Questions on Wave Types*

\[ f = \frac{1}{T}, \quad v = f\lambda, \quad \nu = \omega/k, \quad k = \frac{2\pi}{\lambda}, \quad \omega = 2\pi f, \quad y(x,t) = A\cos(kx - \omega t + \phi), \quad v = \sqrt{B/\rho} \]

1. Give a definition of wavelength. In what units is wavelength measured?
2. What is the difference between wavelength and period? How do you measure each?
3. Give a definition and example of a transverse wave.
4. Give a definition and example of a longitudinal wave.
5. Give a definition and example of a torsional wave.
6. Suppose you have a slinky stretched between you and another person. Describe what you would do to your end to make a) a transverse wave b) a longitudinal wave c) a torsional wave.
7. In the following graph, determine the period and wavelength of the wave on the string. Each block on the lower graph is one meter, time is in seconds as shown on the upper graph.

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9. Why are longitudinal waves sometimes called compressional waves?
10. What are compressions and rarefactions in sound waves?
11. How is simple harmonic motion (a mass on a spring) connected to wave motion for transverse waves?
12. How is simple harmonic motion (a mass on a spring) connected to wave motion for longitudinal waves?
13. What are S-waves and P-waves?
14. Describe the major types of surface earthquake waves.
15. Is a water wave longitudinal, transverse or both? Explain.
16. Find the wavelength of a 20Hz sound wave (about the lowest note humans can hear) and the wavelength of a 20,000 Hz sound wave (about the highest note humans can hear). Assume the speed of sound is 343 m/s.
17. What is the connection between simple harmonic motion and the points on a string when the string has a wave traveling on it?
18. In the following graph, determine the wavelength of the wave. X is measured in centimeters.
19. In the graph above, what is the amplitude of the wave?
20. In the following graph, determine the period of the wave.

21. For the graph above, what is the frequency of the wave?
22. For the preceding graph, what is the amplitude of the wave?
23. What is the angular frequency, \( \omega \), for a 20Hz sound wave? (Hint: See top of page).
24. What is the wave vector, \( k \), for a 4.0 meter sound wave?
25. What are electromagnetic waves? Give some examples.
26. What is the difference between sound waves and radio signals?
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28. What is the difference between sound waves and radio signals?
29. What is the difference between a gamma-ray and visible light?
30. What is the difference between ionizing radiation and non-ionizing radiation?
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32. What is the difference between ionizing radiation and non-ionizing radiation?
33. What is the wavelength of a radio signal of 89.3 MHz, given than M = Mega = 10^6 and the speed of radio signals are the same as light (3.0 \( \times \) 10^8 m/s)?
34. Alternating current in your house oscillates at 60 cycles per second. This gives off a radio signal (that can be detected by special antennas). What is the wavelength of this signal (c = 3.0 \( \times \) 10^8 m/s)?
35. Calculate the frequency of your favorite color. You will need the graph shown on the projector. Hint: Nanometers = nm = 10^{-9} m.
36. Why can’t cell phone signals cause cancer but x-rays can (aren’t they both electromagnetic waves)?
37. Why can we see visible light but not other types of electromagnetic waves?
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* Many of these ideas came from Conceptual Physics 11th Ed. by Paul Hewitt (Addison Wesley, 2011).