Phys 230
Fall 2013

Intermediate Dynamics: Homework 8

Due: 21 October 2013

1 Solutions to the equation of motion for a simple harmonic oscillator

Consider a simple harmonic oscillator satisfying

$$\frac{d^2x}{dt^2} = -\omega^2 x$$

where $\omega \neq 0$.

a) Show, by substitution that $x(t) = Ct$, where $C \neq 0$ is a constant is not a solution to the equation of motion.

b) Show, by substitution that $x(t) = Ct\ \cos(\omega t)$ where $C \neq 0$ is a constant is not a solution to the equation of motion.

c) Show explicitly that $x(t) = 7\cos(3t + 3)$, with $x(t)$ in meters and t in seconds satisfies this equation.

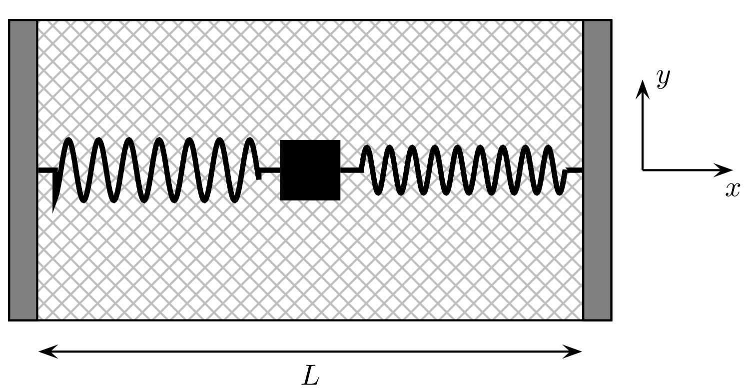
d) Find the angular frequency, frequency and period of the oscillator in the previous part.

2 King, *Vibrations and Waves*, 1.1, page 29.

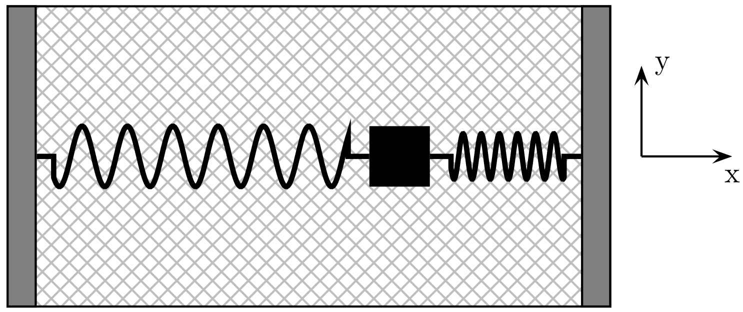
3 King, *Vibrations and Waves*, 1.3, page 30. As a hint consider the normal force exerted by the platform on the block. While the block is in contact with the platform is the normal force non-zero? What about at the moment that the block leaves the platform?

4 Mass and spring system: longitudinal oscillations

Consider a block of mass m resting on a table and connected to two springs as illustrated below. The left spring has spring constant k_1 and the right spring, k_2. The length of the table of length L and when the block is in the center of the table each spring is unstretched.



a) The block is displaced longitudinally (along the length of the springs) as illustrated below and then released from rest at this position. Describe why the block's subsequent motion is restricted to a line along the direction of the x axis. The resulting oscillations are called **longitudinal**.



b) Apply Newton's second law to find an equation of motion for block. Show that the resulting motion is oscillatory and find an expression for the angular frequency of oscillation in terms of k_1, k_2 and m.