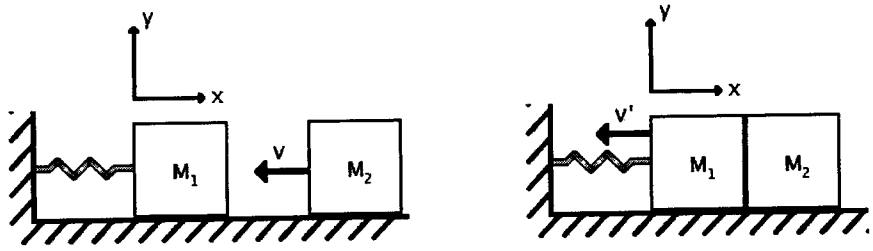
FP19

Stay and Sway

A mass m_1 sits on a frictionless surface and is attached to one end of a spring with spring constant k. The other end of the spring is attached to the wall. The mass and the spring are initially at rest.



A second mass m_2 comes sliding in with velocity $-v\,\hat{x}$, hits the first mass m_1 at time $t = 0$, and sticks to it. This induces oscillations in the spring, which can then be measured. This in turn can be used to determine the mass m_2 of the impinging object.

(3 points) (a) What is the velocity $\vec{v}'$ of the two masses immediately after the collision? Express you answer in terms of v, m_1, and m_2.

(3 points) (b) Find an expression for m_2 in terms of m_1, k, and the angular frequency ω_o of the observed oscillations.

A function which describes the position of the two masses for all time following the collision is $x = A\sin(\omega_o t) + B\cos(\omega_o t)$ where A and B are unknown constants, $t = 0$ is the time of the collision, and $x = 0$ is the equilibrium position of the spring.

(4 points) (c) What are the values of A and B? Express you answer in terms of ω_o, m_1, m_2, and v.