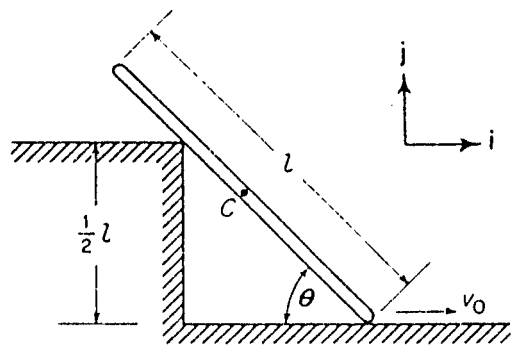20% 1. The lower end of a rigid bar of length l is moved to the right at a constant speed v_O along a horizontal floor. It slides on the corner of a step of height $l/2$. Assuming planar motion with $30° < \theta < 90°$, find: (a) $\dot{\theta}$; (b) $\ddot{\theta}$; (c) $\mathbf{v}_C$ for the position shown in the figure where C is at the center of the bar.


20% 2. The payload of a rocket is spin-stabilized. The spin speed is constant at ω_1 rad/sec. At the height h ft above the ground, before it is in orbit, the rocket turns, making a curve of radius r ft, with speed v_1 ft/sec and rate of change of speed a_1 ft/sec^2. For the position shown in the figure determine (a) the angular velocity and angular acceleration of the payload and (b) the velocity and acceleration of point A on the payload.
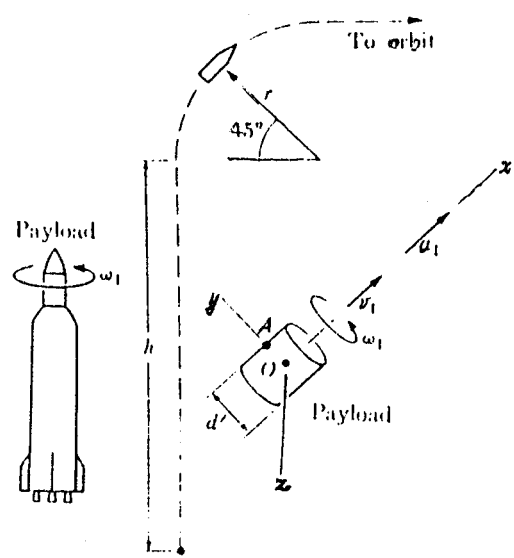
20% 3. The uniform semicircular bar of weight W and radius r is hinged freely at A. a) Find the center of mass position of the bar and the mass moment of inertia of the bar relative to the axis perpenticular to A. b) If the bar is released from rest with AB in horizontal position, determine the initial angular acceleration α of the bar and the reaction forces on the hinge A.
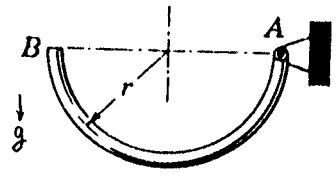
20% 4. The homogeneous solid cylinder of weight W and radious r rolls without slip on a circular surface of radious R. If the motion is confined to small amplitudes oscillation, find the frequency f of oscillation.
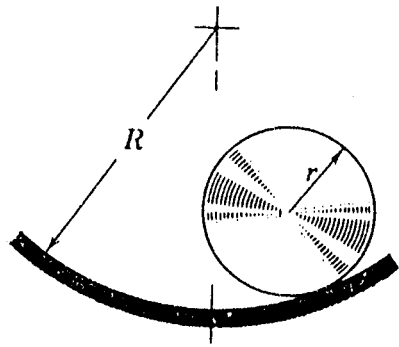
20% 5. The circular disk of mass m and radius r is mounted on the vertical shaft with a small angle α between its plane and the plane of rotation of the shaft. Determine the expression for the bending moment M in the shaft due to the wobble of the disk at a shaft speed of ω rad/sec.