Unit Review: 1D and 2D Waves

1. What is the difference between a mechanical wave and an electromagnetic wave?

2. What is the difference between a transverse wave and a longitudinal wave?

3. Suppose you send a pulse along a rope. How does the position of a point on the rope before the pulse arrives compare to the point's position after the pulse has passed?

4. What is the difference between a wave pulse and a continuous wave?

5. Describe the difference between wave frequency and wave speed.

6. Suppose you produce a transverse wave by shaking one end of a spring from side to side. How does the frequency of your hand compare with the frequency of the wave?

7. Waves are sent along a spring of fixed length.

   a) Can the speed of the waves in the spring be changed? Explain.

   b) Can the frequency of a wave in the spring be changed? Explain.

8. What is the difference between the speed of a transverse wave pulse down a spring and the motion of a point on the spring?

9. Suppose you are lying on a raft in a wave pool. Describe, in terms of the waves you are riding, each of the following: amplitude, period, wavelength, speed, and frequency.

10. What is the amplitude of a wave and what does it represent?

11. A pulse reaches the boundary of a medium in which the speed of the pulse becomes higher. Is the reflection of the pulse the same as for the incident pulse, or is it inverted?

12. A pulse reaches the boundary of a medium in which the speed is lower than the speed in the original medium. Is the reflected pulse upright, or inverted?

13. When a wave crosses the boundary between a thin and a thick rope, its wavelength and speed change, but its frequency does not. Explain why the frequency is constant.

14. What happens to a spring at the nodes of a standing wave?

15. How does a wave pulse reflected from a rigid wall differ from the incident pulse?

16. Describe interference. Is interference a behaviour exhibited by only some types of waves, or all types of waves?

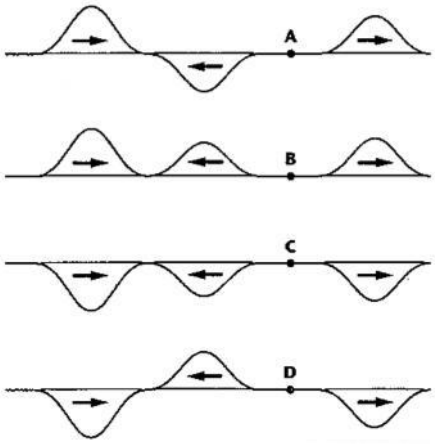
17. Suppose you repeatedly dip your finger into a sink full of water to make circular waves. What happens to the wavelength as you move your finger faster?

18. What happens to the period of a wave as the frequency increases?

19. What happens to the wavelength of a wave as the frequency increases?

20. AM radio signals have wavelengths between 600 m and 200 m, while FM signals have wavelengths of about 3 m. Explain why AM signals can often be heard behind hills while FM signals cannot.

21. In each of the four waves shown below, the pulse on the left is the original pulse moving toward the right. The center pulse is the reflected pulse, and the pulse on the right is the transmitted pulse. At each boundary (A, B, C, and D), is the wave moving from a fast medium to a slow medium, or slow to fast?



22. The Sears Building in Chicago sways back and forth in the wind with a frequency of about 0.10 Hz. What is the period of its vibration?

23. An ocean wave has a length of 10 m. A wave passes a fixed location every 2.0 s. What is the speed of the wave?

24. Water waves in a shallow dish are 6.0 cm long. At one point, the water oscillates up and down at a rate of 4.8 oscillations per second.

    a) What is the speed of the water waves?

    b) What is the period of the water waves?

25. Water waves in a lake travel $4.4\ m$ in $1.8\ s$. The period of oscillation is $1.2\ s$.

    a) What is the speed of the water waves?

    b) What is their wavelength?

26. The frequency of yellow light is $5.0\times10^{14}\ Hz$. Find the wavelength of yellow light. The speed of light is $3.0\times10^{8}\ m/s$.

27. AM radio signals are broadcast at frequencies between 550 kHz and 1600 kHz and travel at $3.0\times10^{8}\ m/s$.

    a) What is the range of wavelengths for these signals?

    b) FM frequencies range between 88 MHz and 108 MHz and travel at the same speed. What is the range of FM wavelengths?

28. A sonar signal of frequency $1.0\times10^{6}\ Hz$ has a wavelength of $1.5\ mm$ in water.

    a) What is the speed of the signal in water?

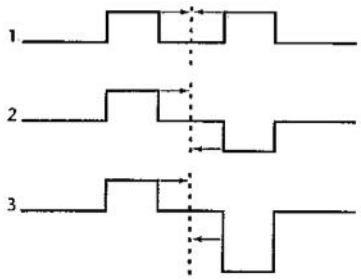
    b) What is its period in water?

    c) What is its period in air?

29. Pepe and Alfredo are resting on an offshore raft after a swim. They estimate that $3.0\ m$ separate a trough and an adjacent crest of waves on the lake. They count 14 crests that pass by the raft in $20\ s$. Calculate how fast the waves are moving.

30. The velocity of the transverse waves produced by an earthquake is $8.9\ km/s$, and that of the longitudinal wave is $5.1\ km/s$. A seismograph records the arrival of the transverse waves $73\ s$ before the arrival of the longitudinal waves. How far away was the earthquake?

31. Sketch the result for each of the three cases shown below, when the centers of the two wave pulses lie on the dashed line so that the pulses exactly overlap.



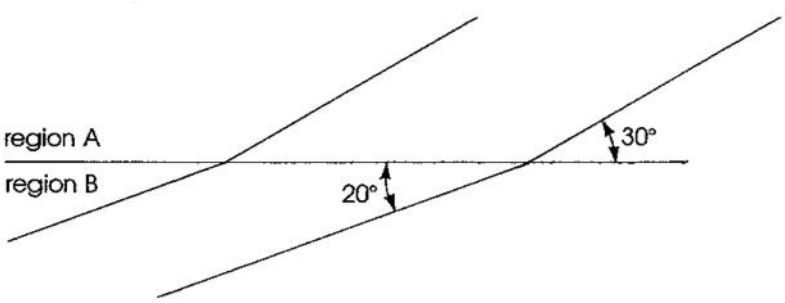
32. A straight wave in the deep region of water in a ripple tank has a speed of 24 cm/s and a frequency of 4.0 Hz. It strikes the boundary between deep and shallow water at an incident angle of $40°$. If the speed in the shallow region is 15 cm/s,

    a) what is the angle of refraction?

    b) what is the wavelength in the shallow water?

33. The wavelength of a straight wave in the deep end of a ripple tank is 2.0 cm, and the frequency is 11 Hz. Wavefronts strike the boundary of the shallow section of the tank at an angle of $60°$ and are refracted at an angle of $30°$. Calculate the speed of the wave in deep water and in shallow water.

34. A plane wave generator with a frequency of 6.0 Hz creates a water wave with a wavelength of 2.0 cm in region A of a ripple tank. The angle between the wavefronts and the straight boundary between regions A and B of the tank is $30°$. In region B, the angle is $20°$, as illustrated below.



Find the velocity in each region.