T.C.
GEBZE TECHNICAL UNIVERSITY
PHYSICS DEPARTMENT

PHYSICS LABORATORY I
EXPERIMENT REPORT

THE NAME OF THE EXPERIMENT

Moments of Inertia and Body Shape

<u>PREPARED BY</u>

NAME AND SURNAME:

STUDENT NUMBER :

DEPARTMENT :

Signature:

Experimental procedure for determining the moments of inertia of rotationally symmetric bodies

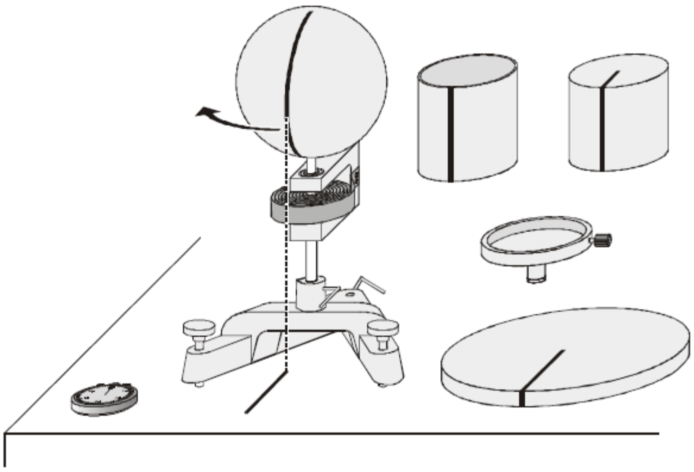
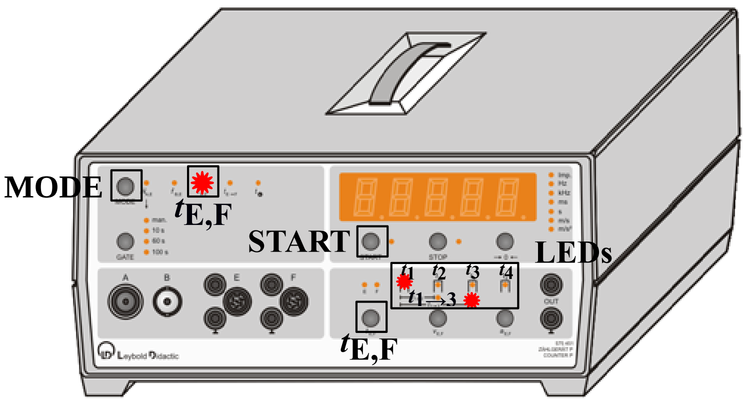


Figure 7.2: Experimental setup for determining the moments of inertia of some rotationally symmetric bodies

Experiment set-up is illustrated in Figure 7.2.

1. Measure masses (M) and radius (R) of the objects and record your measurements to the table 7.1.
2. Put the sphere on the torsion axle, and locate the offset on the sphere so that it is in the photo gate in its equilibrium (rest) position.



3. Set the operation *MODE* on the digital counter to the symbol $t_{E,F}$ for measuring the period.
4. Rotate the sphere to the right by < 180°, press the start button of the digital counter and release the sphere. Wait all the display of storage LED's light up.
5. Read the period T by pressing pushbutton $t_{E,F}$ and select of the time $t_{1\to 3}$ stored in the operation mode $t_{E,F}$ to be displayed as the measured value. *In the storage display, the LED corresponding to the selected time shines more brightly than the others.*
6. Repeat the measurement four times, alternately deflecting the sphere to the left and to the right.
7. Replace the sphere with the disc, and repeat the measurements.
8. Replace the disc with the solid cylinder+supporting plate system, and repeat the measurements.
9. Repeat the measurements with the hollow cylinder+supporting plate system.
10. Finally carry out the measurement with the empty supporting plate.
11. Calculate mean values of measured period of oscillations T and fill in the table 7.1.

Table 7.1: Period of oscillation T for various sample bodies.

Body	M (kg)	R (m)	T_1 (s)	T_2 (s)	T_3 (s)	T_4 (s)	T (s)	$\left[\frac{T}{2\pi}\right]^2$ (s^2)
Solid sphere (*SS*)								
Flat solid cylinder (*Disc*)								
Long solid cylinder (*SC*)								
Hollow cylinder (*HC*)								
Empty supporting plate (*ESP*)								

Calculate the experimental moments of inertia I of different bodies from the average oscillation periods T and ***measured D that is calculated in the previous experiment M6 (D=0.020 Nm/rad)***. Also, the *dimensionless factors (coefficients)* of Eqs. 7.3, 7.5 and 7.7 are listed in rightmost column of the Table 7.2 below and compare with the values calculated from the measured (calculated) data.

$I = D.\left[\frac{T}{2\pi}\right]^2$ units $\frac{I}{MR^2}$

$I_{SS} =$ (________) $\frac{I_{SS}}{MR^2} =$

$I_{Disc} =$ (________) $\frac{I_{Disc}}{MR^2} =$

$I_{ESP} =$ (________) $\frac{I_{ESP}}{MR^2} =$

units

$I_{SC}^{system} = I_{SC} + I_{ESP} =$ (________)

$I_{SC} = I_{SC}^{system} - I_{ESP} =$ (________) $\frac{I_{SC}}{MR^2} =$

$I_{HC}^{system} = I_{SC}^{system} + I_{ESP} =$ (________)

$I_{HC} = I_{HC}^{system} - I_{ESP} =$ (________) $\frac{I_{HC}}{MR^2} =$

Signature:

Table 7.2: Moments of inertia *I* determined from the oscillation periods

Body	I_{exp} **(kg.m^2)**	$\frac{I_{exp}}{MR^2}$	$\frac{I_{theory}}{MR^2}$
Empty supporting plate (*ESP*)			-
Solid sphere (*SS*)			2/5
Flat solid cylinder (*Disc*)			1/2
Long solid cylinder (*SC*) $I_{SC} = I_{SC}^{system} - I_{ESP}$			1/2
Hollow cylinder (*HC*) $I_{HC} = I_{HC}^{system} - I_{ESP}$			1

Make qualitative comparisons of the moments of inertia.

i. Bodies having different masses: (Sphere and Disc)

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ii. Hollow body and solid body: (Hollow cylinder and Solid cylinder)

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iii. Bodies having the same mass and the same shape but different dimensions: (Disc and Solid cylinder)

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Conclusion, Comment and Discussion:

(Tips: Give detail explanation about what you've learned in the experiment and also explain the possible errors and their reasons.)

Signature:

Questions:

1) Imagine rolling *four* objects are placed in a row at the same height at the top of an inclined plane and are released at the same time. The objects are uniform *solid* and *thin hollow spheres,* and *solid* and *thin hollow cylinders* that have same masses and radii. Rank the four objects from fastest (shortest time) down the inclined plane to the slowest. You might have learned that when dropped straight down, all objects fall at the same rate regardless of how heavy they are (neglecting air resistance). Is the same true for objects rolling down an inclined plane? Please explain, why?