

How fast and how quickly speeding up

Physics grades 9-10 (GCSE · IGCSE · O Level · Class 9-10) · Lab

Name: _____ Date: _____ Class: _____

A ball released from rest on a slope speeds up. In this lab you time it over several distances, find the average speed for each, and use the pattern to work out its final speed and acceleration.

Level: Physics grades 9-10 (GCSE · IGCSE · O Level · Class 9-10) · **Curriculum:** IGCSE 1.2, HS-PS2-1

Aim

To find how the average speed of a ball changes over longer distances down a slope, and to use the results to estimate the final speed and the acceleration of the ball.

Equipment

- Smooth straight ramp, about 1.2 m long, raised a few centimetres at one end
- Small steel ball or marble
- Metre rule and masking tape for the marks
- Stopwatch or phone timer
- Calculator

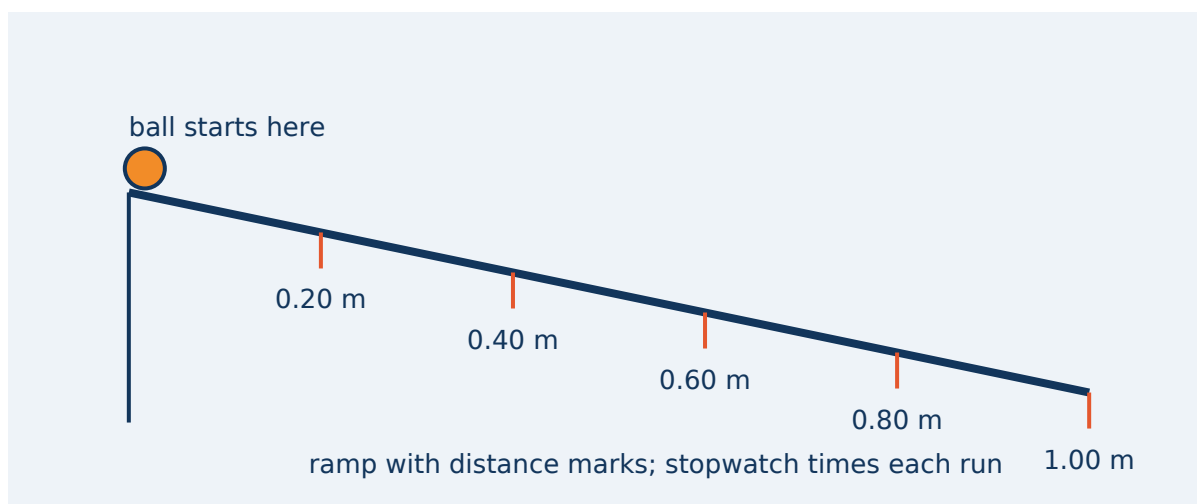
Safety

Safety

Place a box at the bottom of the ramp to stop the ball and keep the floor clear so nobody trips on a rolling ball.

Method

1. Fix the ramp at a gentle slope and mark 0.20, 0.40, 0.60, 0.80 and 1.00 m from the start line with tape.
2. Release the ball from rest at the start line without pushing it.
3. Start the stopwatch at release and stop it as the ball crosses the first mark. Record the time.
4. Repeat three times and find the mean. Then repeat for each of the other marks.



Set-up: the ball is released from rest and timed to each mark.

Results

Mean times from one group (three runs per mark):

Distance from start (m)	Mean time (s)
0.20	0.90
0.40	1.27
0.60	1.55
0.80	1.79
1.00	2.01

Analysis questions

Question 1 Average speed for each distance

Calculate the average speed from the start to each mark, to 3 decimal places.

Question 2 Pattern in the speeds

Describe how the average speed changes with distance and explain what that tells you about the ball.

Question 3 Final speed

For a ball starting from rest with constant acceleration, the final speed is twice the average speed. Calculate the final speed at the 1.00 m mark.

Question 4 Acceleration

Calculate the acceleration of the ball using $a = (v - u) \div t$ for the full 1.00 m.

Question 5 Repeat readings

The three runs for 1.00 m were 2.00 s, 2.03 s and 1.99 s. Calculate the mean, the uncertainty (half the range) and the percentage uncertainty.

Question 6 Sources of error

Explain why timing by hand is a limitation and suggest a better way to time the ball.

Question 7 Converting the result

Convert the final speed to km/h and comment on whether it is reasonable.