OCR A Physics A-Level

PAG 1.3

Investigating initial speed and stopping distance

Equipment

- Metre ruler
- Wooden Blocks
- Light gate
- Interruptor card/piece of card 10x10cm

Method

1. A vehicle is modelled by the block of wood which is pushed and decelerates due to friction with the surface it moves on.
2. Glue the 10 x 10 cm interruptor card to the side of the block of wood so that the time for the width of the card to pass through the gate is recorded. The interruptor card allows the distance moved through the light gate to be fixed, as it registers with the light gate easily without the light gate interrupting the block's motion.
3. Set up the light gate such that it records the average starting velocity of the block moving through it (speed = 0.1 m/time for card to move through in seconds).
4. Record the starting position of the block and position the light gate 2 cm after this point.
5. Push the block and record the position at which it stops.
6. Record the average starting velocity and the corresponding distance between the light gate and the stopping point (stopping distance), in a table.

Calculations

- Find the stopping distance for a range of starting velocities.
- Plot a graph of stopping distance against starting velocity squared, this should be a straight line through the origin as:

$$E_k \text{ of block} = \frac{1}{2}mv^2$$

$$\text{Work done by friction} = \text{force} \times \text{stopping distance}$$

As all the kinetic energy is converted to thermal energy by friction

$$\frac{1}{2}mv^2 = \text{force} \times \text{stopping distance}$$

Mass and ½ are both constants, stopping force is assumed to be constant as the block travels relatively slowly. In reality, the frictional force increases with velocity. However, assuming it is constant:

$$v^2 \propto \textit{stopping distance}$$

Notes

- The surface the block is pushed on and the block material should stay constant so that the frictional force varies as little as possible.