CONSERVATION OF ANGULAR MOMENTUM

Off-center impact, sticking collision, and final angular speed

Name: _____	Period: _____	Date: _____

INVESTIGATION QUESTION **How does impact point affect the final angular speed of a rotating system?**

TIME 30 minutes	SIMULATION BuildPhysics > Conservation of Angular Momentum	UNIT 6 Energy & Momentum of Rotating Systems

Learning targets

- Calculate angular momentum about a chosen axis.
- Test angular-momentum conservation during a sticking collision.
- Relate impact parameter and incoming speed to final angular speed.

Model before you measure

A moving disk strikes and sticks to a freely rotating disk. During the short collision, external torque about the central pivot is negligible.	$L_i = mvb + I_{disk}\omega_i$ $L_f = I_{total}\omega_f$

Important: Measure impact parameter b as the perpendicular distance from the pivot to the incoming disk centerline. Angular momentum depends on the chosen axis.

Pre-lab prediction | 4 minutes

1. What happens to initial angular momentum as impact parameter increases?

2. Predict the final angular speed for a direct hit through the pivot, b = 0.

3. Is kinetic energy conserved when the disks stick together? Explain.

PART A Change impact parameter

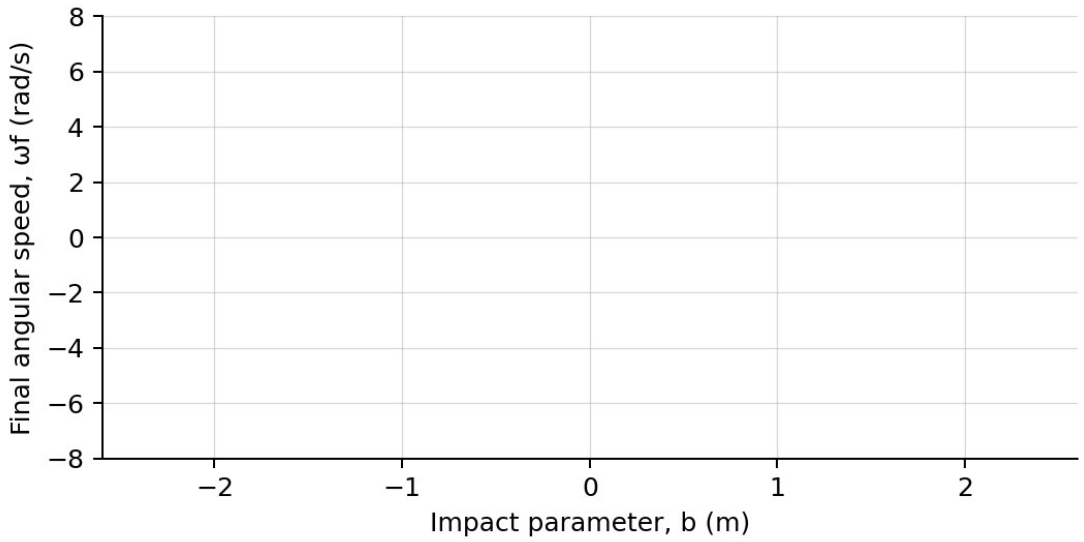
Setup | 3 minutes

- ☐ Load Conservation of Angular Momentum. Record both masses, radii, the rotating disk inertia, and incoming speed.
- ☐ Keep incoming speed and all object properties fixed.
- ☐ Move the incoming disk vertically to create the listed impact parameters.
- ☐ Reset, run through the sticking collision, and record angular momentum and final angular speed.

Sign convention: Choose counterclockwise as positive and record the sign of b, angular momentum, and angular speed consistently.

Data table | 10 minutes

Impact parameter b (m)	Initial orbital L (kg·m²/s)	Total L before (kg·m²/s)	Total L after (kg·m²/s)	Final ωf (rad/s)	K after / K before
-2.0					
-1.0					
0.0					
+1.0					
+2.0					



4. Plot final angular speed versus signed impact parameter. Draw a best-fit line.

PART B Change incoming speed

Speed test | 7 minutes

Fixed geometry: Choose one nonzero impact parameter and keep masses, radii, and all inertia values fixed.

Incoming speed (m/s)	Initial angular momentum (kg·m²/s)	Final angular speed (rad/s)	Total angular momentum after (kg·m²/s)
1.0			
2.0			
3.0			
4.0			

Analysis | 7 minutes

5. How closely was total angular momentum conserved across the collision?

6. How did impact parameter determine the magnitude and direction of final rotation?

7. What relationship did Part B show between incoming speed and final angular speed?

8. Why can angular momentum be conserved while kinetic energy decreases?

Claim-Evidence-Reasoning conclusion

Evaluate this claim: An off-center collision creates angular momentum only because the pivot exerts a torque during impact.

CLAIM	Accept, reject, or revise the statement.
EVIDENCE	Cite at least two measured trials or graph features.
REASONING	Use the system boundary, external torque about the pivot, and the equation L = mvb.

Exit ticket

A moving object passes twice as far from a pivot at the same speed. Predict its angular momentum about that pivot.