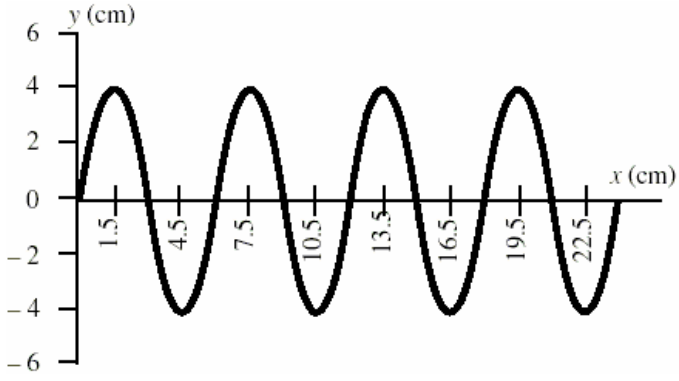
Practice problems for the 1st midterm (Fall 2010)

Questions 1-5 pertain to the following situation: The displacement of a vibrating string versus position along the string is shown in the figure. The periodic wave has a speed of 15.0 m/s and travels to the right.



1. What is the amplitude of the wave?

2. What is the wavelength of the wave?

3. What is the frequency of the wave?

4. What is the period of the wave?

5. The total length of the string is 0.450 m. Knowing the tension as 0.540 N, find the mass of the string.

6. Two canoes are 10 m apart on a lake. Each bobs up and down with a period of 4.0 seconds. When one canoe is at its highest point, the other canoe is at its lowest point. Both canoes are always within a single cycle of the waves. Determine the speed of the waves.

7. The speed of sound in fresh water at 20 °C is 1482 m/s. The speed of sound in helium gas is the same as that of fresh water at 20 °C. Helium is considered a monatomic ideal gas ($\gamma = 1.67$ and atomic mass = 6.647×10^{-27} kg). Find the temperature of the helium gas.

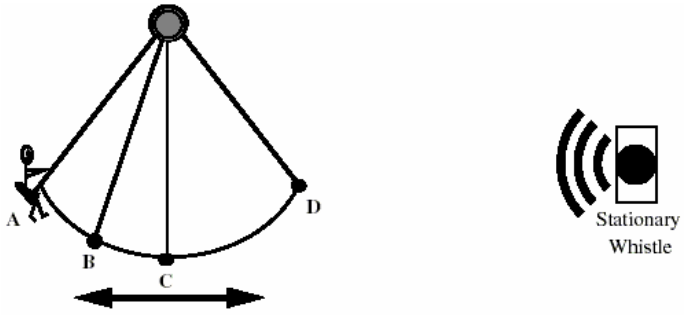
8. A physics student is asked to determine the length of a long, slender, copper rod by measuring the time required for a sound pulse to travel the length of the rod. The

Young's modulus of the copper is 1.10×10^{11} N/m^2 and its density is 8890 kg/m^3. The student finds that the time for the pulse to travel from one end to the other is 1.56×10^{-3} s. How long is the rod?

9. A bell produces sound energy at a rate of 4.0×10^{-3} W and radiates it uniformly in all directions. What is the intensity of the wave 100 m from the bell?

10. During a typical workday (eight hours), the average sound intensity arriving at Larry's ear is 1.8×10^{-5} W/m^2. If the area of Larry's ear through which the sound passes is 2.1×10^{-3} m^2, what is the total energy entering each of Larry's ears during the workday?

Questions 11-14 pertain to the following situation: The diagram shows the various positions of a child in motion on a swing. Somewhere in front of the child a stationary whistle is blowing.



11. At which position(s) will the child hear the highest frequency for the sound from the whistle?
    A) at both A and D
    B) at B when moving toward A
    C) at B when moving toward C
    D) at C when moving toward B
    E) at C when moving toward D

12. At which position(s) will the child hear the lowest frequency for the sound from the whistle?
    A) at both A and D
    B) at B when moving toward A
    C) at B when moving toward C
    D) at C when moving toward B
    E) at C when moving toward D

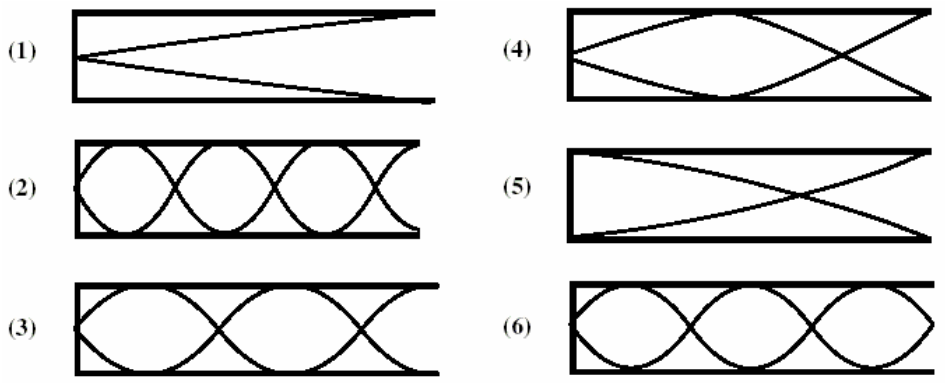
13. At which position(s) will the child hear the same frequency as that heard by a stationary observer standing next to the whistle?
    A) at both A and D
    B) at B when moving toward A
    C) at B when moving toward C
    D) at C when moving toward B

E) at C when moving toward D

14. The stationary whistle emits1200-Hz sound. When the child is at C moving toward D, what frequency does the child hear, knowing the speed of swing at C as 6.3 m/s and the speed of sound as 343 m/s?

15. The beat period occurring when two tuning forks vibrating is 0.333 s. One of the forks is known to vibrate at 588.0 Hz. What are the possible vibration frequencies of the second tuning fork?

Questions 16-18 pertain to the following situation:
The figure shows standing waves of sound in six organ pipes of the same length. Shown is the displacement of the molecules. Each pipe has one end the other end closed. *Note: some of the figures show situations that are not possible.*



16. Which figures do not illustrate possible resonant situations?

17. Which one of the pipes emits sound with the lowest frequency?

18. If the length of the pipes is 0.500 m, what is the frequency of the sound emitted from pipe (3)? The speed of sound is 343 m/s.

19. Find the force between two charges, $q_1 = 4.0\ \mu C$ and $q_2 = 6.0\ \mu C$, knowing the distance between them is 3.1 m.

20. There is a charge, 2.5 μC. What is the electric field at 3.0 m from the charge?

21. There is a parallel plate capacitor. When the charge density is 1.8×10^{-7} C/m^2, find the electric field inside the capacitor.

22. There is a confinement of electron, which has totally -6.4μC. How many electrons does it have? What is the mass of the collection of the electrons? (The charge of an electron and mass of an electron are 1.60×10^{-19} C and 9.11×10^{-31} kg, respectively.)

23. Here is a spring with a hanging mass, 0.250 kg. If the angular frequency of the oscillation is 2.50 rad/s, find the spring constant.

The keys:

1. 0.0400 m (4.00 cm)
2. 0.0600 m (6.00 cm)
3. 250 Hz
4. 4.00×10^{-3} s
5. 1.08×10^{-3} kg
6. 5.0 m/s
7. 633.5 K
8. 5.49 m
9. 3.18×10^{-8} W/m^2
10. 1.10×10^{-3} J
11. E)
12. D)
13. A)
14. 1222 Hz
15. 585.0 or 591.0 Hz
16. (5) and (6)
17. (1)
18. 858 Hz
19. 2.2×10^{-2} N
20. 2500 N/C
21. 2.0×10^{4} N/C
22. 4.00×10^{13} electrons; 3.64×10^{-17} kg
23. 1.56 N/m

Check out the following before the exam:

- **Can you solve all the questions from the beginning without any help and hints?**
- **Do you understand the concept behind each question? Can you relate the above problems to the lecture topics?**