PH105-001 **Practice Exam III** **Fall, 2008**

1. A man weighs himself in air and then standing on a scale at the bottom of a pool of water while completely submerged. In air he weighs 180 lb (801 N), and at the bottom of the pool he weighs 30 lb (133 N). (Density of air = water kg/m^3)

   (a) Draw a force diagram for the man standing on the scale at the bottom of the pool.
   (b) What is his buoyant force (in Newtons)? *B = 668 N*
   (c) What is his volume? *V = 0.0681 m^3*
   (d) What is his density? *ρ = 1199 kg/m^3*

2. A Frisbee has a mass of 160 g and a diameter of 22 cm. It sails through the air at a constant elevation with the air flowing under the Frisbee with speed 10 m/s. What is the speed of the air above the Frisbee? *v = 12.8 m/s*

3. A 200-g mass when attached to the end of a spring hanging vertically is found to stretch the spring by 5 cm from its equilibrium position. The mass is set into oscillation with amplitude 10 cm.

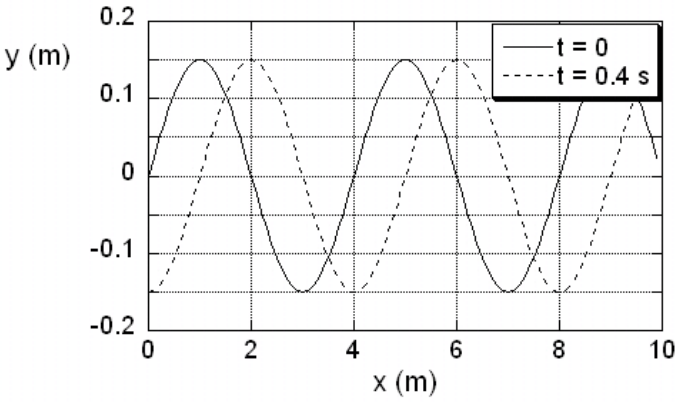
   (a) How long does it take the mass to travel from its lowest to its highest position? *0.224 s*
   (b) What is the maximum speed of the mass? *v_{max} = 1.40 m/s*
   (c) What is the speed of the mass when it is 3 cm from its equilibrium position? *v = 1.34 m/s*
   (d) What is the total energy of oscillation (relative to the mass being at rest at its equilibrium position)? *E = 0.196 J*

4. (a) A meter stick is pivoted to oscillate about an axis through one end. What is its period of oscillation? *T = 1.64 s*
   (b) What would be the period of oscillation if pivoted at the 20 cm mark? *T = 1.53 s*

   $I_{end} = \frac{1}{3}mL^2, \quad I_{cm} = \frac{1}{12}mL^2$

5. A transverse wave on a rope is shown below as a plot of y versus x at two different times, t = 0 and t = 0.4 sec. Both y and x are in meters.

   (a) What is the wavelength? *λ = 4 m*
   (b) What is the wave speed? *v = 2.5 m/s*
   (c) If the rope has a mass density of 0.05 kg/m, what is the tension in the rope? *F=0.3125 N*
   (d) Write down an explicit expression for the transverse displacement of the wave as a function of x and t; i.e., y(x,t). Include all known numerical values in the equation.



   y(x,t) = (0.15 m)sin(1.57x – 3.93t)

6. A rubber cord is tied at one end. You pull on the other end and move it up and down periodically. In doing so you send energy along the cord. Describe all possible ways in which you could increase the rate that energy is transmitted. Justify your answers.

7. The sound level of a point source of sound is 55 dB at a distance of 20 m from the source.

   (a) What is the intensity in W/m^2? $I = 3.16 \times 10^{-7}\ W/m^2$
   (b) How much total power (in watts) is emitted by the sound source? $P = 3.97 \times 10^{-4}\ W$

8. A police car and a motorist are approaching each other on the interstate. The police car is traveling at 30 m/s and the motorist is traveling at 40 m/s.

   (a) If the frequency of the police siren is heard by the policeman at 2000 Hz, at what frequency does the motorist hear the siren? $f = 2{,}447\ Hz$ *(using v = 343 m/s)*
   (b) What frequency will the motorist hear after they pass each other and are going in opposite directions? $f = 1{,}625\ Hz$

9. A stretched string fixed at each end has a mass of 5 g and a length of 1.5 m. The tension in the string is 2 N. What is the vibration frequency for the first harmonic standing wave on this string?

   $f_1 = 8.16\ Hz$

10. An organ pipe has a length of 40 cm and resonates at 20^oC where the speed of sound is 343 m/s. What are the three lowest resonance frequencies that can be obtained if

    (a) the pipe is closed at one end and open at the other? $f = 214\ Hz, 643\ Hz, 1072\ Hz$
    (b) the pipe is open at both ends? $f = 429\ Hz, 858\ Hz, 1286\ Hz$

11. A 200 ml glass beaker is filled to the bream with mercury at 20^oC. How much mercury spills out if the beaker and mercury are heated to 100^oC? The coefficient linear expansion of the glass beaker is $9 \times 10^{-6}\ C^{-1}$ and the coefficient of volume expansion of mercury is $1.82 \times 10^{-4}\ C^{-1}$.

    $\Delta V = 2.5\ ml$

12. A 2-liter container of nitrogen gas has a *gauge* pressure of 5 atmospheres at 20^oC.

    (a) How many molecules of nitrogen (N_2) are in the container? $N = 3.0 \times 10^{23}$

    (b) What will be the gauge pressure if the temperature is increased to 100^oC while keeping the volume constant? $P = 6.6\ atm$