

Exam 2

2.003 Dynamics and Vibrations

This is a closed book quiz. Each student may bring two sides of an $8\frac{1}{2}$ x 11 inch sheet of self-prepared notes.

Problem 1 (10pts)

Collar B can slide along rod AC and is attached by a pin to a block that can slide in the vertical slot shown. The block is acted upon by a force P and a torque M is applied to the rod AC at the pivot point A. All sliding and rotating contacts are frictionless.

- Determine the generalized force conjugate to the generalized coordinate θ .
- State the principle of virtual work and apply this principle to determine the torque M required to maintain equilibrium.

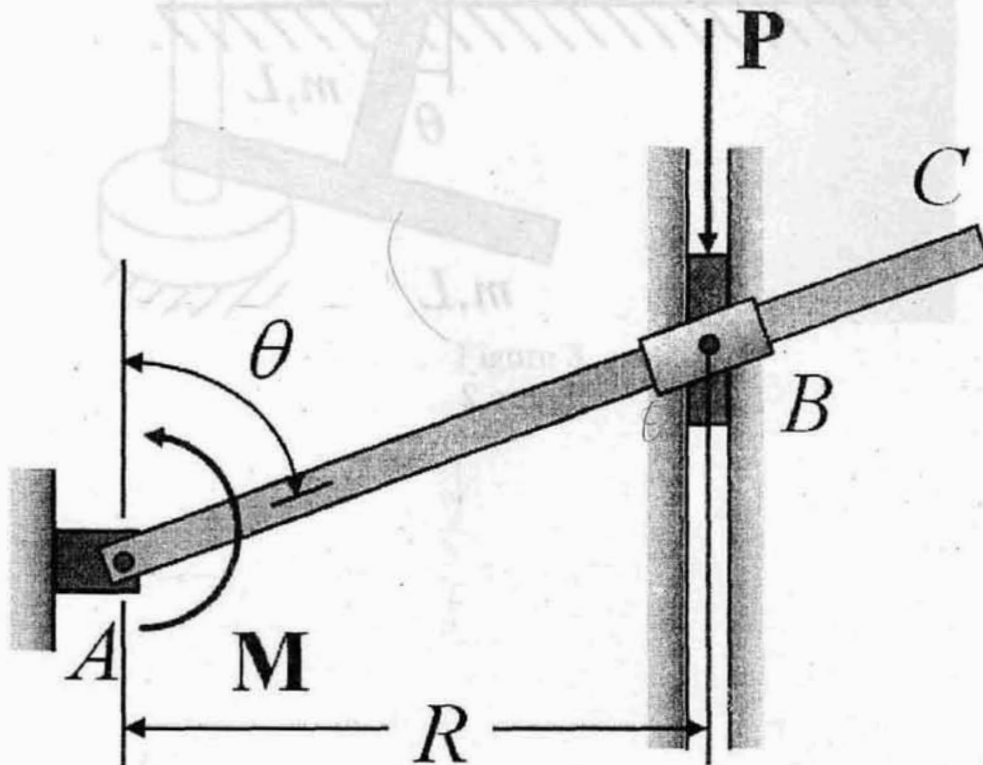


Figure 1

Problem 2 (10 pts)

A cart of mass M is attached to the wall by a spring k . A T-shaped body consisting of two long, thin bars of mass m and length L is pinned to the center of the cart, as shown in figure 2. Find the equations of motion of the system in terms of the generalized coordinates x and θ using Lagrange's equations.

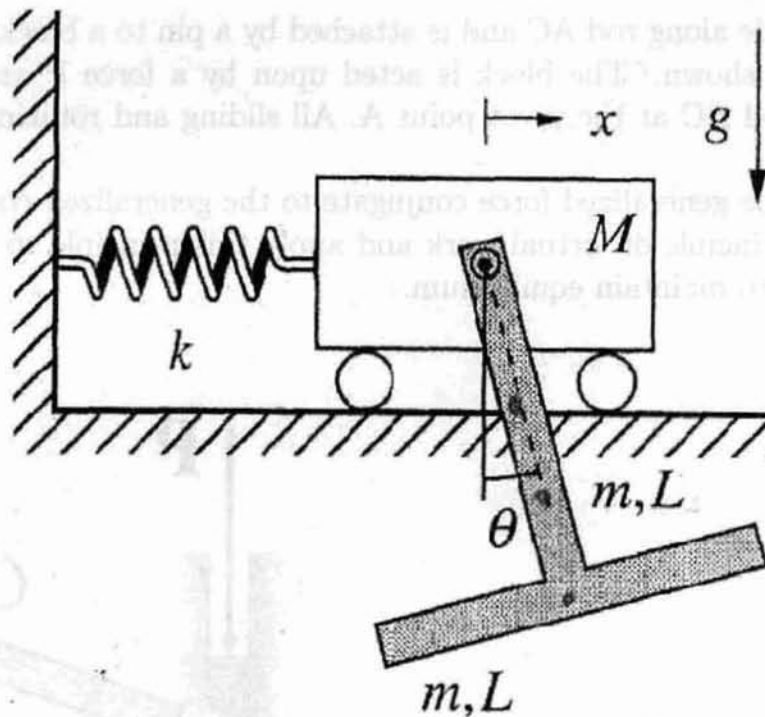


Figure 2

Problem 3 (10pts)

A bead of mass m can slide freely along a taut string as shown in figure 3. Find the equilibrium position of the bead for $\Omega = \text{constant}$, and determine the stability of the equilibrium.

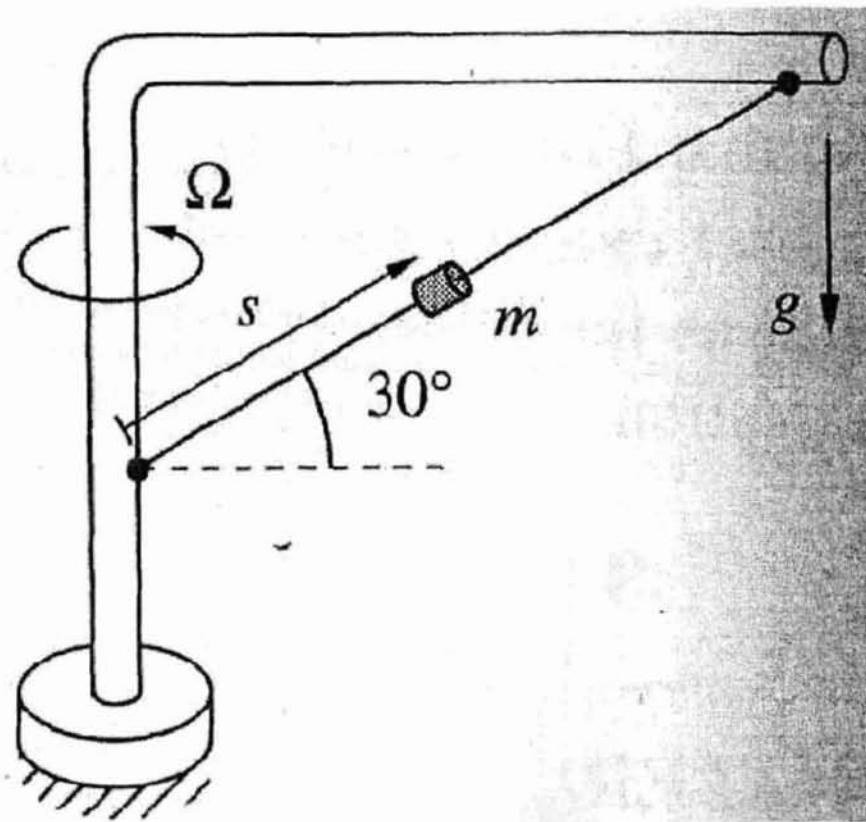


Figure 3