

Solutions

Each answer shows the steps, then the **result**.

2.1

- velocity is the derivative of position; use the power rule:

$$v = \frac{dx}{dt} = \frac{d}{dt}(2t^3)$$

- $v = \mathbf{6t^2}$

2.2

- acceleration is the derivative of velocity:

$$a = \frac{dv}{dt} = \frac{d}{dt}(6t)$$

- $a = \mathbf{6 \text{ m s}^{-2}}$ (constant)

2.3

- integrate the acceleration; the constant is the initial velocity:

$$v = v_0 + \int_0^t a \, dt = 5 + 3t$$

- $v(t) = \mathbf{5 + 3t}$ (v in m s^{-1} , t in s)

2.4

- displacement is the area under the v - t graph, here a rectangle:

$$\Delta x = v \Delta t = (8 \text{ m s}^{-1})(3 \text{ s})$$

- $\Delta x = \mathbf{24 \text{ m}}$

3.1 B

- velocity is the derivative of position

3.2 B

- the slope of the tangent gives the velocity

3.3

(a)

- differentiate the position term by term:

$$v = \frac{dx}{dt} = \frac{d}{dt}(t^3 - 6t)$$

- $v = \mathbf{3t^2 - 6}$

(b)

- differentiate the velocity:

$$a = \frac{dv}{dt} = \frac{d}{dt}(3t^2 - 6)$$

- $a = \mathbf{6t}$

3.4

(a)

- integrate the acceleration; starting from rest gives $v_0 = 0$:

$$v = v_0 + \int_0^t 6t \, dt = 0 + 3t^2$$

- $v = \mathbf{3t^2}$

(b)

- substitute $t = 2 \text{ s}$ into $v = 3t^2$:

$$v(2) = 3(2)^2$$

- $v = \mathbf{12 \text{ m s}^{-1}}$