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PH114-08

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Moment of Inertia

Statement of Purpose:

Our group will observe the state of inertia in a ring and compare it to the expected values calculated from mass and radius of the ring.

Introduction:

Our group used a contraption consisting of a circular plate, string, and a hanging mass. The mass was allowed to fall and drag the disk and plate in a spinning motion. We then used data from a smart pulley to determine the average acceleration of the mass and the system's inertia.

Equipment:

Spinning plate, string, mass, ring, smart pulley, balance

Procedure:

1. Turn on the computer and open Datastudio
2. Measure the mass of the free weight and the radius of the drum and ring
3. Set up the contraption with the mass hanging from a wound string
4. Allow the mass to drop while recording its acceleration in Datastudio
5. Repeat two more times and record accelerations on sheet
6. Add the ring to the system
7. Allow the mass to drop three times and record acceleration again
8. Use equation 7 to calculate the inertia of the disk and ring

Data:

Massdisk = 1.436kg Massring = 1.424kg

Radius (R) = 0.1165m Radius (r) = 0.015m

Inner Disk Radius (R1) = 0.0535m Outer Disk Radius (R2) = 0.0635m

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Disk | a (m/s2) | Idisk (kg m2) | Avg Idisk (kg m2) | % Difference |
| Run 1 | 0.0437 | 0.0100 | 0.0094 | 3.19% |
| Run 2 | 0.0470 | 0.0093 |
| Run 3 | 0.0498 | 0.0088 |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| With Ring | a (m/s2) | Icombined (kg m2) | Avg Icombined (kg m2) | Iring (kg m2) | % Difference |
| Run 1 | 0.0305 | 0.0144 | 0.0142 | 0.0048 | 2.08% |
| Run 2 | 0.0307 | 0.0143 |
| Run 3 | 0.0315 | 0.1396 |

Theoretical Value:

Idisk = (0.5)MR2 = 0.0097kgm2

Iring = (0.5)M(R12 + R22) = 0.0049kgm2

Analysis:

The data we collected during the experiment shows the relationship between the torque applied to the system and its acceleration. By comparing the acceleration of the system with and without the ring engaged, we can see that the added inertia of the ring slows the system's acceleration. Our data does not include references to friction, which may lead to slight errors in the collected accelerations and inertias. Despite this, we can also see that the data collected agrees well with the theoretical values determined from equation 7 in the lab manual. By looking at the equation it is apparent that the value of inertia of an object is definitely related to the distribution of mass and its distance from an axis of rotation.

Conclusion:

In our experiment we discovered the relation between a system's rotation acceleration and its inertia. This relationship allows us to see the connection between the radius of torque and the radius associated with inertia; as the radius of torque increases the radius of inertia must also increase in order to keep the acceleration constant.