## Physics 3210, Spring 2019

1. A *linear triatomic molecule* consists of a heavy atom M attached to two smaller atoms m via equal springs with constant k. Assume motion is only possible in one (x) direction. See the figure below.



- (a) Obtain three coupled equations of motion for the three atoms. Use these equations to show that the center-of-mass of the system will be unaccelerated.
- (b) There will be three normal modes of the triatomic molecule. These may be represented vectorially  $(x_1, x_2, X)$  as follows:

mode 1 := 
$$(1, 1, 1)$$
  
mode 2 :=  $(1, -1, 0)$   
mode 3 :=  $(1, 1, -\xi)$ 

In mode 1, the center-of-mass moves with nonzero velocity. In modes 2 and 3, the center of mass is at rest. What is  $\xi$ ?

(c) Find the frequencies  $\omega_1$ ,  $\omega_2$  and  $\omega_3$  associated with these three normal modes.