Name _____

The Dance of Waves: Understanding the Relationship between Wave Speed, Frequency, and Wavelength

Short Answer Key

1. The relationship between wave speed and wavelength at the beach can be explained by observing that shorter waves, such as ripples in shallow water, reach the shore faster than longer waves, like the rolling waves of the open ocean. Shorter waves have shorter wavelengths, which enable them to cover the distance to the shore more quickly.
2. Changing the length of a guitar string affects its wavelength, frequency, and pitch. Shortening the string increases its frequency and raises the pitch, producing higher notes. Conversely, lengthening the string decreases its frequency and lowers the pitch, resulting in deeper notes.
3. Using the wave equation: Wave Speed (v) = Frequency (f) × Wavelength (λ), if the frequency (f) is 60 Hz and the wavelength (λ) is 2 meters, the wave speed (v) would be 120 meters per second (m/s).
4. In radio broadcasting, specific frequencies are allocated to different stations to prevent interference. If stations used the same frequencies, their signals would overlap, causing garbled or distorted broadcasts. By using different frequencies, stations can transmit their signals without interference, ensuring clear and distinct broadcasts for listeners.
5. A real-world application where understanding the relationship between wave speed, frequency, and wavelength is crucial is in designing wireless communication networks, such as Wi-Fi or cellular networks. To provide reliable and high-speed connectivity, engineers must carefully consider the frequency bands used for data transmission, as different frequencies have varying propagation characteristics. Higher frequencies provide faster data rates but have shorter ranges, while lower frequencies offer greater coverage but at slower speeds. Balancing these factors is essential to deliver efficient wireless communication services.