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. What does the Inertia of the system in this experiment depend on, in terms of the quantities you are going to measure?

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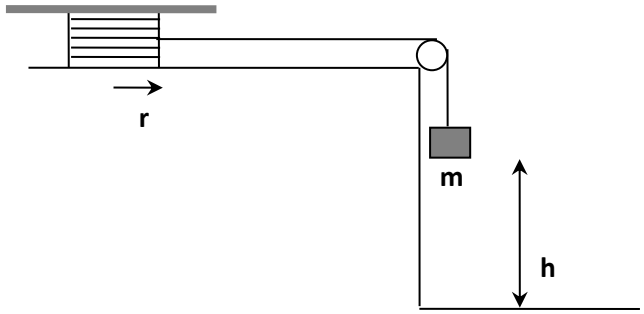
Q2. Show the dimension **analysis** for torque **explicitly! Show your formulae and derivation step by step or no credits**!

EXP.4: Torque and Angular Acceleration

Experiment

OBJECTIVE : To measure the effect of torque acting on a rotating mass.

THEORY :



A rotating object also obeys the Newton's Laws of motion. When we apply a torque on an object, we can express the Newton's Law in terms of the torque and the angular acceleration:

$$\tau = I\alpha$$

where torque is applied through a string wrapped around the drum with a radius r attached to a free falling object of mass *m*.

$\mathcal{T}$ is tension in the string:

$$\vec{\tau} = \vec{r}\, x\, \vec{F}$$

$$\tau = \mathcal{T} r$$

Then the torque and angular acceleration equation becomes

$$I\alpha = \mathcal{T} r$$

Using the force equation

$$\mathcal{T} - mg = -ma \quad (a = \alpha r)$$

we can determine the moment of inertia by measuring the angular acceleration.

$$I = \frac{mgr}{\alpha} - mr^2$$

We can also determine the moment of inertia from the free fall time:

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

APPARATUS : Rotational inertia apparatus with rotational sensor, data logger, mass and hanger set.

PROCEDURE :

EXP.4: Torque and Angular Acceleration

1. Using a small mass (50 g) on the mass holder, observe the rotational motion of the disk on the rotational inertia apparatus. You should set the data logger to **2 samples/s**. When the free fall is completed, retrieve the rotation angles as a function of time from the data logger.
2. Calculate the average angular velocity for successive time intervals and plot the result as a function time. ($\omega_{\text{average}} = \Delta\theta / \Delta t$)
3. From your graph, obtain the angular acceleration of the disk assembly by determining the slope of the straight line fit to your data.
4. Determine the moment of inertia of the disk assembly using the angular acceleration.
5. Determine the free fall time and the height of the mass holder from the floor and calculate the moment of inertia using the equation given above.
6. Compare both results for the moment of inertia and calculate the percentage difference between them:

$$\%\mathbf{diff} = \frac{|\boldsymbol{I_1} - \boldsymbol{I_2}|}{(\boldsymbol{I_1} + \boldsymbol{I_2})/\mathbf{2}} \times \mathbf{100}$$

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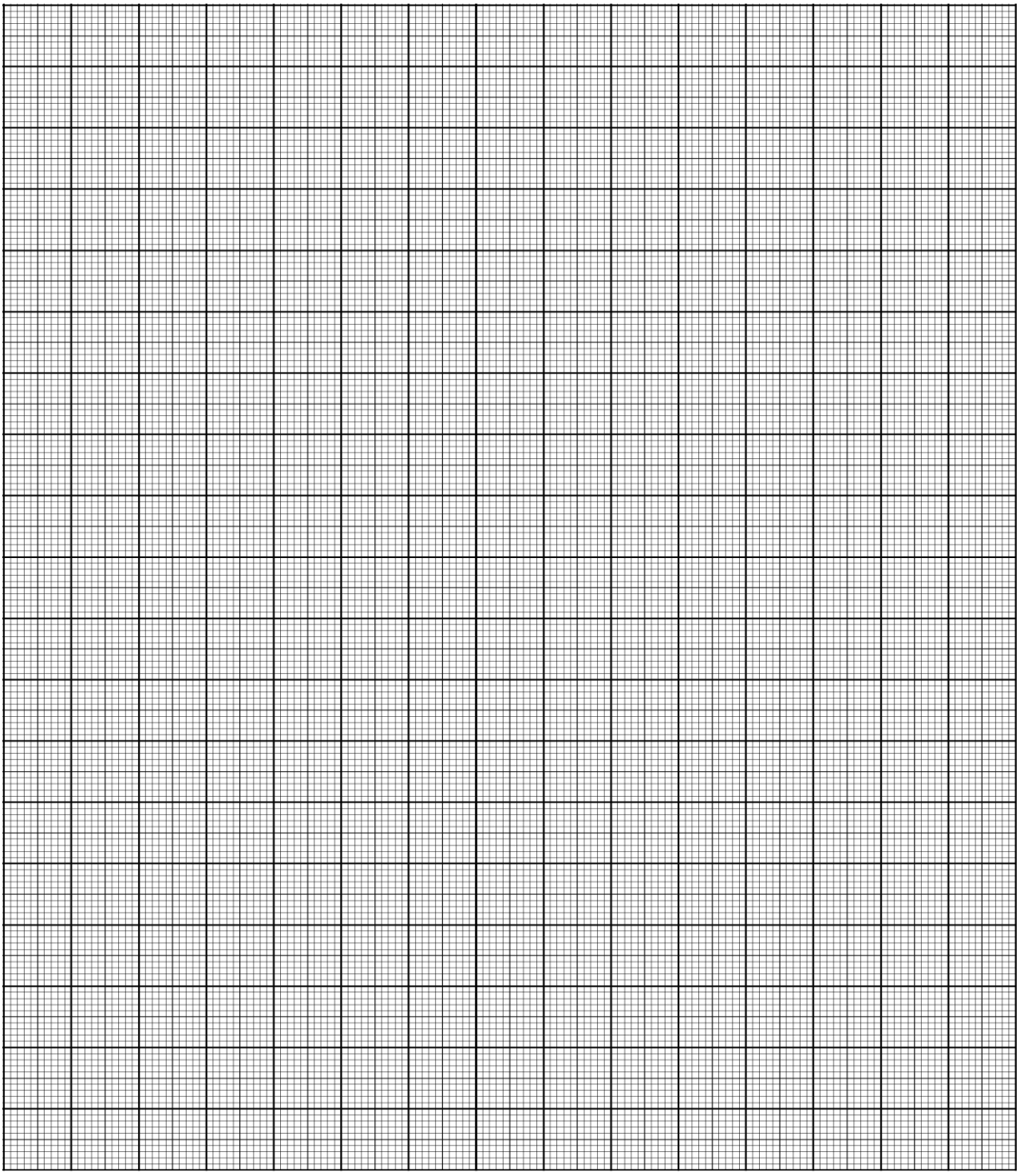
DATA:

Description / Symbol			Value & Unit
Diameter of the drum	d	=	. . . . .
Radius of the drum	r	=	. . . . .
Mass on the mass holder + mass of the holder	m	=	. . . . .
Height of the mass holder from the floor	h	=	. . . . .
Time for descent	T	=	. . . . .

EXP.4: Torque and Angular Acceleration

Δt ( )	t ( )	Θ ( )	$\Delta\Theta$ ( )	$\omega_{average} = \Delta\Theta / \Delta t$ ( )



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From the line, choose two SLOPE POINTS other than data points,

SP_1 : (;)

SP_2 : (;)

CALCULATIONS & RESULTS

By using SP_1 and SP_2, calculate:

Description / Symbol		Calculations(show each step)	Result	Dimension
SLOPE	=	.....	.....	.....
		.....		
Angular Acceleration α	=	.....	.....	.....
Moment of Inertia $I = \frac{mgr}{\alpha} - mr^2$ =		.....	.....	.....
$I = mr^2\left[\frac{gT^2}{2h} - 1\right]$	=	.....	.....	.....
		.....		

%difference for *I*:

Post-Lab Report

Aim of the experiment:

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

Conclusion:

9 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

As the instructor 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, only if 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.