

3/4/2011

*University of Portland
School of Engineering*

EE 301-Electromagnetic Fields-3 cr. hrs.

Spring 2011

You will pay a heavy price for giving these students such tough tests and scaring them to death Inaaaan!
@*\$*#&X@x@*§ξ!



Best of luck to you EE 301 students and please, demonstrate to Inan that unlike what everyone might think, his tests are nothing but simply a piece of cake! (Bring his fame down about giving challenging exams!)

Midterm Exam # 1

(Prepared by Professor A. S. Inan)

I fully agree!

(Friday, March 4, 2011)

(Closed Book Exam; 1 Formula Sheet Allowed)

(Total Time: 55 mins.)

Name: SOLUTIONS! ☺

Signature: *Solutions* ☺

*"Honesty is the best policy."
Aesop (~620B.C. -?)*

*"An honest mind possesses a kingdom."
Lucius Annaeus Seneca (4B.C.-65A.D.)*

*"Honest people are the true winners of the universe."
Anonymous*

*"Honesty is not for sale."
A. Inan*

No worries Mr. Heaviside!

Inan's fame will spiral downward in this test!

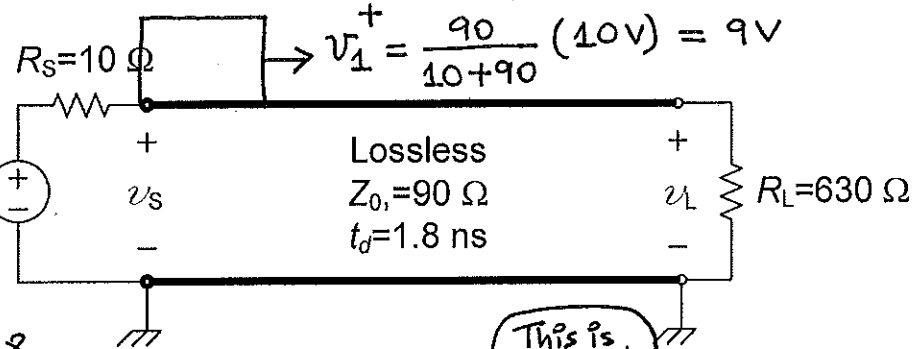
I will demo Inan who I am and what I can achieve



This test is made for babies

(1) (15 mins., Total: 32.5 points) Step excitation of a lossless line. A uniform, lossless transmission line is excited with a step source as shown.

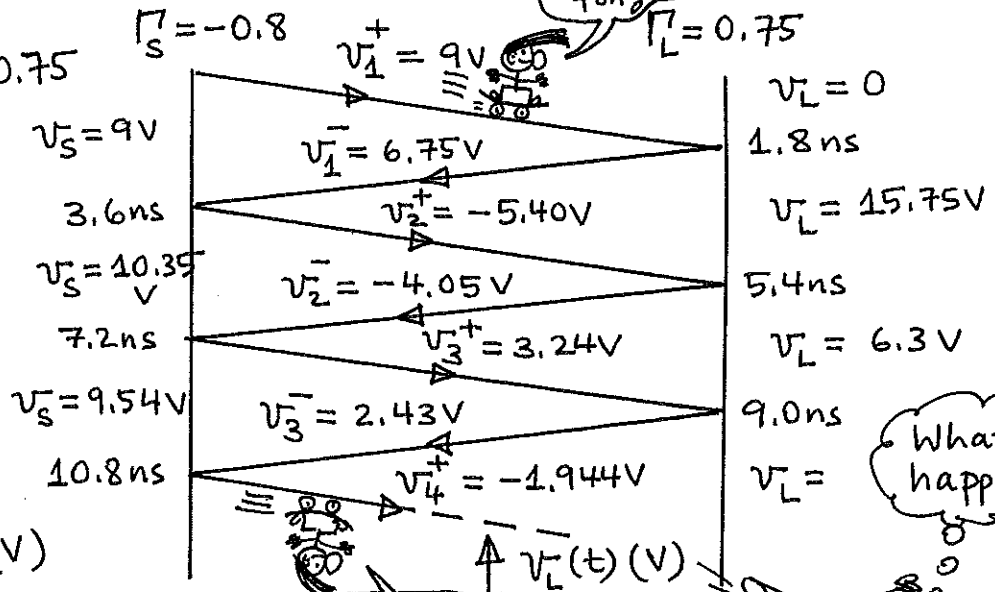
(a) (20 points) Provide an appropriate bounce diagram and use it to sketch both the source-end voltage v_s and the load-end voltage v_L as a function of time between 0 and 10 ns. Provide all the pertinent values on your sketches.



$$\Gamma_s = \frac{10 - 90}{10 + 90} = -0.8$$

$$\Gamma_L = \frac{630 - 90}{630 + 90} = 0.75$$

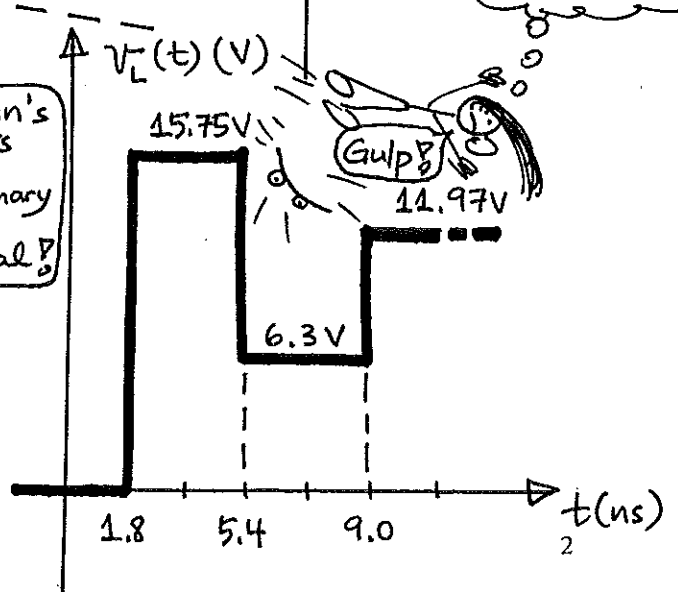
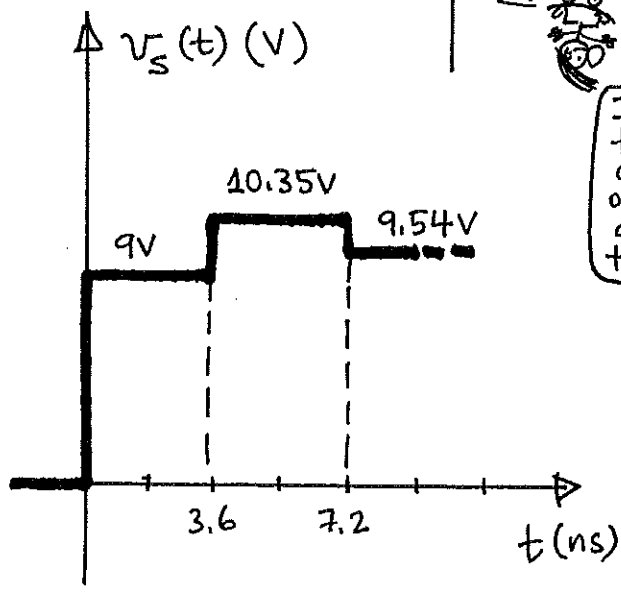
This is so much fun



What happened?

Inan's tests are ordinary and trivial

Gulp



(b) (12.5 points) Redo part (a) if the step source was a pulse source with 0.3 ns pulse width as shown.

Circuit Diagram:

- Source: $10[u(t) - u(t - 0.3\text{ns})]$ (V)
- Series Resistor: $R_S = 10\ \Omega$
- Transmission Line: Lossless, $Z_0 = 90\ \Omega$, $t_d = 1.8\ \text{ns}$
- Load Resistor: $R_L = 630\ \Omega$

Graph 1: $v_S(t)$ (V) vs t (ns)

Time (ns)	Voltage (V)
0.3	9
3.6	1.35
7.2	-0.81

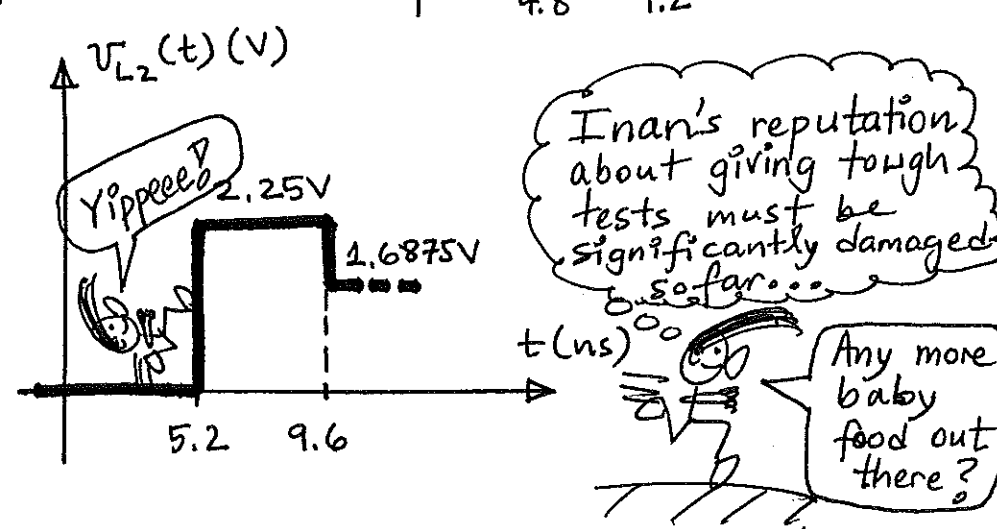
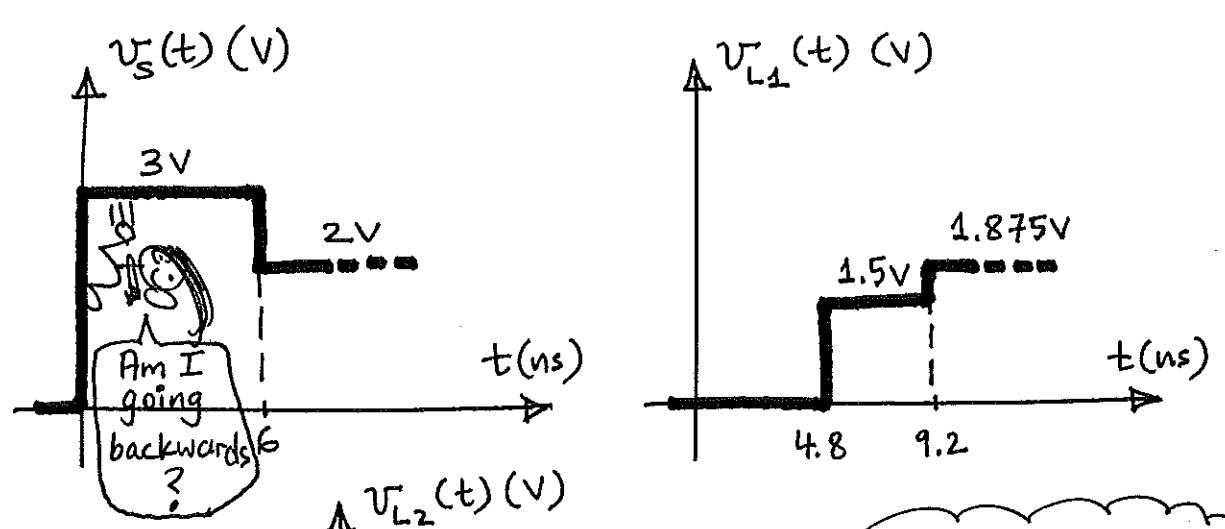
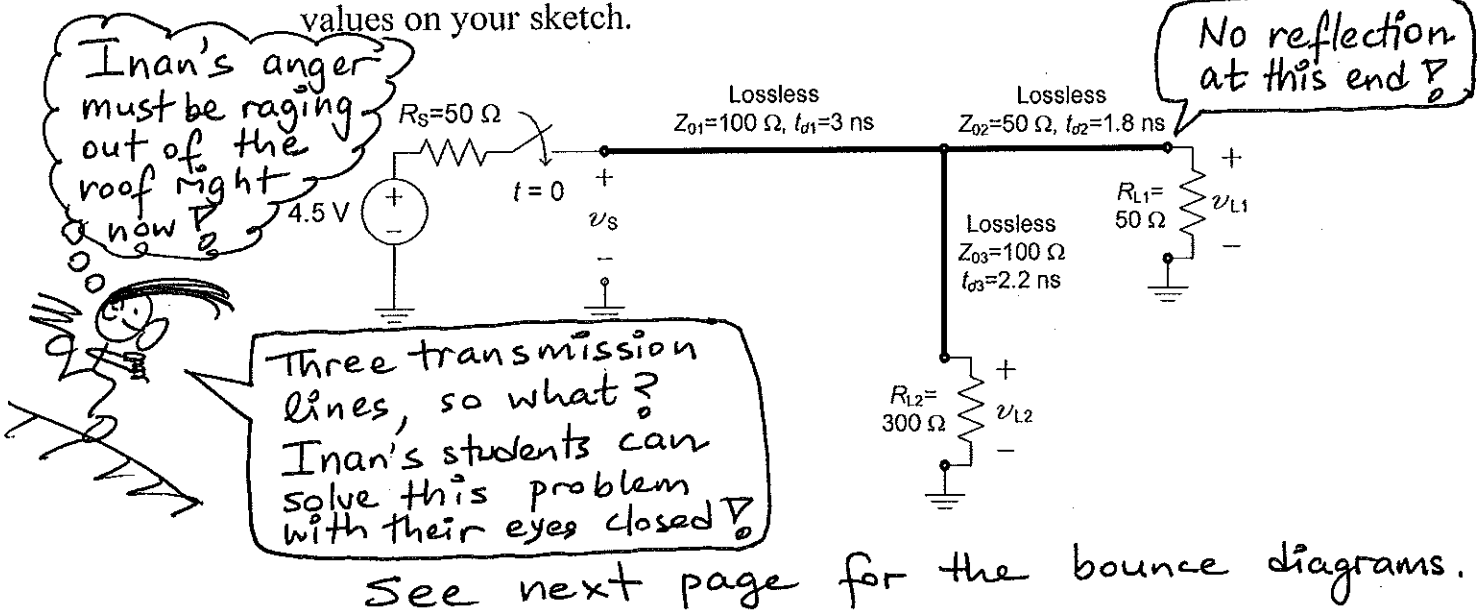
Graph 2: $v_L(t)$ (V) vs t (ns)

Time (ns)	Voltage (V)
1.8	15.75
5.4	-9.45
9.0	5.67

Handwritten Annotations and Speech Bubbles:

- "Inan must be watching and raging with anger" (top left)
- "Inan's students are unstoppable" (middle left)
- "This test is a piece of cake for them" (middle left)
- "Does Inan think we are in elementary school?" (bottom left)
- "All I need is zero energy to take an Inan test" (center)
- "My value equals $v_1^- + v_2^+$ " (center)
- "Having a complete bounce diagram makes these sketches cheezyy and easyyy" (right)
- "And I'm $v_3^+ + v_3^-$ " (right)
- "My value equals $v_2^+ + v_2^-$ " (bottom center)
- "Whoever states that Inan's tests are challenging is dead wrong" (bottom right)
- "The word 'challenging' should not be abused like this" (bottom center)

(2) (15 mins., 32.5 points) **Multiple transmission lines.** For the three transmission-line circuit shown, the switch closes at $t = 0$. Assuming all the lines to be uncharged before $t = 0$, sketch voltages v_S , v_{L1} and v_{L2} between $t = 0$ to 10 ns. Use bounce diagram. Provide all the pertinent values on your sketch.



(Note that the changes in these graphs after $t = 10$ ns are not included.)

(#2)

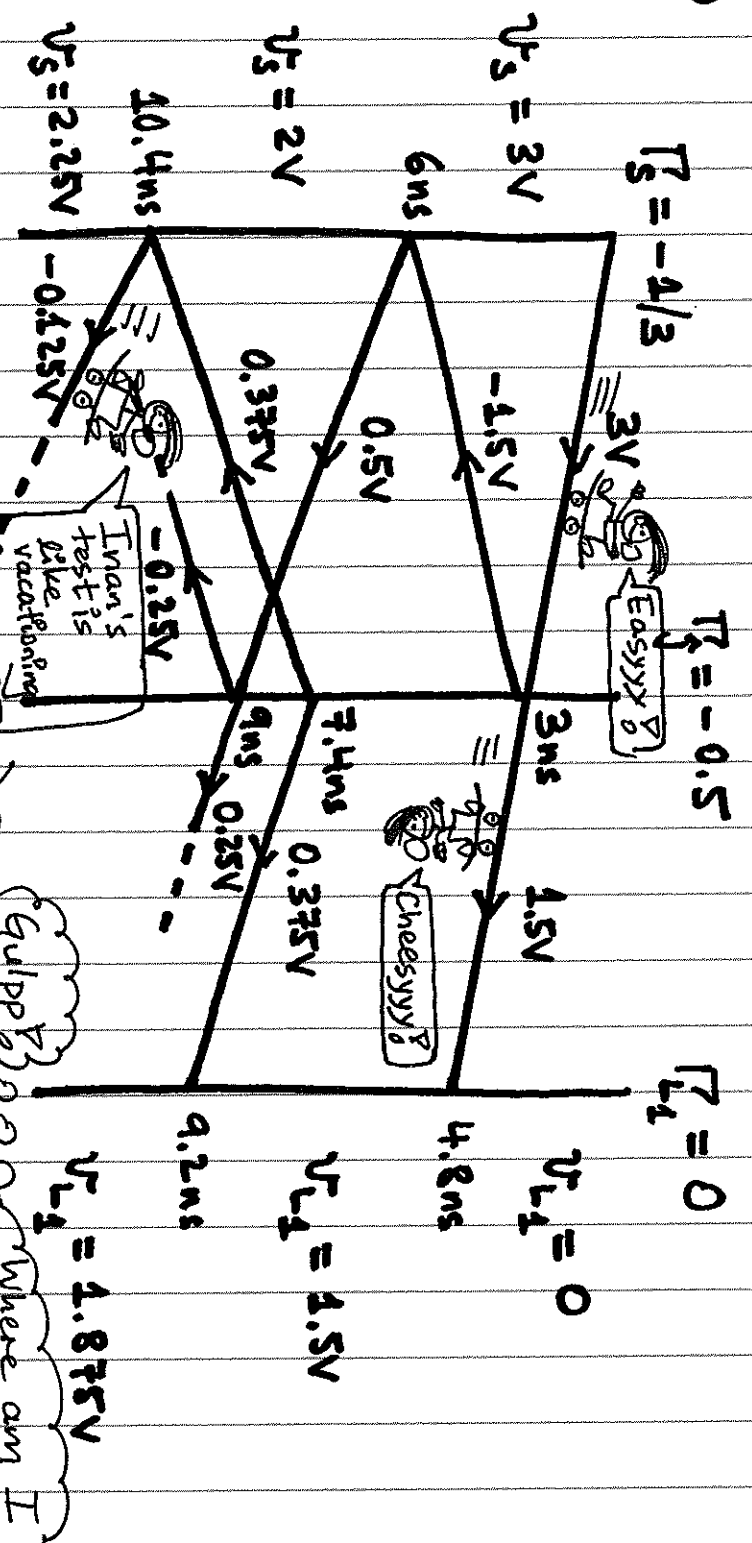
$$T_3 = \frac{50 - 100}{50 + 100} = -\frac{1}{3}$$

$$T_3 = \frac{(50 // 100) - 100}{(50 // 100) + 100} = -0.5$$

$$T_{L1} = 0$$

$$T_{L2} = \frac{300 - 100}{300 + 100} = 0.5$$

$$T_{L2 \rightarrow 1,3} = 0$$



$$T_1 = 0$$

$$T_2 = 0$$

$$T_{L1} = 0$$

$$T_{L2} = 0$$

$$T_{L1} = 4.875V$$

$$T_{L2} = 2.25V$$

$$T_{L2} = 1.6875V$$

Minor bumps and bruises but I'm off to all!

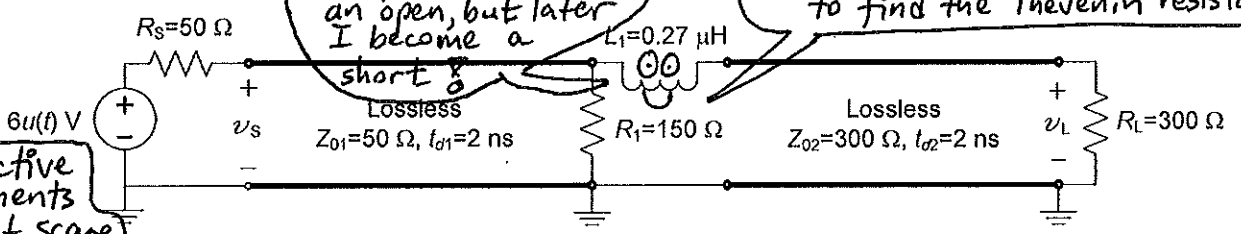
(3) (15 mins., 35 points) **Reactive element at the junction.** In the transmission-line circuit shown, find the complete mathematical expressions and sketch both the source-end voltage v_s and the load-end voltage v_L as a function of time. Sketch the two waveforms separately. Provide all the pertinent values on each sketch.



Reactive elements don't scare me!

At first I act like an open, but later I become a short!

Look between my terminals to find the Thevenin resistance!



They are easy to tackle for Inan students and don't pose any difficulty!

$$\Gamma_S = 0, \Gamma_L = 0, v_1^+ = \frac{50}{100} (6V) = 3V$$

$$\Gamma_{\uparrow} (t = t_{d1}) = \frac{150 - 50}{150 + 50} = 0.5$$

$$\Gamma_{\uparrow} (t \rightarrow \infty) = \frac{(150 // 300) - 50}{(150 // 300) + 50} = 1/3$$

$$v_1^- (t = t_{d1}) = \Gamma_{\uparrow} (t = t_{d1}) v_1^+ = 1.5V$$

I'm the initial value of the reflected voltage wave!

$$v_1^- (t \rightarrow \infty) = \Gamma_{\uparrow} (t \rightarrow \infty) v_1^+ = 1V$$

I'm the final value!

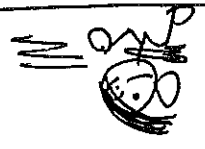
I determine how fast the inductor charges up!

$$\tau = L/R_T = \frac{0.27 \mu H}{(150 // 50) + 300} = 0.8 ns$$

I'm the thevenin resistance!

$$\therefore v_s(t) = 3u(t) + \left[1.5e^{-(t-4ns)/0.8ns} + (1 - e^{-(t-4ns)/0.8ns}) \right] u(t-4ns)$$

$$= 3u(t) + u(t-4ns) + 0.5e^{-(t-4ns)/0.8ns} \cdot u(t-4ns)$$



Inan himself brought his fame down by providing us all the tools and skills we need to tackle these type of problems!

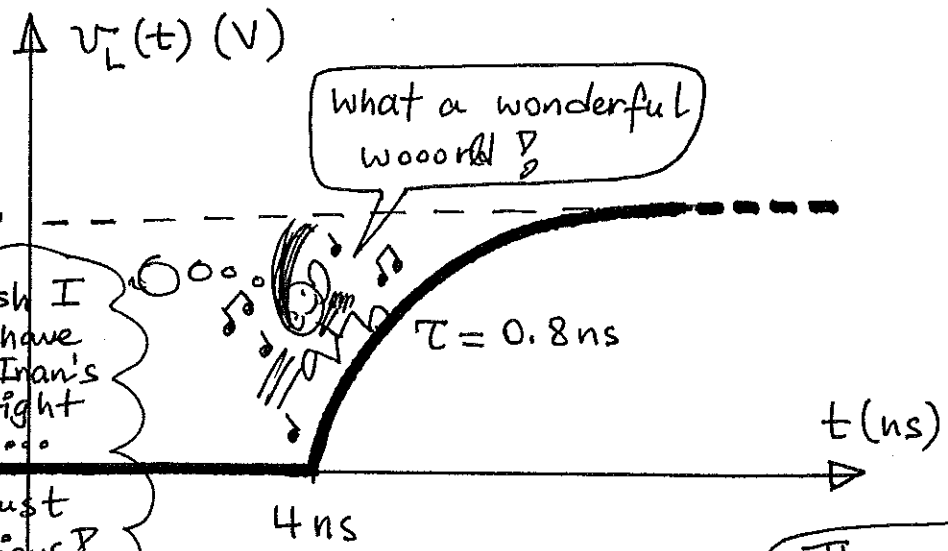
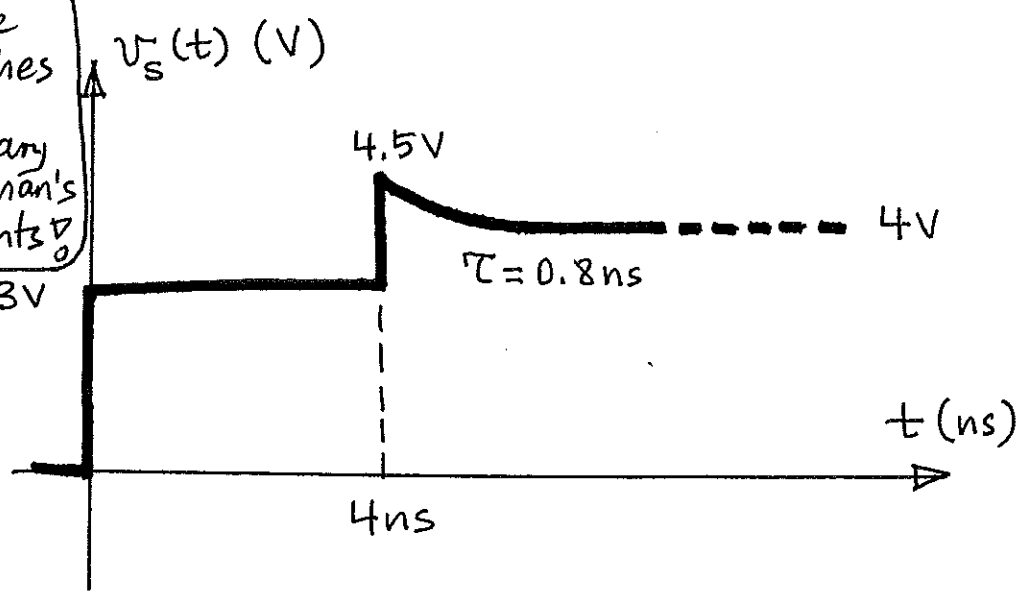
Why am I left out?

$$v_L(t) = 4 \left(1 - e^{-(t-4\text{ns})/0.8\text{ns}} \right) u(t-4\text{ns})$$



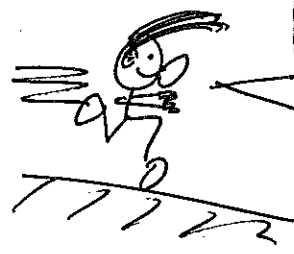
These sketches are ordinary for Inan's students ▽

Big deal ▽



What a wonderful world ▽

I wish I could have seen Inan's face right now...
He must be furious ▽



The mission is achieved and Inan's fame about giving tough and challenging exams is put down once and for all ▽