Physics 123 section 2 CID _____

Homework 13

Score _____ / 30

1. (6 pts) Consider a wave of the form

$$y(x,t) = \frac{y_0}{(kx - \omega t)^4 + 1}.$$

(a) Is the wave moving in the $+x$ or $-x$ direction?

(b) What is the velocity of the wave?

(c) Write an equation for a wave which is identical to this wave but which is moving in the opposite direction.

2. (6 pts) A seismometer detects an earthquake. The faster longitudinal wave (the "P" wave") is detected 21.2 seconds before the slower transverse wave (the "S" wave). If we know that P waves travel at 7.80 km/s and that S waves travel at 4.50 km/s, how far is the seismometer from the epicenter of the quake?

3. (7 pts) (a) Write down an expression for a sinusoidal wave traveling in the $+x$ direction with an amplitude A, an angular frequency ω, and a wavenumber k. Assume that $y(x = 0, t = 0) = 0$ and that dy/dt is positive at the position $x = 0$ at time $t = 0$. (b) Now write the expression for the same wave, but in terms of the amplitude A, the wavelength λ, and the frequency f. (c) Find the velocity of the wave in terms of ω and k. Then remember this equation and never forget it! (d) Find the period T of the wave in terms of ω and k. (e) Write, in terms of A, k, and ω, the expression for a wave traveling in the -x direction assuming that $y(x = 0, t = 0) = A$.

4. (7 pts) I am watching sinusoidal waves travel across a swimming pool. If I look at the water right in front of me, it goes up and down ten times in 11.5 seconds. At the peaks of the wave the water is 4 cm below the edge of the pool. At the lowest points of the wave the water is 6 cm below the edge of the pool. At one particular moment in time you notice that the water height is at a maximum right in front of you, and then drops to a minimum height 0.791 meters away. (a) What is the frequency f for this wave? (b) What is ω for this wave? (c) What is λ for this wave? (d) What is k for this wave? (e) What is the amplitude A of this wave? (f) What is the speed of water waves in this pool? Note that the units for ω are rad/s, and the units for k are rad/m.

5. (4 pts) A sinusoidal wave travels one wavelength per period, so $v = \lambda/T$. Use this as a starting point to prove that $v = \omega/k$. These two equations are really worth remembering!

Extra problems I recommend you work (not to be turned in)

- As we will study in a future unit, light is actually a wave. A laser generates a wave which is almost perfectly sinusoidal. The wavelength of light from a helium-neon laser is 633 nm. The speed of light is 2.9979×10^8 m/s. What is the wavenumber, frequency, period, and angular frequency of the light from a helium-neon laser?

- Explain what x and y physically represent for a transverse wave on a slinky. Explain what they physically represent for a longitudinal wave on a slinky.