Pre-Lab Report

Lab section:

Name & Surname:

Table # :

***Before the Lab* complete this page YOURSELF! Hand it in *in the first 5 min*. of the session PERSONALLY!**

You MUST justify your answers and show all steps. NO COPYCAT answers, or NO credits!

Please read the relevant presentation on PHYS LAB Website.

Q1. Show the dimension analysis for inertia. **Show your derivation / formulae below explicitly or no credits!**

(2nd Question is on the next page!)

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:

$$F = m.a \qquad \leftrightarrow \qquad \tau = I.\alpha$$

Why $2I_2 > I_1$ condition must be satisfied where $I_2 = I_{drum+disk}^{diameter}$ and $I_1 = I_{drum+disk}^{CM}$. **Justify your answers, show calculations if needed or no credits!**

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***Complete this report YOURSELF except DATA taking parts! Use a pencil for plots only and a pen for the rest!* Show your work clearly, NO COPYCAT analysis allowed, or NO credits!**

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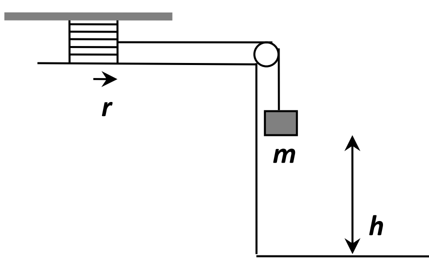
OBJECTIVE : To determine experimentally the rotational inertia of a body.

THEORY :



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:

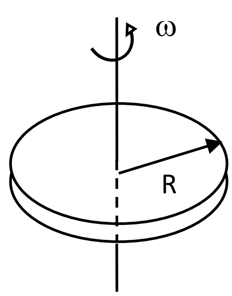
$$\frac{1}{2}mv^2 + \frac{1}{2}I\omega^2 = mgh$$

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

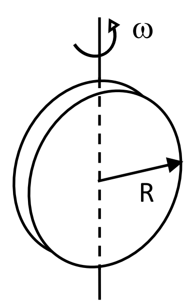
$$v = \frac{2h}{t} \qquad \text{and} \qquad \omega = v/r$$

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

2

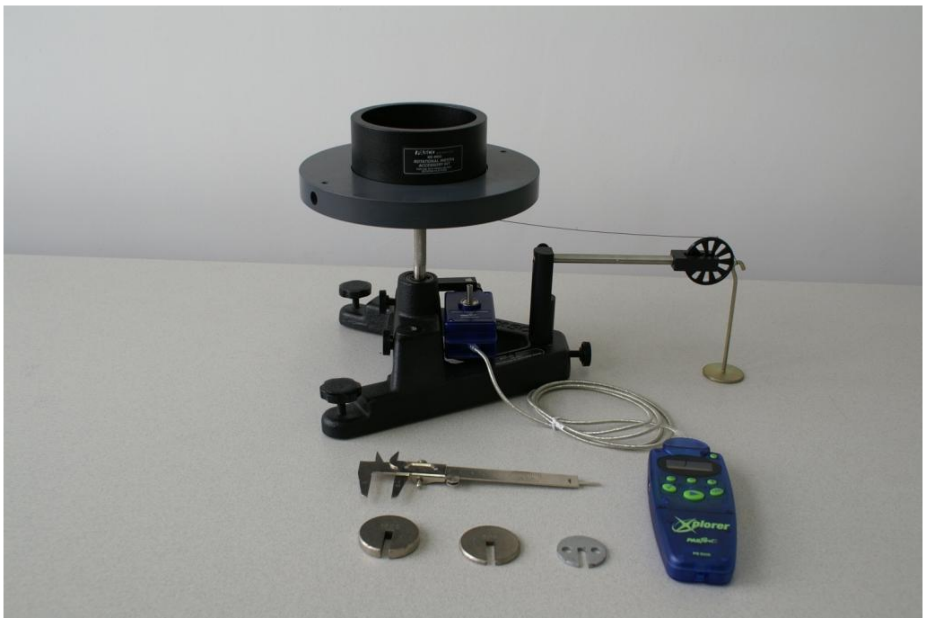
As a special case, the rotational inertia of a uniform disk about an axis passing through its center of mass (CM) and perpendicular to the disk is given by

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

or about its diameter:

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

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



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.

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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	=	....

Rotational Inertia of Disk

			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}	=	....	....

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Description / Symbol		Calculations (show each step)	Result
Rotational Inertia of the drum + Disk about its CM	$I_{drum+disk}^{CM}$ =	....	....
		....	
Rotational Inertia of the drum + Disk about its DIAMETER	$I_{drum+disk}^{DIAMETER}$ =	....	....
		....	

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

Rotational Inertia of the DISK about its CM	I_{DISK}^{CM} =	....	....
Rotational Inertia of the DISK about its DIAMETER	$I_{DISK}^{diameter}$ =	....	....
Rotational Inertia of the DRUM	I_{DRUM} =	....	....

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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} = ...

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

% Error for Rotational Inertia:

ΔI_{DISK}^{CM} :

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

Consult to the resources for this experiment from PHYS LAB Website:

PHYL101 Intro

Presentation #6

PHYL101 Lab Book