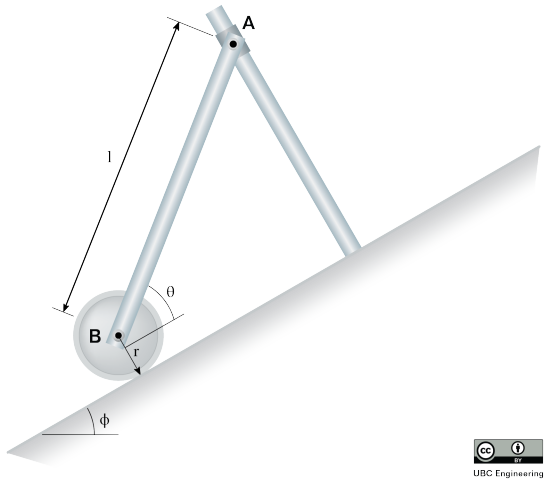
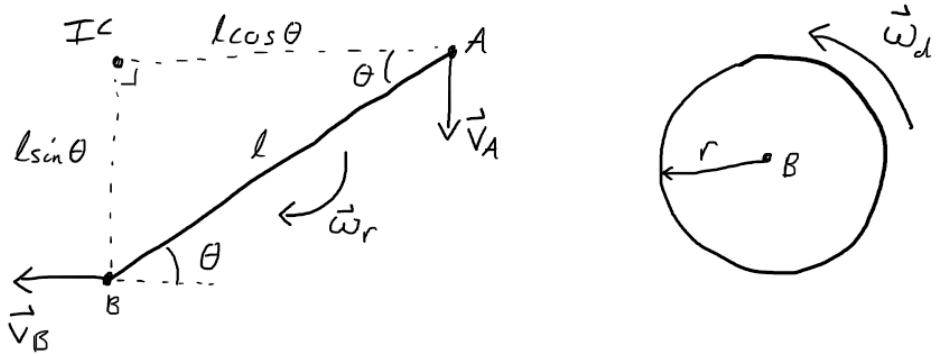
22-R-WE-TW-19



A wheel of mass 2 kg and radius $r = 0.15$ m is connected to a massless rod which is joined with a pin joint to a slider at point A. If the slider moves down its guide at a speed of 0.5 m/s, what is the total kinetic energy of the wheel when the angle $\theta = 45°$? (Treat the wheel as a uniform disk)

Solution:



$$I_B = \frac{1}{2}mr^2 = \frac{1}{2}(2)(0.15)^2 = 0.0225 \text{ [kg} \cdot \text{m}^2\text{]}$$

$$v_A = \omega_r l \cos\theta$$

$$v_B = \omega_r l \sin\theta$$

$$\frac{v_B}{v_A} = \tan\theta$$

$$v_B = v_A \tan\theta = 0.5 \text{ [m/s]}$$

$$v_B = \omega_d r \Rightarrow \omega_d = \frac{v_B}{r} = \frac{0.5}{0.15} = 3.33 \text{ [rad/s]}$$

$$T = \frac{1}{2}mv_B^2 + \frac{1}{2}I_B\omega_d^2$$

$$T = \frac{1}{2}(2)(0.5)^2 + \frac{1}{2}(0.0225)(3.33)^2 = 0.375 \text{ [J]}$$