Exercise walk-through

Representing Motion ▪ 1.3

eXercise

You must be able to

- read **velocity** 速度 as the slope of a position-time (x-t) graph
- read **acceleration** 加速度 as the slope of a velocity-time (v-t) graph
- read **displacement** 位移 as the area under a v-t graph
- match the shapes of x-t, v-t, and a-t graphs for the same motion

Method — Slopes give the next quantity down

- Slope of x-t = velocity.
- Slope of v-t = acceleration.

A straight, rising x-t line has constant slope, so constant velocity and zero acceleration.

Method — Areas give the previous quantity up

- Area under v-t = displacement.
- Area under a-t = change in velocity.

A v-t triangle rising from 0 to 10 m s^{-1} over 4 s has area $\frac{1}{2}(4)(10) = 20$ m.

Method — Matching graph shapes

For constant acceleration: x-t is a parabola (curving), v-t is a straight sloped line, a-t is a flat horizontal line.

Practice 2.1 ▪ 1 mark

What does the slope of a position-time graph represent?

Solution 2.1

Worked steps

The velocity B1.

Practice 2.2 ▪ 1 mark

What does the area under a velocity-time graph represent?

Solution 2.2

Method: Areas give the previous quantity up

Worked steps

The displacement B1.

Practice 2.3 ▪ 2 marks

A *v*-*t* graph holds a constant 6 m s^{-1} for 5 s. Find the displacement.

Solution 2.3

Worked steps

Displacement $=$ area $= 6 \times 5 = 30$ m M1 A1.

Practice 2.4 ▪ 2 marks

A *v*-*t* graph rises straight from 0 to 8 m s^{-1} over 2 s. Find the acceleration.

Solution 2.4

Method: Matching graph shapes

Worked steps

$$a = \frac{\Delta v}{\Delta t} = \frac{8}{2} = 4 \text{ m s}^{-2}$$ M1 A1.

Exam-style 3.1 ▪ 1 mark

The acceleration of an object equals the slope of its

A position-time graph

B velocity-time graph

C acceleration-time graph

D force-time graph

Solution 3.1

Method: Slopes give the next quantity down

A position-time graph

B velocity-time graph ✓

C acceleration-time graph

D force-time graph

Worked steps

B — acceleration is the slope of the velocity-time graph.

Exam-style 3.2 ▪ 1 mark

For motion with constant acceleration, the velocity-time graph is a

A horizontal line

B straight sloped line

C parabola

D circle

Solution 3.2

A horizontal line

B straight sloped line ✓

C parabola

D circle

Worked steps

B — constant acceleration gives a straight sloped v-t line.

Exam-style 3.3 ▪ 2 marks

A *v*-*t* graph is a triangle: velocity rises straight from 0 to 12 m s^{-1} over 6 s.
(a) Find the acceleration.
(b) Find the displacement (the area).

Solution 3.3

Method: Areas give the previous quantity up

Worked steps

(a) $a = 12/6 = 2$ m s^{-2} M1 A1. (b) area $= \frac{1}{2}(6)(12) = 36$ m M1 A1.

Exam-style 3.4 ▪ 1 mark

An x-t graph is a horizontal straight line for 10 s.
(a) State the velocity.
(b) State the acceleration.

Solution 3.4

Method: Matching graph shapes

Worked steps

(a) $v = 0$ (the position is constant) B1. (b) $a = 0$ B1.