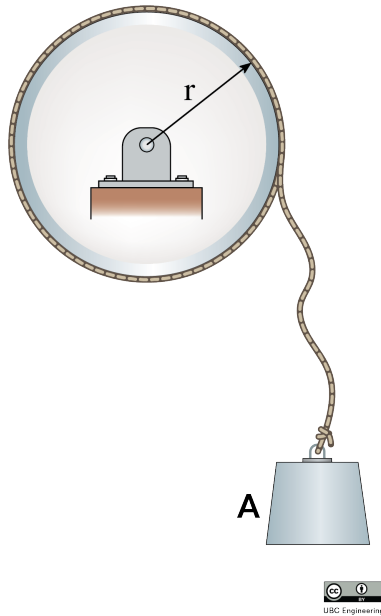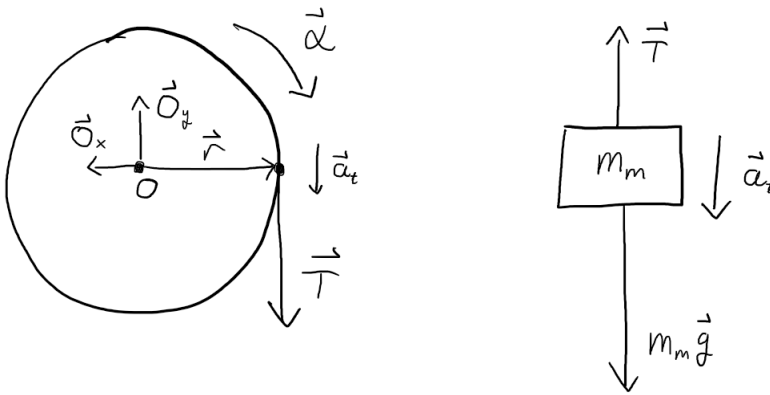# 22-R-KIN-TW-13

A mass of 15 kg is attached to a rope connected to a wheel of mass 30 kg and radius $r = 1$ m. Find the angular acceleration of the wheel.(Use $g = 9.81$ m/s^2 and treat the wheel as a thin cylinder)

Solution:

$$(F_y)_{mass} : T - m_m g = -m_m a_t$$

$$(M_O)_{wheel} : \vec{r} \times \vec{T} = I_O \vec{\alpha}$$

$$I_O = \frac{1}{2} m_{wheel} r^2 = (0.5)(30)(1)^2 = 15 \text{ kg} \cdot \text{m}^2$$

$$\vec{a}_t = \vec{\alpha} \times \vec{r}$$

$$m_m g - T = m_m \alpha r$$

$$T = m_m (g - \alpha r)$$

$$r m_m (g - \alpha r) = I_O \alpha$$

$$rm_mg = \alpha(I_O + r^2 m_m)$$

$$\vec{\alpha} = \frac{rm_mg}{I_O + r^2 m_m} = \frac{(1)(15)(9.81)}{15 + (1)^2(15)} = -4.905\hat{k} \text{ rad/s}^2$$