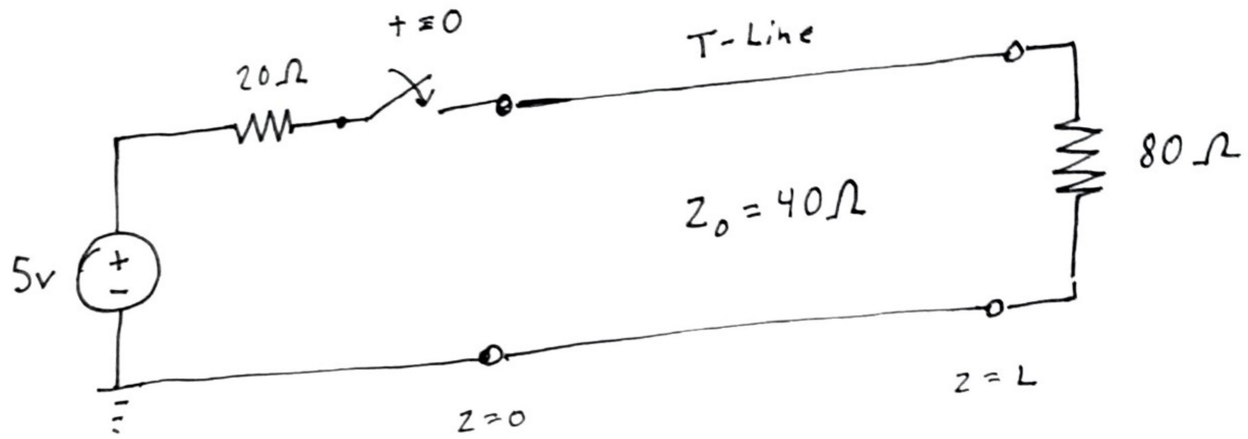
Exam 1 Practice Problems
(optional; not for submission)

1.) Transient Analysis



Consider the circuit above. The voltage source pictured is a DC source. At t=0, the switch closes. The transmission line pictured has a propagation velocity of ½ the speed of light and is 300m long.

a.) What is the amplitude of the initial forward-traveling voltage wave?

b.) How much time elapses between the closing of the switch and the arrival of the forward-traveling voltage wave at the load?

c.) Create a bounce diagram for this circuit, showing the amplitude of each voltage and the voltage at both the transmission line input and the load with respect to time t. The bounce diagram should include the first three reflections.

d.) Graph the voltage at the input of the transmission line with respect to t from the time the switch closes until the time that the third reflection has occurred.

2.) Input Impedance, Reflection and Power

A sinusoidal signal with amplitude 1V and frequency 1 MHz enters an RG-58 transmission line with $Z_0=50\Omega$ and velocity factor 0.6. You place a voltage probe at the load and measure an amplitude of 750mV. The line length is 300m. Approximate the line as having no losses.

a.) What is the reflection coefficient at the load? What is load impedance?

b.) What is the wavelength of the signal on the line?

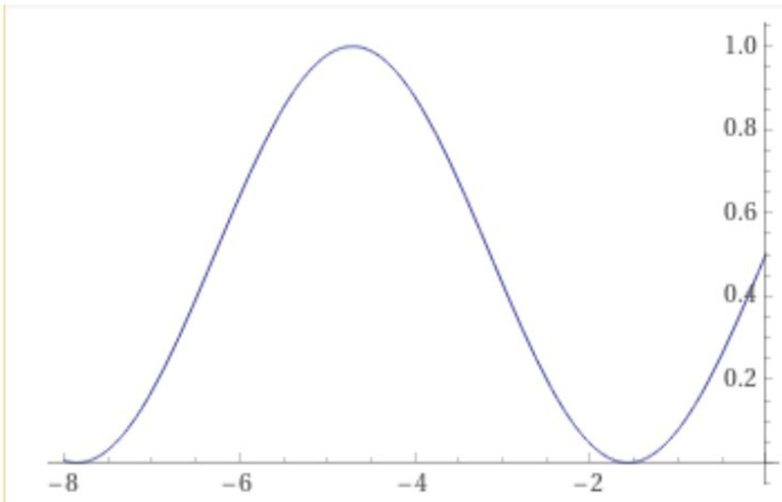
c.) What is the input impedance for this transmission line and signal once the line reaches steady state?

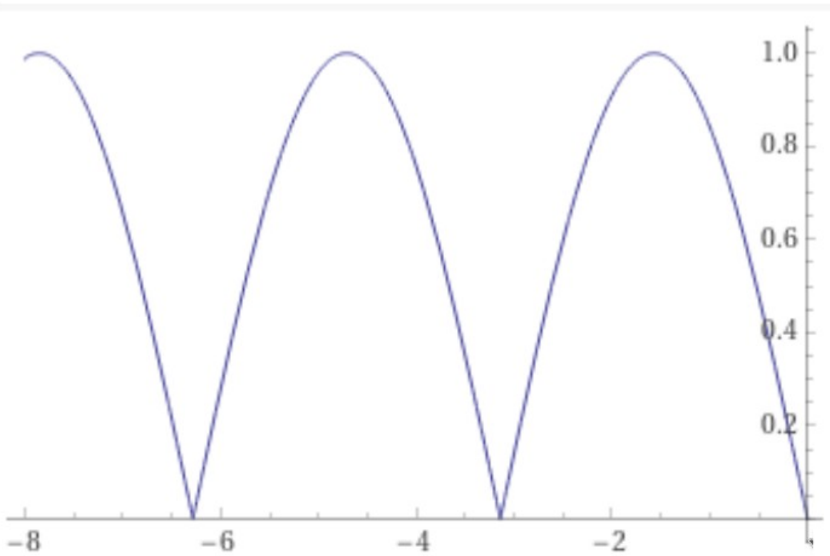
d.) Supposed that the line length is increased by 270m. Without doing any calculations, will the input impedance change? Why or why not?

e.) What is the average power transmitted to the load? What would the average power transmitted to the load be if it were replaced with a different load that was matched to the line?

3.) Standing Waves

Consider the following 2 voltage plots. Suppose that the rightmost side of the plot represents a load at the end of the transmission line, and moving left on the graph represents moving toward the source. The x-axis units are meters and the y-axis units are volts.





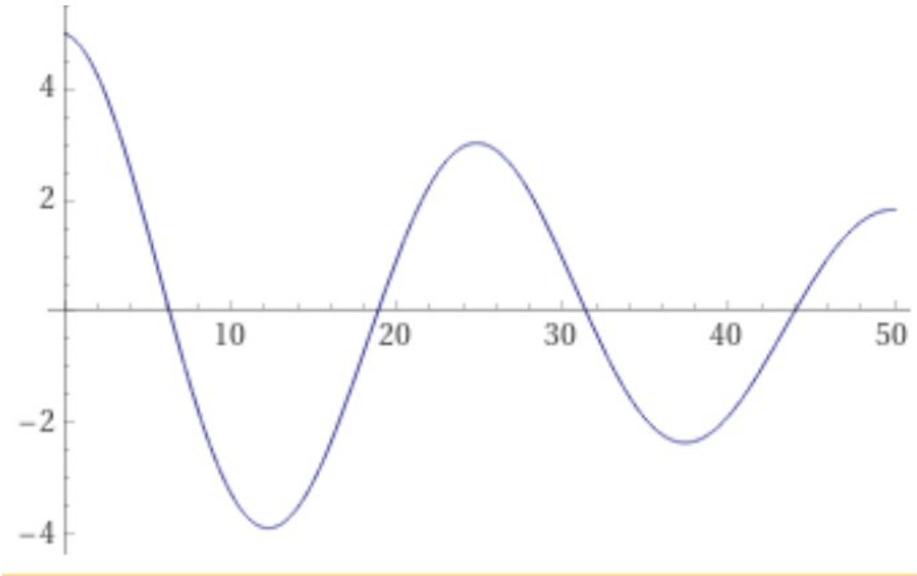
For each of the plots, state the following:

a.) Could this plot represent a standing wave pattern on a transmission line due to refleciton at the load?

b.) If the answer is yes, assume that the transmission line has Z_0=100Ω and find the standing wave ratio, reflection coefficient, and load impedance.

4.) Lossy Transmission Line

The following graph represents a voltage propagating on a lossy transmission line. The y axis is measured in volts and the x axis is measured in meters. Note that at z-0, the amplitude is 5V and at z=50, the amplitude is 2V



What is the attenuation constant? What is the propagation constant?

5.) Low-Loss Tranmission Line

Assume that a transmission line has an inductance per length of 100 microhenries per meter and a capacitance per unit length of 100 picofarads per meter. It also has a resistance per unit length of 0.2 ohms per meter.

a.) Is it reasonable to approximate the line as being low-loss at 1 kHz? (We will state that if the impedance of the series resistance is less than 1% of the impedance of the series inductance, we can use the low-loss approximation.)

b.) Is it reasonable to approximate the line as being low-loss at 1 MHz?

c.) You are tasked with adding a resistor in parallel to the line every 10m in order to make the line dispersionless. What value of resistor do you choose?

6.) Online Exercises

Waves and Phasors

Transmission Lines