1. (20%) A boy of mass m slides on a frictionless cylinder of radius R as shown in Figure 1. He starts from rest when θ=0. Determine the value of θ in degree, at which the boy leaves the cylinder.

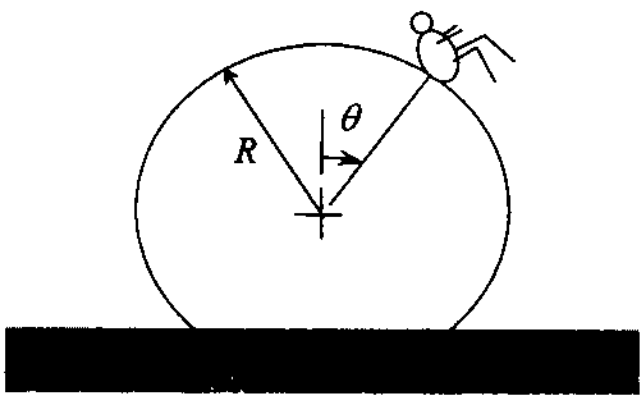

Figure 1

2. (20%) As shown in Figure 2, a rigid pendulum consists of two identical bars of length L and of negligible mass carrying equal masses m. The system swings in the plane of the figure about the frictionless hinge O. Determine the angular acceleration in terms of θ.

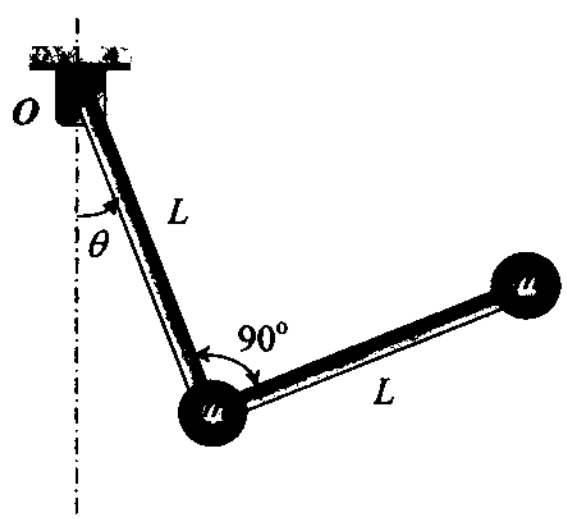

Figure 2

3. (20%) As shown in Figure 3, a disk having a mass m and a radius of gyration k=0.8r is given an initial velocity v_1 and a backspin ω_1. If the coefficient of kinetic friction between the table and the disk is μ, determine the distance the disk travels forward before backspinning stops.

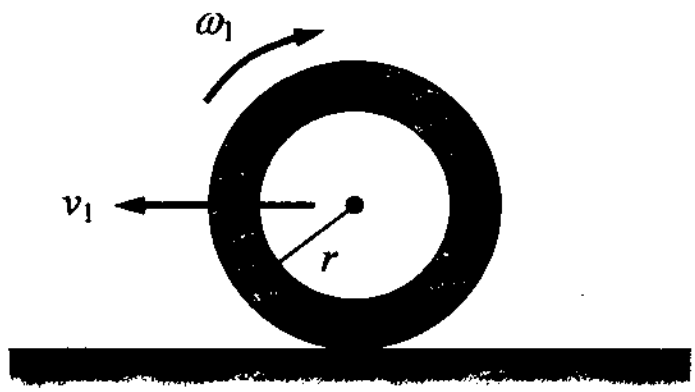

Figure 3

4. (20%) As shown in Figure 4, the solid ball of mass m and radius r rolls without slipping along a horizontal plane with an angular velocity of ω_1. Provided if does not slip or rebound, determine its angular velocity as it just starts to roll up the inclined plane.

Figure 4

5. (20%) As shown in Figure 5, a beam BC of length 15 ft and weight 500 lb is placed against a spring (which has a spring constant of 10 lb/in.) and smooth walls and allowed to come to rest. If the end of the spring is 5 ft away from the vertical wall when it is not compressed, show that the amount that the spring will be compressed is .889 ft (Show your method and develop equations that will match the solution).

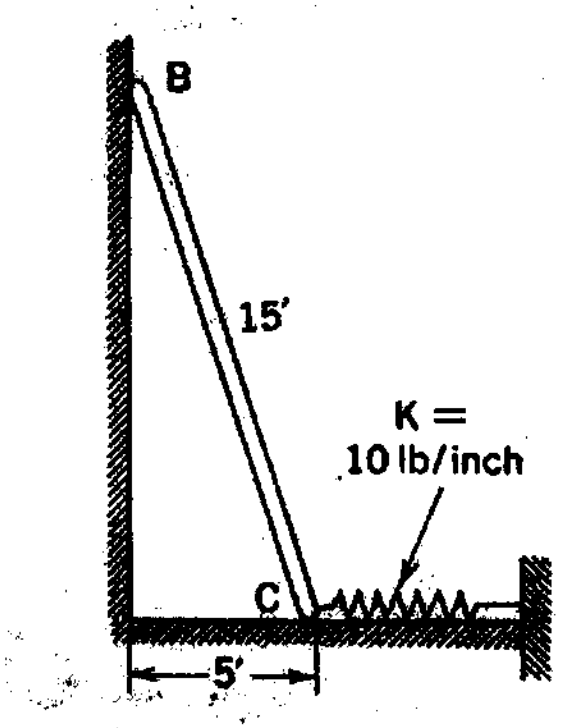

Figure 5