1. Find the equilibrium configurations for the system of equal bars W of length 5 m and mass 25 kg. The spring is unstretched when the bars are horizontal and has a spring constant of 1300 N/m. In other words, please find out the value of θ when the system is in equilibrium. (20%)

Figure 1

2. The boy of mass 30 kg shown in figure 2 is sliding down the spiral slide at a constant speed such that his position, measured from the top of the chute, has components $r = 1.5$ m, $\theta = 0.75t$ rad, and $z = -0.6t$ m, where t is in seconds. Determine the components of force $\mathbf{F}_r$, $\mathbf{F}_\theta$, and $\mathbf{F}_z$ which the slide exerts on him at the instant $t = 3$ s. Neglect the size of the boy. The gravitation acceleration g is 9.8 m/s^2 (20%)

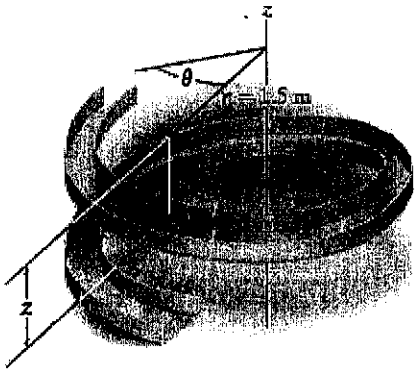

Figure 2

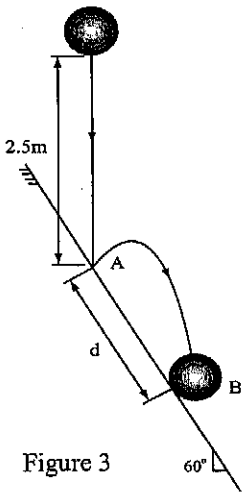

Figure 3

3. The 0.5 kg ball is dropped from rest and falls a distance of 2.5 m before striking the smooth inclined plane at point A. If it rebounds and in $t = 0.5$ s again strikes the plane at point B as shown in figure 3, determine the coefficient of restitution e between the ball and the plane. Also, what is the distance d? The gravitation acceleration g is 9.8 m/s^2. (20%)

4. The collar E is attached to rod AB and pivoted about rod AB while it slides on rod CD. If rod AB rotates clockwise about A and has an angular velocity ω of 6 rad/s and an angular acceleration α of 1 rad/s^2, determine the angular velocity ω_{CD} and angular acceleration α_{CD} of rod CD at the instant shown in figure 4. (20%)

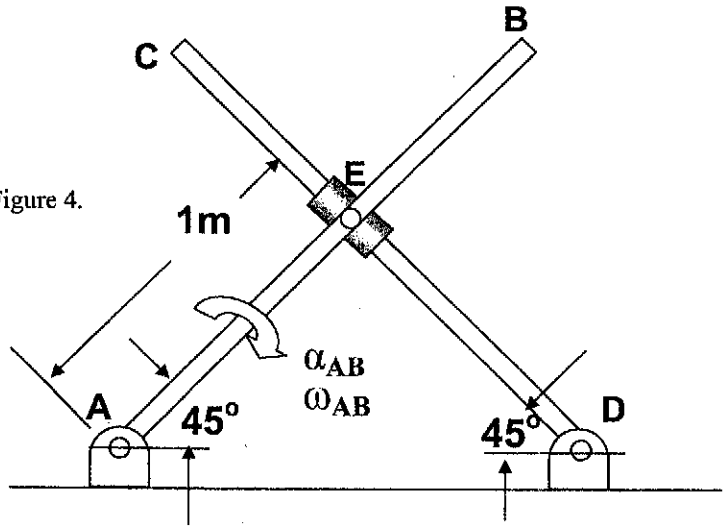

Figure 4.

5. A ball of mass **m** and radius **r** is cast onto the horizontal surface such that it rolls **without slipping** as shown in figure 5. Determine the minimal speed V_G of its mass center G so that it rolls completely around the loop of radius (R+r) without leaving the track. (20%)

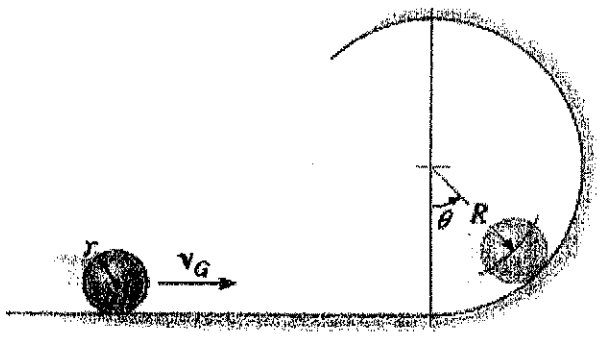

Figure 5