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Objective:- To determine the moment of Inertia of a flywheel about its own axis of rotation.

Apparatus used :- flywheel, metre scale, vernier callipers, stop watch, set of weight and a pen.

formula used :- The moment of inertia I of the flywheel is given by

$$I = \frac{mr\left[\frac{gt^2 n_1}{4\pi n_2^2} - r\right]}{\left[1 + \frac{n_1}{n_2}\right]}.$$

where, m = mass suspended at the end of string.
r = radius of the axle.
n_1 = number of revolutions made by the wheel before the mass is detached from the wheel.
n_2 = no. of revolutions made by the flywheel to come to rest after the mass is detached.
t = time taken by the wheel in n_2 revolutions.
g = acceleration due to gravity.

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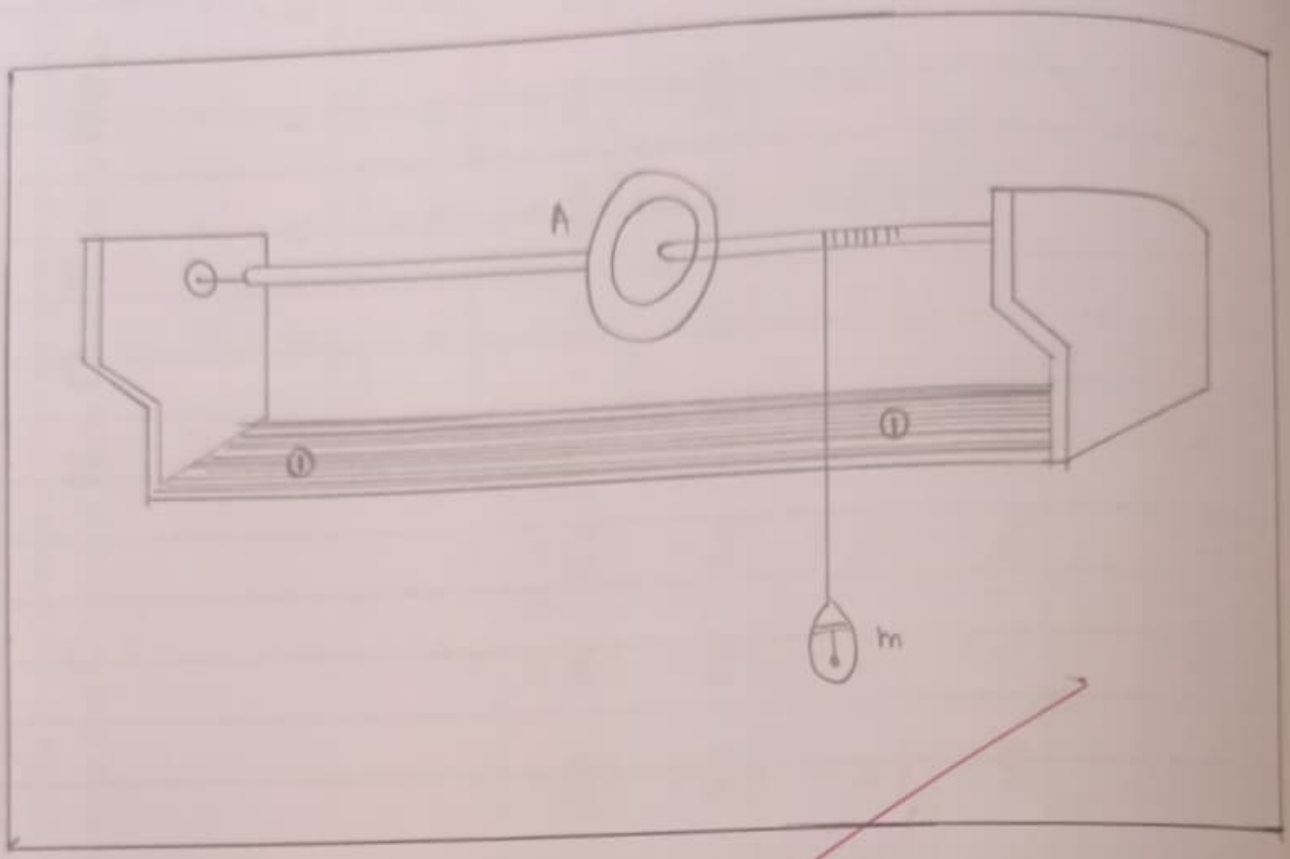

Diagram

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* Observation table :-

S.No	Load mass applied (m) in kg	No. of turns of flywheel before mass detached (n_1)	No of revolution of flywheel come to rest after mass detached (n_2)	Time for n_2 (sec)	Mean n_2	Mean (t)
1.	50 kg	15	35	69		
		15	34	71	34	
		15	33	63		67.6
2.	100 g	15	68	85		
		15	70	86	69.6	85.6
		15	71	86		
3.	150 g	15	102	112		
		15	103	116		116.6
		15	107	122	107.3	
4.	200 g	15	138	137		
		15	140	140	140	138.6
		15	142	139		

* Radius of axis :- $D = M.S.R + (V.S.R * \text{least count})$

$= 2.9 + 2$

$= 4.9$ cm

$R = \frac{D}{2} = \frac{4.9}{2} = 2.45$ cm

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Calculations

By putting value m, r, g, n_1 & n_2 and time from observation table. The calculation of moment of Inertia of flywheel is given by :-

$$I = \frac{mr\left(\frac{gt^2 n_1}{4\pi^2 n_2^2} - r\right)}{\left(1 + \frac{n_1}{n_2}\right)} \text{ gm/cm}^2$$

$$I_1 = \frac{122.5\left(\frac{671754.72}{14519.36} - 2.45\right)}{1.44}$$

$$\Rightarrow 2524.01 \text{ gm/cm}^2$$

$$I_2 = \frac{100 \times 2.45\left[\frac{9.8 \times 85.6 \times 85.6 \times 15}{4 \times 3.14 \times 69.6 \times 69.6} - 2.45\right]}{1 + \frac{15}{69.6}}$$

$$\Rightarrow 3075.10 \text{ gm/cm}^2$$

$$I_3 = \frac{150 \times 2.45\left[\frac{9.8 \times 116.6 \times 116.6 \times 15}{4 \times 3.14 \times 107.3 \times 107.3} - 2.45\right]}{1 + \frac{15}{107.3}}$$

$$\Rightarrow 3668.54 \text{ gm/cm}^2$$

$$I_4 = \frac{200 \times 2.45\left[\frac{9.8 \times 138.6 \times 138.6 \times 15}{4 \times 3.14 \times 140 \times 140} - 2.45\right]}{1 + \frac{15}{240}}$$

$$I_4 = 3989.39 \text{ gm/cm}^2$$

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Result

The moment of Inertia of a given flywheel about its own axis of rotation.

= 3314.26 gm/cm²

Standard result

The standard value of M.I of flywheel is 3314.26 gm/cm²

Percentage error is calculated by

$$\frac{\text{Standard result} - \text{calculated result}}{\text{Standard result}} \times 100$$

Precautions and sources of error

1. The string should be thin and uniform
2. friction b/w support and axis of flywheel should be small by using oil etc.
3. The mass should be allowed to fall gently without any applying force
4. The gentle grip b/w the jaw of vernier calliper of axis is required
5. Make sure the vernier calliper and not have a zero error

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25/09/25

$$I = \frac{I_1 + I_2 + I_3 + I_4}{4}$$

$$\Rightarrow \frac{2524.01 + 3075.10 + 3668.54 + 3989.39}{4}$$

$$\Rightarrow 3314.26 \text{ gm/cm}^2.$$