1. Two boxes weight W and 3W as shown in Fig. 1. The coefficient of static friction between the two boxes and between the lower box and the inclined surface is μ_s. If F=0, the lower box will slip down the inclined surface. What is the smallest force F for which the boxes will not slip? (20%)

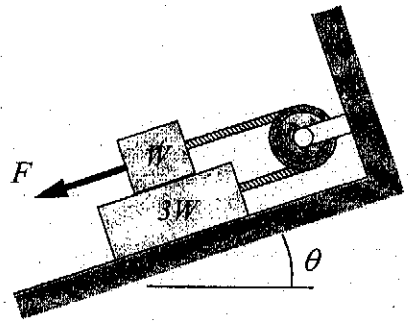
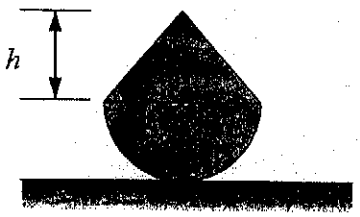


Figure 1

2. As shown in Fig.2, the homogeneous composite object consists of a hemisphere and a cone. It is at rest on the plane surface. Show that this equilibrium position is stable only if $h < \sqrt{3}R$. (20%)



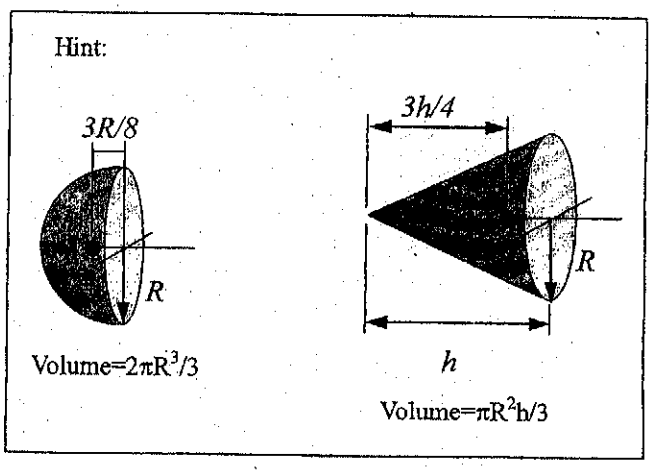


Figure 2

3. As shown in Fig. 3, a rod rotates counterclockwise with constant angular velocity of ω. A collar M slides outward at a constant relative speed v along the rod. It is assumed that the collar M slides from an origin point A (i.e. r=0). At a time moment, the collar reaches point B. The distance from A to B is described by a vector ***r***. Please determine the magnitude of acceleration of the collar M just as it reaches B. (20%)

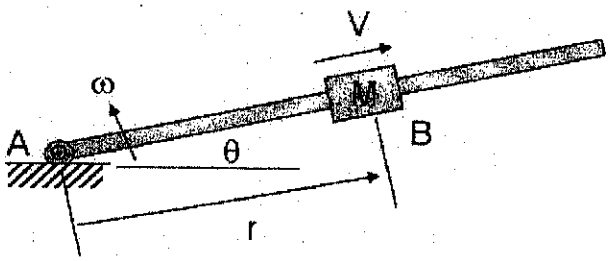


Figure 3

4. A drum of r_1-mm radius is attached to a disk of r_2-mm radius as shown in Fig. 4. The disk and drum have a total mass of ***m***-kg and a combined radius of gyration of r_3-mm. A cord is attached as shown and pulled with a force ***P*** Newton. Knowing that the disk rolls without skidding, determine the minimum value of the coefficient of static friction and the angular acceleration of the point ***G***. (20%)

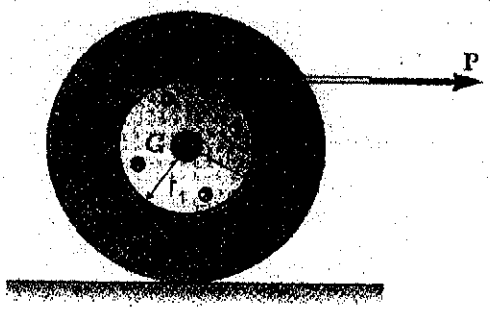


Figure 4

5. The ball B has a mass of 10 kg and is attached to the end of a rod whose mass may be neglected. If the rod is subjected to a torque $M=(3t^2+5t+2)N\cdot m$, where t is in seconds, determine the speed of the ball when $t=2\,s$. The ball has a speed $v=2m/s$ when $t=0$. (20%)

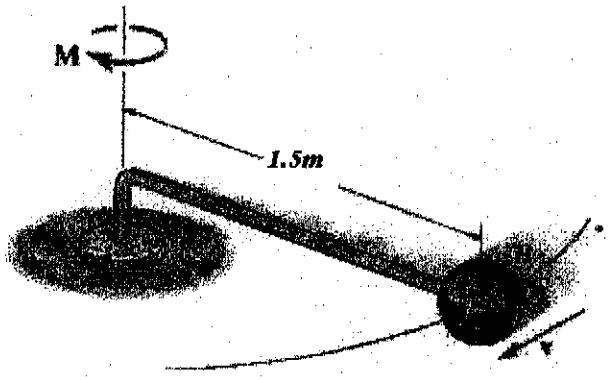


Figure 5