

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

Name: _____ Class: _____ Date: _____

Total: 9 marks

Objective

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

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

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]

3 Exam-style questions

3.1 Velocity is the derivative of [1]

- **A** acceleration
 - **B** position
 - **C** speed
 - **D** distance
-

3.2 The object is at rest when [1]

- **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]

4 Go further

- work through the **4.2 Straight-Line Motion: Connecting Position, Velocity, and Acceleration** lesson on the **Learn** page;
- read the **Contextual Applications of Differentiation** section of the AP Calculus BC handout on the **Know** page.

Solutions

2.1 $v(t) = x'(t)$.

2.2 $a(t) = v'(t)$.

2.3 $v(t) = 2t - 4$; at rest when $2t - 4 = 0$, i.e. $t = 2$.

3.1 B.

3.2 B.

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