**Conservation of Angular Momentum**

**Objective:** To measure moment of inertia and angular velocity during a collision to show that angular momentum is conserved.

# **Equipment**

* Plastic disc.
* Aluminum disc.
* Two metal screws.
* Two discs weights of 50g.
* Computer.
* Turn table.
* Meter stick.
* Some strings.
* Weighting scale

# **Procedure**

1. Prepare the computer by connecting the turn table to the computer.
2. Measure the weight of the plastic disc, Aluminum disc and the screws.
3. Measure the diameter and calculate the radius (R=Diameter/2) of the discs.
4. Screw the aluminum disc with the plastic disc and place it on the center of the turn table.
5. Attach the weights with the string and measure the distance D (distance from one center of the weight to the other center of the weight divided by 2).
6. Spin the table and record:

Wi: Initial circular velocity.   
Wf: Final circular velocity.

1. Repeat step 5 and 6 seven more times to get a different Wi and Wf.
2. Repeat step 5 – 7 three more times by changing distance D.
3. Create a scatterplot of the data from each trial (one graph for each trial). Include axis labels, a legend, and give the graph a title. Find the slope of the line as well.
4. Calculate I (*initial*) with respect to the measurements that you got from the disc and screws where:  
   I (*initial*) = I (*turn* *table*) = I (*plastic*) + I (*aluminum*) + I (*screws*)  
   𝐼 *(𝑝𝑙𝑎𝑠𝑡𝑖𝑐) =* ½ 𝑚*(plastic) \** 𝑟2*(plastic)*𝐼 *(𝑎𝑙𝑢𝑚𝑖𝑛𝑢𝑚) =* ½ 𝑚*(aluminum) \** 𝑟2*(aluminum)*𝐼 *(𝑠𝑐𝑟𝑒𝑤𝑠) =* 𝑚*(𝑠crews)* \* 𝑟2*(aluminum)*
5. Calculate I(*final*).  
   Where:  
   I (*final*) = I(*Initial*) + I(*brass*)  
   I (*brass*) = ½ 𝑚𝑟2(*brass*) + 𝑚𝐷2
6. Calculate the expected slope assuming that the slope is I(initial)/I(final).
7. Record the slope that you got from the scatterplot trendline for each trial.
8. Calculate the % error between the expected slope and measured slope.

**Data**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Trial 1 | |  | Trial 2 | |  | Trial 3 | |
| L (cm) = | 15.7 |  | L (cm) = | 13.1 |  | L (cm) = | 17.4 |
|  |  |  |  |  |  |  |  |
| wi (rad/s) | wf (rad/s) |  | wi (rad/s) | wf (rad/s) |  | wi (rad/s) | wf (rad/s) |
| 10.763 | 7.330 |  | 13.614 | 9.890 |  | 11.054 | 6.807 |
| 15.708 | 10.356 |  | 10.007 | 7.156 |  | 14.835 | 9.308 |
| 12.334 | 8.203 |  | 8.959 | 6.400 |  | 13.788 | 8.261 |
| 11.054 | 7.156 |  | 11.868 | 8.552 |  | 10.007 | 6.167 |
| 13.963 | 9.192 |  | 14.835 | 10.588 |  | 11.868 | 7.098 |
| 8.959 | 5.818 |  | 14.137 | 10.123 |  | 13.032 | 7.912 |
| 13.730 | 8.959 |  | 10.821 | 7.796 |  | 9.076 | 5.469 |

**Results:**

|  |  |  |
| --- | --- | --- |
| *Ii =* | 13224.8397 | g-cm2 |
|  | L (cm) | D (cm) | *If (g-cm2)* | expec slope | meas slope | % error |
| *Trial 1* | 15.7 | 7.85 | 19514.29 | 0.678 | 0.658 | 2.97% |
| *Trial 2* | 13.1 | 6.55 | 17642.29 | 0.750 | 0.720 | 3.91% |
| *Trial 3* | 17.4 | 8.7 | 20921.04 | 0.632 | 0.628 | 0.70% |

**Questions:**

1. It was stated in the video that the angular velocity of the turn table decreases over time due to friction. However, in our calculations, we do not include a term for friction. Why are we able to ignore friction in the experiment?

- The reason why we are able to ignore the friction in the experiment is because the value for friction is to low and it will not affect a lot our result.

2. When we were dropping the brass masses on the turn table, they generally fell so the string connecting them was no longer straight. In other words, the masses did not fall exactly as expected, therefore the distance between them was not exactly as measured. Which trial did this systematic error effect the most? Why did it affect that trial the most?

**-**Trial 2 was mainly affected by the string not being straight once dropping them because it is one of the cases that has the most % error

**Conclusion**

The objective of this experiment was to observe the conservation of angular momentum by calculating the slope angular speed when a mass is dropped above a mass rotating in a circle. The objective of this experiment was successfully met by following the given instructions. The differences in the expected slope and measured slop, found in the result, were fairly close. The %error was probably due to the friction, distance D being reduced after dropping them, software error and/or human error.