

# Vibrations, Waves, and Sound

## Chapter 11-12 In-Class Example Problems

### Period & Frequency of Mass-Springs

- 1a. A certain spring stretches by 5.2cm when a 200N weight is hung from it. The weight is then displaced from equilibrium and set into oscillation. What are the period and frequency of vibration of the mass-spring system?
- b. What value of  $k$  would a spring need, in order for a 100N weight to vibrate with this same period?

### Energy During SHM

2. A 5kg mass is attached to a spring ( $k=1800\text{N/m}$ ) and undergoing simple harmonic motion with a total energy of 450J.
- a. What is the amplitude of vibration of the mass?
- b. What is the maximum velocity reached by the mass?
- c. How fast is the mass moving when the spring is compressed 3cm from equilibrium?

## Mass-sPrings and Position-time Functions

3. The motion of a particular object is described by the following equation:  
 $x = 0.5\cos(1.5\pi t)$ . Find the amplitude of the motion, the frequency of the motion, and the position of the object at 1s.
4. A 0.500kg object is attached to a spring of spring constant 30N/m and released from rest at  $t=0$  from a position 0.25m from equilibrium. Find the equation that describes its x-location as a function of time.

## Pendulums

5. A wave completes a full cycle of motion in a time of 0.35 seconds. If the wave travels 10 meters in that amount of time, calculate the wave's speed.

## Wave Basics

6. A wave completes a full cycle of motion in a time of 0.35 seconds. If the wave travels 10 meters in that amount of time, calculate the wave's speed.

## String Resonant Frequencies

7. A particular string vibrates with four 'loops' at a frequency of 912Hz. What is the fundamental frequency of the string?
8. Two successive harmonics of a vibrating string are 225Hz and 300Hz. Which harmonic (1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup>, etc.) is the 225Hz frequency?
9. The velocity of waves on a certain string is 240m/s. The string is vibrating such that the wavelength of its first harmonic is 52cm. What is the frequency of the 3<sup>rd</sup> harmonic on this string?

## Open and Closed Pipes

10. What will be the fundamental frequency and first two overtones for a 26-cm-long organ pipe at 20°C if it is a closed pipe?

## Strings in Air

11. The velocity of waves on a certain 75cm-long string is 450m/s. What are the frequency and wavelength of the *sound waves* in air, created by this string's vibrations?