General Certificate of Secondary Education
Specimen Controlled Assessment

GCSE Additional Applied Science

Unit 2 How Scientists use Practical Techniques

Specimen Controlled Assessment V1.0

Assignment 2, Option 4: Using analytical techniques to help solve a crime

Notes for Teachers

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Assignment 2, Option 4: Using analytical techniques to help solve a crime

Notes for Teachers

This task relates to Unit 1 Section 3.3.6 – The use of science in analysis and detection.

Method

In this option for Assignment 2, candidates should be given the opportunity to carry out an investigation involving a number of qualitative and quantitative analytical techniques that could be used to solve a crime. They should be given a scenario and materials from the 'crime scene' to analyse and use to draw scientific conclusions.

Candidates should be given the opportunity to practice the techniques to be used in their analysis before completing their investigation. They should, however, plan and make decisions on equipment and readings to be taken for themselves.

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

Candidates should be encouraged to validate their work by the use of secondary data in order to comment on the reproducibility and effectiveness of their own work. The secondary data could be the results of tests on known samples, group or teacher-obtained results or data from other sources.

Area of Investigation

This work should be carried out during the teaching of Unit 1, section 3.3.6 – The use of science in analysis and detection.

Approach to the investigation

Teachers should present candidates with a crime to solve, and provide them with materials that have been collected at the crime scene for analysis using qualitative and quantitative techniques. Samples of the same types of material taken from a number of suspects should also be provided so that candidates have the opportunity to test materials and draw some conclusions from the evidence they obtain by testing as to who committed the crime. Candidates should also be given access to secondary data for them to use to comment on the effectiveness of their own work.

Candidates will need to use **at least four** analytical techniques to test and match samples found at the crime scene and samples linked to those suspected of committing the crime. Candidates could use techniques involving qualitative analysis, refractive index, and chromatography. They could also microscopic techniques. **At least one** of the samples to be analysed **must** give candidates the opportunity to carry out quantitative analysis so that they can manipulate numerical data.

Suggestions for contextualisation of task

Teachers should put the task into a context, so that candidates understand the reason for the investigation that they are carrying out. An example scenario, which teachers are free to use or adapt to suit their circumstances, is given below:

An intruder was caught on CCTV crossing gardens, breaking a ground-floor window and entering Johnston's Science Laboratories. The CCTV footage showed the intruder climbing out of the building through the broken window 2 minutes later, carrying a small box.

Police responded to the alarm and, on arriving at the scene, found that the hard drive of a computer in one of the laboratories was missing. A handwritten note was stuck on the computer screen, stating 'see how you manage without this!'

Police investigators found fibres stuck to the window frame of the broken window. They also found in the laboratory a glass bottle smashed and its contents (a white powder) left all over the floor of the laboratory.

Police interviewed three suspects:

- *Suspect 1 is the owner of the building next to the laboratory who had complained several times to the police about smells coming from the laboratory. This suspect had white powder in the pocket of his jacket and a tear in the sleeve of his jacket. There were fragments of glass and some seeds caught in the turn-ups of his trousers.*
- *Suspect 2 is a technician who worked in the laboratory part-time but who has just been dismissed. This suspect had a pen in the glove box of her car, and there was broken glass and a white powder on the floor of her car. She was wearing a scarf with a fringe, some of which was missing.*
- *Suspect 3 is a well-known local criminal who had previous convictions for breaking and entering and who is suspected of a number of thefts involving computer equipment. This suspect was wearing a sweatshirt with a rip in the shoulder, a pen in his trousers pocket, and he had a small packet of white powder in his coat pocket.*

You are an analytical scientist working in a forensic laboratory and the following materials have been sent to you by the police for analysis. You should analyse the materials and use the evidence you obtain from your analyses to prepare a report that could be presented in court.

Suggestions for materials that could be presented for analysis:

- *fibres from the window frame and clothes of suspects*
- *seeds from the garden and clothes of suspects*
- *white powder collected at the scene and on the clothes of suspects*

- *samples of ink from document at crime scene and from pens found on suspects*
- *fragments of bottle / window glass from the crime scene and from suspects.*

Working safely in the laboratory

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

Preparing secondary data

As part of the task, candidates are required to compare their own results with secondary data.

These data could be the results of tests on known samples, results obtained by other groups within the class, or results that have been obtained by the teacher or technician before the candidates do the practicals themselves.

Stage 1 – Planning

The teacher should lead a discussion with the candidates to outline the scenario and the problem that needs to be solved. The discussion should include the importance of obtaining and analysing scientific evidence to draw conclusions. The scenario suggested above could be used, but this should not preclude centres from adapting the scenario or devising their own scenario to suit their own needs.

Candidates should be given the opportunity to have hands-on experience of the techniques to be used during the delivery of Unit 1. Candidates should then be left to themselves to decide on a plan for the investigation and exactly which measurements and observations they should take.

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

Stage 2 – Practical work

For this part of the investigation candidates may work individually or in groups under normal laboratory supervision.

Each candidate must contribute to the collection of data.

Once the candidates have completed their investigation, they should use secondary data to research and analyse the validity of their own results.

Stage 3 – Data processing, analysis and evaluation

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

In their report candidates should:

1. describe the purpose of the investigation and plan how they will carry out their investigation, including selecting appropriate equipment
2. prepare a risk assessment for the investigation
3. record the data they have obtained appropriately
4. process and analyse the data, carrying out calculations
5. make scientific conclusions based on their analysis of the data
6. evaluate the investigation
7. explain how a forensic scientist might use the results of the investigation in their workplace.

GCSE Additional Applied Science: Marking criteria for Assignment 2

Strand	0 marks	Level 1	Level 2	Level 3	Assessment Objective
1. Planning	No plan presented	The plan devised is basic, stating the purpose of the investigation and including some of the equipment needed, but overall lacks a coherent structure. (1–2 marks)	The plan devised states the purpose of the investigation and includes the equipment needed. It shows some organisation and structure, and is clear enough for another person to follow to collect appropriate data, although there may be some errors. (3–4 marks)	The plan devised clearly states the purpose of the investigation and includes precise details of all the equipment needed. It is logically organised, clearly written and well structured in a series of ordered steps that could easily be followed by another person. (5–6 marks)	3 AO1 3 AO2
2. Assessing and managing risk	No evidence of risks having been identified	There is only a basic attempt at risk assessment and only brief references to health and safety practices. (1–2 marks)	Most of the relevant hazards involved with the investigation have been indentified together with associated risks. Control measures to reduce the risks identified have been suggested, although these may be based on a common-sense approach rather than on any scientific reasoning. (3–5 marks)	The relevant hazards involved with the investigation have been identified, together with the appropriate associated risks. Control measures that are firmly based on scientific reasoning to reduce the risks identified have been suggested. (6–8 marks)	8 AO2

Strand	0 marks	Level 1	Level 2	Level 3	Assessment Objective
3. Collecting data / evidence	No data collected or results presented	Basic observations have been made from first-hand evidence obtained during the investigation. Data is recorded in a simple form such as a two-column table (possibly with some errors – eg incorrect / missing headings, units). A simple bar chart or line graph has been constructed from scales provided. Overall, recording of results has no coherent structure. (1–3 marks)	Rational, accurate observations have been made from first-hand evidence obtained during the investigation. Data is recorded in a more complex form such as a table of three or more columns with few errors that adequately represents the data obtained. There may be some inconsistency in recording of data in terms of number of significant figures. An appropriate graph or chart is constructed, choosing own scale, but with some guidance on the type of chart or graph. Observations that it would be appropriate to repeat are recognised. Results are recorded in a structured way, although there may be some errors. (4–7 marks)	Rational, accurate, reliable observations have been made from the first-hand evidence gained during the investigation. Data is recorded in a sophisticated way, such as a table of three or more columns, with correct units and headings, that represents the data obtained. There is consistency in recording data in terms of using an appropriate number of significant figures throughout. An appropriate chart or graph has been constructed independently, with no guidance given on scales. Anomalous results are identified and an explanation given why it would be appropriate to repeat certain results. Results are recorded logically and clearly, with only minor errors. (8–11 marks)	11AO2

Strand	0 marks	Level 1	Level 2	Level 3	Assessment Objective
4. Processing primary and secondary data / evidence	No attempt made to identify patterns in the evidence or manipulate data	Simple patterns have been identified within data / evidence, with guidance. Simple calculations (such as calculation of a mean from three results) have been carried out. Calculations are poorly organised, lack coherent structure and may contain errors. (1–2 marks)	Patterns within data / evidence have been identified and the quantitative relationship between two variables described where appropriate. Calculations (such as a mean from a set of at least three results) have been carried out to an appropriate number of significant figures. The need to exclude any anomalous readings from the calculation has been recognised. (3–5 marks)	Patterns within data / evidence have been identified and clearly explained using, eg, linear, directly proportional or by describing a complex relationship where appropriate. Complex calculations involving mathematical formulae are carried out to an appropriate number of significant figures and with few errors. (6–8 marks)	4AO2 4AO3
5. Analysing primary and secondary data / evidence	No attempt to draw any conclusions from the data / evidence obtained	Conclusions containing a vague statement of what the evidence shows are given. The conclusions show little logical structure or organisation. There is no reference to secondary data. (1–2 marks)	Conclusions, showing some organisation and structure, are given and relate directly to the evidence obtained. Some comparison with secondary data has been made and some suggestions made on how to increase the validity of the data. (3–4 marks)	Conclusions are clear and logical and relate directly to the evidence obtained (both primary and secondary), recognising its limitations. The conclusions illustrate a comprehensive scientific understanding. (5–6 marks)	6AO3

Strand	0 marks	Level 1	Level 2	Level 3	Assessment Objective
6. Evaluating the practical activity	No evaluation evident	A basic evaluation of the practical activity and a simple suggestion for improvement are given. Although there may be some valid points, there are significant errors and / or omissions in the use of technical terms, spelling, punctuation and grammar, leading to an overall lack of clarity. (1–2 marks)	An evaluation of the practical activity is given, describing the effectiveness of working methods and making some justified suggestions for improvement so that more reliable evidence can be obtained. The evaluation contains a range of technical terms, although not all are used correctly and there are omissions and errors in spelling punctuation and grammar, leading to inconsistency and some lack of clarity. (3–4 marks)	A reasoned and logical evaluation of the investigation is given, covering both strengths and weaknesses of working methods and including justified suggestions for improvement so that more reliable and precise evidence can be obtained. The evaluation is clearly expressed, using technical terms correctly, and with few errors in spelling, punctuation or grammar. (5–6 marks)	6AO3
7. Workplace context	No attempt to put the investigation into a workplace context	A simple workplace application of the investigation is given. There is not necessarily any scientific evidence. (1 mark)	A workplace application of the practical investigation is described and a suggestion made as to how the findings could be used. The opinion uses scientific fact but appreciates that this may be influenced by more evidence. (2–3 marks)	A workplace application of the practical investigation has been researched and explained that summarises how the findings could be used. Scientific evidence from the investigation has been used to provide a basis for opinion. (4–5 marks)	5AO2
Total					**50**