Lab Report

Complete this report YOURSELF except DATA taking parts! This report will not be submitted (except the very last page), but you should carefully complete it as preparation for the applied exam.

Suggested Pre-Lab Questions

Q1. Show the dimension analysis for inertia.

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Q2. In this experiment a mass connected to a rotating drum is free to descend down to the floor. With energy conservation the following expression is found for inertia:

$$I = mr^2 \left[\frac{gt^2}{2h} - 1 \right]$$

This expression so useful that inertia of any object depends only on r, h and t. (please learn what those values are from your book.) Actually independent from the shape of the object we can determine its inertia by putting it on top of a drum to which a mass m is connected and free to descend. Our system somehow is a scale for rotational motion, due to the analogy between the linear and rotational motion:
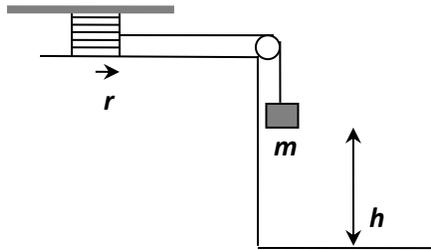
$$F = m.a \qquad \tau = I.\alpha$$

Why $2I_2 > I_1$ condition must be satisfied where $I_2 = I_{drum+disk}^{diameter}$ and $I_1 = I_{drum+disk}^{CM}$.

Experiment

OBJECTIVE : To determine experimentally the rotational inertia of a body.

THEORY :

2

A mass connected to a rotating drum is free to descend down to the floor. For this mass the loss in potential energy is equal to the gain in the translational and rotational kinetic energy:

$$\frac{1}{2}mv^2 + \frac{1}{2}I\omega^2 = mgh$$

The velocity of mass where it touches the floor and the corresponding angular velocity are:

$$v = \frac{2h}{t} \quad \text{and} \quad \omega = v/r$$

As a result, rotational inertia of the drum is given as:

$$I = mr^2\left[\frac{gt^2}{2h} - 1\right]$$
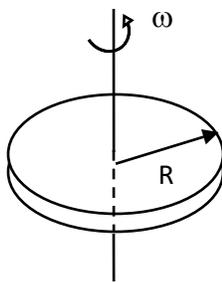
Disk about its CM   Disk about its diameter

As a special case, the rotational inertia of a uniform disk about an axis passing through its center of mass (CM) and perpendicular to the disk is given by

$$I_z = \frac{1}{2}MR^2$$

or about its diameter:

$$I_r = \frac{1}{4}MR^2.$$

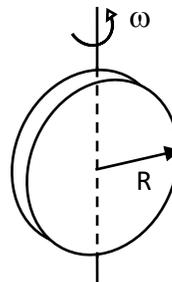***APPARATUS :*** Rotational inertia apparatus, disk and ring masses, mass and hanger set, string.

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PROCEDURE :

1. Wind the cord onto the drum and hang a mass m at the end of the cord. Place the disk mass on the drum. After determining the height of the mass above the floor, release the mass and determine the time for descent. Repeat twice and find the average t. Calculate the rotational inertia of the disk + drum assembly.
2. Repeat the same procedure with the disk mounted on its side. The difference of the moment of inertias should be equal to the moment of inertia of the disk mounted on its side or half the moment of inertia when it is mounted horizontally.
3. Calculate the moment of inertia of the disk and the drum part separately for both cases.
4. Calculate the moment of inertias theoretically from the geometry of the disk for both cases and compare your results to the values you determined in the previous step.

DATA & CALCULATIONS & RESULTS

Description / Symbol		Value & Unit

Diameter of

the drum d = ...

Radius of

the drum r = ...

Height of mass holder

from the floor h = ...

4

R o t a t i o n a l   I n e r t i a   o f   D i s k

	ABOUT CM	ABOUT DIAMETER

Mass on the

mass holder m^* = ...

Time for

descent t^*_1 = ...

Time for

descent t^*_2 = ...

Average time

for descent t^*_{ave} = ...

Description / Symbol	Calculations (show each step)	Result

Rotational Inertia of the drum + Disk $I^{CM}_{drum+disk}$ = ...
about its CM

. . . .

Rotational Inertia of the drum + Disk $I^{DIAMETER}_{drum+disk}$ = ...
about its DIAMETER

. . . .

2 I_2 > I_1, If not, measure time for descent again

5

Rotational Inertia

of the DISK I^{CM}_{DISK} = ...

about its CM

Rotational Inertia

of the DISK $I^{diameter}_{DISK}$ = ...

about its DIAMETER

Rotational Inertia

of the DRUM I_{DRUM} = ...

Description / Symbol	Value & Unit

Mass of the Disk M_{disk} = ...

Diameter of the Disk D_{disk} = ...

Radius of the Disk R_{disk} = ...

Theoretical Values for *I*:

I_{DISK}^{CM} = ...

$I_{DISK}^{diameter}$ = ...

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% Error for Rotational Inertia:

ΔI_{DISK}^{CM} :

$\Delta I_{DISK}^{diameter}$:

Post-Lab Report

Aim of the experiment:

Suggestions for possible solutions to the problems experienced during the experiment:

Conclusion:

7 I have completed this experiment myself as specified in the lab sheet and as explained by the lab instructor.

Name & Surname:

Student ID:

Lab Section:

Table #:

Date:

Signature of the student

- -

<u>As the instructor</u> of this Lab Section I confirm that the student has participated in and completed this experiment on time.

Stamp of the PHYS Labs and signature of the instructor

This page serves as proof of the fact that the student participated in and completed the experiment, <u>only if</u> it is submitted in time and accepted by the Lab instructor. The student and the instructor shall sign it along with the stamp of the Physics Laboratories.