Lab 9: Moment of Inertia

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**Purpose**

To determine the moment of inertia of two different disks compared to their theoretical values through the use of conservation of energy of the angular acceleration.

**Measurements**

The measurements made in this lab were the mass and radius of the small disc, the mass of small weights, time, and change in height. We did these measurements to measure the rotational inertia of a steel and aluminum disc.

**Raw Data**

The raw data we collected in part one was the radius of the small disc, the mass of the small mass, the change in time, and the highest and lowest height of the small mass. We had to find this information for the steel and aluminum discs. The raw data for the steel disc is in “Table 1A”, and the raw data for the aluminum disc is in “Table 1B”.

The raw data we collected in part two was for the mass of the large steel and aluminum disc and the radius of the discs. The data for the steel disc is in “Table 2A”, and the data for the aluminum disc is in “Table 2B”.

Table1A

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| (g) | r (mm) | (s) | h (highest) (m) | h (lowest) (m) |
| 20 | 16.25 | 10.54 | 0.1035 | 0.955 |

Table 1B

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| (g) | r (mm) | (s) | h (highest) (m) | h (lowest) (m) |
| 20 | 16.25 | 6.194 | 0.127 | 0.975 |

Table 2A

|  |  |
| --- | --- |
| M (g) | R (mm) |
| 1354 | 58.5 |

Table 2B

|  |  |
| --- | --- |
| M (g) | R (mm) |
| 471 | 58.5 |

**Data Analysis**

There were two parts to this lab. In part one, we found the experimental value of Inertia, and in the second part, we found the theoretical value of Inertia. The first step we took to calculate our inertia was ensuring all values were in the correct SI unit. We converted the radius from millimeters to meters, grams to kilograms, and our height from centimeters to meters. Our conversions are in “Table 3A” and “Table 3B”. “Table 3A” is the data for the steel disc, and “Table 3B” is the data for the aluminum disc. After finishing the conversions, we had to get our values ready to be put into our equation. Our equation to find the experimental value was: . We squared our radius and time and found the difference between the heights. When we inserted our values into the equation, we got our experimental values for the two discs. For our steel disc, we calculated our inertia to be . The moment of inertia for our aluminum disc was.

In part two, we found the theoretical value of the moment of inertia by using the equation: . The large “M” is different from part one because, in part two, this mass is of the large disc. The value of the “R” is the radius of the large disc. We converted the mass of “M” from grams to kg and the millimeters to meters. To prepare the values for the equation, we just had to square the value of the radius. Now we were ready to insert our values into the equation. The conversions and value of the theoretical can be seen in “Table 4A” and “Table 4B”. “Table 4A” is the data for the steel disc. The data for the aluminum disc is in “Table 4B”.

To see if our experimental value was close to our theoretical value we used the equation . The difference between the experimental and theoretical value for the steel disc was 11.63%, and the difference between the values for the aluminum disc was 11.80%.

Table 3A

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| (g) | (kg) | g | r (m) | (m) | (s) | () | h (highest) (m) | h (lowest) (m) | (m) |
| 20 | 0.020 | 9.81 | 0.01265 |  | 10.54 | 111.0916 | 0.1035 | 0.955 | 0.8515 |

Table 3B

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| (g) | (kg) | g | r (m) | (m) | (s) | () | H  (highest) (m) | h (lowest) (m) | (m) |
| 20 | 0.020 | 9.81 | 0.01265 |  | 6.194 | 38.37 | 0.127 | 0.975 | 0.848 |

**Discussion**

In our lab, we find that the standard deviation for the “measured” *I* was 1.89737for the steel and 6.3246 for the aluminum. for the difference between the “theoretical” *I* and the “measured” *I* ? The difference between the two I’s is that for our steel disc, it was at two deviations away for experimental while the aluminum disk was at negative one away for the theoretical. The percent difference that we got from the calculation was 12.54%. It is significant due to its value in its number from 2.05 x 10 ^-3 to 7.10 x 10 ^-4. The percent difference between our measured I’s and theoretical I’s for steel was 11.63% and for the aluminum disk it was at . Due to the verification of the data being significant, we can leave how it is with no changes to be made within the measured I’s for each disk.

We believe that our measurements are somewhat accurate because our percent difference is less than 20%, with aluminum having a 12.54% difference and steel having a 11.63% difference. Although,the differences is somewhat high, some possible mistakes that could had occur could be the measurement of h might not have been accurate leading to the wrong measurements for t. In addition, due to our standard deviation being low with steel having a 1.89737 standard deviation and aluminum having a 6.3246 standard deviation shows that are data is reliable and not spread out if it was a high number. Overall, I believe that our numbers shows that our data is accurate.