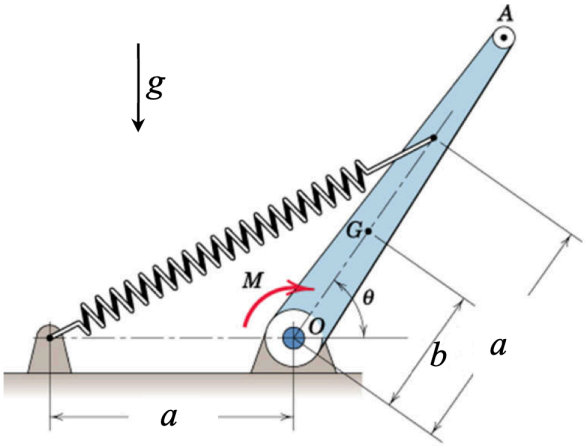
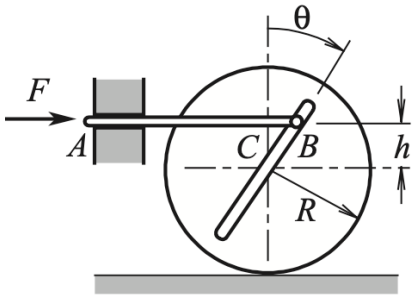
ESO209A: Dynamics: **Tutorial 11**
(Week: 20 - 26 Oct. Based on L15-L19)

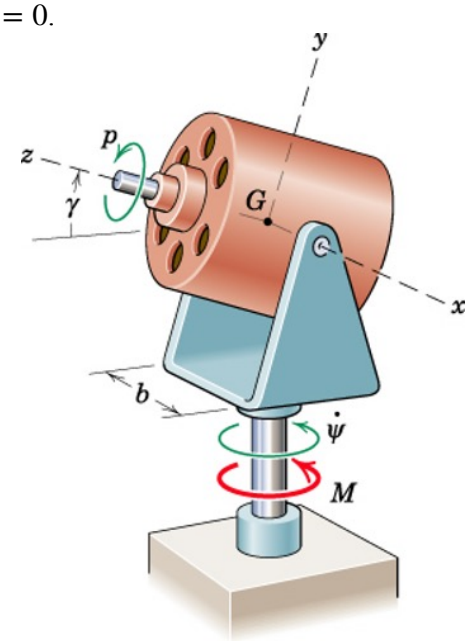
(1) A 10 kg lever OA is initially vertical when the spring is unstretched. A constant torque M is applied to the shaft of the lever from this position to obtain its angular velocity $\omega = 1$ rad/sec when $\theta = 0°$. The radius of gyration of the lever about O is 500 mm, b = 450 mm, a = 800 mm, and stiffness of the spring is 700 N/m. Determine the magnitude of M. Gravity acts vertically downward.



(2) Horizontal force F causes the actuating rod to move to the left at the constant speed v. This rod is connected to the wheel by pin B, which may slide F through the groove. The mass of the wheel is m, the radius of gyration is κ, and μ_s and μ_k are the coefficients of static and kinetic friction, respectively, between the wheel and the ground. Friction between the pin and the groove is negligible, as is the mass of the rod. Consider the instant when $\theta = 30°$. Derive expressions for the acceleration of center C, the angular acceleration of the gear, and the force F under the assumption that (a) the wheel rolls without slipping, (b) there is slippage between the wheel and the ground.



(3) The housing of an electric motor is free to rotate about $\hat{\mathbf{e}}_1$-axis, which passes through the centroid of the armature, which is spinning at a constant rate p, as shown. The radius of gyration of the armature about z-axis is κ_z and that about x-axis is κ_x. Determine $\ddot{\psi}$ when a torque M is applied as shown. Assume $\dot{\gamma} = \dot{\psi} = 0$.



(4) Identical disks A and B spin at the constant rates ω_A and ω_B, respectively, about shaft AB, which is horizontal. The entire system precesses about the vertical axis at the constant rate Ω. Determine the relationship between the spin rates ω_A and ω_B for which this motion can occur without application of a torque acting about the axis of pin C.