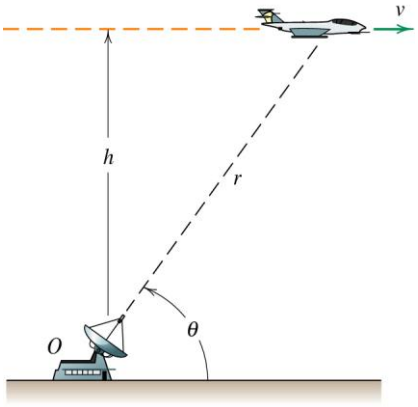
King Saud University, Mechanical Engineering Department
Final Exam, GE 202 Dynamics, Duration 3 hours, 7/3/1436 (29/12/2015)

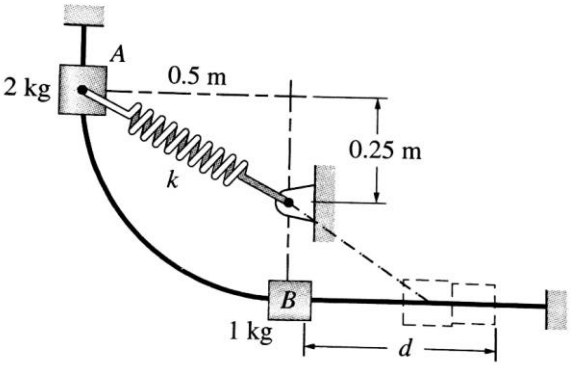
Problem 1

A jet plane flying at a constant speed v at an altitude $h = 12\,\text{km}$ is being tracked by radar located at O directly below the line of flight. If the angle θ is decreasing at the rate of 0.017 rad/s when $\theta = 60°$, determine the values of $\ddot{r}, \ddot{\theta}$ at this instant and the magnitude of the velocity $\mathbf{v}$ of the plane.



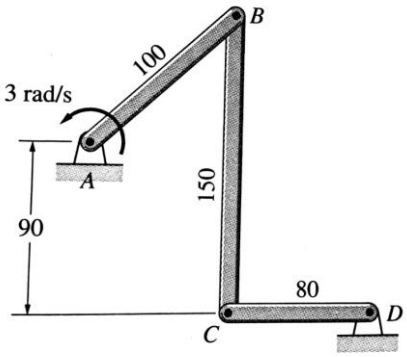
Problem 2

The collars A and B slide with negligible friction along the wire that lies in the vertical plane. The spring attached to A has a stiffness of $k = 150\,\text{N/m}$, and its unstreched length is 0.25 m. Both collars are at rest when A is released in the position shown. After the impact, A and B stick together, (coefficient of restitution $e = 0$), and move the distance d before stopping momentarily. Determine the equation that will find the distance d.



Problem 3

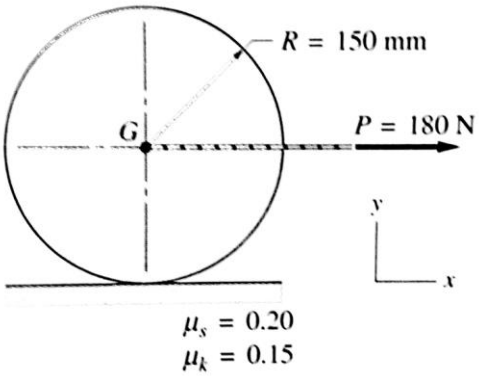
Bar AB is rotating counterclockwise with a constant angular velocity of 3 rad/s. For the position shown (a) determine the angular velocities of bars BC and CD, (ω_{BC}, ω_{CD}), (b) determine the angular accelerations of bars BC and CD, (α_{BC}, α_{CD}).



Dimensions in mm

Problem 4

The figure shows a 20 kg homogeneous disk of radius 0.15 m. The disk is at rest before the horizontal force $P = 180\,\text{N}$ is applied to its mass center G. The coefficients of static and kinetic friction for the surfaces in contact are 0.2 and 0.15, respectively. Draw free body and kinetic diagrams for the disk. Determine the angular acceleration of the disk and the acceleration of G after the force is applied. ($I_G = \frac{1}{2}mR^2$)



Problem 5

A uniform slender 6 kg rod can rotate in a vertical plane about a pivot at B. A spring of constant $k = 600\,\text{N/m}$ and an unstretched length of 225 mm is attached to the rod as shown. Knowing that the rod is released from rest in the position shown, determine its angular velocity after it has rotated through $90°$. ($I_G = \frac{1}{12}mL^2$)