

Exercise walk-through

# 5.6

## **Describing motion along a line (4.5.6.1.1–4.5.6.1.5, RP7)**

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AQA · GCSE · Physics

## Exercises 2.1·2.3

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**2.1** A person walks 300 m in 240 s. Calculate the average speed and state whether it matches a typical walking value. [3]

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**2.2** A car travels 5 km east, then 5 km west in 40 minutes total. State the distance travelled and the displacement. [3]

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**2.3** A v–t graph is flat at 12 m/s for 25 s. State the acceleration and (HT) the distance travelled. [2]

### 3 Exam-style questions

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## Exercises 2.1·2.3

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**2.1** A person walks 300 m in 240 s. Calculate the average speed and state whether it matches a typical walking value. [3]

**2.1**  $v = s/t = 300/240 = \mathbf{1.25}$  m/s (C1, A1); close to the typical 1.5 m/s walking value – a normal walking pace.

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**2.2** A car travels 5 km east, then 5 km west in 40 minutes total. State the distance travelled and the displacement. [3]

**2.2** Distance =  $5 + 5 = \mathbf{10}$  km; displacement = **0** – she is back at the start; time 40 min is extra context (no mark but must not enter the displacement).

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**2.3** A v–t graph is flat at 12 m/s for 25 s. State the acceleration and (HT) the distance travelled. [2]

### 3 Exam-style questions

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**2.3** Acceleration = 0 (constant velocity, B1); distance =  $12 \times 25 = \mathbf{300}$  m.

## Exercise 3.1

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**3.1** A cyclist's distance–time graph rises in a straight line from 0 to 900 m in 6.0 minutes.

(a) Show the graph's gradient and calculate her speed. [3]

(b) She then stops for 4.0 minutes. Describe the graph for that section and state her speed. [2]

(c) Compare her motion with a typical cyclist's speed of 6 m/s. [1]

## Exercise 3.1

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**3.1** A cyclist's distance–time graph rises in a straight line from 0 to 900 m in 6.0 minutes.

(a) Show the graph's gradient and calculate her speed. [3]

(b) She then stops for 4.0 minutes. Describe the graph for that section and state her speed. [2]

(c) Compare her motion with a typical cyclist's speed of 6 m/s. [1]

**3.1** (a) Gradient = rise/run with time converted: 6.0 min = 360 s (C1).

$$v = \frac{900 \text{ m}}{360 \text{ s}} = \mathbf{2.5 \text{ m/s}}$$

(gradient described C1, answer A1) (b) A horizontal (flat) line; speed zero – stationary.

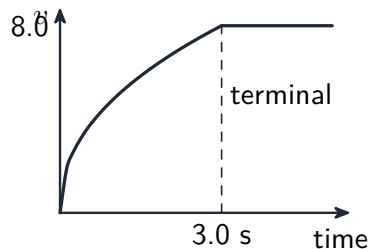
(c)  $2.5 < 6 \text{ m/s}$  – she cycles slower than the typical cyclist.

## Exercise 3.2

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**3.2** A ball is dropped and its  $v$ - $t$  graph curves: steep at first, flattening to a constant  $8.0$  m/s after  $3.0$  s.

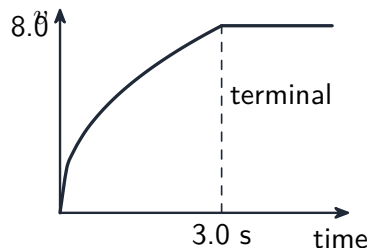
- (a) Describe the forces on the ball in the first 3 seconds and after. [3]
- (b) State what the constant final speed is called and the condition for it. [2]
- (c) Estimate the distance fallen in the first 3 s if the average velocity was  $4.0$  m/s. [2]



## Exercise 3.2

**3.2** A ball is dropped and its  $v$ - $t$  graph curves: steep at first, flattening to a constant 8.0 m/s after 3.0 s.

- (a) Describe the forces on the ball in the first 3 seconds and after. [3]
- (b) State what the constant final speed is called and the condition for it. [2]
- (c) Estimate the distance fallen in the first 3 s if the average velocity was 4.0 m/s. [2]



**3.2** (a) First 3 s: weight downwards exceeds drag, resultant force down, so it accelerates; as speed grows drag grows; after 3 s drag = weight – resultant zero, constant velocity.  
(b) Terminal velocity; reached when the drag (air resistance) equals the weight. (c)  $s = \bar{v}t = 4.0 \times 3.0 = \mathbf{12 \text{ m}}$  (C1, A1).

## Exercise 3.3

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**3.3** A train's velocity–time graph:  $0 \rightarrow 30 \text{ m/s}$  over  $600 \text{ s}$  at uniform acceleration, then  $30 \text{ m/s}$  constant for  $1200 \text{ s}$ , then decelerating uniformly to rest in  $300 \text{ s}$ .

- (a) Calculate the three accelerations ( $\text{m/s}^2$ ). [3]
- (b) (HT) Calculate the total distance travelled. [3]
- (c) Calculate the average speed for the whole journey. [2]

## Exercise 3.3

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**3.3** A train's velocity–time graph:  $0 \rightarrow 30$  m/s over 600 s at uniform acceleration, then 30 m/s constant for 1200 s, then decelerating uniformly to rest in 300 s.

(a) Calculate the three accelerations (m/s<sup>2</sup>). [3]

(b) (HT) Calculate the total distance travelled. [3]

(c) Calculate the average speed for the whole journey. [2]

**3.3** (a) Stage 1:  $a = 30/600 = \mathbf{0.050}$  m/s<sup>2</sup>; stage 2: **0**; stage 3:  $a = -30/300 = -\mathbf{0.10}$  m/s<sup>2</sup> (deceleration 0.10 m/s<sup>2</sup>). (b) (HT) Areas:  $\frac{1}{2} \times 600 \times 30 = 9000$  m;  $1200 \times 30 = 36\,000$  m;  $\frac{1}{2} \times 300 \times 30 = 4500$  m; total = **49 500** m (each stage C1 accumulated, total A1). (c) Total time =  $600 + 1200 + 300 = 2100$  s.

$$\bar{v} = \frac{49\,500}{2100} = \mathbf{24} \text{ m/s (2 s.f.)}$$

(C1, A1)