ME 710
Computational Methods in Structural Dynamics
Winter 1996
Exam #1 Re-Test
No books, notes, or cheat sheets.

1) Find the natural frequencies and mode shapes for a string with the equation of motion

$$c^2 w_{xx}(x,t) = w_{tt}(x,t)$$

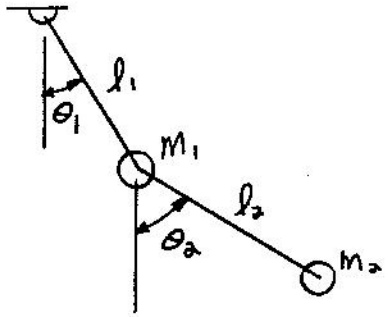
with the boundary conditions

$$w(0,t) = 0 \text{ and } \tau w_x(x,t)|_{x=l} = -kw(x,t)|_{x=l}$$

Show the equation for σ_n, but do not solve.

Write ω_n as a function of σ_n.

2) Derive the equation of motion for the double pendulum shown below.



3) Find the forced response of a beam to a force of 100 sin 3t at its center. The unforced equation of motion is $c^2 w_{xxxx}(x,t) + w_{tt}(xt) = 0$.

The mode shapes are $\sqrt{\frac{2}{\ell}} \sin \frac{n\pi x}{\ell}$.

Lagrange's equation is given by

$$\frac{d}{dt}\left(\frac{\partial L}{\partial \dot{q}_i}\right) - \frac{\partial L}{\partial q_i} = 0$$