

# Physics 101: The Science of Sound

## MiniTest 2a, 10/5/05

Name \_\_\_\_\_

For questions with numerical answers, draw a box around your final answer.

Except as noted, correct answers get full credit. Incorrect answers get partial credit based on the work shown.

If any problem relies on a previous answer, scoring on that problem will be based on YOUR previous answer, whether or not it is correct.

Potentially useful equations

acceleration due to gravity =  $9.8 \text{ m/s}^2$

$$\Delta x = A \cos(\phi)$$

$$\Delta x = A \cos\left(\frac{360^\circ}{T} t + \phi_0\right)$$

$$f = \frac{1}{2\pi} \sqrt{\frac{k}{m}}$$

Scoring:

Raw Total: \_\_\_\_\_/100 pts

Adjusted Score: \_\_\_\_\_%

1) [6 pts] Consider anything that can vibrate. The position in which it will remain unmoving is called the (circle one) ...

- (A) origin.                      (B) central point.                      (C) equilibrium point.  
 (D) displacement position.    (E) point of quiescence.            (F) resting place.

2) [6 pts] In lab, we determined that for a mass bouncing on a spring, increasing the amplitude of motion caused the period of motion to (circle one) ...

- (A) increase proportionally.    (B) decrease.    (C) increase as the square root.    (D) remain unchanged.  
 (E) [The answer depends on whether you mean amplitude or peak-to-peak amplitude.]

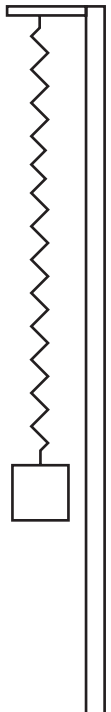
3) [6 pts] The loudness of a sound is primarily associated with which characteristic of the sound source's vibration? (circle one)

- (A) Duration                      (B) Period                      (C) Frequency  
 (D) Amplitude                    (E) Fourier spectrum            (F) Initial phase

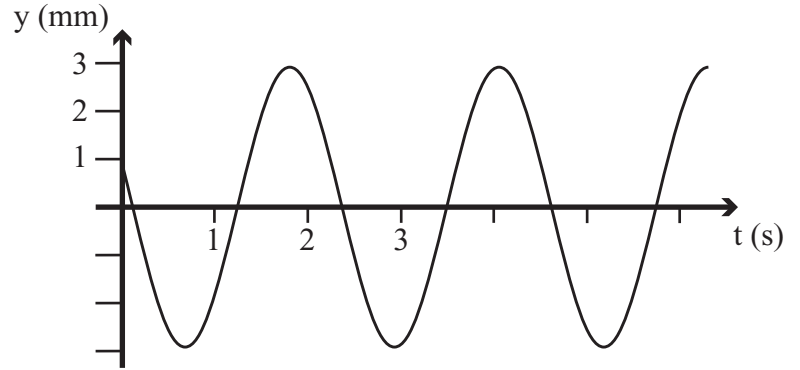
4a) [16 pts] An amusement park ride is essentially a cage on a spring hung from a 45m tall tower. The cage is pulled to the ground, people are strapped in, and the cage is released so that it flies up and bounces. The spring supporting the cage has a stiffness of 1000N/m. The cage, with a mass of 2000kg, would hang unmoving 20m above the ground if there were no people in it.

With some people bouncing in the ride, the operator observes that the lowest points of successive bounces occur 10s apart. Determine the mass of the people in the ride.

4b) [16 pts] When the ride comes to a stop, how far above the ground will the cage be?



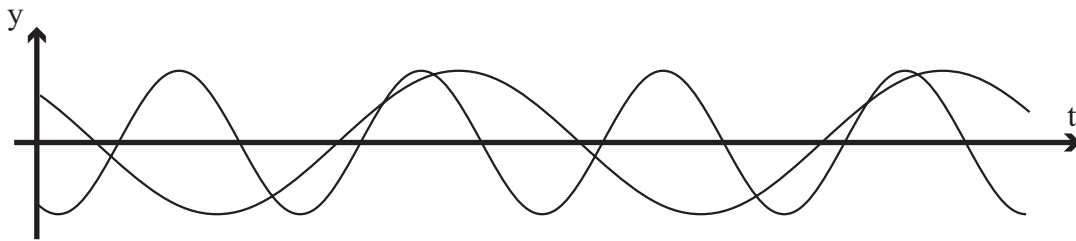
5a) [6 pts] To the right is a graph of the position of something executing SHM. What is the period of this motion?



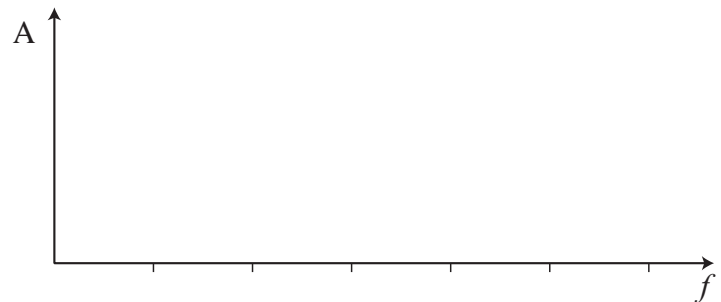
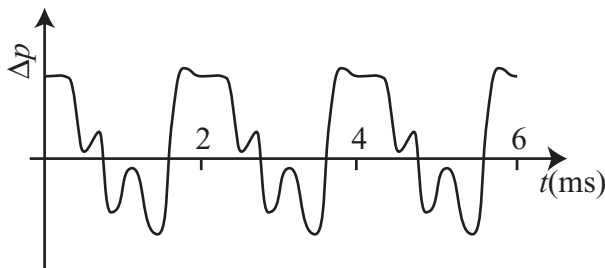
5b) [6 pts] What is the amplitude of this motion?

5c) [6 pts] Estimate the initial phase for this SHM (no calculation necessary).

6) [16 pts] Below are graphs of an ear drum's position when it hears two pure tones separately. Draw, on the same graph, what the ear drum's position vs. time would be while listening to both sounds simultaneously (assuming they are aligned as shown).



7) [16 pts] To the left is a periodic complex sound. Suppose that it is made up from three partials, harmonic including the 2nd and 4th harmonics. Sketch the spectrum for this sound on the right, including labels on the horizontal axis. Do not worry about peak heights.



Extra Credit) [2 pts] How many overtones are in that spectrum?