

## 4.2 Straight-Line Motion: Position, Velocity, and Acceleration

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Name: \_\_\_\_\_ Class: \_\_\_\_\_ Date: \_\_\_\_\_

Total: 9 marks

**KEY WORDS** velocity 速度 • acceleration 加速度 • at rest 静止 • position 位置 • speed 速率

### Objective

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Build the skills to answer exam questions on **straight-line motion: position, velocity, and acceleration**.

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

### 1 Worked examples

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Study these first. Each one shows the method for a question type used later.

#### ■ 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  $v > 0$ .

#### ■ Example

$$x(t) = t^2 - 4t: v(t) = 2t - 4 = 0 \text{ at } t = 2.$$

### 2 Practice

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2.1 State velocity in terms of position.

[1]

2.2 State acceleration in terms of velocity.

[1]

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

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### 3 Exam-style questions

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**3.1** Velocity is the derivative of [1]

|   |   |
|---|---|
| A | B |
| C | D |

**A** acceleration

**B** position

**C** speed

**D** distance

**3.2** The object is at rest when [1]

|   |   |
|---|---|
| A | B |
| C | D |

**A**  $a = 0$

**B**  $v = 0$

**C**  $x = 0$

**D**  $t = 0$

**3.3**  $x(t) = t^2 - 4t$ .

(a) Find  $v(t)$ . [1]

(b) Find  $a(t)$ . [1]

(c) Find when  $v = 0$ . [1]