PHYS 1200 Physics of Everyday Experience

Review questions and exercises for Lecture 22 (V&W-3)

1. What are (a) the wavelength, and (b) frequency of a wave; and (c) how are they related?
2. A harmonic wave propagates on a string at a speed of 5 m/s. An observer sees 2 wave crests passing by his location each second. What is the wavelength of this wave?
3. A video of a harmonic wave propagating on a string shows that the distance between wave crests is 1.5 m and three waves pass a given point each second. What is the speed of this wave?
4. What characteristic of a tuning fork determines the frequency of the sound wave that it produces?
5. Why does a pipe organ need a variety of both long and short pipes?
6. What effect gives rise to standing waves?
7. A string of length 1 m has both ends fixed. A standing wave of wavelength ½ m is excited on this string. How many nodes and antinodes appear on this string?
8. When two violinists play slightly different notes at the same time, the combined sound has a pulsing character. What is the cause of this pulsation?
9. If the speed of sound is 330 m/s, (a) what is the wavelength of the tuba's A_2 (110 Hz) tone, and (b) what is the wavelength of the piccolo's A_6 tone (1760 Hz)?
10. (a) A surface wave on water has a frequency of 0.3 Hz and wavelength 17.3 m. What is the speed of this wave? (b) A surface wave on water has a wave speed of 15.6 m/s and a frequency of 0.1 Hz. What is the wavelength of this wave?

Answers and Solutions (Try to work the problems before reading the solutions.)

1. (a) The wavelength (λ) of a wave is the spatial distance over which the wave is repeated. It is the distance between successive wavelengths. (b) The frequency (f) of a wave is the number of wave cycles occurring each second. (c) Wavelength and frequency are related by the periodic wave relation: λf = v.

2. The frequency of this wave is 2 Hz and v = 5 m/s, so $\lambda = v / f$ = 5 / 2 = 2.5 m.

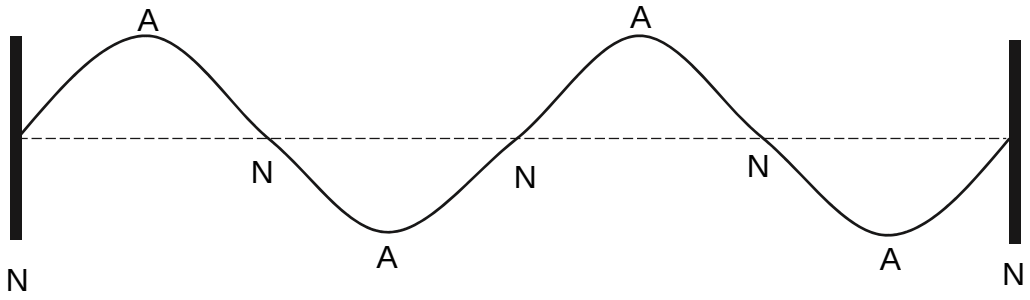
3. $\lambda = 1.5$ m and f =3 Hz → v = λf = 1.5 m (3 Hz) = 4.5 m/s.]

4. The frequency of the sound wave produced by a tuning fork depends on its length. Long tuning forks produce low frequency sound waves and short tuning forks produce high frequency sound waves.

5. The tone produced by air blowing through a pipe depends on the length of the pipe. Many pipes of different lengths are needed to cover a large range of tones.

6. Standing waves are the result of wave interference.

7. If the wavelength is ½ m and the string is 1 m long, then there will be two full wavelengths on the string. There are 5 nodes and 4 antinodes.



8. When sound waves of 2 slightly different frequencies are formed, one hears “beats” or pulsations in the combined waves. The beats are caused by wave interference.

9. (a) $\lambda = v/f = 330/110 = 3\ m$ (b) $\lambda = v/f = 330/1760 = 0.19\,m$

10. (a) $v = \lambda f = 17.3 \times 0.3 = 5.2\ m/s$ (b) $\lambda = v/f = 15.6/0.1 = 156\ m$