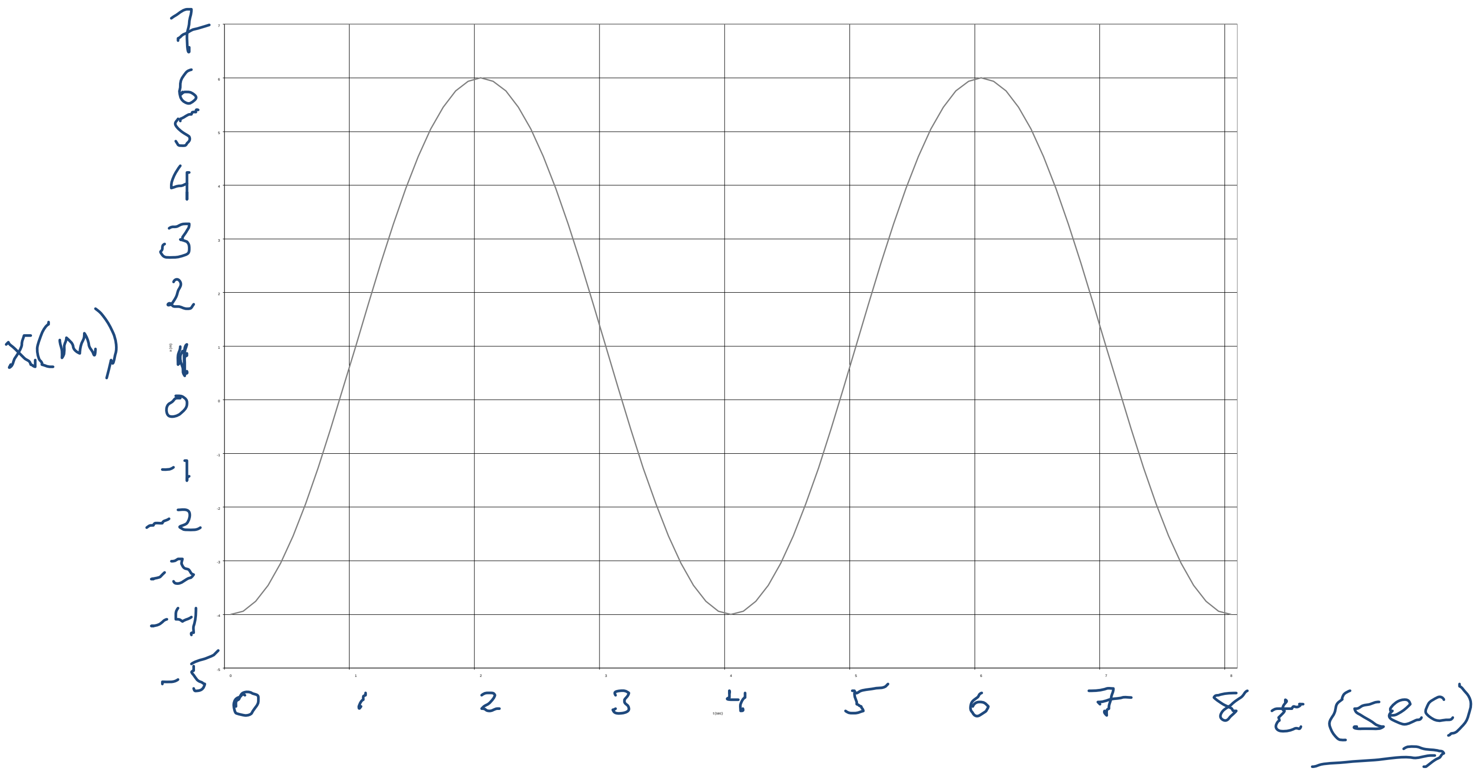
Workshop module 3 - Physics 123, Fall 2013

1. A 2 kg mass is attached to a massless, ideal spring. It is constrained to oscillate along one dimension on a horizontal frictionless surface. A mark has been placed at an arbitrary location on the table to designate the x=0 position for a graph of the motion.



As the mass oscillates without loss of energy it traces the path shown on the graph below.

a) What is the amplitude of the motion for this oscillator?
b) What is the period of the oscillator?
c) When is the mass moving the slowest?
d) When does the mass have its greatest acceleration?
e) What is the spring constant of the spring?

2. A buoy of uniform cross section A and mass M floats in sea water of density ρ. Suppose a bird of mass m lands on top of the buoy, forcing it to sink further into the water. Then, after the buoy is settled, the bird flies away suddenly. Show the buoy will oscillate up and down in simple harmonic motion. What is the period of that up and down motion? What is the frequency of that up and down motion? What is the amplitude of that up and down motion?

3. What is the frequency of a simple pendulum 2.0 m long (a) in a room, (b) in an elevator accelerating upward at 2.0 m/s^2, and (c) in free fall?

4. A mass M is attached to the end of a massless spring with force constant k and unstretched length l_o. The other end of the spring is free to turn (without friction) about a nail driven into a frictionless horizontal surface. The mass is made to revolve about the nail with frequency ω'. What is the length of the spring as a function of ω'? What happens when the frequency of revolution approaches the natural frequency of the spring-mass system? What do you make of this?

5. The evil Dastardly Dan ties Pretty Polly to the train tracks because of his ill feelings about unrequited love. Then Dan trots off for an appointment with his therapist. Fabulous Phil stumbles upon Polly and decides to untie her. Before he does so, Phil puts his ear to the train track to see if there is a danger of an approaching train. Give *TWO* reasons why this method provides Phil with early warning of an approaching train?

6. A wire of uniform linear mass density hangs from the ceiling. It takes 1 second for a wave pulse to travel the length of the wire. How long is the wire?

7. Prove that the Gaussian wave packet described by the equation

$$y(x,t) = (5)e^{-0.1(x-5t)^2}$$

is a traveling wave.