

Measuring velocity and acceleration

ASHPHYS · REVISION CHEAT SHEET

AS Level

9702 AS Ch.2

Chapter 2: Accelerated motion

Lesson 2.6

Sections 2.6

Goal: Find a velocity from a light gate and an acceleration from two velocities.

velocity

01 The big picture

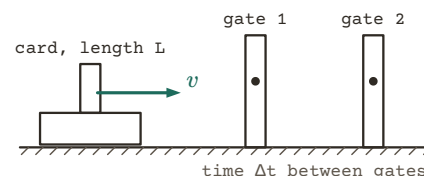
A light gate times how long a card of known length L blocks its beam. The velocity is L/t ; a short card over a short time gives close to the instantaneous velocity.

Two light gates give two velocities. Dividing their difference by the time taken between the gates gives the acceleration. Motion sensors, ticker-timers and video do the same job by recording position against time.

Light gate [paraphrase]

A beam and sensor connected to a timer; it records how long the beam is blocked.

Fig. 1 · A trolley passing two light gates



Each gate times the card; the timer also records the time between the gates.

02 Key equations

Velocity at a gate

$$v = \frac{L}{t}$$

Acceleration between gates

$$a = \frac{v_2 - v_1}{\Delta t}$$

Symbols and units

L length of the card m t time the beam is blocked s Δt time from gate 1 to gate 2 s

03 Sample problems with solutions

Sample 1 · Two light gates

A 5.0 cm card blocks gate 1 for 0.050 s and gate 2 for 0.025 s. It takes 0.40 s to travel between the gates. Calculate the acceleration.

Step 1. Velocities at the gates ($L = 0.050$ m):

$$v_1 = \frac{0.050}{0.050} = 1.0 \text{ m s}^{-1}, \quad v_2 = \frac{0.050}{0.025} = 2.0 \text{ m s}^{-1}$$

Step 2. Acceleration:

$$a = \frac{2.0 - 1.0}{0.40} = 2.5 \text{ m s}^{-2}$$

Answer: $a = 2.5 \text{ m s}^{-2}$

Unit check: $\frac{\text{m s}^{-1}}{\text{s}} = \text{m s}^{-2} \checkmark$

04 Practice problems

P1 A 10 cm card blocks a light gate for 0.20 s. Find the velocity.

Answer: 0.50 m s^{-1}

P2 A trolley's velocity rises from 0.50 m s^{-1} to 1.5 m s^{-1} in 0.80 s. Find the acceleration.

Answer: 1.25 m s^{-2} (1.3 m s^{-2})

P3 Why is a narrow card better for measuring an instantaneous velocity?

Answer: It blocks the beam for a shorter time, so the velocity changes less

P4 Why use a light gate rather than a hand-held stopwatch?

Answer: No human reaction time, so a much smaller timing uncertainty

05 Other useful information

Common mistakes

- ✗ **Wrong:** Leave the card length in cm.
- ✓ **Right:** Convert to metres first: $5.0 \text{ cm} = 0.050 \text{ m}$.

Exam tips

- Δt is the time between the gates, not the time either gate is blocked.

What the syllabus asks

- 9702 topic 2: measure velocity and acceleration. Coursebook 2.6.

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