Problems 15.45,52,63,73 from MasteringPhysics with minor clarifications.

15.45 - Transverse Standing Waves on a Rope

A rope of length L=1.47 m is stretched between two supports with a tension that makes the transverse waves have a speed of v=47.4 m/s.

Part A

What is the wavelength, λ_1, of the fundamental (1st) harmonic?

Part B

What is the frequency, f_1, of the fundamental harmonic?

Part C

What is the wavelength, λ_3, of the second overtone?

Part D

What is the frequency, f_3 of the second overtone?

Part E

What is the wavelength, λ_4, of the forth harmonic?

Part F

What is the frequency, f_4 of the forth harmonic?

15.52 - Weightless Ant

An ant with mass m is standing peacefully on top of a horizontal, stretched rope. The rope has mass per unit length μ and is under tension F. Without warning, Throckmorton starts a sinusoidal transverse wave of wavelength λ propagating along the rope. The motion of the rope is in a vertical plane.

Part A

What minimum wave amplitude, A, will make the ant become momentarily weightless? Assume that m is so small that the presence of the ant has no effect on the propagation of the wave.

15.63 - Sinusoidal Transverse Wave

A sinusoidal transverse wave travels on a string. The string has length L and mass m. The wave speed is v and the wavelength is λ.

Part A

If the wave is to have an average power of P_{av}, what must be the amplitude of the wave?

Part B

For this same string, if the amplitude and wavelength are the same as in part A, what is the average power for the wave if the tension is increased such that the wave speed is doubled?

15.73 - Pit and Plank

A wooden plank is placed over a pit that is L =5.00m wide. A physics student stands in the middle of the plank and begins to jump up and down such that she jumps upward from the plank two times each second. The plank oscillates with a large amplitude, with maximum amplitude at its center.

Part A

What is the speed of transverse waves, v, on the plank?

Part B

At what rate does the student have to jump to produce large-amplitude oscillations if she is standing 1.25m from the edge of the pit? (Note: The transverse standing waves of the plank have nodes at the two ends that rest on the ground on either side of the pit.)