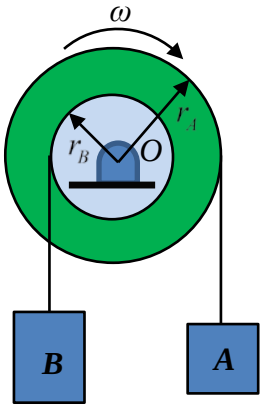
4-2. A double pulley, with a mass of $m_O \sim N(10,1^2)$ kg and a radius of gyration around its center of $k_O = 0.3$ m, consists of two parts connected to each other. The portion with $r_B = 0.2$ m is connected to block B, $m_B \sim N(10,1^2)$ kg, while the portion with $r_A = 0.4$ m is connected to block A, $m_A \sim N(5,0.5^2)$ kg. If the weight of the cables is negligible and they do not slip, find the kinetic energy of the system when $\omega = 5$ rad/s clockwise.



Solution:

$$\begin{aligned} T &= \frac{1}{2} I_O \omega_O^2 + \frac{1}{2} m_A v_A^2 + \frac{1}{2} m_B v_B^2 \\ &= \frac{1}{2}\left(m_O k_O^2\right)\omega^2 + \frac{1}{2} m_A \left(\omega r_A\right)^2 + \frac{1}{2} m_B \left(\omega r_B\right)^2 \\ &= \frac{1}{2} k_O^2 \omega^2 m_O + \frac{1}{2} r_A^2 \omega^2 m_A + \frac{1}{2} r_B^2 \omega^2 m_B \end{aligned}$$

$$\mu_T = \frac{1}{2} k_O^2 \omega^2 \mu_{m_O} + \frac{1}{2} r_A^2 \omega^2 \mu_{m_A} + \frac{1}{2} r_B^2 \omega^2 \mu_{m_B} = 26.25 \text{ J}$$

$$\sigma_T = \sqrt{\left(\frac{k_O^2 \omega^2}{2}\right)^2 \sigma_{m_O}^2 + \left[\frac{\left(\omega r_A\right)^2}{2}\right]^2 \sigma_{m_A}^2 + \left[\frac{\left(\omega r_B\right)^2}{2}\right]^2 \sigma_{m_B}^2} = 1.59 \text{ J}$$

Therefore, $T \sim N(26.25,1.59^2)$ J . **Ans.**