

Reading motion graphs and acceleration

Grade 8 science (Year 9 · Class 8) · Lab

Name: _____ Date: _____ Class: _____

How does the motion of a ball change as it rolls down a ramp? In this lab you time a ball over several distances, draw its distance-time graph, and use the results to find the speed in each section and the acceleration of the ball.

Level: Grade 8 science (Year 9 · Class 8) · **Curriculum:** MS-PS2-2

Aim

To measure how a ball moves down a ramp, to draw its distance-time graph and to find its speed and acceleration.

Equipment

- Smooth plank, about 1.2 m long, raised on a few books
- Steel ball or toy car
- Metre rule and masking tape for markers
- Stopwatch (or phone timer)
- Tray or cushion at the bottom

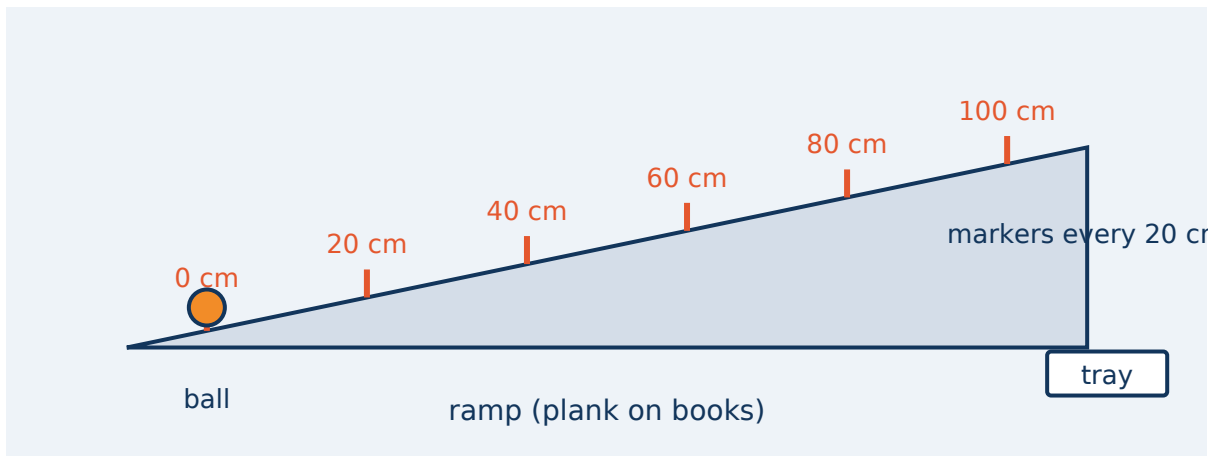
Safety

Safety

Place a tray at the bottom so the ball does not roll across the floor where someone could slip. Keep books and the plank stable and stand clear of the ramp.

Method

1. Mark the plank at 0, 20, 40, 60, 80 and 100 cm from the start line, as shown.
2. Hold the ball at the 0 cm mark and release it without pushing.
3. Start the stopwatch at release and stop it as the ball passes the 20 cm mark. Repeat three times and record the mean time.
4. Repeat steps 2 and 3 for the 40, 60, 80 and 100 cm marks.
5. Calculate the speed in each 20 cm section later using the times.



Ramp with marker lines every 20 cm.

Results

Sample mean times from the release point:

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 Section speeds

Calculate the average speed in each 20 cm section (use the time difference between marks).

Question 2 Distance-time graph

Plot distance (y-axis) against time (x-axis) and describe the line.

Question 3 Estimating acceleration

The speed in the first section applies at the middle time of 0.45 s and in the last section at 1.90 s. Use these to estimate the acceleration.

Question 4 Final speed

Calculate the average speed over the whole 1.00 m. For constant acceleration from rest, the final speed is twice the average speed. Calculate the final speed and the acceleration from it.

Question 5 Reaction time

Timing by hand adds an error of about ± 0.1 s. Find the percentage error in the time for the first mark and say why this matters.

Question 6 Steeper ramp

Predict how the graph changes if the ramp is raised higher, and explain.

Question 7 Improvements

Suggest two improvements to the method.