

Calculating acceleration

AS Level

9702 AS Ch.2

Chapter 2: Accelerated motion

Lesson 2.2

Sections 2.2

Goal: Use $a = (v - u)/t$ and rearrange it for v , u or t .

01 The big picture

For an object with initial velocity u that reaches final velocity v after a time t , the acceleration is the change in velocity divided by the time.

The same equation, rearranged, gives the final velocity: $v = u + at$. To find the time, t is in the denominator, so swap it with the lone term a in one step (cross-multiplication): $t = (v - u)/a$.

Initial velocity u [paraphrase]

The velocity at the start of the time interval.

Final velocity v [paraphrase]

The velocity at the end of the time interval.

02 Key equations

Acceleration

$$a = \frac{v - u}{t}$$

Final velocity

$$v = u + at$$

Time (swap t and a)

$$t = \frac{v - u}{a}$$

Symbols and units

u initial velocity m s^{-1} v final velocity m s^{-1} t time taken s

03 Sample problems with solutions

Sample 1 · Velocity and time

A car moving at 5.0 m s^{-1} accelerates uniformly at 2.0 m s^{-2} . Calculate (a) its velocity after 6.0 s and (b) the time it takes to reach 25 m s^{-1} .

Step 1. (a) Final velocity:

$$v = u + at = 5.0 + 2.0 \times 6.0 = 17 \text{ m s}^{-1}$$

Step 2. (b) t is in the denominator: swap t and a .

$$t = \frac{v - u}{a} = \frac{25 - 5.0}{2.0} = 10 \text{ s}$$

Answer: (a) 17 m s^{-1} (b) 10 s

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

04 Practice problems

P1 A train slows from 20 m s^{-1} to 8.0 m s^{-1} in 6.0 s .

Calculate its acceleration.

Answer: -2.0 m s^{-2}

P2 A stone falls from rest with $a = 9.81 \text{ m s}^{-2}$. Find its velocity after 1.5 s .

Answer: 14.7 m s^{-1} (15 m s^{-1})

P3 A plane needs 75 m s^{-1} to take off and accelerates from rest at 2.5 m s^{-2} . How long does it take?

Answer: 30 s

P4 A cyclist at 6.0 m s^{-1} decelerates at 0.80 m s^{-2} . How long until they stop?

Answer: 7.5 s

05 Other useful information

Common mistakes

- ✗ **Wrong:** Use $v - u$ the wrong way round.
- ✓ **Right:** Always final minus initial; a negative answer means slowing down.

- ✗ **Wrong:** Use $a = +0.80 \text{ m s}^{-2}$ for a deceleration.
- ✓ **Right:** Use $a = -0.80 \text{ m s}^{-2}$, or the time comes out negative.

Exam tips

- List u , v , a , t with units before you substitute.

What the syllabus asks

- 9702 topic 2: define and use acceleration. Coursebook 2.2.

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