Solutions

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

2.1

- $a = v\dfrac{dv}{dx}$

2.2

- $\int v\,dv = \int 2x\,dx \Rightarrow \frac{1}{2}v^2 = x^2 + C$; $v = 0$ at $x = 0 \Rightarrow C = 0$, so $v^2 = 2x^2$

3.1 B

- Use $a = v\dfrac{dv}{dx}$ for a position-dependent force

3.2

(a)

- $2v\dfrac{dv}{dx} = 6x$, i.e. $v\dfrac{dv}{dx} = 3x$

(b)

- $\int v\,dv = \int 3x\,dx \Rightarrow \frac{1}{2}v^2 = \frac{3}{2}x^2 + C$; at $x = 0$, $v = 2 \Rightarrow C = 2$; at $x = 2$: $\frac{1}{2}v^2 = 6 + 2 = 8 \Rightarrow v^2 = 16$; $v = 4$ m s^{-1}

3.3

- $v = \int(4 - 2t)\,dt = 4t - t^2 + C$; $v = 0$ at $t = 0 \Rightarrow C = 0$; at $t = 3$: $v = 12 - 9 = 3$ m s^{-1}; the force has reversed (since $4 - 2t < 0$ for $t > 2$), so the particle is slowing after $t = 2$