Py 130 Test 3 Fall 2006

Name (Print): _____

Pledged (Signed): _____

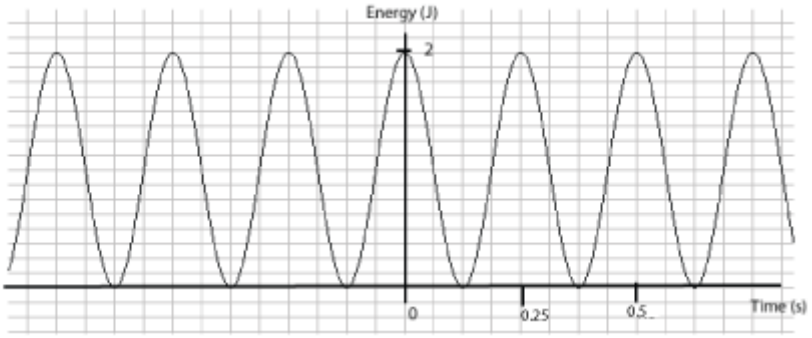
This test should be completed during one regular 50 min class period. Your problem solving approach counts! Be sure and show all work including basic formulas and diagrams.

Do all of the following problems. Start each problem on a fresh page or the back of a page. Clearly label the problem number. Place the answers in order and staple the sheets as you turn in the test. Sign and **pledge** this sheet.

1) (25 pts) An organ pipe that is closed at both ends produces a frequency of 1200 Hz when resonating in its third lowest frequency. Assume the speed of sound is 300 m/s.
    a. (5 pts) Sketch the wave in the pipe and describe the wave. What physical quantity are you sketching?
    b. (5 pts) What is the wavelength of this sound wave?
    c. (5 pts) What is the length of this pipe?
    d. (10 pts) Write a formula for the wave function $u(x,t)$ that describes the wave inside the pipe. Assume the maximum amplitude is A but show numeric values for all other constants.

2) (20 pts) Using Newton's second law and the universal law of gravitation between a mass M and a satellite mass m, drive an expression for the orbital speed of mass m. Assume that $M>>m$ and that the small mass is traveling in a circular orbit or radius r. By what multiplicative factor does the orbital speed change if the radius of the orbit r is doubled? By what multiplicative factor does the orbital speed change if the mass of the orbiting particle m is doubled but r remains unchanged? What if M is doubled?

3) (25 pts) Two identical loud speakers are placed 4 m apart on a table in front of a physics classroom and caused to emit a steady 150 Hz tone. Assume the speed of sound is 300 m/s.
    a. You are standing between the two speakers and walk 5 meters in a direction perpendicular to the line passing through the speakers. (That is, you walk away from the table.) Do you hear a maximum or minimum at your new position? Explain your reasoning.
    b. Starting where you made your measurement in part (a), how far must you walk before you hear a sound maximum if you walk parallel to the front of the table? In other words, you walk 5 m in part (a), turn 90 degrees and continue walking. Show your exact location on a sketch.
    c. Do you hear maximum and minimum in sound intensity if you start walking away from both speakers along a line connecting the two speakers? Explain.



4) (30 Pts) A 0.25 Kg mass is attached to a spring and caused to oscillate. The **potential energy** of the oscillator as a function of time is shown above.
   a. (5 pts) What is the frequency of oscillation? What is the spring constant? What is the maximum displacement of the mass from equilibrium?

   b. (10 pts) Write a formula x(t) for the **position** of the mass as a function of time and sketch this function. Be sure to include units and scales on the axes. Is your formula for x(t) unique? That is, are the numbers in your formula the only values that reproduce the potential energy graph shown above or are other numbers possible? Explain.

   c. (10 pts) Sketch the kinetic energy and the total energy as a function of time. (You may add your sketches to the graph above.) Write a formula for the **kinetic energy** as a function of time. Write a formula for the **total energy** as a function of time.