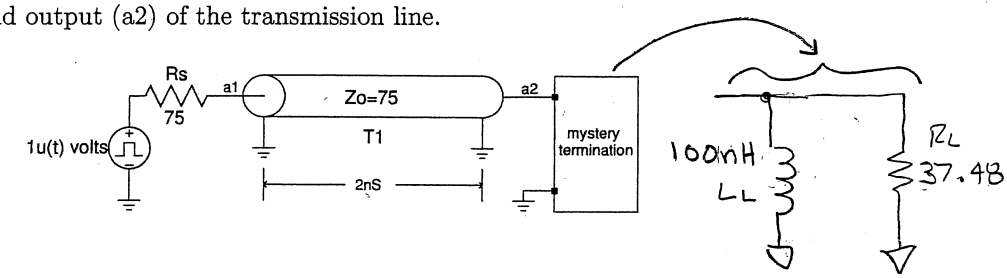
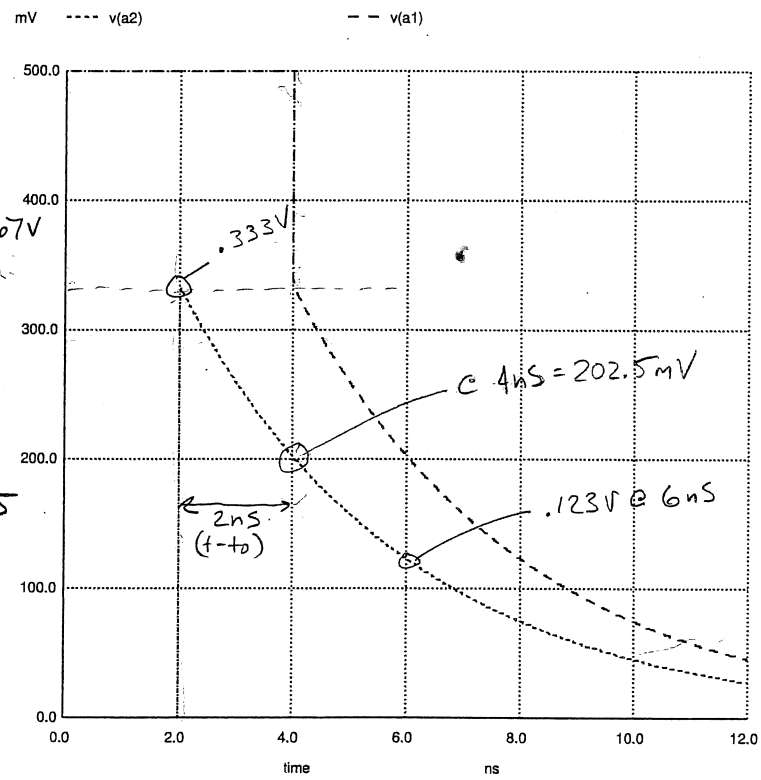
3. In the circuit below, T1 is a lossless transmission line with $Z_o = 75\Omega$, terminated with an unknown termination consisting of two passive circuit elements. Also shown are the voltage waveforms at the input (a1) and output (a2) of the transmission line.





- Incident wave was 0.5V
- Reflection was $0.5 - 0.33 = -0.167V$
- $\rho_L = \frac{R_L - 75}{R_L + 75} = \frac{-0.167}{0.5}$

$\frac{R_L - 75}{R_L + 75} = -0.334$

$-0.334(R_L + 75) = R_L - 75$

$-0.334R_L - 25.05 = R_L - 75$

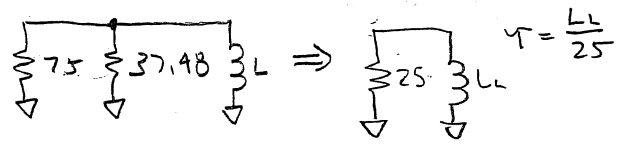
$-1.334R_L = -50$

$R_L = 37.48\Omega$

(a) [19] Determine the lumped-element termination. Draw the terminating circuit including the lumped-element values with appropriate units. Provide a short rationale for your answer.

Final voltage asymptotic to ϕ volts → shunt inductor
Reflected wave at far end indicates a resistance less than Z_o → shunt resistor

Determine τ:



$\tau = \frac{L_L}{25}$

$x(t) = x(\infty) + [x(t_o^+) - x(\infty)]e^{-t/\tau}$; pick a point on the graph, say 4nS ($t - t_o = 2ns$)

$.2025 = 0 + [.333 - 0]e^{-\frac{(2\times10^{-9})(25)}{L}}$

$.2025 = .333e^{-\frac{5\times10^{-8}}{L}}$

$-.4974 = \frac{-5\times10^{-8}}{L} \Rightarrow L = 1\times10^{-7}H$

$= 100nH$