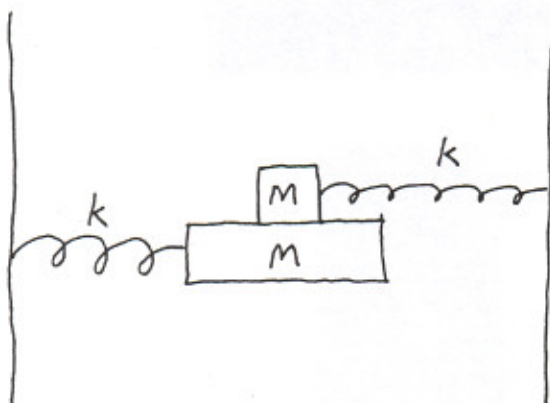


## Classical Mechanics

**Directions:** Solve all 3 problems.

1. (35 pts) Two identical harmonic oscillators are placed so that the two masses slide against one another as shown below. A frictional force (coefficient  $\mu$ ) exists between the masses and is proportional to the instantaneous relative velocity. (You may assume the contact area between the masses does not vary.)



- (a) Calculate the frequencies of the normal modes of this system.
- (b) For the case  $\mu^2 = 2km$ , obtain expressions for the time dependence of the normal mode coordinates in terms of the given parameters (plus any arbitrary constants which depend on initial conditions).
2. (25 pts) A homogeneous cube (mass  $M$ ), each edge of which has a length  $L$ , is initially in a position of unstable equilibrium with one edge in contact with a horizontal plane. The cube is then given a small displacement and allowed to fall. Assuming the edge *cannot* slide on the plane, calculate the angular velocity of the cube at the instant when one face strikes the plane. Express your answer in terms of  $L$ ,  $M$ ,  $g$ , and  $I$ , the moment of inertia for rotation of the cube about an edge.

