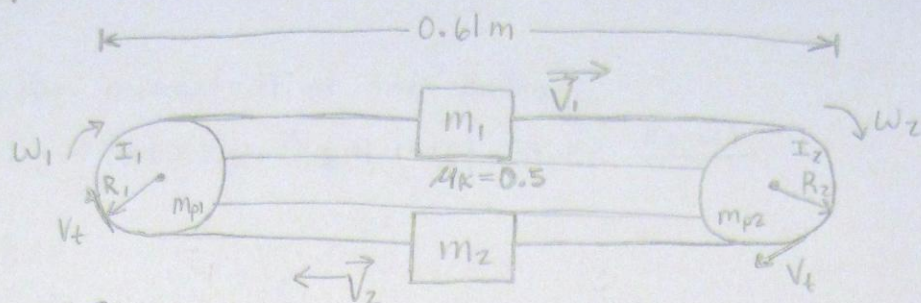


Conveyor Moving at Constant Velocity, therefore acceleration is zero



$$m_{p1} = m_{p2} = 2.3 \text{ kg} = m_p$$

$$m_1 = 0.5 \text{ kg} = m_1$$

$$m_2 = 0.05 \text{ kg} = m_2$$

$$V_t = R\omega = (0.064 \text{ m}) 6.4 \frac{\text{rad}}{\text{s}} = 0.4096 \text{ m/s} \approx 0.41 \text{ m/s} = V_t$$

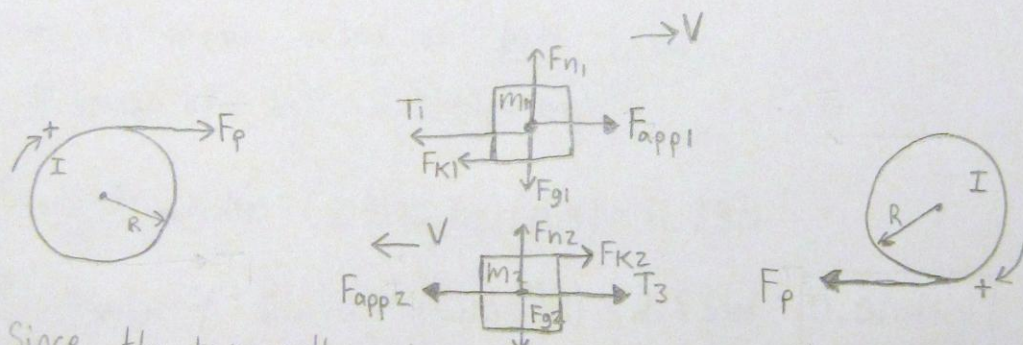
$$V_1 = V_2 = 0.25 \text{ m/s} = V$$

$$R_1 = R_2 = 0.064 \text{ m} = R$$

$$\omega_1 = \omega_2 = 6.4 \text{ rad/s} = \omega$$

$$I_1 = I_2 = \frac{1}{2} m_p R^2 = \frac{1}{2} (2.3 \text{ kg}) (0.064 \text{ m})^2 = 0.005 \text{ kg} \cdot \text{m}^2 = I$$

Free-Body Diagram:



★ Since the two pulleys turn at a constant ω , $\alpha = 0$

Newton on m_1 :

$$F_{g1} = 4.9 \text{ N}$$

$$F_{k1} = \mu_k F_n = -2.45 \text{ N}$$

$$\sum F_x = ma = 0 \Rightarrow F_{k1} + F_{app1} = 0 \Rightarrow F_{app1} = -F_{k1}$$

$$|F_{app1}| = 2.45 \text{ N}$$

Newton on m_2 :

$$|F_{app2}| = m_2 g \mu_k = 0.245 \text{ N}$$

Power to move both masses:

$$F_T = |F_{app1}| + |F_{app2}| = 2.7 \text{ N}$$

$$P = F_T V = 2.7 \text{ N} (0.25 \text{ m/s}) = 0.68 \text{ W}$$

$$\approx 0.001 \text{ hp}$$

Angular momentum of the pulleys:

$$L = I\omega = (0.005 \text{ Kg} \cdot \text{m}^2)(6.4 \text{ rad/s}) = 0.032 \frac{\text{Kg} \cdot \text{m}^2}{\text{s}}$$

$$P = \tau \omega$$

$$\tau = I\alpha$$

$$\alpha = 0 \text{ to } 6.4 \text{ rad/s} \text{ in } 1 \text{ s} \Rightarrow \alpha = 6.4 \text{ rad/s}^2$$

$$\tau_{\text{needed}} = (0.005 \text{ Kg} \cdot \text{m}^2)(6.4 \text{ rad/s}^2) = 0.032 \text{ N} \cdot \text{m}$$

$$P = \tau \omega = 0.032 \text{ N} \cdot \text{m} (6.4 \text{ rad/s}) = 0.21 \text{ W}$$

Since there are two pulleys $P_{\text{Tot}} = 2P$

$$P_{\text{Tot}} = 0.42 \text{ W} = 0.000563 \text{ hp} = \boxed{0.001 \text{ hp}}$$

The belt weighs $0.55 \text{ Kg}/0.31 \text{ m}$

Power to move 1.3 m of belt 1.3 m :

$$\text{Total mass of belt} = 2.31 \text{ Kg} = m_b$$

$$|F_{\text{app}}|_b = m_b g \mu_k = (2.31 \text{ Kg})(g)(0.5) = 11.33 \text{ N}$$

$$P = |F_{\text{app}}|_b \cdot v = (11.33 \text{ N})(0.25 \text{ m/s}) = 2.83 \text{ W} = \boxed{0.004 \text{ hp}}$$

Total Power needed to move both masses, spin both pulleys, and move the belt:

$$P_{\text{TOTAL}} = 0.001 \text{ hp} + 0.001 \text{ hp} + 0.004 \text{ hp} = 0.006 \text{ hp}$$

Assume 75% Motor Efficiency:

$$P_{\text{out}} = 0.75 P_{\text{IN}}$$

$$P_{\text{IN}} = \frac{4}{3} P_{\text{out}} = \frac{4}{3} (0.006 \text{ hp}) = 0.008 \text{ hp}$$

Multiply by two for Assurance:

$$\text{HP Needed} = 0.016 \text{ hp} \\ \approx \frac{1}{60} \text{ hp}$$