More Rotational Motion

Moment of inertia for various shapes

$$I = \sum_i m_i r_i^2$$

$I_{hoop} = Mr^2$

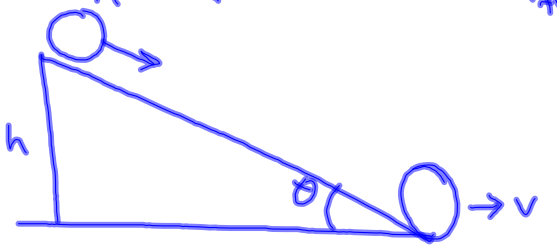
$I_{sphere} = \frac{2}{5}Mr^2$ (solid sphere)

$I_{hollow\ sphere} = \frac{2}{3}Mr^2$

$I_{disk} = \frac{1}{2}Mr^2$

$I = \beta Mr^2$

↖ for simple objects



$$mgh = \frac{1}{2}mv^2 + \frac{1}{2}I\omega^2$$

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

$$= \frac{1}{2}mv^2 + \frac{1}{2}\beta mr^2\frac{v^2}{r^2}$$

$$= \frac{1}{2}mv^2(1+\beta)$$

$v = \omega r$

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

$$\frac{2gh}{1+\beta} = v^2$$

$$v = \sqrt{\frac{2gh}{1+\beta}}$$

The greater the moment of inertia, the more slowly it rolls.