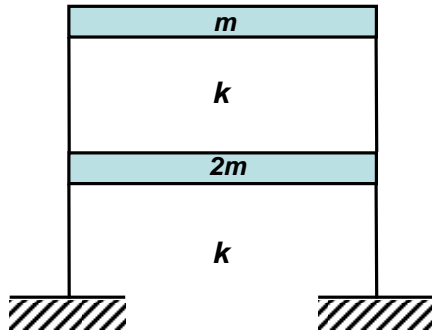


CE 573 – Structural Dynamics

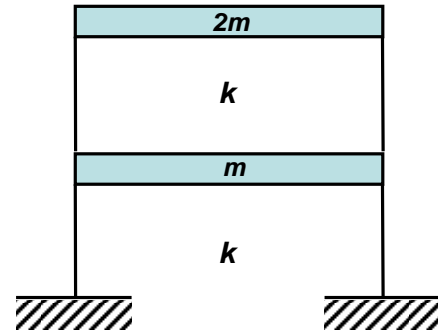
Homework #8

due 6 November 2009, Friday, 1:30pm

- 1) Compare the natural frequencies and mode shapes of the following structures.



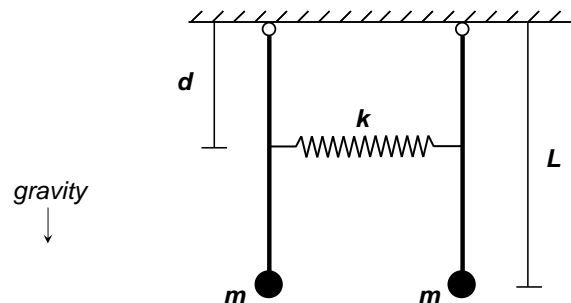
(a)



(b)

- 2) Two objects of identical mass m are hanging from a ceiling with massless rigid rods of length L . As shown in the figure below, the rods are connected to the ceiling with frictionless hinges. Furthermore, the rods are connected to each other at d distance from the hinges with a massless linear spring with stiffness k . When both rods are oriented vertically, the system is in equilibrium. Assume that oscillations are small and are about the vertical, i.e. equilibrium state, and note the presence of gravity.

- What is the minimum number of degrees of freedom required to describe this system?
- Write the differential equation(s) of motion for the system. Make sure that you use small oscillations assumption to simplify your derivation and answer.
- Find the characteristic shape(s) of the system. (Note: Characteristic shapes are also known as mode shapes).
- Find the characteristic/natural frequency (frequencies) associated with the characteristic shape(s).
- What happens if k is zero? What happens if k is infinite?



- 3) Derive the differential equations of motion for the system shown below. Assume that the rod of length L is rigid and massless. Let the angle θ be small so that you may “linearize” the equations of motion.

