A rope is wrapped around the pulley and connected to the two masses as shown. There is no slippage between the rope and the pulley—namely, the rope will cause the pulley to undergo an angular acceleration \( \alpha \). The moment of inertia of the pulley about \( O \) is \( I_0 \), its mass is \( M_1 \), and the torque due to friction about the bearing at \( O \) is \( \tau_{fr} \), and the tensions are \( T_A \) and \( T_B \) as shown. Assume a bearing force \( B \) that is holding up the system.

(3) 1. Draw a FBD of the pulley.

2. Write Newton's 2nd Law for rotation for the FBD and apply it using \( I_0 \), \( \alpha \), \( T_A \), \( T_B \), \( R \), \( \tau_{fr} \), \( M_1 \), and \( B \) as described.

\[
\sum \tau = I_0 \alpha + T_B R - T_A R + B(o) + M_1(o) - \tau_{fr} = I_0 \alpha
\]

B. An object accelerates at a constant rate from \( 0 \text{ rad/s} \) to \( 2 \frac{m}{s} \) along \( \frac{1}{4} \) of a circular arc having radius \( 0.5 \text{ m} \).

1. Find the angle turned through in radians. \( \Theta = \Theta_0 = \left( 90^\circ \right) \left( \frac{\pi \text{ rad}}{180^\circ} \right) = \frac{\pi}{2} \text{ rad} = 1.57 \text{ rad} \)

2. Find the distance traveled.

\( s = r \Theta = (0.5 \text{ m}) (1.57 \text{ rad}) = 0.79 \text{ m} \)

3. Find the tangential acceleration. From Big 4: \( v^2 = v_0^2 + 2 a_s \) or \( a = \frac{v^2}{2s} = \frac{(2 \text{ m/s})^2}{2(0.79 \text{ m})} = \)

4. Find the radial acceleration when the object is moving at \( 2 \frac{m}{s} \).

\( a_{rad} = \frac{v^2}{R} = \frac{(2 \text{ m/s})^2}{0.5 \text{ m}} = \)

5. Find the angular acceleration.

\( \alpha = \frac{a_{tan}}{R} = \frac{2.55 \text{ m/s}^2}{0.5 \text{ m}} = \)

6. Find the angular velocity when the object is moving at \( 2 \frac{m}{s} \).

\( v = R \omega \)

\( \frac{2m}{s} = (5 \text{ m}) \omega \)

\( \omega = \frac{2 \text{ m/s}}{5 \text{ m}} = 0.4 \text{ rad/s} \)

Some of you found the time.

\( \Theta = \omega t \)

\( \frac{\pi}{4} = \frac{0.4 \text{ rad/s}}{\frac{\pi}{2} \text{ rad/s}} \cdot t = \frac{1}{4} \pi \cdot s = 0.79 \text{ s} \)

EQNS \( \Sigma F_x = m_0 \alpha \) \( \Sigma F_y = m_0 g \) \( \Sigma \tau = I_0 \alpha \) Connectors: \( F = D \) \( \frac{F}{R} \) \( w = \omega_0^2 + 2 \omega (\Theta - \Theta_0) \)

\( s = \Theta t \)

\( v = R \omega \)

\( \alpha_{tan} = \alpha \)

\( \alpha_{rad} = \frac{v}{R} \)

\( w = \frac{v}{R} \alpha \)