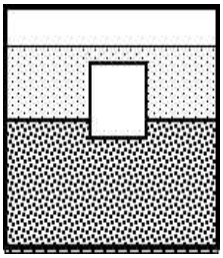
Workshop module 12 - Physics 113, Fall 2006

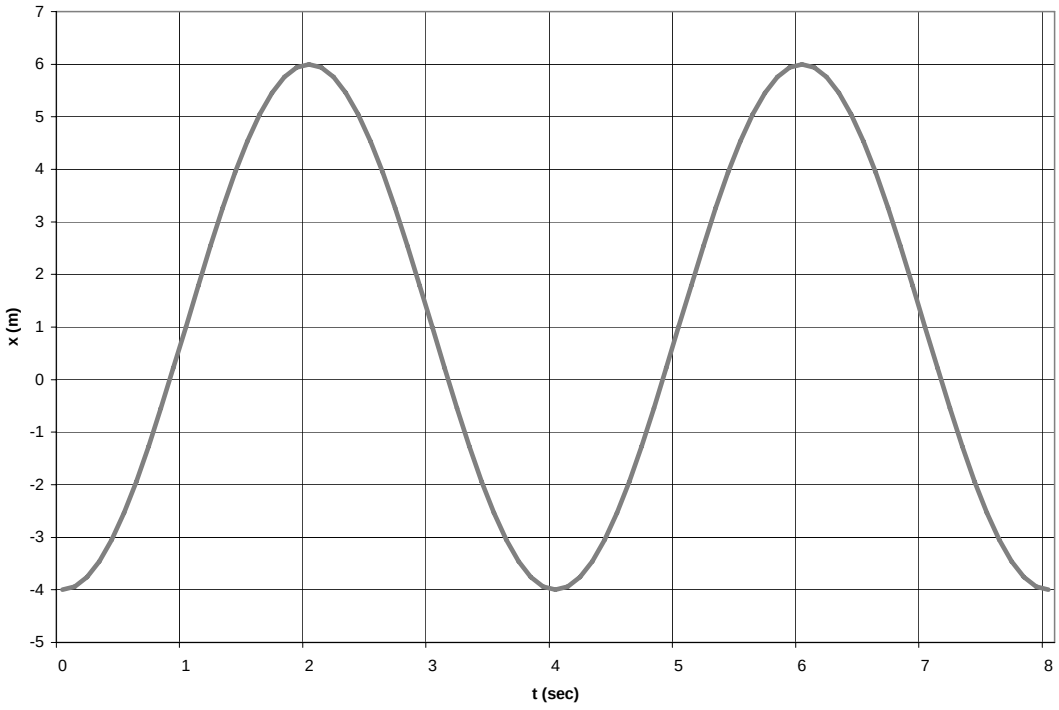
1. A cubical block of wood floats at an oil-water interface in a large tank. The block is 9.0 cm on a side and has its lower surface 1.5 cm below the interface. The density of the oil is 750 kg/m^3. What are the forces on the block? Draw a free body diagram for the block. What is the mass of the block?



2. A tornado passes by your house. When the first windows break, does the glass blow inside the house or outside the house. Why?

3. A pipe enters a house in the basement carrying water with a speed of 3 ft/s at a pressure of 25 lbs/in.^{2}. The pipe has an inside diameter of 1.0 in. as it enters the house. What is the speed and pressure of the water coming out of a faucet on the second floor of the house, assuming the pipe has tapered to an inside diameter of 0.5 in. and that the faucet is 30 ft above the point the pipe enters the house? *(hint: There are two unknowns here. You will need two equations. Is the amount of water flowing out of the pipe on the second floor the same as the amount of water flowing into the house? Is energy conserved?)*

4. 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?

5. A buoy of uniform cross section A and mass M floats in sea water of density ρ.
   (a) Draw a free body diagram for the object.
   (b) How far below the surface of the fluid is the bottom of the buoy?
   (c) Suppose a bird of mass m lands on top of the buoy, forcing it to sink further into the water. At the new equilibrium position, how much farther below the surface of the fluid is the bottom of the buoy than it was in part (b)?
   (d) Suppose the bird flies away suddenly. Show the buoy will oscillate up and down in simple harmonic motion.
   (e) What is the period of that up and down motion?
   (f) What is the frequency of that up and down motion?
   (g) What is the amplitude of that up and down motion?