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**Birzeit University**

physics 211

**Experiment No.4**

**Moment of Inertia of a Flywheel**

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**-Abstract:**

\* The aim of the experiment:

To find the moment of inertia of a flywheel by :

I =

\* Tools :

Flywheel mounted on a horizontal axis , weights , meter scale , caliper , and stop watch .

**- Theory :**

Let **I** be the moment of inertia of the flywheel defined as :

I=

Where r is the distance of mass elements **dm** from the axis of rotation . let **r =**  be the radius of the axle , **R** be the radius of the wheel itself . Let **v** be the linear velocity of falling object and ω be the angular velocity of flywheel . Let **n** be the number of rotations of the wheel before the object reaches ground , and **N** be the number of subsequent rotations until the wheel stops . If **W**  be the work done against friction per one rotation , then :

mgh = m + + nW

We use the fact that the flywheel's energy is dissipated against the friction incurred in **N** rotation ,then :

NW =

W = , where w =

→ mgh = +

One can show that :

v = 2= 2× ( average velocity of fall)

mgh = 2 +

then , I = m =

- **Procedure :**

a) The string around the axle is winded several turns .

b) Allow the weight to fall from rest , while measuring the following quantities :

1) the time of fall (until the mass hits the ground ) .

2) The number of turns the wheel **n** makes weight hits the ground .

3) The number of turns **N**, after the wheel hits the ground ,until stops.

**-Data:**

R= (9.9 ±0.1) cm.

d = ( 2.53 ± 0.05) cm.

r = (1.27 ± 0.05) cm.

h = (60 ± 0.1) cm.

M = (7.12 ± 0.01) Kg.

m = (0.99 ± 0.01) Kg.

g = 9.8 m/s2.

|  |  |  |  |
| --- | --- | --- | --- |
| I(Kg.m2) | N | n | t(sec) |
| 0.03 | 32 | 7 | 5.31 |
| 0.03 | 28 | 7 | 5.44 |
| 0.01 | 36 | 7 | 5.40 |
| 0.03 | 38 | 7 | 5.28 |
| 0.03 | 35 | 7 | 5.03 |
| 0.026 | 33 | 7 | 5.30 |

|  |
| --- |
| Avg. |

I= (26 ±2) ×10 -3 Kg.m2

**- Calculations:**

R= (9.9 ±0.1) cm.

d = ( 2.53 ± 0.05) cm.

r = (1.27 ± 0.05) cm.

h = (60 ± 0.1) cm.

M = (7.12 ± 0.01) Kg.

m = (0.99 ± 0.01) Kg.

g = 9.8 m/s2.

I =

I1 =

= 0.03 Kg.m2

I2 =

= 0.03 kg.m2

I3 =

= 0.01 kg.m2

I4 =

= 0.03 kg.m2

I5 =

= 0.03 kg.m2

Iavg. =

= 0.03

Ither.= 0.5 ×M×R 2

= 0.5 ×7.12×(9.9×10 -2) 2 = 0.035 kg.m 2

\*errors:

∆t = Ωn-1/

= 0.07 sec.

∆N = 2 rot.

∆n = zero

∆I/I = 2∆t/t + ∆N/N + ∆n/n

∆I = 0.026

∆I = 0.002 kg.m2

**-Result and Conclusion :**

Iexp. = (26 ± 2) ×10-3 kg.m2

Ither.= (35±2) ×10 -3kg.m 2

The value of the moment of inertia is acceptable because the random errors 2∆R≤ d ,so 2×0.002 ≤ 0.026, then 0.004 is least than 0.026 , and the theoretical value is near of the experimental value .

We have systematic errors in the experiment in the lab , when we measure **N** may be we count the rotations .

When we take 60 cm above the ground ,it is not exactly ma byy more or less.

The distance from the ground to the mass divide by the circumference to give us **n** , in mathematics :

**n =** 60/(2π×1.27) = 7.5 rot.

This is value near the value of **n** experimental so it is acceptable .