Name _____ **Student ID** _____ **Score**_____
last *first*

1. Lab questions.

A standing wave (image above) in a string with two fixed ends is generated by a vibrator at a frequency of 120 Hz. The length of string is 1.00 m.

1. (4 pts) Which choice best represents the fundamental frequency (f_o) and fundamental wavelength (λ_o) of the string?

A. f_o = 120 Hz; λ_o= 1.00 m;
B. f_o = 120 Hz; λ_o= 2.00 m;
C. f_o = 24.0 Hz; λ_o= 2.00 m;
D. f_o = 24.0 Hz; λ_o= 0.200 m;
E. f_o = 120 Hz; λ_o= 0.200 m;

2. (4 pts) Given the applied tension T=9.8 N for the above pattern, which choice best represents the mass per unit length of the string?
A. 4.2 g/m
B. 1.7 g/m
C. 1.1 g/m
D. 0.60 g/m
E. 0.20 g/m

2. Lecture MC questions.

A speaker produces sound of frequency 1000 Hz, at a fixed power output. The sound level is measured to be 70.0 dB at point *P* located 1.00 m from the speaker.

The power is now increased by a factor of 4, so that the speaker produces 4 times as much energy per unit time in sound waves.

3. (4 pts) Which choice best represents the sound level detected at point *P*?

74 dB	76 dB	112 dB	140 dB	280 dB
A	**B**	**C**	**D**	**E**

Name _____ **Student ID** _____ **Score**_____
last *first*

II. Lecture MC questions, cont.

A pendulum consists of a thin spherical shell (mass = M = 2.00 kg, radius = R = 12.0 cm) attached to a rod (mass ~ 0, length = L = 40.0 cm) and suspended from a fixed pivot as shown in Figure 1. Ignore friction and air drag for this problem.

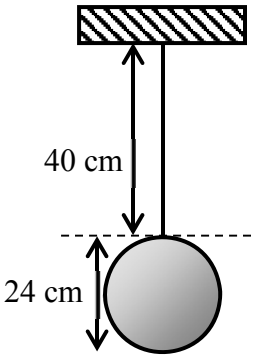
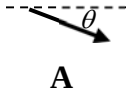


Figure 1

4. (3 pts) Which choice best represents the direction of acceleration of the center of the spherical shell when it is at a midpoint of its arc to the left of the original vertical position (NOT its maximum angle)? See Fig. 2.

				
A	**B**	**C**	**D**	**E**

Suppose that you time this pendulum, and it completes exactly 68.0 complete cycles in 100 s. [Hint: think carefully about all given distances.]

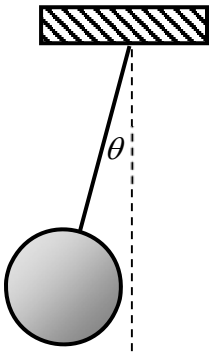
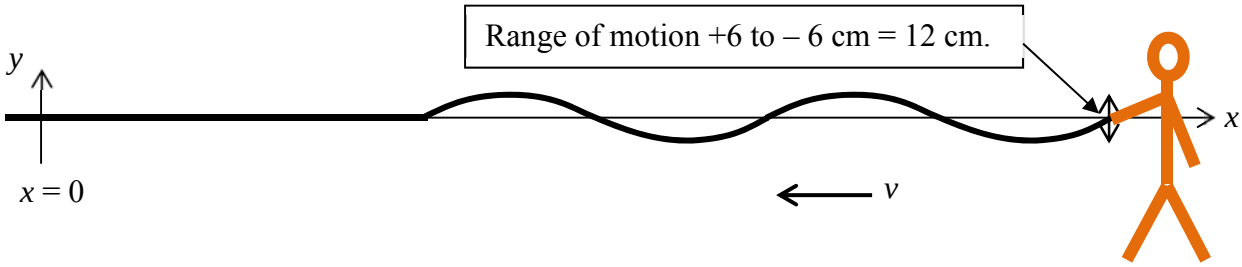


Figure 2

5. (5 pts) Which choice best represents the value of g in the vicinity of this pendulum?

9.83 m/s^2	9.76 m/s^2	9.67 m/s^2	9.58 m/s^2	9.49 m/s^2
A	**B**	**C**	**D**	**E**

II. Lecture MC, cont. A person stands holding one end of a very long, taut string and shakes the string end to produce sinusoidal waves, as shown. The maximum range of motion of the person's hand covers a vertical distance of 12 cm, as shown, and the person's hand completes a full cycle of oscillation in 0.20 s. The average tension in the string is 30 N, and the mass per unit length is 6.8×10^{-2} kg/m. A coordinate system is given for reference in answering the questions.



Consider the following general equation for such waves:

$$y(x,t) = A\cos(kx \pm \omega t + \phi)$$

In this equation, all constants and variables are expressed in Standard International units.

Name _____ **Student ID** _____ **Score**_____
last *first*

6. (3 pts) Which choice best represents the appropriate plus or minus sign for $\pm\omega t$?

A. + **B.** – **C.** either is correct. **D.** Not enough information to answer.

7. (3 pts) Which of these best represents the value of k in SI units?

A. 30 **B.** 3.0 **C.** 15 **D.** 1.5 **E.** Need more information

II. Lecture MC, cont. A closed organ pipe has an effective length L = 64.0 cm.

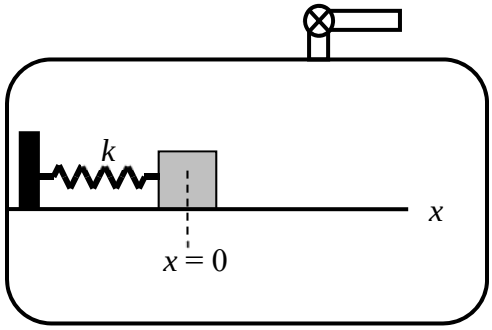
8. (4 pts) Which choice best represents its fundamental frequency?

A. 134 Hz **B.** 179 Hz **C.** 268 Hz **D.** 536 Hz **E.** None of these.

9. (4 pts) Which choice best represents the frequency of its first overtone (the next higher frequency above the fundamental frequency?

A. 804 Hz **B.** 536 Hz **C.** 402 Hz **D.** 268 Hz **E.** None of these.

III. Lecture HG questions. A block of mass m = 0.633 kg is attached to a spring (k = 100 N/m) and placed on a frictionless horizontal surface. The other end of the spring is attached to a fixed rod, and the entire apparatus is enclosed in a vacuum chamber as shown. With no air in the chamber, the mass is set into simple harmonic motion with an amplitude of 0.100 m.



10. (6 pts) If x = 0 where the spring exerts zero force on the block, and if t = 0 when the block is at its maximum negative value of x, write an equation for $x(t)$ for this block. Insert appropriate numerical values for all constants. Show your work.

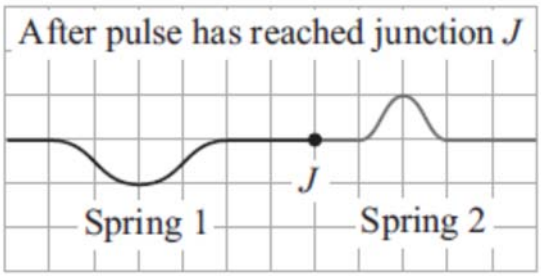
11. (4 pts) Compute the period of this simple harmonic motion.

Now a valve is opened in the vacuum chamber (see figure above) so that air at room temperature and pressure enters the chamber. [Ignore any effects on the motion while the pressure comes to equilibrium; assume this happens instantaneously.]

12. (5 pts) Describe how the oscillations change, if at all, after the air has been admitted.

IV. Tutorial questions

The diagram shows two springs joined at junction *J*. The springs are shown at an instant after an incident pulse has reached the junction. Note that the incident pulse may have originated on the left end or right end of the springs.



13. [5 pts] Is the mass density of Spring 1 greater than, less than, or equal to the mass density of Spring 2? Explain. If there is not enough information to determine, state so explicitly.

14. [5 pts] From which end of the springs (left or right) did the incident pulse originate? Explain. If there is not enough information to determine, state so explicitly.