

# How fast and how quickly speeding up

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

The model answers use the sample table. Your own times will differ a little, but the average speed should rise with distance and the acceleration should be roughly constant for your slope.

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

## Question 1 Average speed for each distance

$0.20 \div 0.90 = \mathbf{0.222 \text{ m/s}}$ ;  $0.40 \div 1.27 = \mathbf{0.315 \text{ m/s}}$ ;  $0.60 \div 1.55 = \mathbf{0.387 \text{ m/s}}$ ;  $0.80 \div 1.79 = \mathbf{0.447 \text{ m/s}}$ ;  $1.00 \div 2.01 = \mathbf{0.498 \text{ m/s}}$ .

## Question 2 Pattern in the speeds

The average speed **increases** with distance. If the speed were constant the average would be the same for every distance, so the ball must be speeding up, which means it accelerates.

## Question 3 Final speed

$v = 2 \times 0.498 = 0.996$ , so the final speed is **1.0 m/s** (2 s.f.).

## Question 4 Acceleration

$a = (v - u) \div t = (1.0 - 0) \div 2.01 = 0.4975$ , so **0.50 m/s<sup>2</sup>**.

## Question 5 Repeat readings

Mean =  $(2.00 + 2.03 + 1.99) \div 3 = 6.02 \div 3 = \mathbf{2.01 \text{ s}}$ . Uncertainty =  $(2.03 - 1.99) \div 2 = \mathbf{0.02 \text{ s}}$ . Percentage =  $0.02 \div 2.01 \times 100 = \mathbf{1.0 \%}$ .

## Question 6 Sources of error

Human **reaction time** of about 0.2 s is large compared with the short times for the first marks, and it varies from run to run. Better: use two light gates linked to a data logger, or film the run in slow motion on a phone and count frames.

**Question 7 Converting the result**

$1.0 \text{ m/s} \times 3.6 = \mathbf{3.6 \text{ km/h}}$ , about the speed of a slow walk. That is reasonable for a ball on a gentle slope 1 m long.