PHYSICS PRACTICAL SHEETS

Date: 2078/06/10 Prime..... CAMPUS
Class: BSc. CSIT
Roll No.:
Shift:
Object of the Experiment (Block Letter)

Experiment No.: 2
Group:
Sub.:
Set:

06/10

VARIETY PRODUCT

TO STUDY THE TORSIONAL PENDULUM AND DETERMINE THE MI OF GIVEN BODY BY USING TORSIONAL PENDULUM

APPARATUS REQUIRED:

i) Disk
ii) Wire
iii) Ring
iv) Stopwatch
v) Screw gauge
vi) Vernier callipers

THEORY:

Torsional pendulum is a heavy circular disc suspended from one end of a fine wire attached to its curve, the other ends of the wire is fixed in a torsional head. When the disk is turned in a horizontal plane, so as to twist the wire and then released, it executes torsional pendulum. The time period of the torsional vibration is given by:

$$T = 2\pi\sqrt{\frac{I}{C}} \quad \text{— (i)}$$

where I be the MI of disk about the wire as axis and 'C' is couple per unit angle of twist or torsional constant given by:

$$C = \frac{\pi\eta r^4}{2l} \quad \text{— (ii)}$$

where, η is modulus of rigidity of wire.
'r' is radius of wire.
'l' is length of wire.

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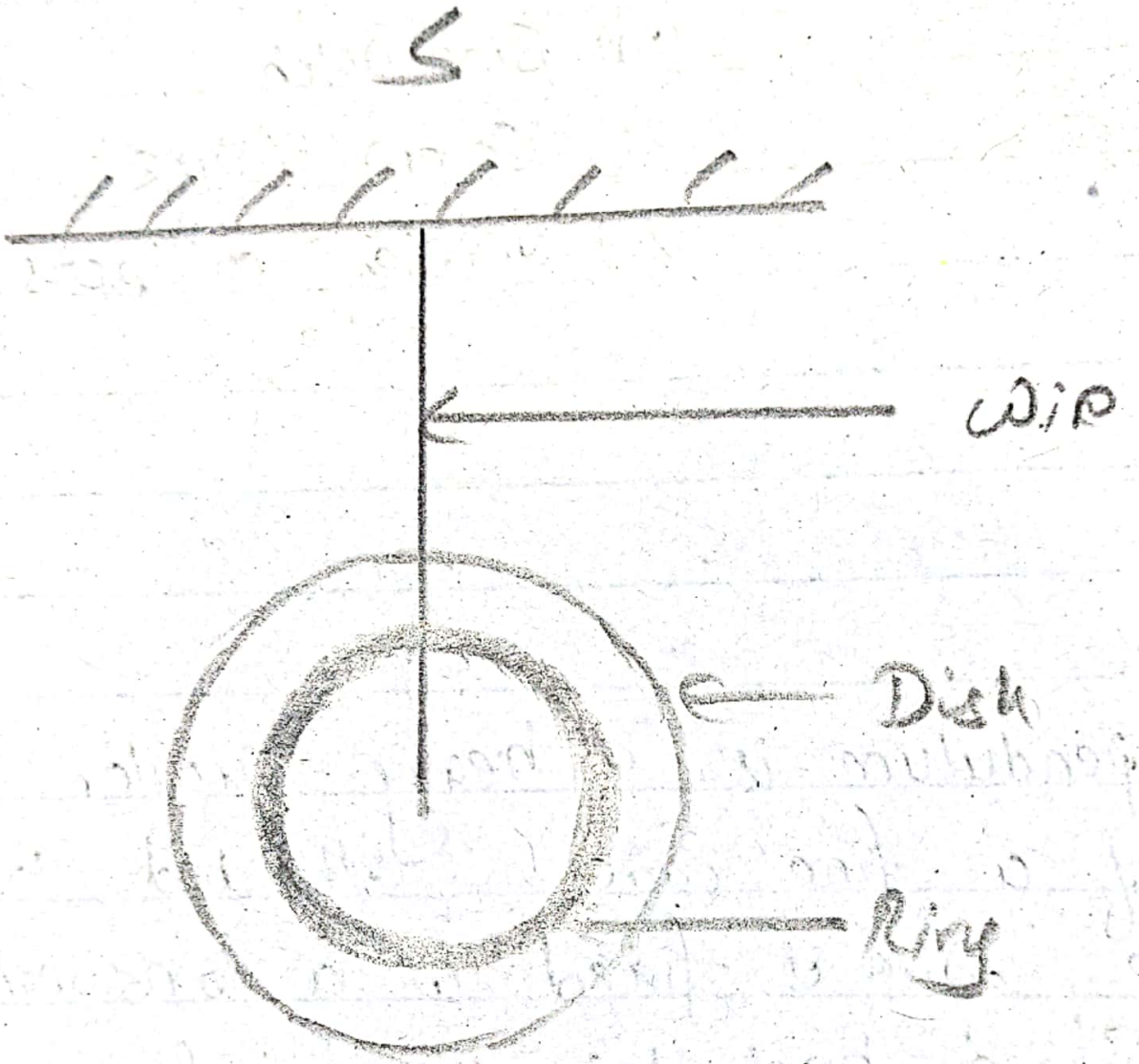

fig. Torsional pendulum.

The whole system (disk & ring) oscillates with time period

$$T_1 = 2\pi\sqrt{\frac{(I+I_1)}{C}} \quad \text{--- (i)}$$

Where, 'I_1' is moment of inertia of ring.

Now,

$$T_1^2 - T^2 = 4\pi^2\left(\frac{I+I_1}{C}\right) - 4\pi^2\frac{I}{C}$$

$$= \frac{4\pi^2 I_1}{C}$$

$$\Rightarrow I_1 = \frac{C(T_1^2 - T^2)}{4\pi^2}$$

$$\Rightarrow I_1 = \frac{\pi\eta}{2l} r^4 \frac{(T_1^2 - T^2)}{4\pi^2}$$

$$\Rightarrow I_1 = \frac{\eta r^4 (T_1^2 - T^2)}{8\pi l}$$

OBSERVATIONS:

Least count of screw gauge (LC) = $\frac{\text{Pitch}}{N} = \frac{0.5}{50} = 0.01$ mm

Length of wire (l) = 87.6 cm = 0.876 m

Value of modulus of rigidity of wire $\eta = 11 \times 10^6$ N/m^2

Zero error = 5 × L.C = −0.05 mm

Zero correction = +0.05 mm

Table for determination of diametre of wire:

SN	MSR (x)	CSR (c)	Value of CSR $y = a \times L.C$	Total diametre $(x+y)$	Mean diametre	Corrected diametre d(mm)
1	0.5	0	0	0.5		
2	0.5	1	0.01	0.51		
3	0.5	3	0.03	0.53	0.516	0.566
4	0.5	2	0.02	0.52		
5	0.5	2	0.02	0.52		

Radius of wire $(r) = d/2 = 0.566/2$

$= 0.283\,mm = 2.83 \times 10^{-4}\,m.$

Table for determination of time period:

SN	Time for 10 vibration (without ring) t (sec)	Time period $T = t/10$ (s)	Time for 10 vibration (with ring) t_1 (sec)	Time period $T_1 = t_1/10$ (s)	$(T_1^2 - T^2)$ (sec)	Mean $(T_1^2 - T^2)$ sec
1	111	11.1	140	14	72.79	
2	111	11.1	139	13.9	70	
3	111	11.1	138	13.8	67.23	71.682
4	111	11.1	140	14	72.79	
5	111	11.1	141	14.1	75.6	

CALCULATION:

$$I_1 = \frac{\pi r^4 (T_1^2 - T^2)}{8\pi l}$$

$$= \frac{11 \times 10^{10} \times (2.83 \times 10^{-4})^4 \times 71.682}{8 \times 2.14 \times 0.876}$$

$$\therefore I_1 = 2.29 \times 10^{-3} \text{ kgm}^2$$

RESULT:

The MI of given body is found to be 2.29×10^{-3} kgm^2

CONCLUSION:

Hence, by using the torsional pendulum, the MI of given body can be determined ie. 2.29×10^{-3} kgm^2.

PRECAUTIONS:

1) The screw gauge should not be screwed too tightly.
2) The time should be measured properly.
3) The pendulum should be stable.
4) The diameter and length of wire should be measured properly.

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