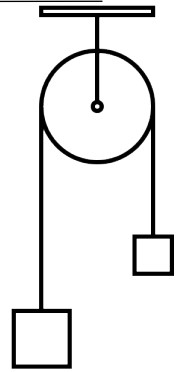


PHY 123 Lab 5 – Rotation Kinematics & Torque Workshop

The purpose of this open-ended experiment is to explore the concepts of rotational kinematics and torque. You will design and conduct experiments to apply Newton’s second law to rotating systems, Newton’s first law to a system in equilibrium, and you will practice calculating rotational quantities.

(A) Rotational Acceleration (Net Torque)

- Using the pulley and photogate system, attach two different masses to a string to create an Atwood’s machine, as shown to the right. Choose masses that have relatively close quantities. Set the photogate to the correct settings for measuring the motion of the pulley – the mode should read “photogate timing,” with “photogate mode” measuring the “pulley” and “outside edge” for 25 events.
- Release the system from rest and collect data on its motion. As we saw last time, the graph will display tangential velocity vs. time. We will assume the friction acting on the pulley is negligible, as is the mass of the string.
- Use your data to calculate the following showing all work and using correct units:
 - Tangential acceleration of the system (how did you find this?).
 - Angular acceleration of the system (circumference of inner groove = 0.150 m).
 - Sum of the torques acting on the pulley (neglecting F_f).



a_T	
α	
$\sum \tau$	

(B) Force of Friction Acting on the Pulley

1. Previously we assumed negligible friction on the pulley but we know there must be some degree of friction or the pulley would spin forever. Remove the masses and string.
 - Spin the pulley and devise a procedure for estimating the frictional torque acting on it (you may use the photogate for this). Use your calculated value for the moment of inertia of the pulley from part A.
 - Estimate the number of revolutions from start to finish. Show your calculations below with appropriate formulas and correct units.

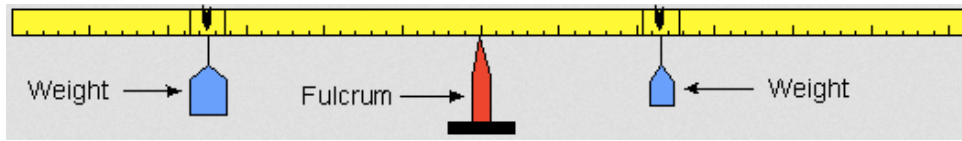


FRictionAL TORQUE ACTING ON PULLEY

NUMBER OF REVOLUTIONS

(C) Rotational Equilibrium

1. Balance a meter stick on a fulcrum using two different masses attached to two different positions, as shown below. Test to make sure the system is well balanced. Sketch a free body diagram and determine the moment of inertia of the system, the sum of the torques, and the force of the fulcrum on the meter stick. Show your calculations with correct units.



FREE BODY DIAGRAM	I_{system}
FORCE OF FULCRUM ON METERSTICK	$\sum \tau$

2. Suppose you were to remove one of the masses (choose which one). Calculate the following showing all work with correct units:
 - Moment of inertia of the system.
 - Net torque on the system.
 - Angular acceleration of the system.
 - Tangential acceleration at the tip of the meter stick.
 - Rotational velocity after the system has rotated 90°.

I_{system}	
$\sum \tau$	
α	
a_T	
ω_f	