PHYS 160 - Exam #2 - Triangle Waves

Don't forget your name or plot titles. For all plots in this quiz, please plot over the values $t = 0 \ldots 4$. Write your name in the upper corner of this exam and turn it it when you leave.

Prep-work (15pts)

- Go online and look up the triangle wave function. Remember that any sine wave can be written as:

$$a \sin(\omega(t + \phi))$$

Write three helper functions, as we did for the square wave:

- $a(k)$, the amplitude of the kth sine wave in the series
- $\text{term}(t, k, \omega, \phi)$
- $\text{triangle}(t, \omega, \phi, N1, N2)$

  Where $N1, N2$ are the starting and ending number of terms in the summation.

Plotting (30pts)

- Plot the triangle wave with the first 50 terms, no phase angle and $\omega = 1$.
- On a new plot, adjust ω until you get a period of exactly 1. We will use this ω for the rest of the exercise and call it ω_0.
- Plot the triangle series with only a *single term*.
- Is a single term a good approximation?
- Observe the effect of all the other terms by plotting the triangle series with one term, and overlaying another plot with the other terms ($N1 = 1, N2 = 100$).

Interference (35pts)

- Write a new helper function called $\text{overlap}(t, \Delta)$ that returns the sum of two triangle waves, each with $N1 = 0, N2 = 50$, a period of 1, but differing phase angles. The first should have $\phi_1 = 0$ and the second should have $\phi_2 = \Delta$. When you define the function here, use the unapply method.

$$\text{overlap}(t, \Delta) = \text{triangle}(t, \omega_0, 0, 0, 50) + \text{triangle}(t, \omega_0, \Delta, 0, 50)$$

- Plot $\text{overlap}(t, 1.8)$, $\text{triangle}(t, \omega_0, 0, 0, 50)$ and $\text{triangle}(t, \omega_0, 1.8, 0, 50)$ on the same plot and describe what you see (note the amplitude!).
- Animate, over 100 frames the range $\Delta = 0 \ldots 1$ the function $\text{triangle}(t, \omega_0, \Delta, 0, 50)$. If you've done this correctly it should simply slide across the screen.
- Animate, over 100 frames the range $\Delta = 0 \ldots 1$ the overlap function.
- Describe what happens during this animation at $\Delta = 1/2$, both from a graphical perspective and a physical one.

Points of interest (20pts)

- Solve for *all* points of intersection of the two functions: $\text{triangle}(t, \omega_0, 0, 0, 50)$ and $\text{triangle}(t, \omega_0, 0.4, 0, 50)$.
- On a single picture, plot each of the above graphs with a third plot (in point style) indicating the points of intersection.