Exercise walk-through

Straight-Line Motion: Connecting Position, Velocity, and Acceleration ▪ 4.2

eXercise

You must be able to

- relate **position** 位置, **velocity** 速度, and **acceleration** 加速度 by differentiation
- find when an object is at rest

Method — Straight-line motion

- velocity $v(t) = x'(t)$;
- acceleration $a(t) = v'(t) = x''(t)$;
- **speed** $= |v(t)|$.

The object is **at rest** when $v = 0$; it moves in the positive direction when $v > 0$.

Method — Example

$x(t) = t^2 - 4t$: $v(t) = 2t - 4 = 0$ at $t = 2$.

Practice 2.1 ▪ 1 mark

State velocity in terms of position.

Solution 2.1

Worked steps

$v(t) = x'(t)$ B1.

Practice 2.2 ▪ 1 mark

State acceleration in terms of velocity.

Solution 2.2

Method: Straight-line motion

Worked steps

$a(t) = v'(t)$ B1.

Practice 2.3 ▪ 2 marks

For $x(t) = t^2 - 4t$, find $v(t)$ and the time at rest.

Solution 2.3

Worked steps

$v(t) = 2t - 4$; at rest when $2t - 4 = 0$, i.e. $t = 2$ M1 A1.

Exam-style 3.1 ▪ 1 mark

Velocity is the derivative of

A acceleration

B position

C speed

D distance

Solution 3.1

A acceleration

B position ✓

C speed

D distance

Worked steps

B.

Exam-style 3.2 ▪ 1 mark

The object is at rest when

A $a = 0$

B $v = 0$

C $x = 0$

D $t = 0$

Solution 3.2

Method: Straight-line motion

A $a = 0$

B $v = 0$ ✓

C $x = 0$

D $t = 0$

Worked steps

B.

Exam-style 3.3 ▪ 1 mark

$x(t) = t^2 - 4t$.
(a) Find $v(t)$.
(b) Find $a(t)$.
(c) Find when $v = 0$.

Solution 3.3

Worked steps

(a) $v(t) = 2t - 4$ B1. (b) $a(t) = 2$ B1. (c) $t = 2$ B1.