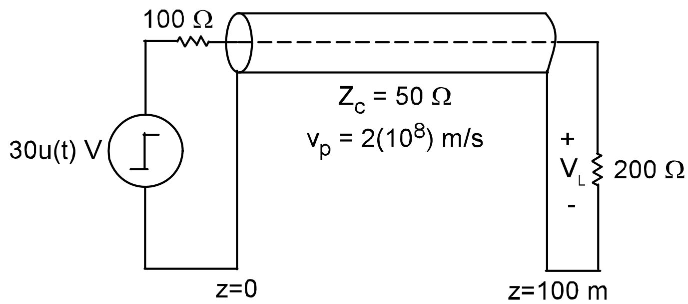
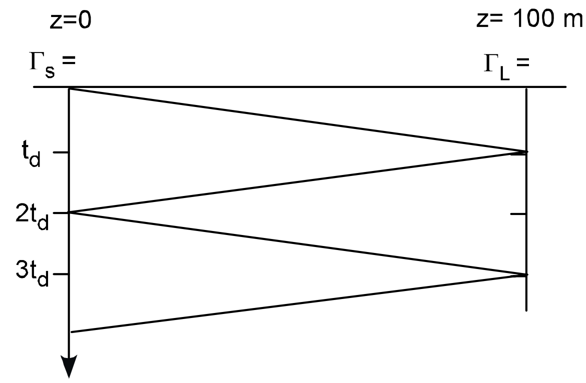
1. Given the system shown below,





i) Complete and label the bounce diagram through $3t_d$. (9 pts)

ii) Determine V_L(50 m, 1 μs) (4 pts)

iii) Determine V_L in steady-state. (4 pts)

iv) During the transient, will the voltage, V_L, overshoot its steady-state value? *Why or why not? (4 pts)*

v) Show how to modify the system, with one resistor, that will cause the transient solution to end in exactly $2t_d$. *In the diagram above, place the resistance and show its value.*

With this resistance in place, what would be the steady-state load voltage? (4 pts)

2. An electromagnetic wave in region 1 (air), its electric vector *parallel* to the POI, impinges upon region 2 ($\varepsilon_2=4\varepsilon_o$, $\mu_2=\mu_o$, $\sigma_2=0$) with θ_i = 60°.

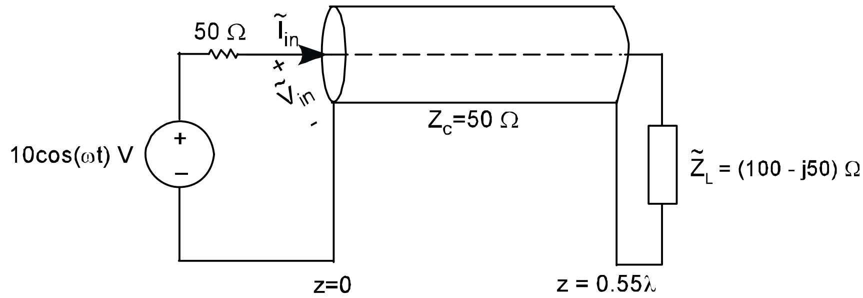
i) Determine, θ_t, the angle of refraction (5 pts)

ii) Can a wave traveling in region 1 be totally reflected at the region 1/region 2 interface? *Why or why not?* (5 pts)

iii) Determine the transmission coefficient. (8 pts)

iv) What portion of the incident power is transmitted into region 2? (7 pts)

3. The system shown below involves a lossless transmission line.



i) Determine the impedance, $\tilde{Z}_{in}$, and the reflection coefficient, $\tilde{\Gamma}_{in}$, at the input of the transmission line. (10 pts)

ii) Find the phasor voltage, $\tilde{V}_{in}$, and the phasor current, $\tilde{I}_{in}$, at the input of the transmission line. (8 pts.)

iii) What is the average power input to the transmission line? (5 pts)

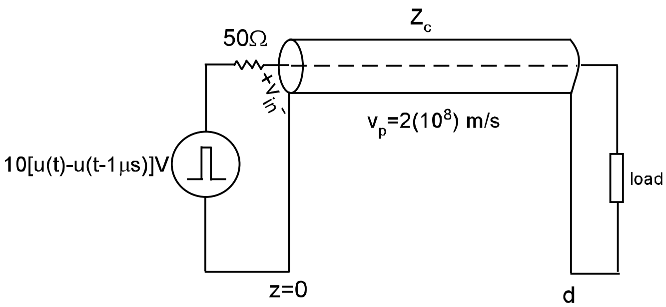
iv) What is the average power absorbed by the load? (2 pts)

4. Mark ***each*** True/False as either ***T*** or ***F***. (2½ pts each)

___ The input impedance for very long lossy transmission lines (“long” implying that $2\alpha d$ grows large) will be approximately Z_c no matter what load impedance is connected to the line.

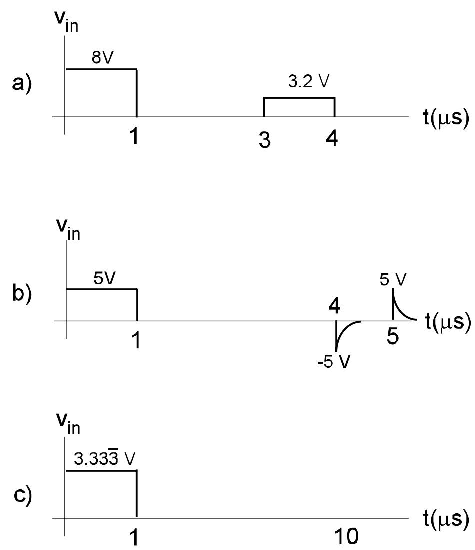
___ Given that Z_c = 100 Ω and $\mathcal{C}$ = 100 pF/m, it can be shown that $v_p = 10^8$ m/s.

9 pts.



*Hints: For the **loads** in a), b), and c), possibilities are R, parallel RC, or series RL.*

You should be able to determine the resistance of all resistances.



a) d: ______ Z_c: ______ load: ______

b) d: ______ Z_c: ______ load: ______

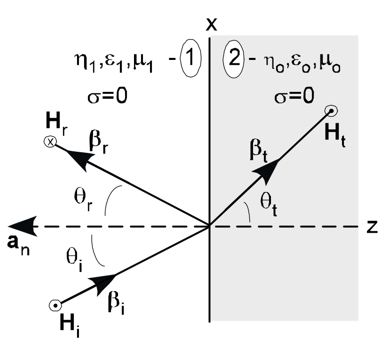
c) d: = 400m Z_c: ______ load: ______

___ Consider two lossy lines of lengths, $d_1=\lambda$ and $d_2=10\lambda$. Both lines have Z_c=50Ω and have identical $\mathcal{L}$, $\mathcal{C}$, $\mathcal{R}$, and $\mathcal{G}$. Each line is terminated with R_L=100Ω. At the input, the reflection coefficient for the shorter line will be smaller in magnitude than that of the longer line.
Why or why not? ____

____

___ A 1.75λ long lossless transmission line is short-circuited at the load end. For this transmission line, the input impedance and the VSWR are both infinite.

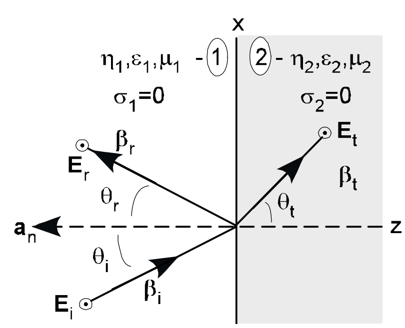
___ $\tilde{\underline{H}}_i = 10e^{-j\beta z}\mathbf{a}_x$ A/m is incident on a PEC. The reflected magnetic vector is $\tilde{\underline{H}}_r = 10e^{j\beta z}\mathbf{a}_x$ A/m.



___ Given that region 2 is free space, the above diagram is possible. *Why or why not?* ________

____

____



___ The result of a refraction experiment is shown above. Given this result, it is not possible for an incident wave in region 1 to be totally reflected.

Answers

1. *ii) 16 V, iii) 20 V, iv) No. v) place 100 Ω resistor in parallel to 100 Ω source resistance to obtain match, 24 V*
2. *i) θ_t = 25.7° ii) No, iii) 0.526, iv) 0.998*
3. *i)* 0.446∠-63.5° *(50 – j50) Ω, ii)* 0.0894∠26.6° A, 6.325∠-18.4° V , *iii) 0.2 W, iv) 0.2 W*
4. *T, T, (300 m, 200 Ω, open), (400 m, 50 Ω, RC with R = 50 Ω), (400 m, 25 Ω, 25 Ω), F, T, T, T, F*