OCR
RECOGNISING ACHIEVEMENT

SPECIMEN

GENERAL CERTIFICATE OF SECONDARY EDUCATION

GATEWAY SCIENCE

PHYSICS B

B753

Unit B753: Physics 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 – Speaker wires

Introduction

Controlled assessment tasks for GCSE Physics 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 resistance of wires of different thicknesses. 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 P4 Radiation for Life candidates should be familiar with setting up a circuit to collect data on current and voltage, and calculating the resistance of a wire (P4c).

Teachers may wish to refer to:

http://www.practicalphysics.org/go/Experiment_276.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:

voltage = current x resistance

Candidates should know how to calculate cross sectional area of wire from the radius:

area = πr^2

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 work 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.

Speaker wires

Part 1 stimulus material: Research and collecting secondary data

In home cinema and hi-fi systems, electrical wires connect the amplifier to the speakers. The quality of the sound produced can depend upon the thickness of these wires. The thickness of wire is known as the gauge (SWG in the UK and AWG in the US). How do you know what gauge of wire to use?

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

How does the distance between the amplifier and the speakers affect the gauge of wire needed for good quality sound?

Data to show the relationships between the gauge, diameter and resistance of speaker wires.

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 will need to make choices about: the variables to be measured; the length of wire to be tested; the range of wire gauges used; the voltage used; the accuracy of measurements made of voltage and current and diameter of the wire; the number of replicates; allowing the wire to cool between measurements; the set up of the circuit. **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.

Speaker wires

Part 2 stimulus material: Planning and collecting primary data

George is setting up a home cinema system. He connects the speakers to the amplifier with speaker wires of 16 gauge but is unhappy with the quality of the sound. When he tries 12 gauge, the quality seems better.

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

Plan an investigation to test your hypothesis. Your teacher will provide a range of wires of different thicknesses 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: resistance values calculated by substituting in the equation; average resistance calculated per unit length of wire; quantitative treatment provided of spread of data and thus level of uncertainty; calculating cross sectional area of wire from the diameter; graph drawn with correct scales and accurate plotting to show relationship between resistance and cross sectional area. **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:

- selection of Eureka wire (also known as Constantan or Contra) of different gauges, eg 0.71 mm (22 SWG), 0.46 mm (26 SWG), 0.32 mm (30 SWG) and 0.24 mm (34 SWG).
- metre rule
- insulating tape
- 2 crocodile clips
- 5 leads
- ammeter
- voltmeter
- variable power supply or cells, 1.5 V, with holders
- micrometer.

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

Candidates should be made aware that the wire could become very hot if the current used is too high or the length of wire is too short.

A variable resistor in series may help to control the current.

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: short length or low gauge wires are good for sound quality; evidence of quantitative data collected but does not show the relationships between gauge, diameter and resistance.*	*Information collected could include the identification of relationship between length or gauge of wire and resistance; resistance and quality of sound linked; some quantitative data collected regarding gauge, diameter and resistance.*	*Information collected could include the identification of the relationship between length and resistance, and gauge of wire and resistance; link between quality of sound and these factors explained; quantitative data collected regarding gauge, diameter and resistance, with correct units, which enables relationships to be determined.*	

* 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 it is easier for electricity to get through thicker wires.* *Plan includes appropriate measurements for a range of gauges of wire. At least two replicates used.*	*Hypothesis could relate diameter of wire to resistance, and resistance to sound quality.* *Candidate could include choices about the variables to be measured; the length of wire to be tested; the number and range of wire gauges used; the number of replicates. The method recognises the heating effect on the wire and shows some indication of how the circuit will be set up.*	*Hypothesis could relate cross sectional area of the wire to the resistance, and the resistance to sound quality; comments on other factors such as length of wire or material of wire.* *Candidate could include choices about: the variables to be measured; the length of wire to be tested (to 1.0mm); the number and range of wire gauges used; the voltage used (to 0.5v); explanation of resolution chosen (will relate to available equipment); the number of replicates ; how long to leave the wire to cool after each measurement; the set up of the circuit. Minimising errors could include using a fixed length for measuring the wire.*	

* 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 gauge of wire used and current, voltage or resistance.*	*Data could include gauge or diameter of wire used, length of wire, current and voltage or resistance presented in table(s).*	*Single table of results provided showing gauge of wire, diameter of wire, length of wire, current and voltage or resistance, correct units used for all variables. Replicates are similar values, showing precision.* *Length measured to the nearest 0.1mm; voltage to 0.5v; current to 0.5amps showing that measurements are precise (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		*Recognises that working with electrical current carries risks, for example of electric shocks.*	*Some understanding of risks of working with electrical current, but not necessarily applied to this experiment. Standard laboratory safety procedures are required.*	*Standard laboratory safety procedures are required for this practical. Risks of working with electrical currents comprehensively evaluated, risks are reduced to include ensuring the current does not get too high, which could cause overheating.*	

* 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 attempt to calculate resistance from current and voltage data; mean resistance calculated . Presenting data could include simple graph to show relationship between gauge of wire and resistance.*	*Mathematical techniques could include resistance calculated from current and voltage data; mean resistance of wires calculated correctly. Presenting data could include line graph drawn to show the relationship between diameter and resistance with few errors in scaling or plotting or line of best fit.*	*Graphical and mathematical techniques could include mean resistance per unit length of wire calculated correctly; quantitative treatment provided of spread of data and thus level of uncertainty; cross sectional area of wire calculated correctly from the diameter; graph drawn with correct scales and accurate plotting to show relationship between cross sectional area and resistance.*	

* 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		*Identification that as gauge decreases resistance decreases, or as diameter increases resistance decreases.*	*Correlation between diameter or gauge and resistance described using quantitative data, with some explanation. Explanation of changing resistance could be based on use of V=IR.*	*Different correlations described using quantitative data for diameter and resistance and cross-sectional area and resistance, interpretation explains why resistance is dependent on cross sectional area. Assesses uncertainly eg considers variation in line of best fit, uses range bars etc.. Appropriate comments made regarding the similarities and differences between data for commercial speaker wires and primary 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		*Comments made about accuracy of measurement of voltage, current or resistance.*	*Accuracy of measurements linked to use of meters, with suggestions given how to improve accuracy of measurement.*	*Possible affects of temperature considered and evaluated. Sources of inaccuracy in meters quantified and discussed. Repeatability of results discussed and explained.*	

* 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		*Factors identified and relationships described, with reference to original hypothesis.*	*Scientific explanation of the factors which will affect resistance and sound quality, linked to hypothesis. Explanation linked to experimental data and research.*	*Detailed scientific explanation given of relationships between current, voltage, resistance, gauge and cross-sectional area, based on research and experimental data. Relationships linked to original hypothesis. Considers effects of distance and diameter on sound quality, explaining how these can be altered to result in good quality sound.*	

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

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