

Homework #9 - Phys 273

1) Consider the function

$$y(x) = \begin{cases} 0 & -L < x < -1/2 \\ d & -1/2 < x < 1/2, \text{ and repeating with period } 2L. \\ 0 & 1/2 < x < L \end{cases}$$

In this expression, (d) is a constant, and $L > 1$.

- a) Sketch this function for the case $L = 1$, assuming $d = 1$.
- b) Sketch this function for the case $L = 4$, assuming $d = 1$.
- c) Consider $L = 1$ and $d = 1$ again. Calculate the expansion coefficients for the complex Fourier Series for this function.
- d) Let $q = n\pi$. Re-write the expansion coefficients from part (c) as a function of (q), and make a plot of the expansion coefficients as a function of (q).
- e) Now we let L go to infinity, so that the function is no longer periodic. Sketch the function again and calculate its Fourier Transform, $A(k)$.
- f) Plot the Fourier Transform $A(k)$ as a function of k .
- g) Compare the result from part (d) to the result from part (f). What are the similarities, and what are the differences?

2) A transverse wave on an infinitely long string is described by

$$y(x, t) = 0.5 \sin\left(\frac{\pi x}{2} - 50\pi t\right)$$

- a) What are the amplitude, wavelength, and wave number of the wave?
 - b) What are the frequency (f), period, and velocity of the wave?
 - c) What is the maximum transverse speed of any particle in the string.
- 3) A wave on a string with a frequency of 20 Hz travels with a velocity of 80 m/s.
- a) If the mass density of the string is 0.1 kg/m, what is the tension of the string?
 - b) What is the distance between two points on the wave which are separated by a phase difference of 30 degrees?

