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ASUTOSH COLLEGE

(Affiliated to University of Calcutta)

Semester 1- Examination

Physics-Hon's

Paper-CC2

Practical Examination

Full Marks-30

Time- 2Hrs

Answer any ***One*** questions

1. Determine the Moment of Inertia of a metallic cylinder about an axis passing through the C.G. and to determine the Modulus of Rigidity of the suspension wire using the time period data, of the cradle and with rectangular body of known moment of Inertia.

(a) (i) Write down the expression for moment of inertia of a rectangular bar (I_1) of length 'l', and breadth 'b' about an axis passing through its center of mass and perpendicular to its length.
(ii) Write down the expression for moment of inertia of a cylinder (I_2) of length 'L', and radius 'r' about an axis passing through its center of mass and perpendicular to its length.
(iii) Write down the expression for moment of inertia of a cylinder (I_2) in terms of moment of inertia of a rectangular bar (I_1) considering oscillation time period about a vertical axis of empty cradle (T_0), cradle with rectangular bar (T_1) and cradle with cylinder (T_2).
(iv) Write down the expression for rigidity modulus 'η' of the material of the wire in terms of length of wire 'l' and radius of wire 'r' while suspended with a body having moment of inertia 'I' and time period of torsional oscillation 'T'.
(v) Write down the expression for restoring couple (c) exerted by suspension wire of length 'l' for one radian twist at its free end in terms of rigidity modulus 'η' of the material of the wire, length of wire 'l' and radius of wire 'r'.

[2+2+2+2+2]

(b) Calculate moment of inertia of a rectangular bar (I_1) and moment of inertia of a cylinder (I_2) using following data.
Rectangular Bar: Length- **10.2**cm, Breadth: **3.9** cm, Mass-**280** gm
Cylinder: Length: **12.9** cm, Diameter: **2.44** cm, Mass- **470** gm

[2+2]

(c) Using the given data: time period of torsional oscillation empty cradle (T_0) = **7.1** Sec, cradle with rectangular bar (T_1) = **9.0** Sec and cradle with cylinder (T_2) = **11.0** Sec
Determine moment of inertia of a cylinder (I_2) assuming calculated value of moment of inertia of a rectangular bar (I_1) and compare I_2 with previously directly calculated I_2 and comment on agreement or apparent difference between the results discussing appropriate causality.

[2+(1+2)]

(d) (i) Calculate rigidity modulus 'η' of the material of the wire from given data:
length of suspension wire 'l'=88cm, and radius of suspension wire 'r' = **0.45** mm.
(ii) Calculate restoring couple (c) exerted by suspension wire [3+3]

(e) (i) Define moment of inertia and radius of gyration and state the unit of moment of inertia and modulus of rigidity. (ii) Does the value of rigidity modulus depend on length and diameter of the wire? (iii) Will the period of torsional oscillation be affected by the change in the acceleration due to gravity?

$[(1+1+\frac{1}{2}+\frac{1}{2})+1+1]$

2. **Determination of Moment of Inertia of a flywheel.**

(a) Write down the expression for moment of inertia of a flywheel (I) in terms of falling mass (m), initial number of turns of thread wound over the flywheel (n_1), number of rotations of the flywheel before coming to rest after detachment of the load from the axle (n_2), radius of the axle (r), time interval during which flywheel comes to rest after the detachment of the peg from the axle (t_{stop}) and acceleration due to gravity (g).

[5]

(b) Complete the following table of measurement of time and rotation after detachment of mass

Given: Dead weight of the hanger = 52.3 gm
Perimeter of the flywheel (p) = 61.5 cm

Weight (gm)	Net weight (gm)	t_{stop} (Sec)	No of rotation after opening the peg				$\bar{t}_{stop}$ (Sec)	$\bar{t}^2{}_{stop}$ (Sec^2)	Mean (n_2)
			N	s	$n'=\frac{s}{p}$	$n_2=N+n'$			
140	192.3	17.44	13	-6.0			18.16		
		18.88	13	-10.6					
150	202.3	19.34	15	+10.8			19.5		
		19.66	15	-7.3					
170	222.3	18.75	17	0.0			19.03		
		19.31	17	-4.0					

[9]

(c) Complete the following table for calculation of moment of inertia of flywheel

Given: No of turns of the thread wound over the axle n_1= 15
Radius of the axle r =1.089 cm = 1.089×10^{-2} m
acceleration due to gravity (g)=9.8 m sec^{-2}

m (Kg)	n_1	n_2	$\bar{t}^2{}_{stop}$ (sec^2)	r (m)	mr (Kg-m)	$\frac{n_2}{n_1+n_2}$	$\frac{n_1}{n_2^2}$	$\frac{g}{4\pi}$ (m sec^{-2})
0.1923	15			1.089×10^{-2}				
0.2023	15			1.089×10^{-2}				
0.2223	15			1.089×10^{-2}				

[6]

(d) Calculate moment of inertia of flywheel for all three tabulated results and calculate their mean. [3+1]

(e) (i) Define moment of inertia and radius of gyration and state their units (ii) State two applications of flywheel (iii) State the advantage or disadvantage of increasing or decreasing the mass of attached peg.

[$(1+1+\frac{1}{2}+\frac{1}{2})+2+1$]

3. **Determination of Gravitational acceleration, 'g' using bar pendulum**

(a) Write down the working formula for determination of gravitational acceleration (g) using bar pendulum explaining all the terms involved in the formula.

(5)

(b) From distances of holes from the nearer end find distances of center of gravity (C.G) from point of suspension.

Hole number	Near distance x_n (cm)	Distance of C.G r_n =50- x_n (cm)
1	5.5	
2	10.5	
3	15.5	
4	20.5	

(2)

(c) Complete the following table for calculation of time period

Knife edge at hole number	Number of Observation	Side A		Side B		Mean time $\bar{t}$ (Sec)	Time period T (sec)
		Time t_A (Sec)	$\overline{t_A}$ (Sec)	Time t_B (Sec)	$\overline{t_B}$ (Sec)		
1	50	1 min 20 sec		1 min 20.15 sec			
		1 min 20 sec		1 min 20.19 sec			
2		1 min 18 sec		1 min 18.47 sec			
		1 min 18 sec		1 min 18.25 sec			
3		1 min 17.12 sec		1 min 17.16 sec			
		1 min 17.14 sec		1 min 17.28 sec			
4		1 min 16.44 sec		1 min 16.40 sec			
		1 min 16.44 sec		1 min 16.50 sec			

(4)

(d) Complete the following table for estimation of terms for drawing the graph T^2r vs r^2:

r_n (from 1st table) (m)	T (from 2nd table) (Sec)	r_n^2 (m^2)	T^2 (Sec^2)	$T^2 r_n$ (Sec^2 m)

(5)

(e) Plot T^2r vs r^2 graph and from the slope of the graph estimate gravitational acceleration (g).

(5+4)

(f) Write down differences between bar pendulum and simple pendulum.

(5)