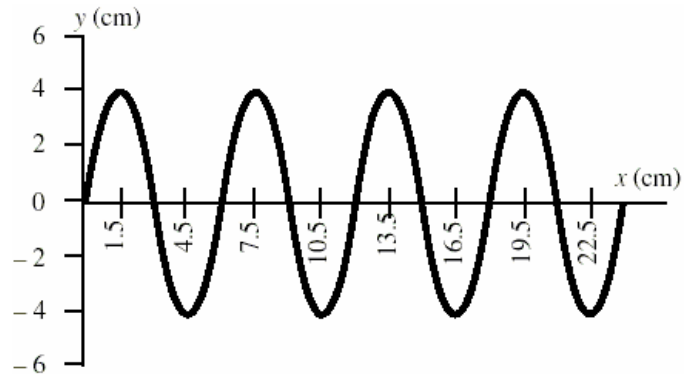


Sample problems for the 1st midterm

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 10 cm/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. 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.
6. The speed of sound in fresh water at 20 °C is 1482 m/s. At what temperature is the speed of sound in helium gas 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).

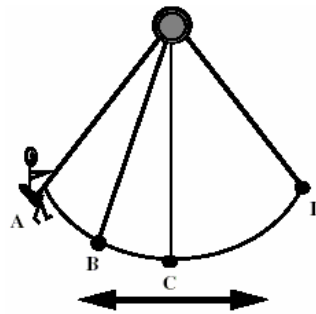
7. A physics student is asked to determine the length of a long, slender, copper rod by measuring the time required for a sound pulse to travel the length of the rod. The Young's modulus of the copper is $1.1 \times 10^{11} \text{ N/m}^2$ and its density is 8890 kg/m^3 . The student finds that the time for the pulse to travel from one end to the other is $1.56 \times 10^{-3} \text{ s}$. How long is the rod?

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

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

Questions 10-12 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.



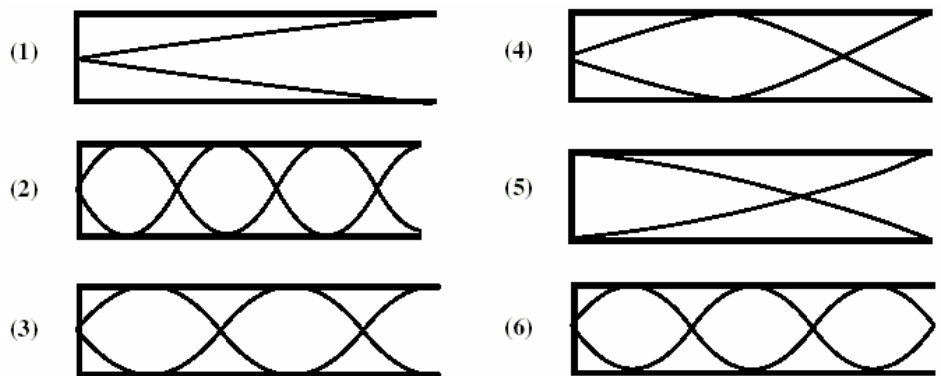
10. At which position(s) will the child hear the highest frequency for the sound from the whistle?
 - A) at both A and D
 - B) at B when moving toward A
 - C) at B when moving toward C
 - D) at C when moving toward B
 - E) at C when moving toward D

11. 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

12. At which position(s) will the child hear the same frequency as that heard by a stationary observer standing next to the whistle?
- at both A and D
 - at B when moving toward A
 - at B when moving toward C
 - at C when moving toward B
 - at C when moving toward D
13. 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 14-16 pertain to the following situation:

The figure show 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.*



14. Which figures do not illustrate possible resonant situations?
15. Which one of the pipes emits sound with the lowest frequency?
16. 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.

The keys:

- | | | |
|------------|--|-----------------------|
| 1. 4 cm | 7. 5.5 m | 13. 585.0 or 591.0 Hz |
| 2. 6 cm | 8. $3.18 \times 10^{-8} \text{ W/m}^2$ | 14. (5) and (6) |
| 3. 1.67 Hz | 9. $1.1 \times 10^{-3} \text{ J}$ | 15. (1) |
| 4. 0.60 s | 10. E) | 16. 858 Hz |
| 5. 5.0 m/s | 11. D) | |
| 6. 633 K | 12. A) | |

Additional Problems for Sample test of the 1st midterm

- Find the force between two charges, knowing the distance between them is 3.1 m
$$\begin{cases} q_1 = 4.0 \mu\text{C} \\ q_2 = 6.0 \mu\text{C} \end{cases}$$
- A test charge is in an electric field. The charge and the electric field are $3.0 \mu\text{C}$, 2.0 N/C respectively. What is the force on the charge placed there?
- There is a charge, $2.5 \mu\text{C}$. What is the electric field at 3.0 m from the charge?
- There is a parallel plate capacitor. When the charge density is $1.8 \times 10^{-7} \text{ C/m}^2$, find the electric field inside the capacitor.
- By comparing $F = kq_1q_2/r^2$ with $E = kq/r^2$, discuss the significances of electric force and field.

Answer keys:

- $2.3 \times 10^{-2} \text{ N}$
- $6.0 \times 10^{-6} \text{ N}$
- 2500 N/C
- $2.0 \times 10^4 \text{ N/C}$