Ph.D. Qualifying Examination

Dynamics

Spring 2016

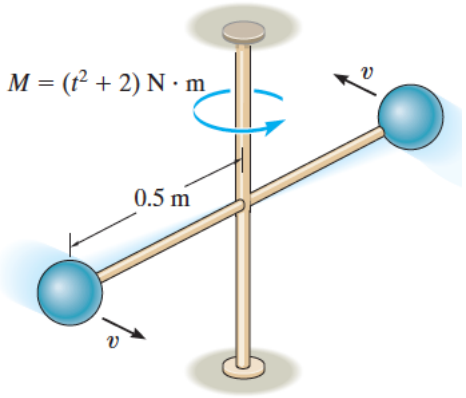
Notes:

1. Duration: 2.5 hours

2. Closed book, closed notes (one sheet of formulas is allowed).

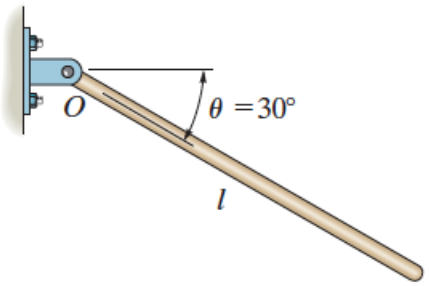
3. Total of 4 problems (all of the same value); calculator is allowed.

Problem 1:
Each ball has a negligible size and a mass of 10 kg and is attached to the end of a rod whose mass may be neglected. If the rod is subjected to a torque $M = (t^2 + 2)$ N.m, where t is in seconds, determine the speed of each ball when t = 3 s. Each ball has a speed v = 2 m/s when t = 0.

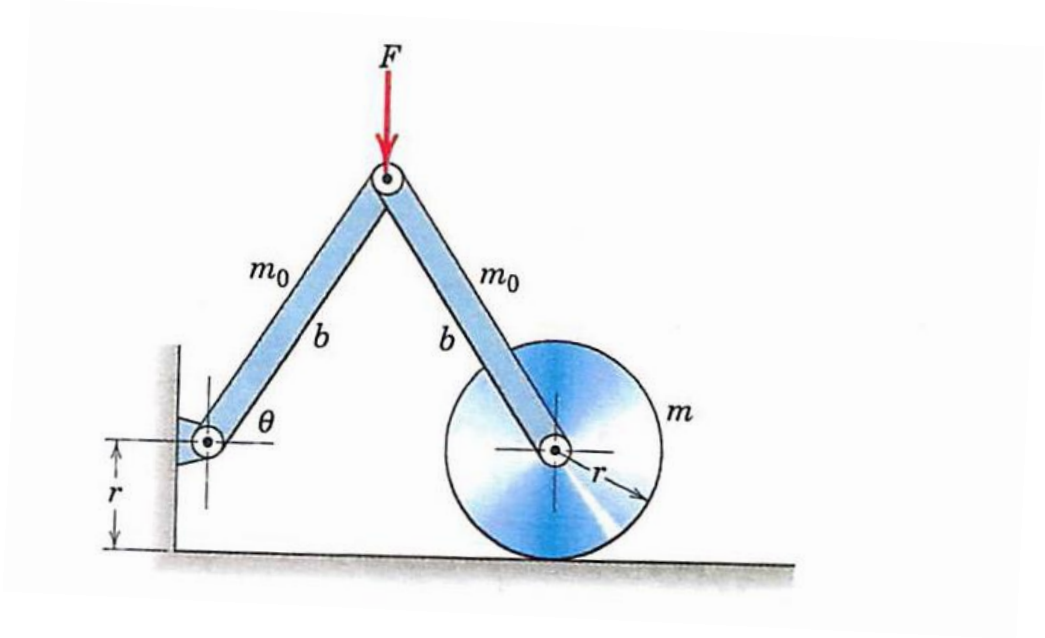


Problem 2:

The bar has a mass of 1 kg and length of 2 m. If it is released from rest from the position $\theta = 30^o$, determine its angular acceleration. $I_G = 1/12\ ml^2$; $I_O = 1/3\ ml^2$.



Problem 3:
A constant force ***F*** is applied in the vertical direction to the symmetrical linkage starting from the rest position shown. Determine the angular velocity ω which the links acquire as they reach the position θ=0**.** Each link has a mass m_0. The wheel is a solid circular disk of mass *m* and rolls on the horizontal surface without slip. For the wheel $I_{cm}=mr^2/2$ and the linkage $I_{cm}=mb^2/12$.



Problem 4:
The uniform disk of mass *m* is rotating with an angular velocity ω_0 when it is placed on the horizontal surface. Determine the time before it stars to roll without slip. The coefficient of kinetic friction is μ_k. For the wheel $I_{cm}=mr^2/2$.