

Units of acceleration

AS Level

9702 AS Ch.2

Chapter 2: Accelerated motion

Lesson 2.3

Sections 2.3

Goal: Explain why acceleration is in m s^{-2} , and convert other units to it.

01 The big picture

Acceleration is a change in velocity (m s^{-1}) divided by a time (s), so its SI unit is metres per second per second: m s^{-2} (also written m/s^2).

An acceleration of 3 m s^{-2} means the velocity grows by 3 m s^{-1} every second. Before calculating, convert every quantity to SI units: km h^{-1} to m s^{-1} (divide by 3.6), minutes to seconds, cm to m.

m s^{-2} [paraphrase]

Metres per second per second: the change in velocity, in m s^{-1} , each second.

02 Key equations

The unit of a

$$\frac{\text{m s}^{-1}}{\text{s}} = \text{m s}^{-2}$$

km h^{-1} to m s^{-1}

$$1 \text{ km h}^{-1} = \frac{1}{3.6} \text{ m s}^{-1}$$

Symbols and units

a	acceleration	m s^{-2}	v	velocity	m s^{-1}	t	time	s
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03 Sample problems with solutions

Sample 1 · 0 to 100 km h^{-1}

A car accelerates from rest to 100 km h^{-1} in 8.0 s. Calculate its average acceleration in m s^{-2} .

Step 1. Convert the velocity to m s^{-1} :

$$v = \frac{100}{3.6} = 27.8 \text{ m s}^{-1}$$

Step 2. Divide by the time:

$$a = \frac{27.8 - 0}{8.0} = 3.47 \text{ m s}^{-2}$$

Answer: $a = 3.5 \text{ m s}^{-2}$ (2 s.f.)

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

04 Practice problems

P1 A motorbike goes from rest to 60 km h^{-1} in 5.0 s. Find its acceleration.
Answer: 3.3 m s^{-2}

P2 A rocket's speed rises by 30 m s^{-1} every 2.0 s. Find its acceleration.
Answer: 15 m s^{-2}

P3 Express 1.2 cm s^{-2} in m s^{-2} .
Answer: 0.012 m s^{-2}

P4 A train slows from 72 km h^{-1} to rest in 1.0 minute. Find its acceleration.
Answer: -0.33 m s^{-2}

05 Other useful information

Common mistakes

- ✗ **Wrong:** Give acceleration in m s^{-1} .
- ✓ **Right:** m s^{-1} is velocity; acceleration is m s^{-2} .
- ✗ **Wrong:** Divide km h^{-1} by seconds.
- ✓ **Right:** Convert to m s^{-1} ($\div 3.6$) and minutes to seconds first.

Exam tips

- Write the unit at every step; a wrong unit shows a missed conversion.

What the syllabus asks

- 9702 topic 2: define and use acceleration; SI units. Coursebook 2.3.

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