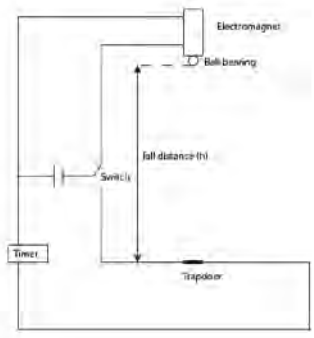
Edexcel Physics A Level

Core Practical 1

Determine the Acceleration of a Freely-Falling Object

Method 1: Using an Electromagnet



- Open switch to break connections between battery and electromagnet in the primary circuit and turn on the timer in the secondary circuit
- Electromagnet demagnetises causing steel ball to fall a distance, h, from the bottom of the ball to the top of the trap door
    - h is measured using a ruler
- When the ball falls through the trap door is breaks the connection of the timer to the battery hence the timer stops
- Record the time taken to fall h metres, t, repeat process three times, discard anomalies and find average t
- Vary h and record corresponding t
- Given that s = h, u = 0, a = g, t = t, using $s = ut + \frac{1}{2}at^2$:

$$t^2 = \frac{2}{g}h$$

- Plot t^2 against h, draw line of best fit, the gradient (m) will be $\frac{2}{g}$

$$g = \frac{2}{m}$$

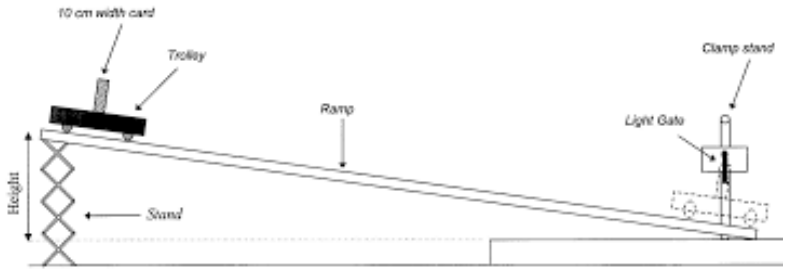
Safety

- If dropping off of a table, clamp electromagnet stand to table to prevent it toppling over
- Be aware of falling ball – use a tray to capture ball at the bottom
- Small currents used in circuit – no danger of electrical shock

Evaluation

- Small t values: use larger distance to reduce uncertainty
- Time delay between the timer starting and the ball being released due to residual magnetism in ball: use a lower current so that the electromagnet has a weaker magnetic field
- No air resistance (not fast enough)

Method 2: Using a trolley down a Ramp



- Attach a card to top of trolley/object and measure its width using a ruler
- Release it from top of ramp and start the stopwatch
- Light gate at the bottom of the ramp will record the time for which the card passes through
    - Calculate instantaneous final speed, v, of the card as:

$$v = \frac{\text{length of card}}{\text{time}}$$

- Once the card reaches bottom of the ramp stop the stopwatch and record time taken, t
- Repeat procedure 3 times, discard anomalies and calculate mean t
- Vary v (by reducing distance of the trolley from bottom of ramp) and record the respective values of t
- Given that u = 0, v= V a = g, t = t, using $v = u + at$:

$$v = gt$$

- Plot v against t, draw line of best fit, the gradient (m) will be g

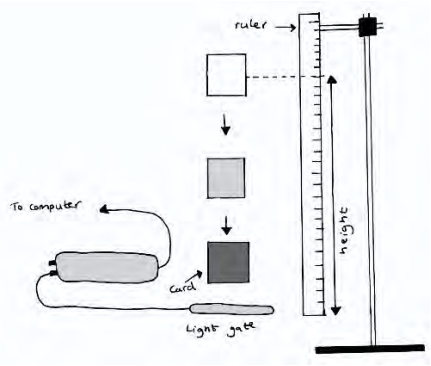
Safety

- Be aware of falling trolley – use a tray to capture trolley at the bottom

Evaluation

- Small t values: use larger distance to reduce uncertainty
- Air resistance (for larger distances) records a smaller v
- Friction between the ramp and the wheels of the trolley
- Reaction time: use of stopwatch

Method 3: Free fall of Card



- Clamp a thin piece of card to the top and measure height, h, from the centre of card to the top of the light gate using a ruler clamped parallel using a set square
- Release the card from the top
- Light gate at the bottom will record the time for which the card passes through
    - Calculate instantaneous final speed, v, of the card as:

$$v = \frac{\text{length of card}}{\text{time}}$$

- Repeat procedure 3 times, discard anomalies and calculate mean v for the given h
- Vary h and record the respective values of v
- Given that s = h, u = 0, v= v a = g, using $v^2 = u^2 + 2as$:

$$v^2 = 2gs$$

- Plot v^2 against s, draw line of best fit, the gradient (m) will be 2g

$$g = \frac{m}{2}$$

Evaluation

- Small t values: use larger distance to reduce uncertainty
- Air resistance acting on the card means the acceleration will be less than g
- Reaction time has no effect on results as light gate is used to measure time
- Path taken by card is not directly vertical introducing uncertainty in the measure of h: attach blue tack to the bottom tips of the card for stability