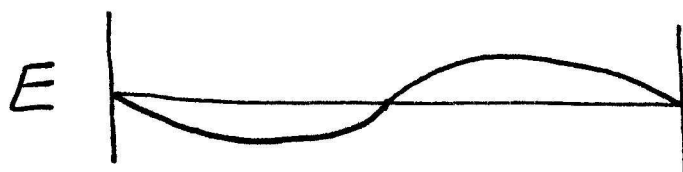
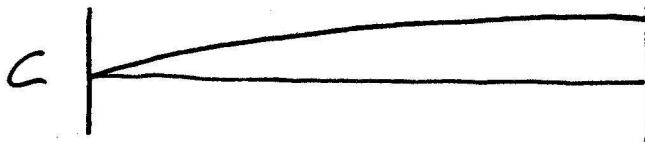
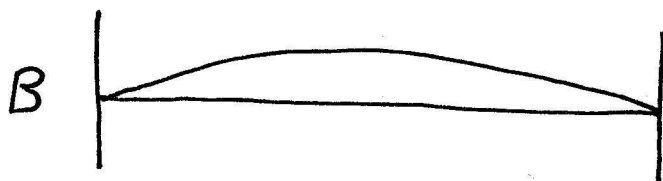
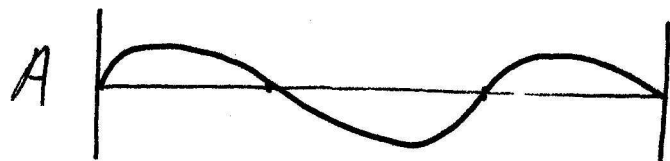


Use these images to answer the following problems.



1. In image A, if the speed of the waves is 200 m/s and the length of the string is 1.2 m, what is the frequency  $f$  of the oscillation?

- A) 500 Hz
- B) 160 Hz
- C) 167 Hz
- D) 250 Hz

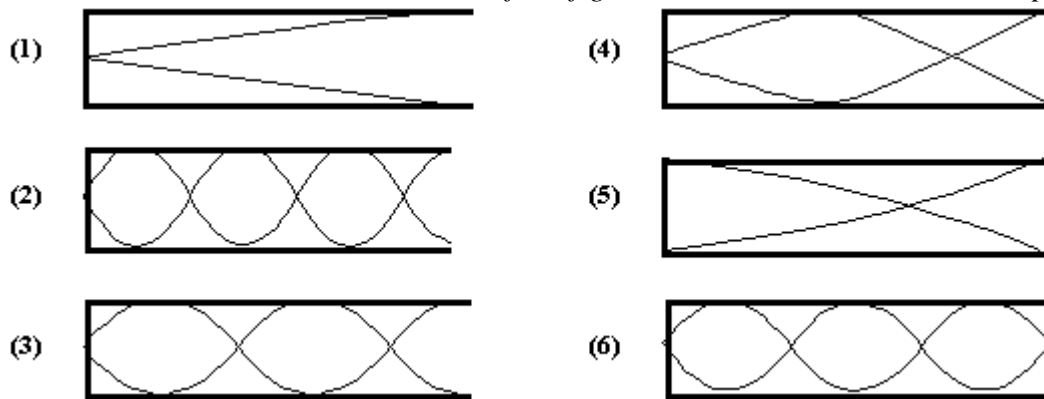
2. Which sketch represents the wave in a pipe with the **left side open**?

- A) A
- B) B
- C) C
- D) D
- E) E

3. In image B, if the wavelength is  $\lambda = 6\text{ m}$ , what is the length of the string?

- A) 2 m
- B) 3 m
- C) 6 m
- D) 9 m
- E) 12 m

The figures show standing waves of sound in six organ pipes of the same length. Each pipe has one end open and the other end closed. *Note: some of the figures show situations that are not possible.*



4. Which figures *do not* illustrate possible resonant situations?

- A) 1 and 4
- B) 2 and 3
- C) 4 and 5
- D) 5 and 6
- E) 4, 5, and 6

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

- A) 1
- B) 2
- C) 3
- D) 4
- E) 6

6. Which one of the pipes emits sound with the highest frequency?

- A) 1
- B) 2
- C) 3
- D) 4
- E) 6

7. Which one of the pipes is resonating in its *third* harmonic?

- A) 1
- B) 2
- C) 3
- D) 4
- E) 6

8. 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.

- A) 172 Hz
- B) 344 Hz
- C) 429 Hz
- D) 515 Hz
- E) 858 Hz

9. A 4.00-m long string, clamped at both ends, vibrates at  $2.00 \times 10^2$  Hz. If the string resonates in six segments, what is the speed of transverse waves on the string?
- A) 100 m/s
  - B) 133 m/s
  - C) 267 m/s
  - D) 328 m/s
  - E) 400 m/s
10. A rope of length  $L$  is clamped at both ends. Which one of the following is not a possible wavelength for standing waves on this rope?
- A)  $L/2$
  - B)  $2L/3$
  - C)  $L$
  - D)  $2L$
  - E)  $4L$
11. Determine the shortest length of pipe, open at both ends, which will resonate at 256 Hz. The speed of sound is 343 m/s.
- A) 0.330 m
  - B) 0.670 m
  - C) 0.990 m
  - D) 1.32 m
  - E) 1.67 m