

2.003/1.053 Dynamics and Controls I
Spring 2007

Exam 1

March 21st, 2007

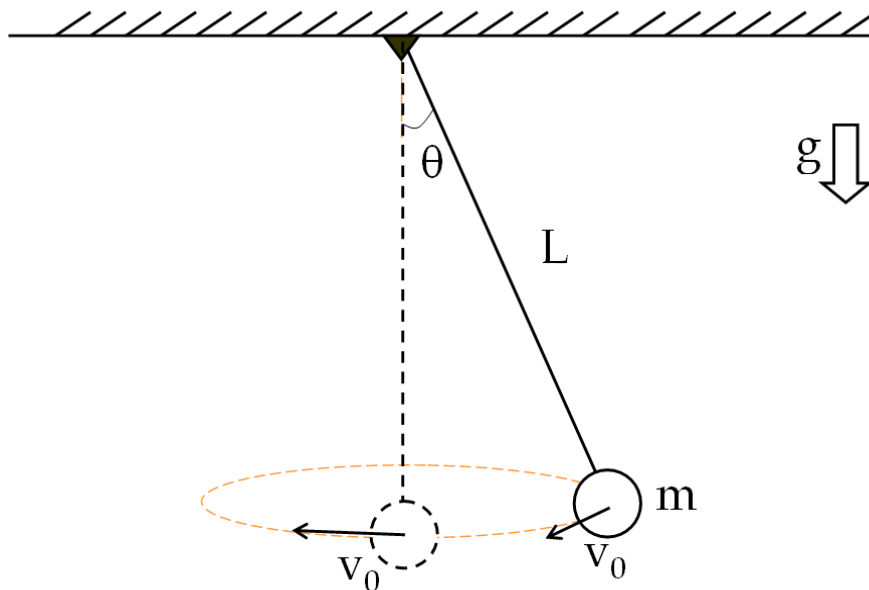
You are allowed one double-sided sheet of notes.
There are three questions and each is worth 10 points.
You have *80 minutes* to complete *all* questions.

1 Conical pendulum

A ball of mass m is attached to the end of a chord of length L in a gravitational field g . The chord is tied at the top to a pivot point. The ball is given a velocity v_0 such that it describes a circular trajectory in the horizontal plane.

Derive a formula for the angle θ which the chord makes with the vertical.

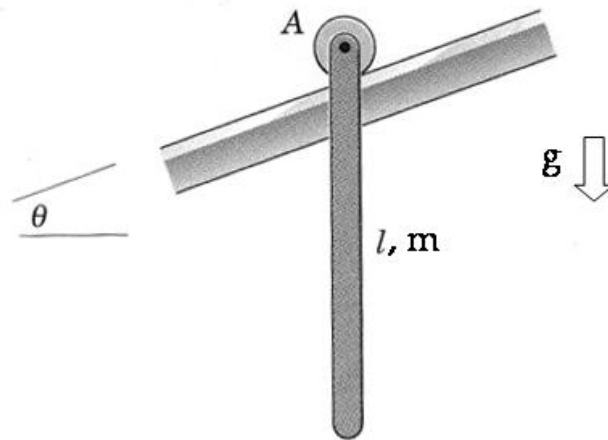
Neglect air resistance and the size of the ball, and assume the chord remains taut at all times.



2 Rod pendulum with moving pivot

The slender rod of mass m and length l is released from rest in the vertical position, connected at point A to a small, massless roller resting on the incline.

Determine the initial linear downslope acceleration of point A the moment after release.



3 Rolling wheel

A wheel of diameter R , consisting of a thin uniform rim of mass M and six thin uniform spokes mass m , is released from rest of the top of a hill of height h .

What is the angular velocity of the wheel when it reaches the bottom, assuming that it rolls without slipping?

