1. A small block having a mass of 0.1kg is given a horizontal velocity v_1=0.4m/s when r_1=500mm. It slides along the smooth conical surface, see Fig. 1. When it descends to h=100mm, determine its speed and the angle of decent θ, that is, the angle measured from the horizontal to the tangent of the path.(20%)

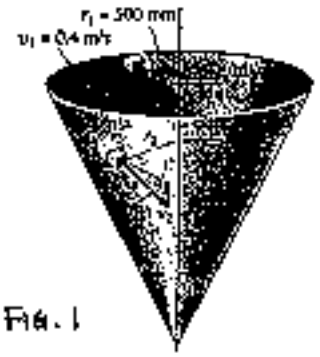

Fig. 1

2. A 2-Kg sphere moving horizontally to the right with an initial velocity of 5 m/s strikes the lower end of an 8-kg rigid rod AB, see Fig. 2. The rod is suspended from a hinge at A and is initially at rest. Knowing the coefficient of restitution between the rod and sphere is 0.8, determine the angular velocity of the rod and the velocity of the sphere immediately after the impact.(20%)

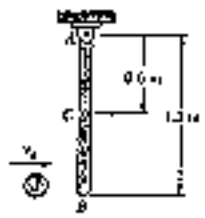

Fig. 2

3. (1)The 100-N disk rolls on the curved surface without slipping, see Fig 3. The link AB weights 25N. If the disk is released from rest when θ=0°, determine its angular velocity when θ= 90°.(20%). Hint: $I_{disk}=\frac{1}{2}mR^2$

(2)If the disk rolls in a small oscillations at the position θ= 90° , determine the natural frequency of the system.(15%)

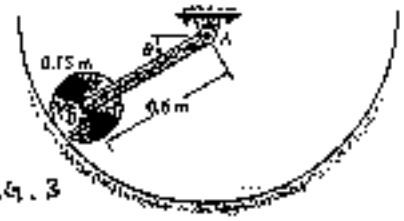

Fig. 3

4. Consider the two points A and B shown in Fig. 4-1. Their location is specified by the position vector r_A and r_B, which are measured from the fixed X,Y, Z coordinate. Let A be the origin of the x, y, z coordinate system, which is assumed to be both translating and rotating with respect to the X,Y,Z coordinates.

(1)At the instant considered, point A has a velocity v_A and an acceleration a_A, find the velocity and the acceleration at point B. (10%).

(2)Use your equations to find the velocity and the acceleration at point p as shown in Fig. 4-2;(10%)

(3)What is the angular acceleration of the disk?(5%)

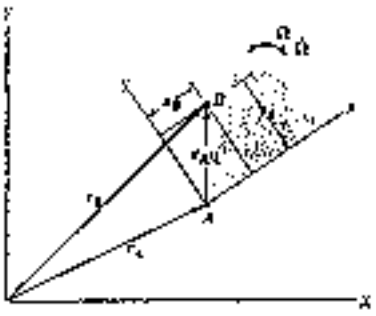

Fig. 4-1

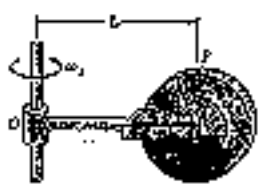

Fig. 4-2