Name _____ Section _____

EM406
Examination I
September 23, 2005

Problem	Score
1	/10
2	/40
3	/35
4	/15
Total	/100

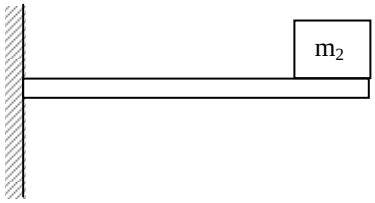
Show all work for credit
AND
Turn in your signed help sheet

Name _____ 10 pts

EM406 Examination I **Problem 1** September 23, 2005

Problem 1

Assuming the mass of the beam is 0.6 kg and it has a natural frequency of 100 rad/s. What lumped mass, m_2, needs to be attached to the end to reduce the natural frequency to 80 rad/s?

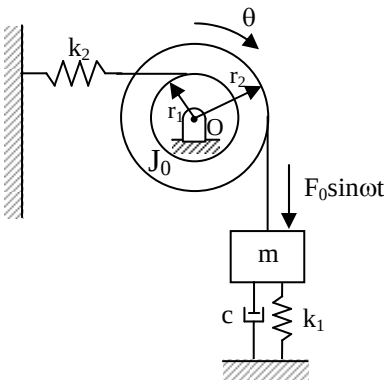


Name _____ 40 pts

EM406 Examination I **Problem 2** September 21, 2004

Find

a) the equation of motion for the system shown in terms of θ.
b) the natural frequency and damping ratio in terms of the labeled system parameters



Assume the equation of motion with numbers is:

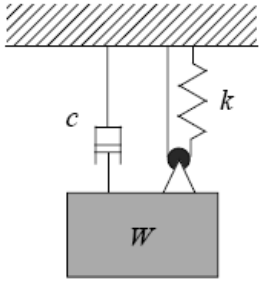
$2\ddot{\theta} + 10\dot{\theta} + 200\theta = 5\sin\omega t$.

c) Determine the steady state response for ω = 12 rad/s.
d) Using your answer from part c) determine the maximum pretension required in the rope so that it does not go slack. Assume J_0 = 1 kg-m^2, k_2 = 5000 N/m, r_1 = 0.1 m. (5 pts)

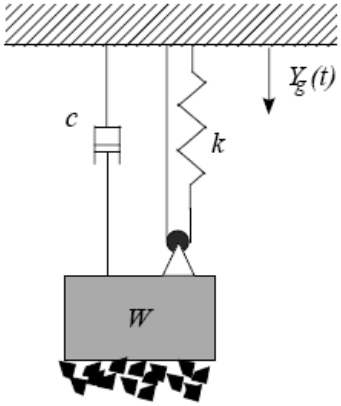
Name _____ 35 pts

EM406 Examination I **Problem 3** September 23, 2005

An electromagnet weighing W = 400 lbs is holding up W_2 = 200 lbs of scrap iron. At time t = 0, the magnet is turned off and the scrap iron is dropped. Simultaneously, the support for the system starts moving according to $Y_g(t) = 2 \sin\omega t$ inches, where positive is indicated in the figure below.



(a) Electromagnet in static equilibrium under own weight



(b) Electromagnet in static equilibrium under combined self-weight and scrap iron

a) Determine the equation of motion for the system after the magnet is turned off. Be sure to clearly label your variables and directions of positive motion, as well as your reference point from which you are measuring. Leave in symbolic form.
b) Determine the initial conditions for the dynamic motion after the iron is dropped if k = 100 lb/in. (5 pts)
c) What is the magnitude steady state response given $\zeta = 0.05$, k = 100 lb/in and the forcing frequency is three times the natural frequency of the system.
d) Discuss how you would determine the total response of the system, but do not actually do any calculations or algebra. (5 pts)

Name _____ 15 pts

EM406 Examination I **Problem 4** September 23, 2005

A laboratory notebook for a secret project was burned in a fire by terrorists. The only two scraps of paper remaining are shown below and you know that they refer to the same vibrating system. Determine the natural frequency and damping ratio for the system. To save time, set up the equations but do not solve.