

Name: _____

DISC: _____

Score: ____ / 20

Instructions:

- Do your own work.
- Answer the questions below in the space provided.
- Make sure you show all your work and any equations that you use.
- Please place a box around your answers.
- Remember to give the correct units with all numerical answers.

| | | | |
|----|----|----|----|
| Q1 | Q2 | Q3 | Q4 |
| | | | |
| 10 | 10 | 5 | 5 |

1. A block of mass M is tied to a string fixed at the center of a frictionless circular disk as shown below. The block rotates with constant angular speed ω and radius R around the center.

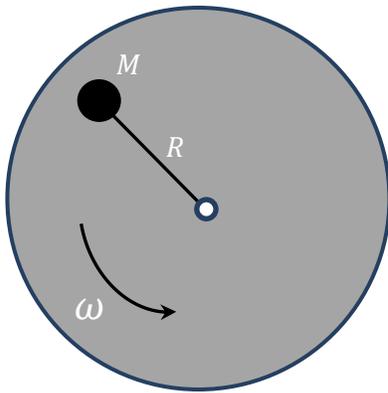


Table 1: Properties of the System

| R | M | I | ω |
|-------|--------|--------|----------|
| 1.4 m | 2.5 kg | MR^2 | 8 rad/s |

Figure 1: Top View of a Rotating Block

External Torques (2 pts):

- a. Are there external torques acting on this system around the axis of rotation?
- No, since the disk is frictionless.
 - Yes, since the string has tension pulling on the block.

Explanation of Conservation (3 pts):

- b. Like linear momentum, angular momentum is a conserved quantity. In your own words, explain the conditions under which angular momentum is conserved.

Angular Momentum (2 pts):

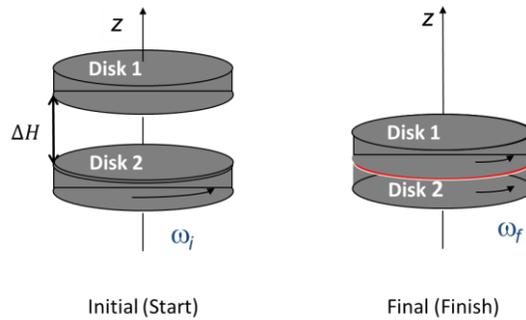
- c. Remember, angular momentum is $L = I\omega$. What is the angular momentum of the block?

New speed (3 pts):

- d. You pull on the string, reducing the radius of rotation to $1/4$ of the original radius. Calculate the new angular speed ω_{new} .

2. Consider a system consisting of two circular disks as shown below. Their masses, radii, and initial angular speeds are given as follows:

| DISK | MASS | RADIUS | INITIAL ω |
|------|-------|--------|------------------|
| 1 | 50 kg | 0.6 m | 0 rad/s |
| 2 | 40 kg | 0.6 m | 40 rad/s |



- a. Initially, Disk 1 is stationary and Disk 2 is rotating with angular speed ω_i as shown in the figure above (left panel). Disk 1 suddenly falls onto Disk 2; then, they stick together and rotate with angular speed ω_f as depicted in the right panel. Explain in your own words what you expect to be conserved and why.

Explanation (3 pts):

- b. Calculate the angular momentum for the *Initial* system.

Angular Momentum (2 pts):

- c. What is the *final* angular momentum of the system?

Angular Momentum (2 pts):

- d. Find the *final* angular speed (ω_f) of the system.

Final speed (3 pts):