interpreted to assess uncertainty of data. Appropriate comments made about different enzymes having different optima when comparing own results and research data.*	
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 uncertainties of measurements of mass and volume. Comment made about accuracy of measurements.*	*Comments made on accuracy of measurements of mass and volume and difficulties in controlling temperature.*	*Variation between replicate volumes of juice used to inform discussion of repeatability of results and uncertainty of the evidence. Inaccuracies in measurements of mass and volume quantified and discussed. Impact of difficulties in controlling temperatures evaluated.*	

* 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 and 6		*Hypothesis confirmed or rejected with idea of different enzymes requiring different conditions understood.*	*Review of hypothesis provides a scientific explanation of why different enzymes and conditions will be required. Denaturing of enzymes at high temperatures linked with experimental data.*	*Detailed scientific explanation given of why different enzymes and conditions will be required, based on research and experimental data. Denaturing of enzymes at high temperatures explained in terms of enzyme structure.*	

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