## Solutions

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

**2.1**

- $v = u + at = 4 + 3(5) = 19$ m s$^{-1}$

**2.2**

- gradient $= \dfrac{14 - 2}{6 - 0} = 2$ m s$^{-2}$

**3.1 C**

- $v = u + gt = 0 + 10(3) = 30$ m s$^{-1}$

**3.2**

(a)

- $v^2 = u^2 + 2as$: $0 = 30^2 + 2a(75)$; $a = -\dfrac{900}{150} = -6$, so deceleration 6 m s$^{-2}$

(b)

- $v = u + at$: $0 = 30 - 6t \Rightarrow t = 5$ s

**3.3**

(a)

- $v = 0$: $12t - 3t^2 = 0 \Rightarrow 3t(4 - t) = 0 \Rightarrow t = 4$ s

(b)

- $v \geqslant 0$ for $0 \leqslant t \leqslant 4$, so distance $= \displaystyle\int_0^4 (12t - 3t^2)\,dt = [6t^2 - t^3]_0^4; = 96 - 64 = 32$ m

**3.4**

(a)

- $s = \frac{1}{3}t^3 - 2t^2 + 3t$; at $t = 4$, $s = \frac{64}{3} - 32 + 12 = \mathbf{\frac{4}{3}}$ m

(b)

- $v = (t - 1)(t - 3)$, so the particle is at rest at $t = 1$ and $t = 3$ and moves backwards between them
- $s(1) = \frac{4}{3}$, $s(3) = 0$, $s(4) = \frac{4}{3}$, so distance $= \frac{4}{3} + \frac{4}{3} + \frac{4}{3} = \mathbf{4}$ m

(c)

- displacement is a vector, so backward motion cancels; distance is a scalar and counts it all

**3.5**

(a)

- graph: straight line from $(0, 0)$ to $(5, 10)$, horizontal to $(15, 10)$, straight line down to $(19, 0)$
- area under the graph $= \frac{1}{2}(5)(10) + 10(10) + \frac{1}{2}(4)(10) = \mathbf{145}$ m

(b)

- $145/19 = \mathbf{7.6}$ m s$^{-1}$