

Solutions

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

2.1

- rotational kinetic energy:

$$K = \frac{1}{2}I\omega^2 = \frac{1}{2}(2 \text{ kg m}^2)(3 \text{ rad s}^{-1})^2$$

- $K = \mathbf{9 \text{ J}}$

2.2

- Nine times (ω is squared)

2.3

- Translational $\frac{1}{2}mv^2$ and rotational $\frac{1}{2}I\omega^2$

2.4

- $K = \frac{1}{2}I\omega^2$, rearranged for ω :

$$\omega = \sqrt{\frac{2K}{I}} = \sqrt{\frac{2(18 \text{ J})}{4 \text{ kg m}^2}}$$

- $\omega = \mathbf{3 \text{ rad s}^{-1}}$

3.1 B

- $K = \frac{1}{2}I\omega^2$

3.2 C

- a rolling object has both terms

3.3

(a)

- rotational kinetic energy:

$$K = \frac{1}{2}I\omega^2 = \frac{1}{2}(0.8 \text{ kg m}^2)(5 \text{ rad s}^{-1})^2$$

- $K = \mathbf{10 \text{ J}}$

(b)

- $K \propto \omega^2$, so doubling ω gives four times the energy: $4 \times 10 \text{ J} = \mathbf{40 \text{ J}}$

3.4

(a)

- $K_{\text{total}} = K_{\text{trans}} + K_{\text{rot}} = 12 \text{ J} + 6 \text{ J} = \mathbf{18 \text{ J}}$

(b)

$$\bullet \frac{K_{\text{rot}}}{K_{\text{total}}} = \frac{6 \text{ J}}{18 \text{ J}} = \frac{1}{3}$$