

Exercise walk-through

5.2

Kinematics: constant acceleration

Pearson Edexcel · International A-Level · Mathematics

Check yourself

Check yourself

State modelling assumptions and their consequences; vector velocities, positions, bearings; multi-phase suvat and motion graphs; paired equations over a pulley with the 2T pulley force; impulse on one body and momentum conservation with rebounds; μR moving versus capped at rest; equilibrium by two resolutions; moments about successive tilting pivots.

Exercises 2.1·2.3

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]

Exercises 2.1·2.3

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]

2.1 $0 = 12 - 2t$ gives $t = 6 \text{ s}$; $s = 12(6) - \frac{1}{2}(2)(36) = 72 - 36 = 36 \text{ m}$.

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

2.2 $0 = 20^2 - 2(5)s$ gives $s = \frac{400}{10} = 40 \text{ m}$.

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]

2.3 Max height $= \frac{15^2}{2(9.8)} = \frac{225}{19.6} = 11.5 \text{ m}$ (2 s.f. 11); time up $= \frac{15}{9.8} = 1.53 \text{ s}$, so total time back $= 3.1 \text{ s}$.

Exercises 2.4·3.1

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

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]

Exercises 2.4·3.1

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

2.4 $a = \frac{20 - 8}{15} = 0.8 \text{ m s}^{-2}$; distance = trapezium area = $\frac{1}{2}(8 + 20)(15) = 210 \text{ m}$.

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3.1 (a) Up positive, origin A, $s = -12$ when $t = 4$: $-12 = 4U - 4.9(16)$, so $4U = 66.4$ and $U = 16.6 \text{ m s}^{-1}$ (17 to 2 s.f.). (b) $v^2 = 16.6^2 + 2(9.8)(12) = 510.8$, so $v = 22.6 \text{ m s}^{-1}$ (23). (c) V-shaped graph: starts at 16.6, falls to zero at $t = 1.7 \text{ s}$, rises to 22.6 at $t = 4$; the falling leg is shorter than the rising leg, and both meet ON the time axis (no vertical jump).

Exercise 3.2

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

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3.2 $v^2 = 2(9.8)(45) = 882$, so $v = 29.7 \text{ m s}^{-1}$ (30).

Local review guidance: one suvat relation per phase with signed quantities; 2–3 s.f. final answers with units; graph shapes honouring non-negativity of speed and continuity at the vertex. This is authored classroom guidance.