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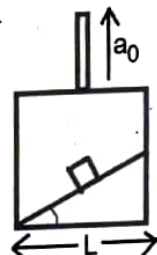
School: School of Science
Program: B.Sc.
Year: 1st **Semester:** 1st
Examination: End Semester Examination
Examination year: December - 2022

Course Code: PH109 **Course Name:** Mechanics, Elasticity and Special theory of Relativity
Date: 06/12/2022 **Total Marks:** 40
Time: 08:30 am to 10:30 am **Total Pages:** 2

Instructions:

- Write each answer on a new page.
- Use of a calculator is permitted.

Q. No.	Details	Marks	COs*	BT
Q.1	Choose a correct alternative	2*5=10		
	<p>1. With what acceleration 'a' should the box of figure descend so that the block of mass M exerts a force $Mg/4$ on the floor of the box?</p> 		CO1 CO2 CO3 CO4 CO5 CO6	BT BT BT
	2. Define moment of inertia. Explain theorem of parallel axes and Perpendicular axes in detail			
	3. Define modulus of rigidity and solve the following: A metal wire of 1m long and 2mm diameter is stretched by a load 40kg. If $Y = 7 \times 10^7 \text{ N/m}^2$ for the metal, then the stress produced will be?			
	4. Convert the equation written in Cylindrical coordinates into an equation in Cartesian coordinates: $4\sin\theta - 2\cos\theta = r/z$.			
	5. Use Lorentz transformation equations to prove the relation $x'^2 - c^2t'^2 = x^2 - c^2t^2$			
Q.2	Answer the following:	3*5=15		
	1. A particle suspended from a vertical spring oscillates 10 times per second. At the highest point of oscillation the spring becomes unstretched. a) Find the maximum speed of the block b) Find the speed when the spring is stretched by 0.20 cm. Take $g = \pi^2 \text{ ms}^{-2}$.			

	2. Derive the expression for centre of mass of a uniform semicircular wire.		CO1	
	3. Define angular momentum and obtain the expression $L=I\omega$.		CO2	BT1
	4. A and B are twins. B enters a spacecraft and synchronizes his watch with A ($t=t'=0$). The spacecraft closes and quickly accelerates to a velocity given by $v=0.8692c$. The spacecraft goes to a nearby star 10 light years away and promptly returns to earth with the same speed. What will be age difference between A and B?		CO3	BT2
			CO4	BT3
			CO5	BT5
			CO7	
	5. State Kepler laws and define escape velocity of a celestial object.		CO8	
		3*5=15		
Q.3	Answer in detail			
	1. What Bulk Modulus? Derive an expression relating Young's Modulus(Y), Bulk Modulus (k) and Poisson's Ratio (σ). and hence obtain the below expression: $\frac{3}{Y} = \frac{1}{3k} + \frac{1}{\eta}$			
	2. A particle slides down a smooth inclined plane of elevation θ , fixed in an elevator going up with an acceleration a_0 . The base of the incline has a length L. Find the time taken by the particle to reach the bottom.			
			CO1	
			CO2	
			CO3	
			CO4	BT1
			CO5	BT2
			CO6	BT3
			CO7	BT5
			CO8	
	3. Draw the schematic Michelson-Morley experiment and solve the following: In the Michelson-Morley experiment, the wavelength of the monochromatic light used is 5000\AA . What will be the expected fringe shift on the basis of stationary ether hypothesis if the effective length of each plate is 5m ? (velocity of the earth = $3 \times 10^4 \text{ m/sec}$ and $c = 3 \times 10^8 \text{ m/sec}$).			
	4. Define Bending Moment of a beam. Derive an expression of flexural rigidity of a beam.			
	5. Derive the expression for time dilation.			