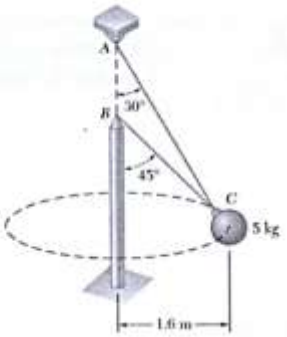
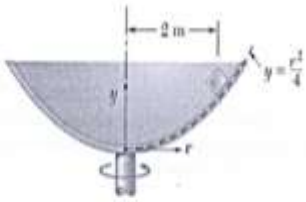
SHEET NO: 6

1.



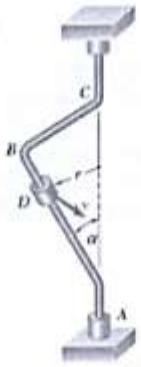
Two wires AC and BC are tied at C to a sphere which revolves at a constant speed v in the horizontal circle shown. Determine the range of values of v for which both wires remain taut.

2.



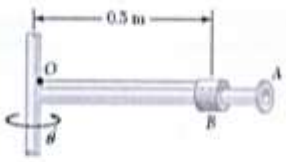
A 3-kg block is at rest relative to a parabolic dish which rotates at a constant rate about a vertical axis. Knowing that the coefficient of static friction is 0.5 and that $r = 2$ m, determine the maximum allowable velocity v of the block.

3.



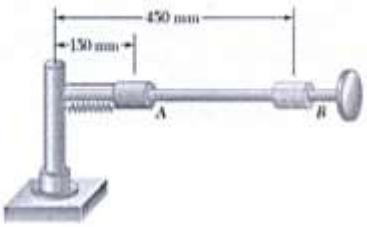
A small, 300-g collar D can slide on portion AB of a rod which is bent as shown. Knowing that $\alpha = 40°$ and that the rod rotates about the vertical AC at a constant rate of 5 rad/s, determine the value of r for which the collar will not slide on the rod if the effect of friction between the rod and the collar is neglected.

4.



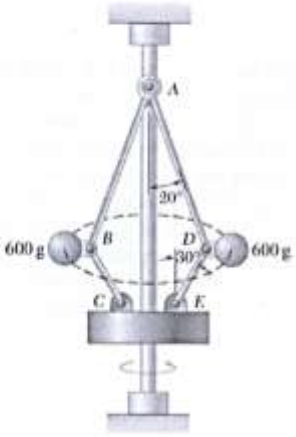
The horizontal rod OA rotates about a vertical shaft according to the relation $\theta = 10t$, where θ and t are expressed in rad/s and seconds, respectively. A 250-g collar B is held by a cord with a breaking strength of 18 N. Neglecting friction, determine, immediately after the cord breaks, (a) the relative acceleration of the collar with respect to the rod, (b) the magnitude of the horizontal force exerted on the collar by the rod.

5.



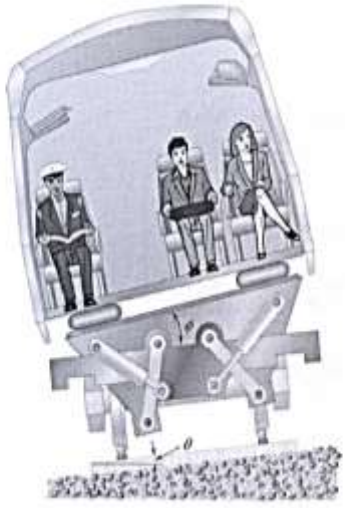
A 1 kg collar can slide on a horizontal rod, which is free to rotate about a vertical shaft. The collar is initially held at A by a cord attached to the shaft. A spring of constant 30 N/m is attached to the collar and to the shaft and is undeformed when the collar is at A. As the rod rotates at the rate $\dot{\theta} = 16$ rad/s, the cord is cut and the collar moves out along the rod. Neglecting friction and the mass of the rod, determine (*a*) the radial and transverse components of the acceleration of the collar at A, (*b*) the acceleration of the collar relative to the rod at A, (*c*) the transverse component of the velocity of the collar at B.

6.



The 600 g flyballs of a centrifugal governor revolve at a constant speed v in the horizontal circle of 150 mm radius shown. Neglecting the weights of links AB, BC, AD, and DE and requiring that the links support only tensile forces, determine the range of the allowable values of v so that the magnitudes of the forces in the links do not exceed 80 N.

7.



Tilting trains, such as the *American Flyer*, which will run from Washington to New York and Boston, are designed to travel safely at high speeds on curved sections of track, which were built for slower, conventional trains. As it enters a curve, each car is tilted by hydraulic actuators mounted on its trucks. The tilting feature of the cars also increases passenger comfort by eliminating or greatly reducing the side force $\mathbf{F}_s$ (parallel to the floor of the car) to which passengers feel subjected. For a train traveling at 160 km/h on a curved section of track banked through an angle $\theta = 6°$ and with a rated speed of 100 km/h, determine (*a*) the magnitude of the side force felt by a passenger of weight W in a standard car with no tilt ($\phi = 0$), (*b*) the required angle of tilt ϕ if the passenger is to feel no side force. (See Sample Problem 12.6 for the definition of rated speed.)