

KEY WORDS velocity • acceleration

Kinematics: constant acceleration

Objective

Solve single- and multi-phase suvat problems with signs chosen per phase, and read and sketch displacement-time, velocity-time and speed-time graphs (objectives 3.1).

1 Key knowledge and worked examples

Method. List s, u, v, a, t per phase with signs (up positive or down positive – then stay consistent). Choose the formula that omits the unknown you do not need. Graphs: velocity-time gradient = acceleration, area = displacement (negative below the axis); speed-time graphs never go negative, so up-then-down motion is a V with its vertex on the time axis.

Worked example – up then down (WME01 June 2025 Q3). Projected up from A, 12 m above the ground at B, reaching B after 4 s (up positive, origin A): $-12 = 4U - 4.9(16)$ gives $U = 16.6 \text{ ms}^{-1}$; then $v^2 = 16.6^2 + 2(9.8)(12)$ gives $v = 22.6 \text{ ms}^{-1}$. The speed-time graph falls from 16.6 to 0 at $t = 16.6/9.8 = 1.7 \text{ s}$, then rises to 22.6 at $t = 4$ – a V, downward leg longer.

2 Practice

2.1 A car decelerates uniformly from 12 m s^{-1} to rest with acceleration -2 m s^{-2} . Find the time taken and the distance travelled. [3]

2.2 A train brakes from 20 m s^{-1} to rest with uniform deceleration 5 m s^{-2} . Find the braking distance. [3]

2.3 A ball is projected vertically upwards at 15 m s^{-1} from a point on level ground. Find its maximum height and the time until it returns to the point of projection. [4]

2.4 On a velocity-time graph, a particle accelerates uniformly from 8 ms^{-1} to 20 ms^{-1} in 15 s. Find its acceleration and the distance travelled. [4]

3 Exam-style questions

3.1 (*Edexcel IAL WME01 June 2025 Q3.*) A particle is projected vertically upwards from A with speed $U \text{ m s}^{-1}$. A is 12 m vertically above the point B on horizontal ground. The particle moves freely under gravity until it hits the ground at B, 4 seconds after leaving A. (a) Find U . (b) Find the speed with which the particle hits the ground. (c) Sketch a speed-time graph for the motion from A to B, marking the values of the speed at A, at B and at the instant the speed is zero. [8]

3.2 (*Original.*) A stone is dropped from rest and falls 45 m to the ground. Find its speed on impact. [3]
