

GENERAL CERTIFICATE OF SECONDARY EDUCATION

TWENTY FIRST CENTURY SCIENCE

ADDITIONAL SCIENCE A

A154

Unit A154: (controlled assessment)

PHYSICS A

A184

Unit A184 (controlled assessment)

Factors that affect the motion of a vehicle along a surface

Information for teachers

This is one of two specimen controlled assessment materials for Additional Science A (Unit A154). In actual examination series, six tasks will also be available.

This is the only task available as specimen assessment materials for Physics A (Unit 184). In actual examination series, two tasks will be available.

Marks from this specimen task must not be submitted to OCR.

There are two documents provided for candidates:

- **Information for Candidates (1)** defines the topic of the investigation and placed it into a relevant context. This should be issued to candidates at the start of the task.
- **Information for Candidates (2)** provides some secondary data to supplement that which candidates collect for themselves. It should be issued to candidates only on completion of the data collection part of their investigation.

Information for teachers

Specimen controlled assessment task: Investigating factors that affect the motion of a vehicle along a surface

These notes provide background information for the preparation of candidates for this task and advice on the assessment of the practical investigation report.

Reference should also be made to Section 5 of the specification for Additional Science A or Physics A and the '*Guide for controlled assessment for GCSE Twenty First Century Science*'.

General guidance for teachers

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

Preparation of candidates

It is expected that before candidates attempt this controlled assessment task they will have received general preparation in their lessons. Learning activities to develop the relevant skills should have been provided and the broad requirements of the assessment made clear to candidates. More specific details of practical techniques, the development of skills associated with these techniques, and possible methods and choice of equipment for the task should be covered when teaching the relevant part(s) of the specification, and must be completed prior to setting the task.

From their work for 'Module P4: Explaining motion', candidates should be familiar with the principals of inter-conversion of gravitational potential energy and kinetic energy as a vehicle moves down a slope, and the dissipation of energy as the vehicle slows down.

Candidates should investigate factor(s) that affect the motion of a vehicle (trolley, model car or toy railway wagon) along a surface. It is important that the wheels of the vehicle are of relatively small mass compared to the body of the vehicle if kinetic energy is to be calculated from:

$$\text{kinetic energy} = \frac{1}{2} \times \text{mass} \times [\text{velocity}]^2$$

Suggested areas for investigation include the **effect of speed** on the stopping distance of the vehicle, and the **effect of the surface** on the stopping distance of the vehicle.

To get the vehicle moving, the vehicle could be released down a slope, such as a plank of wood, dynamics ramp or other suitable track. The speed of the vehicle could be changed by varying the angle of the slope or distance that the vehicle accelerates down. Suitable ranges to use can be determined by preliminary investigation.

Candidates can determine the speed of the vehicle by experimentation (for example using light gates) and/or by estimation (for example, carrying out calculations based on a potential energy to kinetic energy conversion).

Assessment of the quality of written communication (QWC)

The quality of written communication is assessed in Strands S and R of this controlled assessment task. Candidates should be advised that the quality of written communication will be assessed. Further information about the assessment of QWC may be found in the specification.

Risk assessment

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

Guidance on assessment

All assessment of the practical investigation is based on the final report submitted by the candidates.

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

Additional guidance on marking criteria

Strand S

There is no task-specific guidance for this strand, as candidates' plans and hypotheses/predictions will depend upon the contextualisation of the task by centres and the choices made by candidates.

Strand C

There is no task-specific guidance for this strand, as candidates' data will depend upon the contextualisation of the task by centres and the plans developed by candidates.

Strand A

Candidates working at higher levels could estimate the speed of the vehicle by carrying out a calculation based on the conversion of gravitational potential energy to kinetic energy.

Data should be displayed in tables and appropriate graphs. While bar charts will be used to display data obtained from the investigation of the effect of different surfaces on stopping distance, data obtained should be the subject of statistical analysis for those candidates working at higher levels.

Candidates working at higher levels could proceed to consider various methods to measure the spread of data around their calculated means. This could extend from the range indicated by error bars on graphs, inter-quartile ranges, box and whisker plots (boxplots), to variance and standard deviation. Tests of significance, eg the Student's t-test, could be used to analyse apparent differences between sets of data, helping to support or reject candidates' initial hypotheses.

Strand E

There is no task-specific guidance for this strand, as the evaluation which may be carried out will depend upon the contextualisation of the task by centres and the plans developed by candidates.

Strand R

On a basic level, candidates could compare their results with those from other groups in the class that have carried out an identical investigation.

Candidates could use internet and textbook sources to supplement their data; this could include data from organisations such as The Royal Society for the Prevention of Accidents (RoSPA) on the effect of speed on the stopping distances of cars, as well as websites providing information on the effect of different road surfaces on stopping distances.

Further analysis could be undertaken using the data provided by OCR. The data can be used by candidates across the mark range, with candidates providing simple interpretations at lower levels, through to a more rigorous analysis necessitating the collection of further information.

Candidates could discuss the implications of road texture on fuel economy, discussing chipping size and the nature of the road surface. This should be related to their own findings on the movement of their vehicle on different surfaces and how this is affected by speed (where possible), linked to the relevant background science.

Candidates should appreciate the limitations of comparisons with secondary data, and of the secondary data itself.

For motor vehicle stopping distances, the effect of thinking distance and breaking distance could be discussed. For the secondary data provided by OCR, relevant considerations could include:

- practical and measuring techniques, eg the range of factors that may affect road noise
- other variables, eg weather conditions during testing
- the limitation that experimentation was limited to Volvo cars.

These considerations will affect the conclusions that can be drawn from the secondary data. A literature search will indicate that road unevenness, as well as the coarseness of chippings, has a significant effect on vehicle movement.

Guidance for technicians

In this assessed investigation, candidates may be offered a choice between different methods for studying factors that affect the motion of a vehicle along a surface.

The factors under investigation include the effect of speed on the stopping distance of a vehicle, and the effect of surface on the stopping distance of a vehicle.

Suggested equipment**All investigations:**

Choice of different materials for the slope, eg, planks of wood or dynamics ramps to give minimum directional guidance and/or or plastic piping or wooden beading to give more positive guidance.

Vehicles – trolley, model car or toy railway wagon

Range of different surfaces

Rules or tape measures

Balance

Stop watches or stop clocks

Light gate

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