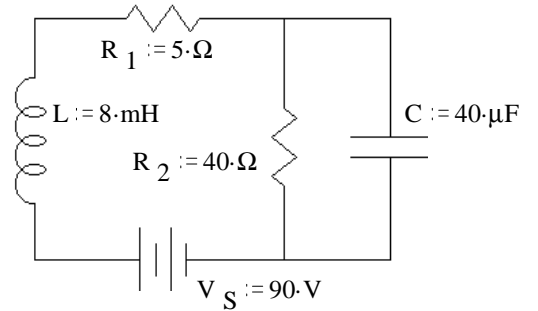# ECE 2210/00 Exam 2 given: Fall 14   (The space between problems has been removed.)

1. (9 pts) The following circuit has been connected as shown for a long time.
   Find the energy stored in the capacitor and the inductor (2 answers).
   Also show the values of the voltage(s) and current(s) necessary to
   answer this question.

$R_1 := 5 \cdot \Omega$

$L := 8 \cdot mH$

$R_2 := 40 \cdot \Omega$

$C := 40 \cdot \mu F$

$V_S := 90 \cdot V$

2. (32 pts) The switch has been open for a long
   time and is closed (as shown) at time $t = 0$.
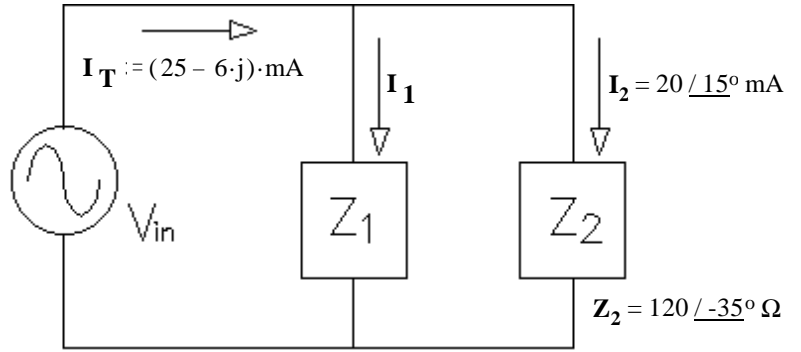
   a) Find the complete expression for $i_L(t)$.

$V_S := 45 \cdot V$

$R_1 := 80 \cdot \Omega$

$R_2 := 30 \cdot \Omega$

$R_3 := 60 \cdot \Omega$

$i_L(t)$

$L := 2.7 \cdot mH$

$t = 0$
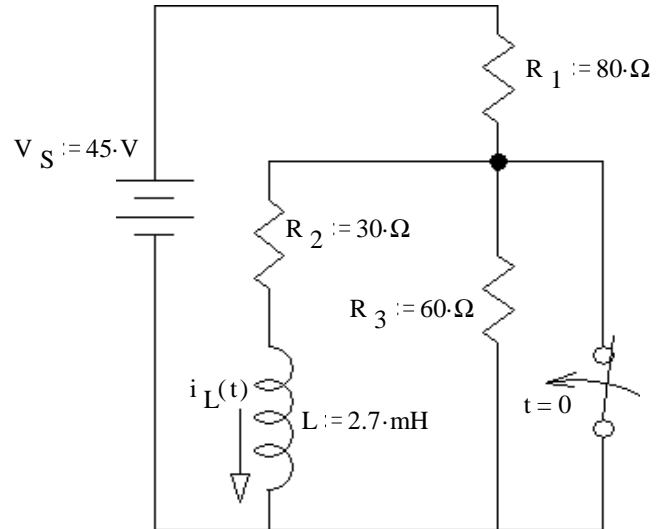
   b) Find i_L at time $t = 1.2\tau$. $i_L(1.2 \cdot \tau) = ?$

   c) At time $t = 1.2\tau$ the switch is opened again. Find the complete expression for $i_L(t')$, where t' starts at $t = 1.2\tau$.
      Be sure to clearly show the time constant.

3. (18 pts) Find $\mathbf{Z}_{eq}$ in simple polar form (give me numbers).
   For partial credit, you must show work and/or intermediate results.

   $f := 5 \cdot kHz$

$L := 10 \cdot mH$

$C := 0.02 \cdot \mu F$

$R_1 := 2.2 \cdot k\Omega$

$R_2 := 1 \cdot k\Omega$
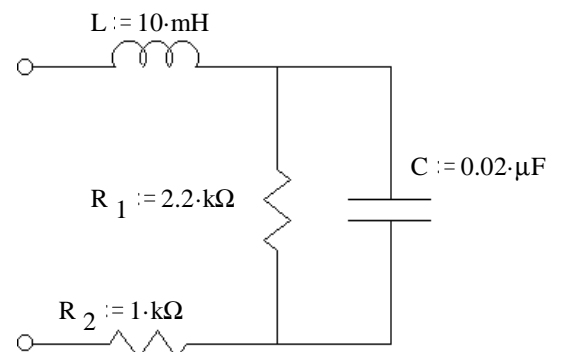
4. (23 pts)   a) Find $\mathbf{Z_1}$. For partial credit you
   must show work and/or intermediate results.

$\mathbf{I_T} := (25 - 6 \cdot j) \cdot mA$

$\mathbf{I_1}$

$\mathbf{I_2} = 20 \underline{/\,15^o}$ mA

Z_1

Z_2

V_{in}

$\mathbf{Z_2} = 120 \underline{/\,-35^o}\ \Omega$

b) To make $\mathbf{Z_1}$ in the simplest way, what part(s) would you need? Just circle the needed part(s), don't find the values.
   resistor   capacitor   inductor   power supply   current source
      Thevenin resistor   Ideal transformer   voltmeter   ammeter   scope

c) Circle 1:   i) $\mathbf{I_2}$ leads the source voltage ($\mathbf{V_{in}}$)   ii) $\mathbf{I_2}$ lags the source voltage ($\mathbf{V_{in}}$)

5. (18 pts) The voltage across a 4 µF capacitor is shown below. Make an accurate drawing of the capacitor
current. Make reasonable assumptions where necessary. Label your graph.

Note: You will be graded on the accuracy of your plot at 0, 3, 6, 9 and 10ms, so calculate those values and
plot or label them carefully. Between those points your plot must simply be the correct shape.

You **MUST SHOW** how you calculate your values starting from the original relationships between voltage and current.

That is: **Start** with the **interger** and/or **differential** equations for the capacitor!

$C := 4 \cdot \mu F$

$v_C(t)$
(volts)

A parabola that
ends at 9ms

time (ms)

time (ms)
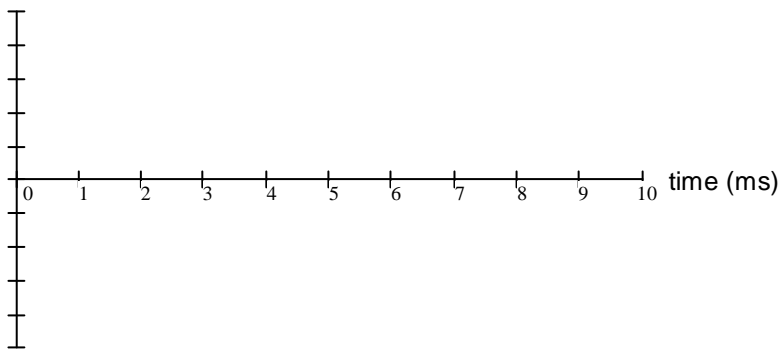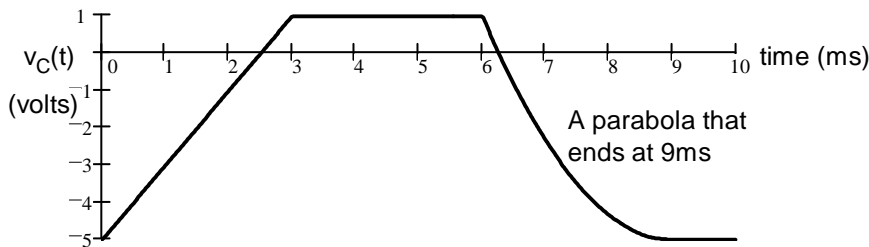
Answers

1. $128 \cdot mJ$ $16 \cdot mJ$ 2. a) $300 \cdot mA \cdot e^{\frac{-t}{90 \cdot \mu s}}$ b) $90.4 \cdot mA$

   c) $300 \cdot mA - 209.6 \cdot mA \cdot e^{\frac{-t'}{42 \cdot \mu s}}$

3. $1902\ \Omega \underline{/-22.6^o}$

4. a) $191.4 \underline{/\,43.05^o}\ \Omega$ b) resistor   inductor   c) i)   5.

i(t)
(mA)

time (ms)