

The equations of motion

AS Level

9702 AS Ch.2

Chapter 2: Accelerated motion

Lesson 2.8

Sections 2.8

Goal: Choose and use the right suvat equation for uniform acceleration in a straight line.

01 The big picture

For uniform (constant) acceleration in a straight line, five quantities describe the motion: s , u , v , a and t . Each equation links four of them, so if you know three you can find the others.

Pick the equation that leaves out the quantity you neither know nor need. Choose a positive direction and give every vector (s , u , v , a) a sign.

suvat equations [paraphrase]

The four equations of uniformly accelerated motion in a straight line.

02 Key equations

No s

$$v = u + at$$

No a

$$s = \frac{1}{2}(u + v)t$$

No v

$$s = ut + \frac{1}{2}at^2$$

No t

$$v^2 = u^2 + 2as$$

Symbols and units

s displacement m u, v initial, final velocity $m\ s^{-1}$ a acceleration (constant) $m\ s^{-2}$

03 Sample problems with solutions

Sample 1 · Braking distance

A car travelling at $25\ m\ s^{-1}$ brakes with a constant deceleration of $5.0\ m\ s^{-2}$. Calculate its stopping distance.

Step 1. Known: $u = 25$, $v = 0$, $a = -5.0$.

Unknown: s . No t , so use $v^2 = u^2 + 2as$:

$$0 = 25^2 + 2(-5.0)s$$

Step 2. Rearrange for s :

$$s = \frac{625}{10} = 62.5\ m$$

Answer: $s = 63\ m$ (2 s.f.)

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

04 Practice problems

P1 A car accelerates from rest at $2.0\ m\ s^{-2}$ for $8.0\ s$.

How far does it travel?

Answer: $64\ m$

P2 A train speeds up from $10\ m\ s^{-1}$ to $30\ m\ s^{-1}$ over $400\ m$. Find its acceleration.

Answer: $1.0\ m\ s^{-2}$

P3 A ball is thrown straight up at $15\ m\ s^{-1}$. Find its maximum height ($g = 9.81\ m\ s^{-2}$).

Answer: $11.5\ m$ (11 m)

P4 A cyclist at $4.0\ m\ s^{-1}$ accelerates at $1.5\ m\ s^{-2}$ for $6.0\ s$. Find the final velocity.

Answer: $13\ m\ s^{-1}$

05 Other useful information

Common mistakes

- ✗ **Wrong:** Make a positive when the object slows down.
- ✓ **Right:** If u is positive and it slows, a is negative.

Exam tips

- Write " $s = ?$, $u = \dots$, $v = \dots$, $a = \dots$, $t = \dots$ " first; the empty slot picks the equation.

What the syllabus asks

- 9702 topic 2: solve problems with the suvat equations. Coursebook 2.8.

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