

Determining g

AS Level

9702 AS Ch.2

Chapter 2: Accelerated motion

Lesson 2.12

Sections 2.12

Goal: Describe a free-fall experiment to find g , and get g from a graph of s against t^2 .

01 The big picture

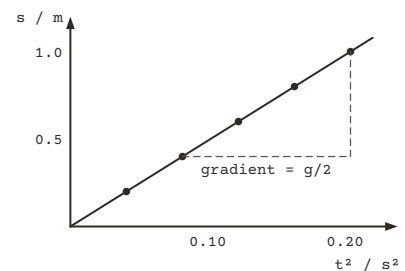
Drop a small steel ball from rest from an electromagnet. Switching off the magnet starts a timer; the ball hitting a trapdoor stops it. Measure the height s with a metre rule and repeat each height, averaging t .

From rest, $s = \frac{1}{2}gt^2$, so a graph of s against t^2 is a straight line through the origin with gradient $g/2$. Light gates with a falling card, or video, can also be used.

Free fall [paraphrase]

Falling with only the weight acting: acceleration g , no air resistance.

Fig. 1 · s against t^2



A straight line through the origin: gradient = $g/2$.

02 Key equations

From rest

$$s = \frac{1}{2}gt^2$$

One drop

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

From the graph

$$g = 2 \times \text{gradient of } s-t^2$$

Symbols and units

s	height fallen	m	t	time to fall	s	g	acceleration of free fall	m s^{-2}
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03 Sample problems with solutions

Sample 1 · One drop

A ball falls 1.20 m from rest in a mean time of 0.495 s. Calculate g .

Step 1. Rearrange $s = \frac{1}{2}gt^2$:

$$g = \frac{2s}{t^2} = \frac{2 \times 1.20}{0.495^2} = 9.79 \text{ m s}^{-2}$$

Answer: $g = 9.79 \text{ m s}^{-2}$ (3 s.f.)

Unit check: $\frac{\text{m}}{\text{s}^2} = \text{m s}^{-2} \checkmark$

04 Practice problems

P1 The gradient of a graph of s against t^2 is 4.95 m s^{-2} .

Find g .

Answer: 9.90 m s^{-2}

P2 A ball falls 0.80 m from rest in 0.40 s. Find g .

Answer: 10 m s^{-2}

P3 Why use a small, dense ball?

Answer: Air resistance is negligible compared with its weight

P4 Why repeat each height and average the times?

Answer: To reduce the effect of random errors

05 Other useful information

Common mistakes

- ✗ **Wrong:** Plot s against t and take the gradient as g .
- ✓ **Right:** That curves; plot s against t^2 and double the gradient.

Exam tips

- Measure s from the bottom of the ball to the trapdoor.

What the syllabus asks

- 9702 topic 2: describe an experiment to find g using a falling object. Coursebook 2.12.

Explore: [Practice questions for this lesson](#)