Homework 2 Conceptual Questions

a) *The standing wave ratio can be found using the absolute value of reflection coefficient at the load. Why is the absolute value used? Why doesn't the sign of the reflection coefficient matter?*

The standing wave ratio is the ratio of the maximum voltage measured on the line (the point of total constructive interference between the forward and backward traveling waves) and the minimum voltage (the point of total *destructive* interference). There will be a maximum and minimum voltage regardless of the sign of reflection coefficient; the sign simply determines where the maxima and minima lie.

b) *Suppose that in Problem 1, the frequency of the sinusoidal input voltage signal were increased by 50%. Would this change the standing wave pattern? If so, describe how.*

Increasing the frequency by 50% would result in a frequency that was 1.5 times the original frequency and a wavelength that was 1/1.5, or two-thirds, of the original wavelength. The standing waves in the pattern would be compressed to two-thirds of their original width. Since the original chart shows two maxima/minima, there would be room for three maxima/minima in the new graph.

c) Why don't standing wave patterns ever have values below 0?

Standing wave patterns are graphs of wave pattern amplitude, and amplitude is never less than zero.

c) In principle, a standing wave pattern could exist for a non-sinusoidal input signal as well. Choose some non-sinusoidal input signal, length of line, Z0, and load impedance and draw the standing wave pattern that will result from it. Show calculations to justify the correctness of your drawing.

A standing wave pattern can be produced for an arbitrary signal through a simple process: write an equation for the forward-traveling wave, use the reflection coefficient to determine the backwards-traveling wave, write an equation of the forwards and backwards traveling waves together, and then graph the magnitude of this sum (in other words, take the absolute value.)

*https://www.wolframalpha.com/input?i=absolute+value+of+%285*e%5E%28i*50*pi*t%29%2B3*e%5E%28i*150*pi*t%29%2B5*e%5E%28-i*50*pi*t%29%2B3*e%5E%28-i*150*pi*t%29%29+from+0+to+pi%2F25*

This link will set up a standing wave pattern in Wolfram Alpha. The original wave consists of a 5V component at 25 Hz and a 3V component at 75 Hz. The reflection coefficient is 1, so the backwards traveling wave has the same amplitude for both components.