**Investigating the effect of initial speed on stopping distance**

**Introduction**

This experiment should be carried out when learners are familiar with kinetic energy and work done.

**Aim and skills covered**

* To use data loggers to measure speed with a light gate
* Use of appropriate analogue apparatus to measure distance

**Intended class time**

* 60 to 90 minutes

**Links to Specifications**

**Physics A**

* 3.1.1 (a) displacement, instantaneous speed, average speed, velocity and acceleration
* 3.1.1 (b) graphical representations of displacement, speed, velocity and acceleration
* 3.1.2 (a)(ii) techniques and procedures used to investigate the motion and collisions of objects
* 3.1.2 (c) reaction time and thinking distance; braking distance and stopping distance for a vehicle
* 3.3.1 (b) *W = Fx cosθ* for work done by a force
* 3.3.2 (a) kinetic energy of an object; *Ek = ½ mv2*

**Physics B Advancing Physics**

* 4.2 a(iv) calculation of work done
* 4.2 a(vii) measurement of displacement, velocity and acceleration
* 4.2 b(i) make appropriate use of the terms: displacement, speed, velocity, work, energy
* 4.2 b(ii) sketching and interpreting graphs of accelerated motion;
* 4.2 c(vii) work done *ΔE = FΔs*
* 4.2 c(viii) kinetic energy *= ½ mv2*
* 4.2 d(i) investigate the motion of objects with data obtained from data loggers

**Practical Skills**

* 1.2.1(b) safely and correctly use a range of practical equipment and materials
* 1.2.1(c) follow written instructions
* 1.2.1(d) make and record observations/measurements
* 1.2.1(e) keep appropriate records of experimental activities
* 1.2.1(f) present information and data in a scientific way
* 1.2.1(g) use appropriate software and tools to process data, carry out research and report findings
* 1.2.1(h) use online and offline research skills including websites, textbooks and other printed scientific sources of information
* 1.2.1(i) correctly cite sources of information
* 1.2.1(j) use a wide range of experimental and practical instruments, equipment and techniques appropriate to the knowledge and understanding included in the specification
* 1.2.2 (a) use analogue apparatus to measure length
* 1.2.2(d) use of light gates for timing
* 1.2.2(k) use of ICT such as computer modelling, or data logger with a variety of sensors to collect data, or use of software to process data

**CPAC**

1. Follows written procedures
2. Safely uses a range of practical equipment and materials
3. Makes and records observations
4. Researches, references and reports

**Mathematical skills**

* M0.1 Recognise and make use of appropriate units in calculations
* M0.2 Recognise and use expressions in standard form
* M0.3 Use ratios, fractions and percentages
* M0.4 Estimate results
* M1.1 Use an appropriate number of significant figures
* M1.4 Make order of magnitude calculations
* M2.4 Solve algebraic equations, including quadratic equations
* M3.1 Translate information between graphical, numerical and algebraic forms
* M3.2 Plot two variables from experimental or other data

**Equipment**

* wooden block
* interrupt card
* data logging system
* light gate
* metre rules x2

**Health & Safety**

Materials being dropped should not be likely to break or shatter. Care should also be taken to avoid possible injury from dropped materials.

These experiments are referred to in the “Mainly Physics” section of the CLEAPSS Laboratory Handbook, section 12.4 Dynamics.

Before carrying out any experiment or demonstration based on this guidance, it is the responsibility of teachers to ensure that they have undertaken a risk assessment in accordance with their employer’s requirements, making use of up-to-date information and taking account of their own particular circumstances. Any local rules or restrictions issued by the employer must always be followed.

**Notes**

* These practical activities are not controlled assessments, should not be carried out in exam conditions and can be adapted by the centre. Students can collaborate during the activities which should take place as part of the normal teaching sequence. They are intended to be formative with students acquiring and practising skills throughout the course.
* To achieve a pass in the Practical Endorsement each student is required to demonstrate competence in all the skills, apparatus and techniques listed in section 1.2 of the specification and assessed against the Ofqual Common Practical Assessment Criteria (CPAC) at the end of the course.
* The skills, apparatus and techniques can be demonstrated during any practical work undertaken during the A Level course whether an OCR practical activity or not.
* OCR recommends that this experiment is trialled by the teacher in advance of giving it to the students to ensure familiarity with the data logging equipment and the suitability of the worksheet for the data loggers being used,

**Recording**

* Learners should not need to re-draft their work but rather keep all their notes as a continuing record of Practical Activity.
* As evidence for the practical endorsement learners should have evidence of the data collected from their group in a clear and logical format.
* They should have researched, referenced and commented on the comparison between their own result and that, for example, from the Highway Code.
* In addition, to support the assessment of practical skills in the written examination they should have interpreted their data and established a hypothesis for the relationship.