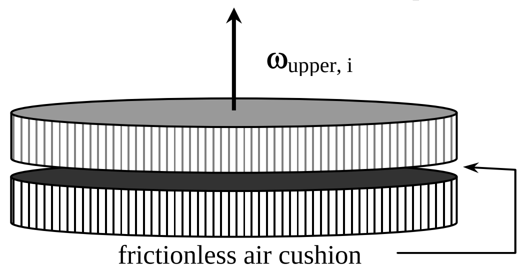
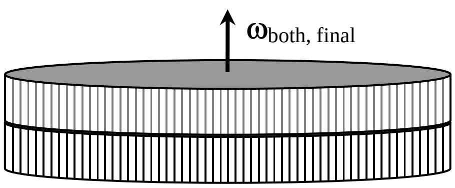
Lab #8 **Rotational Dynamics**
Physics 111 Name: ________________

The moment of inertia "I" reflects both the mass of an object as well as the location of that mass with respect to the pivot point. The moment of inertia for for an *individual* mass "m" is given by $I_{one\,mass} = mr^2$. The moment of inertia for a disk of mass "m" and radius "r" is given by $I_{disk} = \frac{1}{2}mr^2$. The moment of inertia for a sphere of mass "m" and radius "r" is given by $I_{sphere} = \frac{2}{5}mr^2$. Each of these has both m and r^2 but it's the factor in front of the mr^2 that makes each moment of inertia unique.

Angular collisions—spinning disks ($I_{disk} = \frac{1}{2}mr^2$)



Consider the two disks separated by a ***frictionless*** cushion of air. The upper disk is spinning with an initial angular speed $\omega_{upper,i}$, while the lower disk is stationary.



two disks in contact, after collision

←Here, the cushion of air has been removed and the top disk has crashed down onto the bottom one. The top disk causes the bottom disk to start spinning, and they quickly spin with a ***common final angular velocity*** $\omega_{both,\,final}$.

A. Using the angular dynamics setups in the lab, start with the the ***<u>lighter</u>*** of the two upper disks.

- Spin the top disk so the digital readout is at least at "1,000." This is the number of lines on the side of the disk going past the photogate each second.
- Record the initial values for the lines/second for the top disk.
- Remove the pin from the center of the disks, allowing the air to escape and the top disk to crash into the lower disk.

Disk Measurements	mass	radius
Upper disk		
Lower disk		

Data	before contact	after contact
lines/second upper disk		
lines/second lower disk		

B. Repeat the above procedure with the ***<u>heavier</u>*** upper disk.

Disk Measurements	mass	radius
Upper disk		
Lower disk		

Data	before contact	after contact
lines/second upper disk		
lines/second lower disk		

Rotational Dynamics

Name: _________________

A. [20 pts] Recopy your data below for the collision of the ***lighter*** upper disk with the lower disk.

Disk Measurements	**mass**	**radius**
Upper disk		
Lower disk		

Data	**before contact**	**after contact**
lines/second upper disk		
lines/second lower disk		

Angular speeds	$\omega_i = (^{\text{lines per sec}}/_{200})\, 2\pi$ **(rad/sec)**	ω_f **(rad/sec)**
Upper disk		
Lower disk		

Calculate the moment of inertia of the upper disk:

Calculate the moment of inertia of the lower disk:

Calculate the ***initial total*** angular momentum of the ***system***.

Calculate the ***final total*** angular momentum of the ***system***.

Cite relevant numbers and ***explain*** whether the angular momentum was or was not conserved.

Calculate the ***initial*** total angular kinetic energy of the ***system***, and calculate the ***final*** total angular kinetic energy of the ***system***. State whether the kinetic energy of the system was conserved or not.

Lab #8

Rotational Dynamics

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B. [20 pts] Recopy your data below for the collision of the ***heavier*** upper disk with the lower disk.

Disk Measurements	**mass**	**radius**
Upper disk		
Lower disk		

Data	**before contact**	**after contact**
lines/second upper disk		
lines/second lower disk		

Angular speeds	$\omega_i = (^{\text{lines per sec}}/_{200})\, 2\pi$ **(rad/sec)**	ω_f **(rad/sec)**
Upper disk		
Lower disk		

Calculate the moment of inertia of the upper disk:

Calculate the moment of inertia of the lower disk:

Was the angular momentum of the ***system*** conserved according to your data? Justify your answer by calculating the initial and final angular momenta and comparing them.

Was the kinetic energy of the ***system*** conserved according to your data? Justify your answer by calculating the initial and final angular kinetic energies and comparing them.