

CHALLENGE PROBLEM #2

Use any means at your disposal to solve this problem.

Solution attempts are due by **November 16, 2007**.

Bonus points for the course will be given only for correct answers.

A massless rope of length L is wound tightly around a disk of radius R and mass M ($I_{DISK} = \frac{1}{2}MR^2$) between points A and B as shown. The rope is fixed to the disk at point A only. Attached to the other end of the rope is a mass, m . (The mass does not swing – it only moves up and down.) As the weight of the mass, m , pulls downward, the disk will accelerate rotationally about the central axis. Later, the mass will be directly beneath the disk axis and will wind around the disk on the other side, causing the disk to slow down and stop until the rope attachment point is back at point A . The system will oscillate back and forth as described. The system starts from rest as shown. Using any method of your choice,

- (a.) If the axis exerts a force of friction, $F = -a\dot{\theta}$, find the value of a that causes the system to be critically damped,
- (b.) Determine the angular velocity of the disk, $\dot{\theta}$, as a function of angular displacement, θ , for the case in which $a=0$.

NOTE: The rope can not stretch or buckle and all motion is confined to the plane shown.

