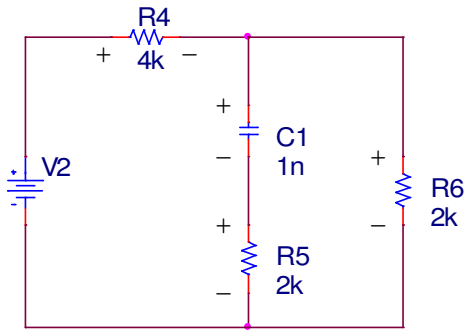
Voltage/Current Continuity

1)



In the above circuit, the voltage is defined as follows:

$$V1 = \begin{cases} 5V & t < 0 \\ 10V & 0 < t \end{cases}$$ (the voltage source changes from 5V to 10V at t = 0)

a. Write V1 in the format ___ + (or -) ____u(t) (for example 2-2u(t))

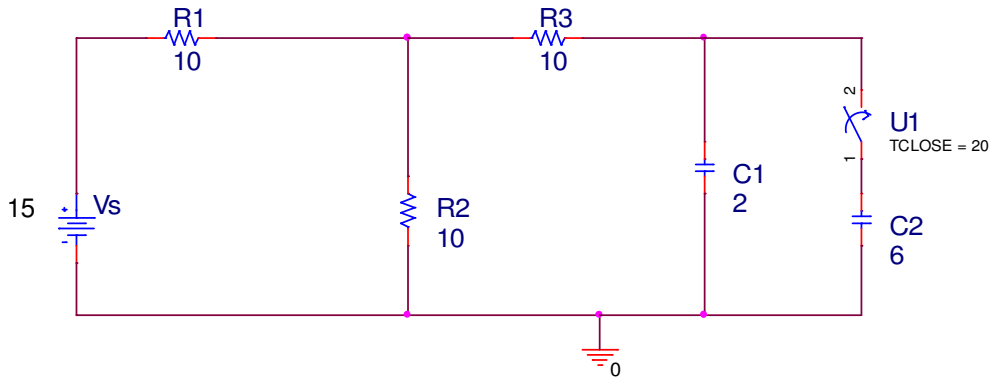
b. At t = 0- (just before the voltage changes), determine the voltage across each component and the current through each component (use the polarities indicated in the circuit). Draw the circuit.

Component	Voltage	Current
R4		
R5		
R6		
C1		

c. At t = 0+ (just after the voltage changes), determine the voltage across each component and the current through each component for the polarities indicated in the circuit. Draw the circuit.

Component	Voltage	Current
R4		
R5		
R6		
C1		

2) First order circuits (Differential Equations)

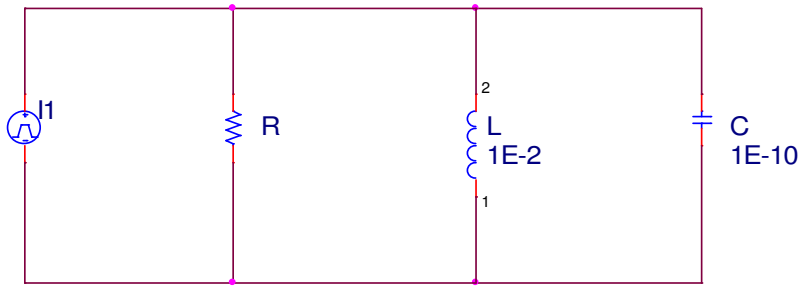


In the above circuit, the source turns on at t = 0 with a voltage of 15V, Vs=15u(t)V. Additionally, at t = 20s the switch in series with C2 is closed. You can (should) ignore C2 for part a) of this problem.

a) For 0<t<20s, determine the voltage across C1 as a function of time, Vc(t). If you do any circuit reduction/transformation, include a drawing of your circuit.

b) For t>20s, determine the votlage across C1 as a function of time. Use the resistor and capacitor values in your solution. If you do any circuit reduction/transformation, include a drawing of your circuit.

3) Secord order differential equations



In the above circuit, the source current is 20mA for t < 0 and 0 for t > 0 (the source turns off at t = 0).

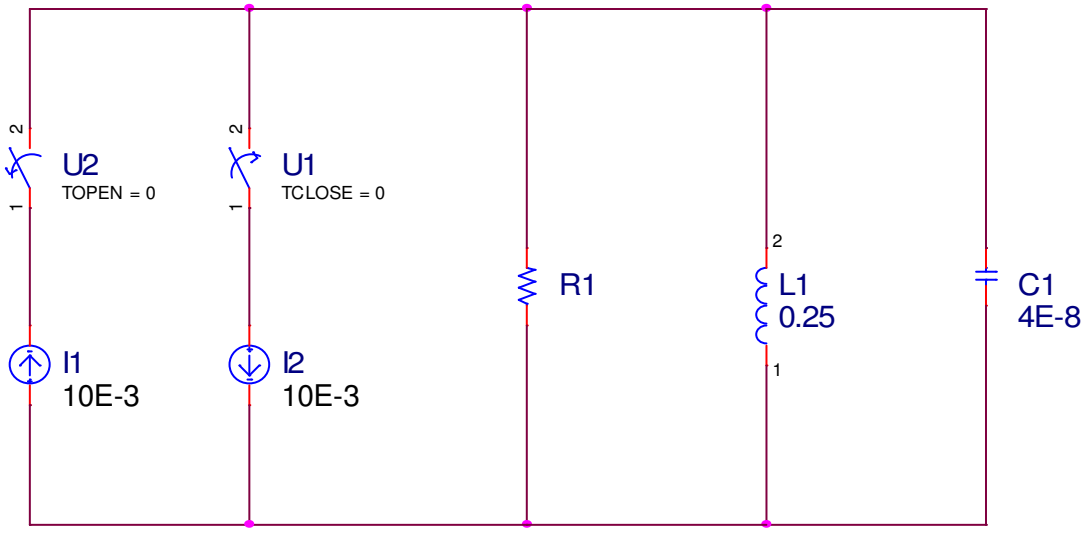
a) What is the initial (t=0+) current through the inductor? What is the (t=0+) voltage across the inductor?

b) What is the DC steady state current through the inductor as t ->∞?

c) Symbolically, what is the differential equation defining the current through the inductor?

d) For R1 = 100Ω, determine the current through the inductor as a function of time for t>0.

4) Second order, s- domain and Laplace



At t =0, U1 closes and U2 opens

a) Draw the s-domain equivalent circuit. Include all intial conditions and label your component values using symbolic notation (i.e. sL1)

b) Using impedances, determine the transfer function for the current through the capactor, C1. Use symbolic vlaues in your expression (R, L, C, I1, I2)

c) Find the current through the capacitor as a function of time for R1 = 12.5k. Is this circuit underdamped, overdamped or cricially damped.

d) Find the current through the capacitor as a functino of time for R1 = 0.25k. Is this circuit underdamped, overdamped or cricially damped.