Name:_____

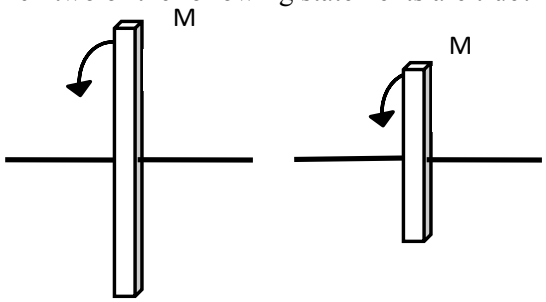
$\vec{L} = I\vec{\omega}$ $\quad \vec{\tau} = \frac{\Delta \vec{L}}{\Delta t}$ $\quad I = \sum_i mr^2$ $\quad \vec{\tau}_{external}\Delta t = \Delta \vec{L}_{system}$

1.) Which two roles did you play in this week's bicycle wheel lab?

Reader Actor Enforce Observer I did not attend lab

2.) Describe one scenario your lab group tested for which your observations or experiences surprised you. If nothing surprised you, please describe a scenario that confirmed your expectations. If you did not attend lab, please move on to the next question.

3.) Two rods of the same mass, but different lengths are spinning at the same angular speed about an axis of rotation at their centers. Which two of the following statements are true?



rod 1 rod 2

A.) The magnitude of the angular momentum of rod 1 is greater than that of rod 2.
B.) The magnitude of the angular momentum of rod 1 is less than that of rod 2.
C.) The magnitude of the angular momentum of rod 1 is equal to that of rod 2.
D.) The direction of the angular momentum of the rods is down.
E.) The direction of the angular momentum of the rods is up.
F.) The direction of the angular momentum of the rods is to the left.
G.) The direction of the angular momentum of the rods is to the right. 3._____

4.) A bicycle wheel is free to rotate about its axle. The wheel has a moment of inertia of 0.88 kg·m^2 and is spinning with an angular speed of 35.2 rad/s. Jane holds the axle of the wheel so that the axle is horizontal. She then tilts the axle by 90° until it is vertical, and stops.

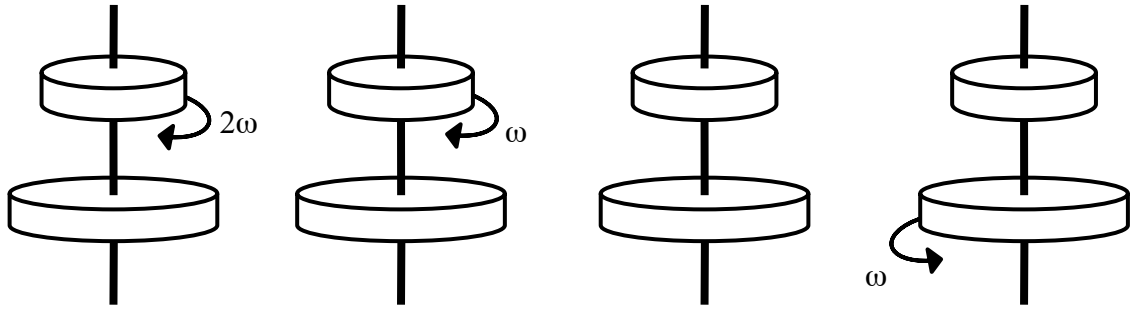
A.) Jane experiences a larger amount (magnitude) of resistance, or torque, when the axle is stopped at the vertical position than when the axle is in the horizontal position.
B.) Jane experiences the same amount (magnitude) of resistance, or torque, when the axle is stopped at the horizontal and vertical positions as when the axle is being tilted.
C.) Jane experiences a resistance, or torque, only while the axle is being tilted.
D.) Jane experiences a larger amount (magnitude) of resistance, or torque, when the axle is stopped at the horizontal and vertical positions than when the axle is being tilted.

4._____

5.) For each of the following ranking problems, two disks are free to rotate about an axle. **For every configuration, the moment of inertia of the lower disk is twice as large as the moment of inertia of**

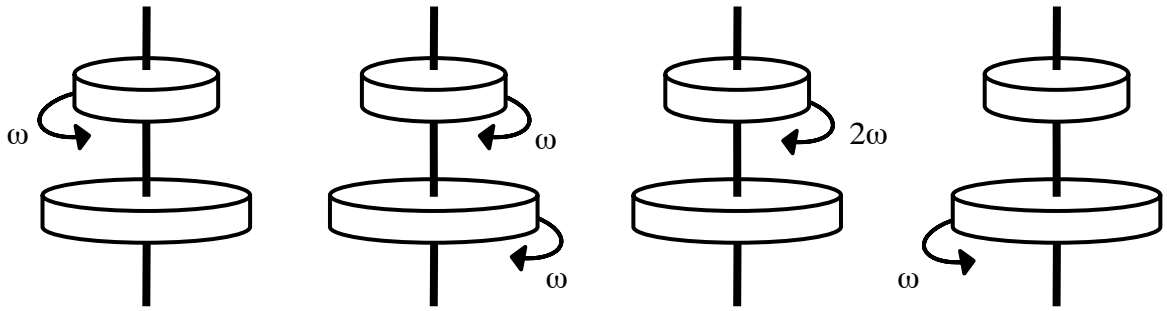
the upper disk. Each disk may rotate at an angular speed of ω or 2ω, or it may not rotate at all. For each set of four configurations, **rank the magnitudes of the angular momentum** of the systems from smallest to largest, with 1 being the smallest. Assign the same value to configurations that have the same magnitude of angular momentum.

A.)



_____ _____ _____ _____

B.) Again, rank the magnitudes of the angular momentum of the systems below, with 1 being the smallest. If more than on configuration has the same magnitude of angular momentum, assign the same number to those configurations.



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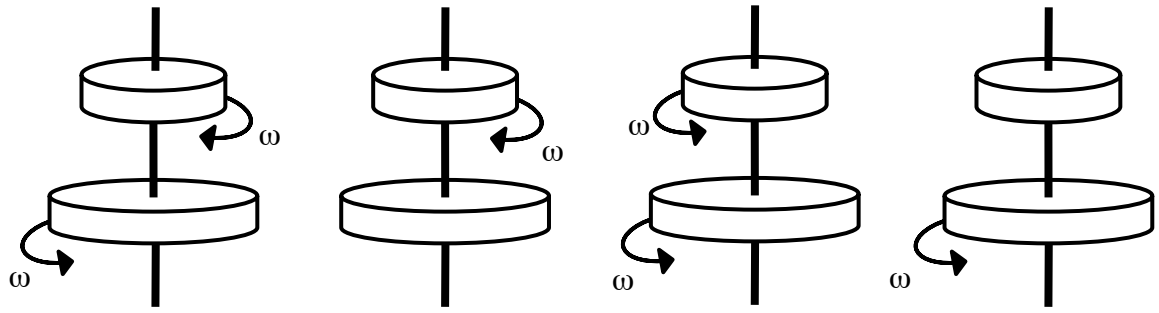
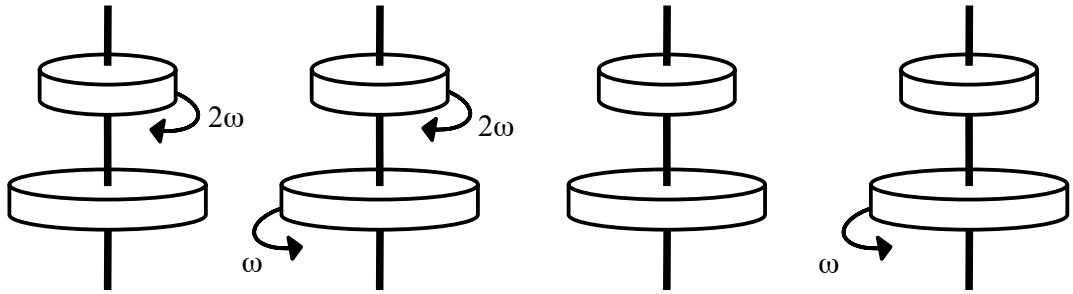
C.) Again, rank the magnitudes of the angular momentum of the systems below, with 1 being the smallest, assigning the same value to configurations with the same magnitudes of angular momentum.



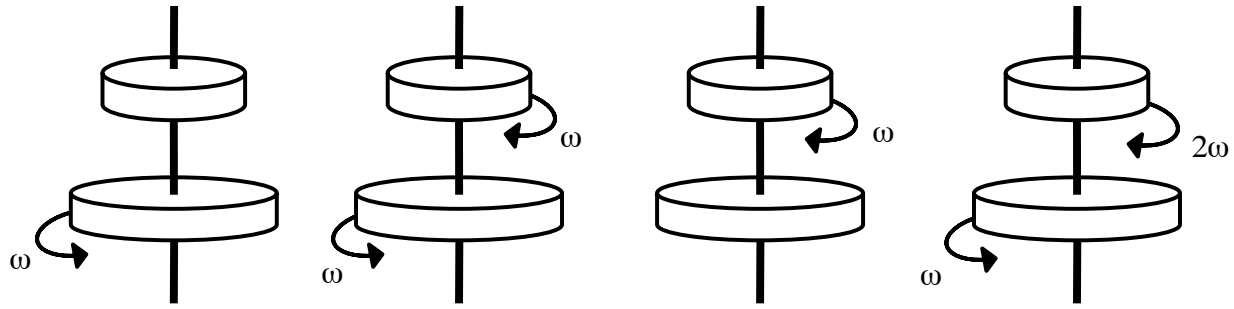
_____ _____ _____ _____

D.) Again, rank the magnitudes of the angular momentum of the systems below, with 1 being the smallest, assigning the same value to configurations with the same magnitudes of angular momentum.



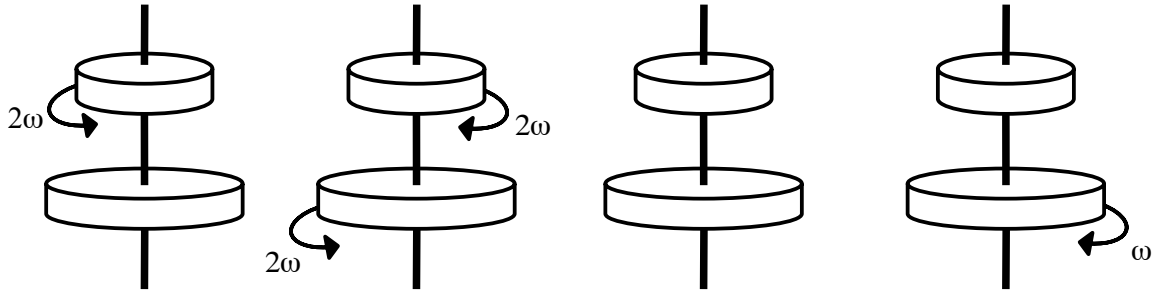
_____ _____ _____ _____

E.) Again, rank the magnitudes of the angular momentum of the systems below, with 1 being the smallest. If more than on configuration has the same magnitude of angular momentum, assign the same number to each configuration.



_____ _____ _____ _____

F.) Again, rank the magnitudes of the angular momentum of the systems below, with 1 being the smallest, assigning the same value to configurations with the same magnitudes of angular momentum.



_____ _____ _____ _____

6.) Casey is wondering why he experienced a significant resistance, or torque, when he tilted the axle of a spinning double bicycle wheel in his physics lab. His TA correctly explains that

A.) The direction of the angular momentum vector of the system changes as the axle is tilted.

B.) The magnitude of the angular momentum of the system changes as the axle is tilted.

C.) The angular speed of the wheels changes as the axle is tilted.

D.) The moment of inertia of the system changes as the axle is tilted.

6._____

You must show your work clearly in order to receive full credit for the following problems. When possible, please begin your work with an equation in variable form, such as given on the first page of the test.

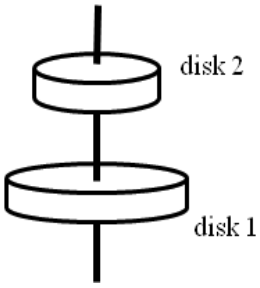
7. A single bicycle wheel is spinning about its axle at an angular speed of 10.2 rad/s. The wheel has a moment of inertia of 1.6 kg·m^2.

   A.) What is the magnitude of the angular momentum of the wheel?

   B.) The axle is rotated, or tilted, by 180° to its final position. Determine the magnitude of the change in angular momentum, $\Delta\vec{L} = \vec{L}_f - \vec{L}_i$, for the wheel.

8.) A child (m = 18.1 kg) is standing on the outer edge of a merry-go-round (I = 522.0 kg·m^2, r = 1.6 m). The merry-go-round is spinning with an angular speed of 6.1 rad/s. Mom says it's time to leave the park, and plucks the child (straight up) off of the merry-go-round. What is the angular speed of the merry-go-round after the child is removed?

9.) Two disks are free to rotate about the same axle. The moment of inertia of disk 1 is 5.1 kg·m^2, and the moment of inertia of the disk 2 is 1.7 kg·m^2. Disk 1 spins counterclockwise with an angular speed of 2.7 rad/s, and disk 2 spins clockwise with an angular speed of 8.1 rad/s.



A.) What is the magnitude of the angular momentum of the two-disk system?

B.) The axle is rotated, or tilted, by 180° from its initial to its final position. Determine the magnitude of the change in angular momentum, $\Delta\vec{L} = \vec{L}_f - \vec{L}_i$, for the two-disk system.

C.) Is a torque required, or must a torque be applied, to tilt the axle by 180°? Please justify your answer.

D.) Would your answer to part C change if the angular speed of disk 2 was reduced to 7.1 rad/s in the same clockwise direction, and the axle was again tilted by 180°? Please justify your answer.