

Phy131 Seventh Homework Assignment
Due Friday June 6

Do any 5 out of the 8 problems

Figures for the questions can be found the the last page of the assignment

Question 1.

As a way to get more energy for human use, Grey wants to take energy away from the rotational energy of the earth. How much energy in Joules would be lost from the earth's rotational energy if the day were to be one second longer? Note: this way we all would be able to get one second more sleep per day. Take the mass of the earth to be 5.98×10^{24} kg, and the radius to be 6.37×10^6 m.

Question 2.

To swing the baseball bat faster, some players "choke-up" on the bat. Find the rotational inertia of a thin rod of length L and mass m about a point that is $L/4$ away from one end. Express your answer in terms of L and m .

Question 3.

Marius, Lara and Julian are spinning around on a carousel, whose radius is 4 meters. Each child has a mass of 40 kg, and the carousel has a mass of 240 kg. Assume that the carousel is a uniform circular disk.

Initially, all three children are sitting at the edge of the carousel, 4 meters from the center. The carousel is initially rotating with a period of 2 seconds. If all three children move to the center, what is the new period of rotation?

Question 4.

Ray Williams, a Cal Poly Physics graduate, throws a bowling ball of mass M and radius R down the lane. The ball is thrown with an initial speed of v_0 , and is initially not rotating. The coefficient of friction between the ball and the lane is μ . As the ball moves down the lane, it skids, slowing the ball down and causing it to start rotating. Eventually, the ball rolls without slipping.

What is the final speed of the ball with it rolls without slipping? Express your answer in terms of v_0 .

Question 5.

Consider the set-up shown on the last page. The pulley has a mass of m and a radius R . Assume that the pulley is a cylindrical disk. The coefficient of friction between the block and the table is μ .

- a) What is the acceleration of the system? Express your answer in terms of g and μ .
- b) What are the tensions T_1 and T_2 ? Express your answer in terms of m , g , and μ .

Question 6.

A cylinder travels down the ramp and off the cliff as shown in the figure on the next page. The cylinder leaves the cliff traveling horizontally. If the cylinder were to **slide without friction and not rotate**, it would land a distance d_0 from the base of the cliff. If the cylinder **rolls down the ramp**, how far from the base of the cliff does it land? Express your answer in terms of d_0 .

Question 7.

Suppose that there are N forces acting on a rigid object, and that the net force on the object is zero: $\sum_i^N \vec{F}_i = 0$. Show that the net torque, $\tau_{Net} = \sum_i^N (\vec{r}_i \times \vec{F}_i)$ is independent of the choice of axis.

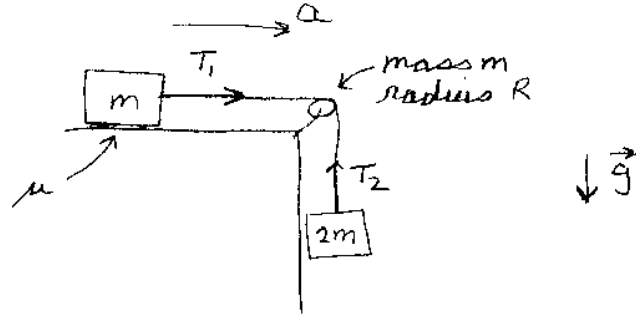
Question 8.

A string, which is wrapped around a cylinder, passes over a pulley and is attached to a block of mass m . See the figure on the next page. The cylinder has a mass of m_0 and a radius R . The height of the ledge is $R/3$. What is the maximum value of m such that the cylinder does not roll up the step? Express your answer in terms of m_0 .

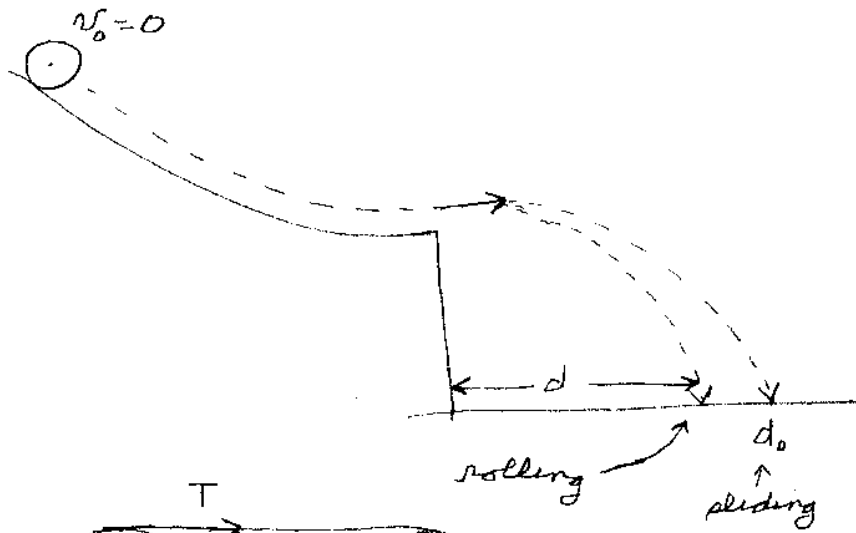
See the next page for the figures

Figures for HWK 7

5



6



8

