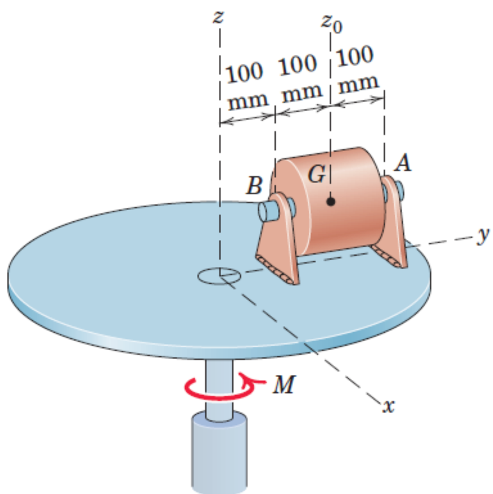
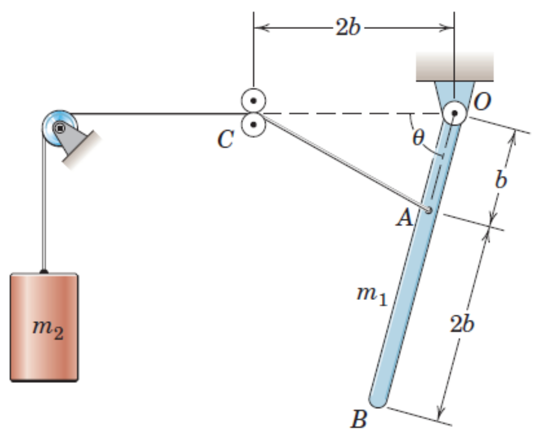
DYNAMICS (ME232)

Tutorial-6: Plane Kinetics of Rigid Bodies

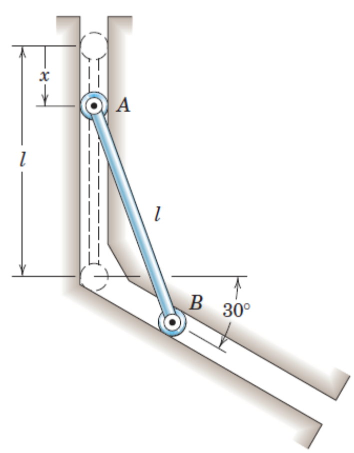
1. The 12-kg cylinder supported by the bearing brackets at A and B has a moment of inertia about the vertical z_0-axis through its mass center G equal to 0.080 kg.m^2. The disk and brackets have a moment of inertia about the vertical z-axis of rotation equal to 0.60 kg.m^2. If a torque M=16N.m is applied to the disk through its shaft with the disk initially at rest, calculate the horizontal x-components of force supported by the bearing at A and B.



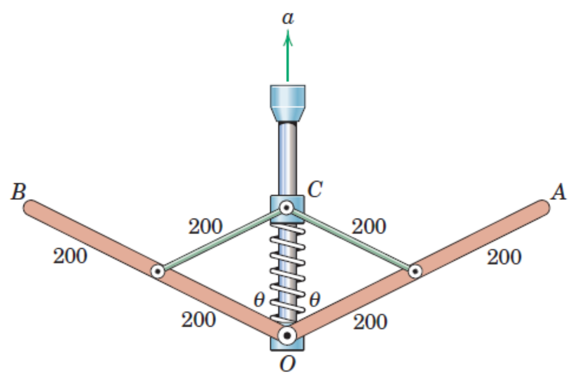
2. The system is released from rest when the angle $\theta = 90°$. Determine the angular velocity of the uniform slender bar when θ equals $60°$. Use the values m_1=1 kg, m_2=1.25 kg, and $b = 0.4$ m.



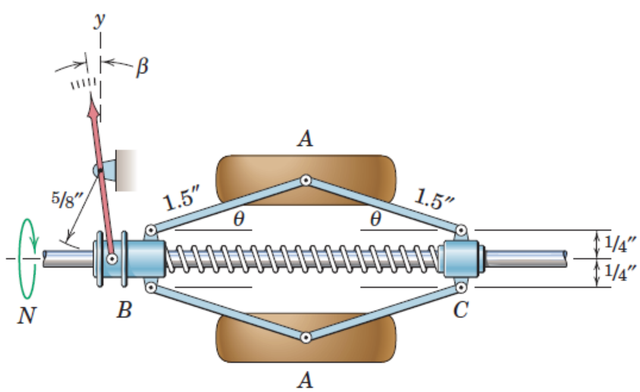
3. The uniform slender rod of length l is released from rest in the dashed vertical position. With what speed v_A does end A strike the $30°$ incline? Neglect the small mass and friction of the end rollers.



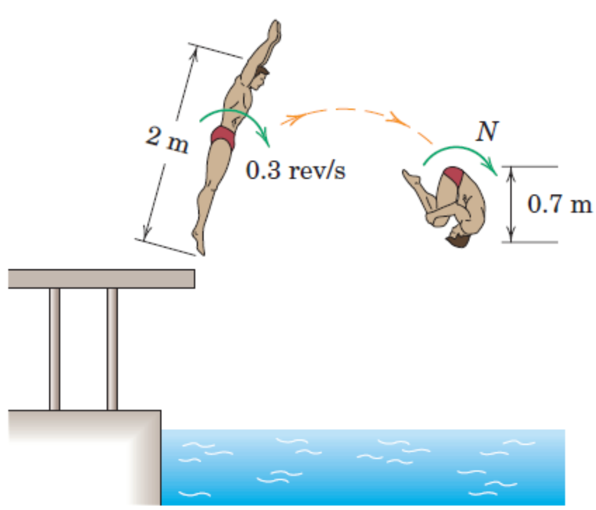
4. Each of the uniform bars OA and OB has a mass of 2 kg and is freely hinged at O to the vertical shaft, which is given an upward acceleration $a = g/2$. The links which connect the light collar C to the bars have negligible mass, and the collar slides freely on the shaft. The spring has a stiffness $k = 130$ N/m and is uncompressed for the position equivalent to $\theta = 0$. Calculate the angle θ assumed by the bars under conditions of steady acceleration.



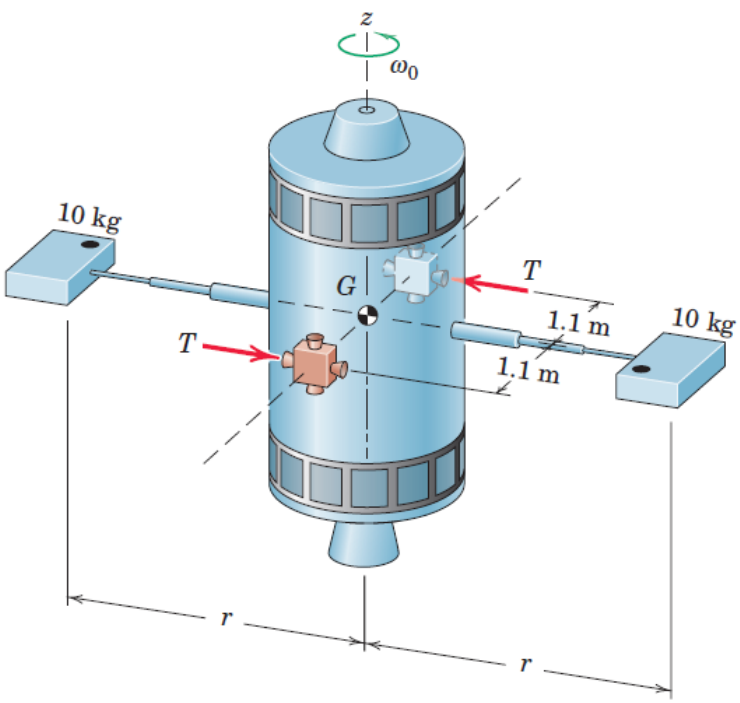
5. The mechanical tachometer measures the rotational speed N of the shaft by the horizontal motion of the collar B along the rotating shaft. This movement is caused by the centrifugal action of the two 12-oz weights A, which rotate with the shaft. Collar C is fixed to the shaft. Determine the rotational speed N of the shaft for a reading $\beta = 15°$. The stiffness of the spring is 5lb/in., and it is uncompressed when $\theta = 0$ and $\beta = 0$. Neglect the weights of the links.



6. Just after leaving the platform, the diver's fully extended 80-kg body has a rotational speed of 0.3 rev/s about an axis normal to the plane of the trajectory. Estimate the angular velocity N later in the dive when the diver has assumed the tuck position. Make reasonable assumptions concerning the mass moment of inertia of the body in each configuration.



7. Two small variable-thrust jets are actuated to keep the spacecraft angular velocity about the z-axis constant at ω_O=1.25 rad/s as the two telescoping booms are extended from $r_1 = 1.2$ m to $r_2 = 4.5$ m at a constant rate over a 2-min period. Determine the necessary thrust T for each jet as a function of time where $t = 0$ is the time when the telescoping action is begun. The small 10-kg experiment modules at the end of the booms may be treated as particles, and the mass of the rigid booms is negligible.



8. A 55-kg dynamics instructor is demonstrating the principles of angular momentum to her class. She stands on a freely rotating platform with her body aligned with the vertical platform axis. With the platform not rotating, she hold a modified bicycle wheel so that its axis is vertical. She then turns the wheel axis to a horizontal orientation without changing the 600-mm distance from the centerline of her body to the center, and her students observe a platform rotation rate of 30 rev/min. If the rim-weighted wheel has a mass of 10 kg and a centroidal radius of gyration $\bar{k} = 300$ mm, and is spinning at a fairly constant rate of 250 rev/min, estimate the mass moment fo Inertia I of the instructor (in the posture shown) about the vertical platform axis.