Experiment 11 - Moments of inertia of simple bodies and Parallel Axis Theorem

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**Objective**

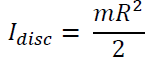
The purpose of this experiment is to study the factors which influence the moment of inertia of bodies.

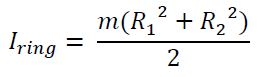
**Theoretical equations**

The moment of inertia can be calculated by the equation below.





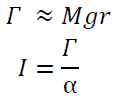




Parallel axis theorem



The moment of inertia I of the system will be measured by using the method below.



M is the mass of the hanging weight, and r is the radius of the wheel unwinding the string.

**Equipment**

String, weights, pulley, rotating platform, rotary motion sensor, disk, ring, etc.

**Equipment setup**

Rotating platform was used in the experiment. Rotary motion sensor recorded the angular acceleration. The disk or the ring will be on the platform, and the inertia of each or both of them will be measured.

**Procedure**

1. The moment of inertia of the disk is measured.

2. The moment of inertia of the ring is measured by measuring the total moment of inertia .

3. How the total moment of inertia of the platform +displaced disc depends on the displacement x of the center of the disc is shown.

**Data and Calculation (Measurement results)**

(1) M, r, α for a single disc, ᴦ,

M=0.2kg, r=0.0125m, α=2.29rad/s^2

ᴦ= 0.0245N\*m

= 1.4037kg

R=0.115m

ᴦ/ α=0.01069kg\*m^2

is 0.00928kg\*m^2.

Calculated I value is close to The difference between 0.01069kg\*m^2 and 0.00928kg\*m^2 is about 0.00141kg\*m^2.

(2) M, r, α for single disc + ring, ᴦ,

M=0.2kg, r=0.0125m, α=1.67rad/s,

ᴦ= 0.0245N\*m

Calculated value -> ᴦ/ α=0.01467kg\*m^2

0.01467kg\*m^2-0.01069kg\*m^2(calculated = 0.00398kg\*m^2

Since R1=0.06m and R2=0.05, is 0.004378kg\*m^2.

The difference between the calculated value and the value from the formula is about 0.000398kg\*m^2.

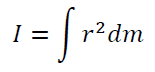
(3)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **M,kg** | **r,m** | **ᴦ**, N\*m | α, rad/s^2 | **I(total), kg\*m^2** | **x,m** | **I'(total),kg\*m^2** |
| 0.2 | 0.0125 | 0.0245 | 1.58 | 0.0155 | 0.04 | 0.0247 |
| 0.2 | 0.0125 | 0.0245 | 1.31 | 0.0187 | 0.06 | 0.0275 |
| 0.2 | 0.0125 | 0.0245 | 1.12 | 0.0219 | 0.08 | 0.0314 |
| 0.2 | 0.0125 | 0.0245 | 0.997 | 0.0246 | 0.1 | 0.0364 |
| 0.2 | 0.0125 | 0.0245 | 0.662 | 0.0370 | 0.12 | 0.0426 |
| 0.2 | 0.0125 | 0.0245 | 0.5 | 0.0490 | 0.14 | 0.0499 |
| 0.2 | 0.0125 | 0.0245 | 0.442 | 0.0554 | 0.16 | 0.0583 |
| 0.2 | 0.0125 | 0.0245 | 0.4 | 0.0613 | 0.18 | 0.0679 |

Yes, it confirms the parallel axis theorem since the slope of the graph is close to 1.

**Results and Conclusion**

From the experiment above, there are several factors, which affect the moment of inertia. Depending on size, shape, and mass of the body, the moment of inertia is measured by the equations below.



The moment of inertia I of the body relative to the new axis is calculated by using the formula below.



Because of the friction between the pulley and the string, the acceleration could be different than what it should be. It could be the experimental error.