Experiment 10 - Conservation of Angular Momentum

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**Objective**

The purpose of this experiment is to study the conservation of angular momentum.

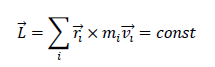
**Theoretical equations**

For a point masses m with the velocity the angular momentum relative to some point O is defined as:











I is the moment of inertia of the body relative to this axis, and is the angular velocity of the body.

If the moment of inertia changes (while the external torques are still absent), the angular will also change so that



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is the projection of the total external torque onto axis of rotation

**Equipment**

String, weights, pulley, rotating platform, rotary motion sensor, point masses.

**Equipment setup**

Rotating platform was used in the experiment. Rotary motion sensor recorded the angular acceleration.

**Procedure**

1. Measure the moments of inertia of the system I1 and I2 when the sliding weight on the platform is fixed near the outer and inner screws.

2. After measuring the moments of inertia, the hanging weight is removed so that there are no external torques accelerating the system.

3. Pull in the weight and observe the change of angular speed.

4. The experiment should be done for 10 to 15 different positions of stopper screws.

**Data and Calculation (Measurement results)**

**M= 0.2kg, r=0.00585m**

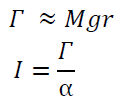
|  |  |  |
| --- | --- | --- |
| **I1, kg\*m^2** | **ω1, rad/s** | **L1, kg\*m^2/s** |
| 0.0164 | 8.25 | 0.1349 |
| 0.0164 | 8.43 | 0.1379 |
| 0.0164 | 8.25 | 0.1349 |
| 0.0164 | 9.35 | 0.1529 |
| 0.0164 | 11.4 | 0.1865 |
| 0.0164 | 9.56 | 0.1564 |
| 0.0164 | 10.7 | 0.1750 |
| 0.0164 | 9.47 | 0.1549 |
| 0.0164 | 7.54 | 0.1233 |
| 0.0164 | 11 | 0.1799 |

|  |  |  |
| --- | --- | --- |
| **I2, kg\*m^2** | **ω2, rad/s** | **L2, kg\*m^2/s** |
| 0.0091 | 14.4 | 0.1310 |
| 0.0092 | 14.1 | 0.1293 |
| 0.0093 | 14 | 0.1305 |
| 0.0096 | 15.2 | 0.1452 |
| 0.0098 | 17.3 | 0.1695 |
| 0.0101 | 15.1 | 0.1532 |
| 0.0103 | 15.4 | 0.1591 |
| 0.0110 | 13.4 | 0.1477 |
| 0.0112 | 10.4 | 0.1169 |
| 0.0118 | 13.8 | 0.1633 |

**Results and Conclusion**

From the experiments above, the angular momentum conservation law is supported.

By using the equation below,



We can find the I1 and I2 values when the sliding weight on the platform is fixed near the outer and inner screws. The angular velocity with the released sliding weight is observed, and the change of angular velocity is recorded right after the weight is pulled in.

The given equation below proves the angular momentum conservation law.



Since the results from the experiment show the slight difference between L1 and L2, the angular momnetum conservation law is still applied.

Because observed angular speed could decrease due to the friction in axis, it could be one of the errors in the experiment.

**Comprehension questions**

The tension force of the string that pulls in the sliding weight does not affect the angular momentum of the system because it is canceled out with the tension force of the string which hangs the weight.

is the initial KE, and is the final KE. The initial KE and the final KE are different. We know that and are equal but when both the initial KE and the final KE are compared by canceling out the same common values they have, the inital KE has and the fianl KE has Therefore, the initial and final KE are different.