

A basketball rolls along a horizontal floor with constant linear velocity v

- 1) What fraction of total kinetic energy is rotational?
- 2) How does the fraction change if the speed is increased to $2v$?

$$\begin{aligned} E_K &= E_{K_T} + E_{K_R} \\ &= \frac{1}{2} m v^2 + \frac{1}{2} I \omega^2 \end{aligned}$$

$$I = \frac{2}{3} m r^2 \quad \text{hollow sphere}$$

$$\omega = \frac{v}{r}$$

$$= \frac{1}{2} m v^2 + \frac{1}{2} \left(\frac{2}{3} m r^2 \right) \left(\frac{v^2}{r^2} \right)$$

$$= \frac{1}{2} m v^2 + \frac{1}{3} m v^2$$

$$= \frac{5}{6} m v^2$$

$$\frac{\frac{1}{3} m v^2}{\frac{5}{6} m v^2} = \frac{\frac{1}{3} \frac{16}{5} v^2}{v^2} = \frac{2}{3}$$

40%

$$\frac{\frac{1}{3} m (2v)^2}{\frac{5}{6} m (2v)^2}$$

40% No change