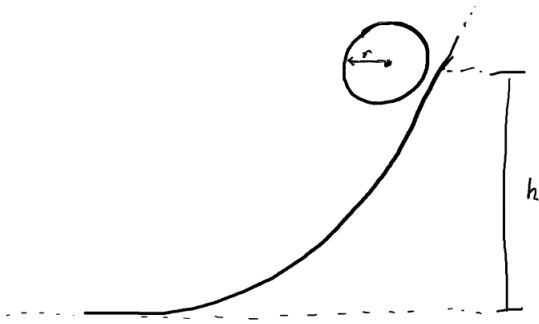


22-R-WE-TW-20



A wheel of mass 4 kg and radius $r = 0.1$ m starts at rest and rolls down a hill of height $h = 4$ m. You measure the speed of the wheel's center of mass at the bottom of the hill to be $v = 6.57$ m/s. If the wheel rolls without slipping and there is no energy lost due to friction, what is the radius of gyration of the wheel? (Use $g = 9.81$ m/s²)

Solution:

$$V_g = mgh$$

$$E_0 = E_f$$

$$T_0 + V_g = T_f$$

$$0 + mgh = \frac{1}{2}mv^2 + \frac{1}{2}I\omega^2$$

$$I = mk^2$$

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

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

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

$$k^2 = r^2 \left(\frac{2gh}{v^2} - 1 \right)$$

$$k = r \sqrt{\frac{2gh}{v^2} - 1} = (0.1) \sqrt{\frac{2(9.81)(4)}{6.57^2} - 1} = 0.0905 \text{ [m]}$$