Rotational Dynamics Activity 1   Name:

A block with mass 'm_1' is connected by a rope across a frictionless pulley with mass 'm_2' and diameter 'd'. A constant force 'F' as tension is applied to the other end of the rope. m_1: _____ m_2: _____ d: _____ F: _____

What is the magnitude and direction of the acceleration of the block? Parts a – f are steps for deriving an equation for a. Please show your work. $g = 10\ m/s^2$

a.) Draw a free body diagram for both the block and pulley.

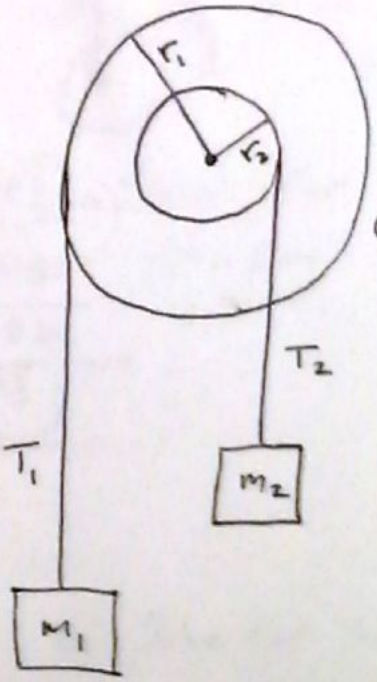
b.) Apply Newton's Law and solve for tension.

c.) Use $\tau = I\alpha$ and use $I_{disk} = \frac{1}{2} m r^2$ to relate tension and α.

d.) Recall that $a = \alpha r$ and account for direction of rotation.

e.) Combine the equations from parts b, c and d.

f.) Solve for a.



Rotational Dynamics Activity 2

r_1: ____ r_2: ____ m_1: ____ m_2: ____ I: ____

① Solve for α, a_1 and a_2. Use $g = 10\ m/s^2$

② Solve for T_1 and T_2

a.) Draw freebody diagrams for m_1 and m_2

b.) Use Newton's 2nd Law to derive two equations.

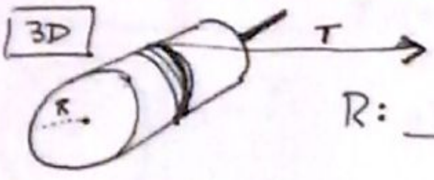
c.) Derive an equation for net torque and use $\tau = I\alpha$

d.) Use $a_1 = a_{T_1} = \alpha \cdot r_1$ & $a_2 = a_{T_2} = \alpha r_2$ to solve for α.

e.) Use α to find a_1 and a_2.

f.) Solve for T_1 and T_2.

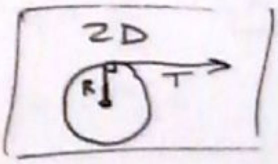
Rotational Dynamics Activity 3 Name: ________



R: ______ T: ______ $Mass_1$: ______ $I_{cylinder} = \frac{1}{2} m R^2$

#1 a.) Solve for α. First derive an equation for α.

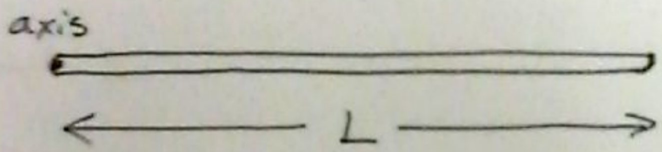
Use: $\tau = I\alpha$



b.) Solve for ω_f after 3 seconds. Assume $\omega_o = 2$ rad/sec.

c.) How much time is required to reach $\omega_f = 300 \frac{rad}{sec}$

$I = \frac{1}{3} m L^2$

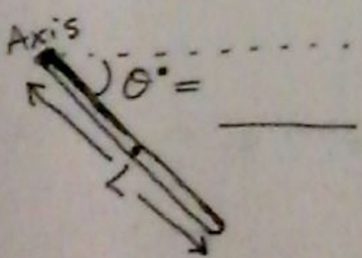


Uniform Rod $g = 10\ m/s^2$

L: ______ $Mass_2$: ______

#2 Solve for α. First derive an equation for α.

#3

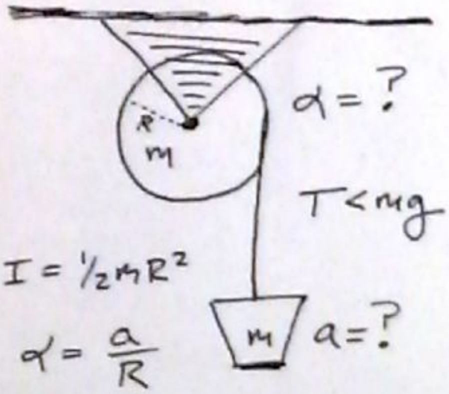


The same uniform rod is now $\theta°$ from horizontal

Solve for α. First derive an equation for α.

Rotational Dynamics Activity 4 Name: ____________

M: ______ R: ______



$I = \frac{1}{2} M R^2$

$\alpha = \frac{a}{R}$

$g = 10\ m/s^2$

A.) Draw a free body diagram for the bucket

B.) Draw a free body diagram for the wheel.

c.) Using $\Sigma F = m \cdot a$ and $\tau_{net} = I\alpha$, derive an equation for a.

d.) Solve for a.

e.) Solve for α.

F.) If $\omega_0 = 10\ rad/s$, what is ω_F after 60 seconds?

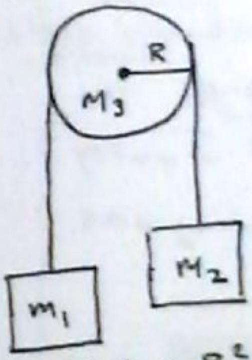
g.) What is the speed of the bucket after 60 seconds?

$g = 10\,m/s^2$

Rotational Dynamics Activity 5

Name:

M_1: ____ M_2: ____ M_3: ____ R: ____



$I = \frac{1}{2} M_3 R^2$

In an Atwood machine, a block of mass m_1 and a less massive block of M_2 are connected by a string that passes over a pulley of mass M_3 and Radius R. ① What are the translational accelerations a_1 and a_2 of the two blocks? ② What is the rotational acceleration α of the pulley?

Ⓐ Draw free body diagrams of the forces and torques.

Ⓑ Create equations using $\Sigma F = m \cdot a$ and $\tau = I\alpha = r_\perp F$ and $\alpha = \frac{a}{R}$

Ⓒ Use substitution to combine the equations from part B.

ⓓ Solve and evaluate for a_1 and a_2 and α.

ⓔ If you neglect the mass of the pulley, what is the acceleration equation? Where have you seen this before?