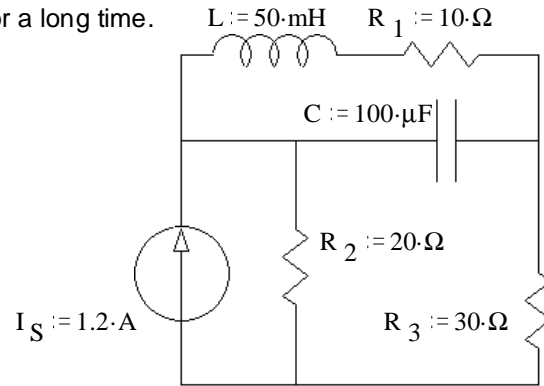# ECE 2210/00 Exam 2 given: Spring 10   (The space between problems has been removed.)

1. (15 pts) The following circuit has been connected as shown for a long time. $L := 50 \cdot mH$ $R_1 := 10 \cdot \Omega$

   Find the energy stored in the capacitor and in the inductor.
   Also show the values of the voltage(s) and current(s)
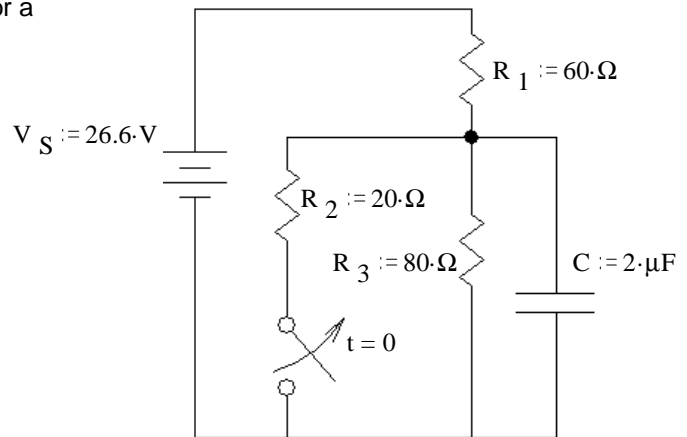   necessary to answer this question.

   $C := 100 \cdot \mu F$

   $R_2 := 20 \cdot \Omega$

   $I_S := 1.2 \cdot A$ $R_3 := 30 \cdot \Omega$

2. (24 pts) The switch has been closed (making contact) for a
   long time and is opened (as shown) at time $t = 0$.
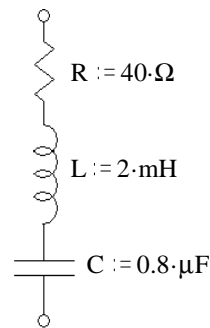
   a) Find the complete expression for $v_C(t)$.

   b) Find v_C at time $t = 2\tau$. $v_C(2 \cdot \tau) = ?$

   c) At time $t = 2\tau$ the switch is closed again.
      Will the time constant be different now?
      If yes, find the new time constant.

   $V_S := 26.6 \cdot V$

   $R_1 := 60 \cdot \Omega$

   $R_2 := 20 \cdot \Omega$

   $R_3 := 80 \cdot \Omega$ $C := 2 \cdot \mu F$

   $t = 0$

3. (13 pts) Find $\mathbf{Z_{eq}}$ in simple polar form (give me numbers & units).

   $f := 3 \cdot kHz$

   $R := 40 \cdot \Omega$

   $L := 2 \cdot mH$

   $C := 0.8 \cdot \mu F$

4. (13 pts) Reduce the following to a single complex
   number in either rectangular or polar form.

   $$39 \cdot e^{j \cdot 67.38 \cdot deg} + \cfrac{1}{\left(\cfrac{1}{50}\right) + \cfrac{1}{\left(-j \cdot \cfrac{1}{0.048}\right)}}$$

5. (17 pts) The magnitude of the source voltage and the magnitude of the current are shown.

   a) If the box contained a resistor, what would be its value?
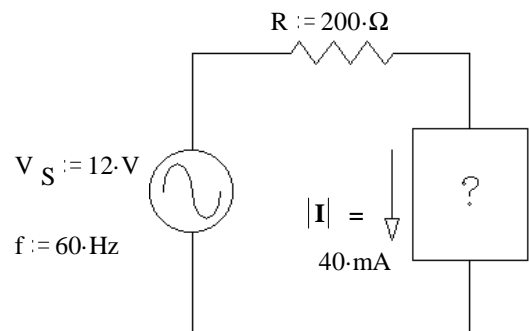
   b) If the box contained an inductor, what would be its value? $L = ?$

   c) If the box contained a capacitor, what would be its value? $C = ?$

   d) If the current is leading the voltage, which component is it?

            R   L   C   (circle one)

   e) By how many degrees does the current lead?

   $R := 200 \cdot \Omega$

   $V_S := 12 \cdot V$

   $f := 60 \cdot Hz$

   $|I| = 40 \cdot mA$

   ?

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6. 16 pts) The voltage across an inductor is shown below. Make an accurate drawing of the inductor current.
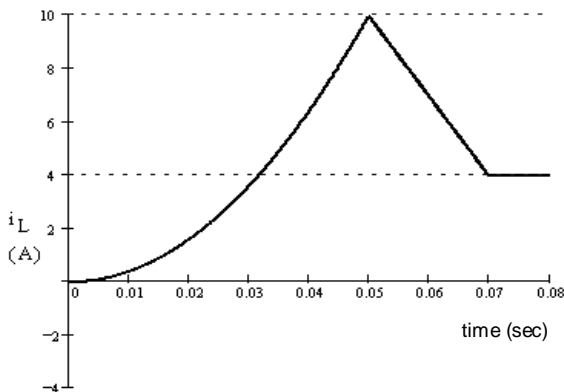Make reasonable assumptions where necessary. Label your graph.

Note: You will be graded on the accuracy of your plot at $0, .05, .07,$ and $.08$ sec, 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. $L := 50 \cdot mH$
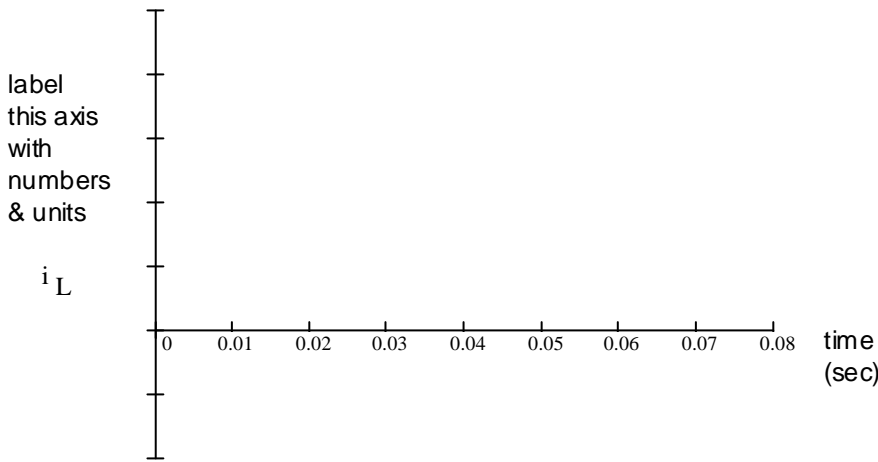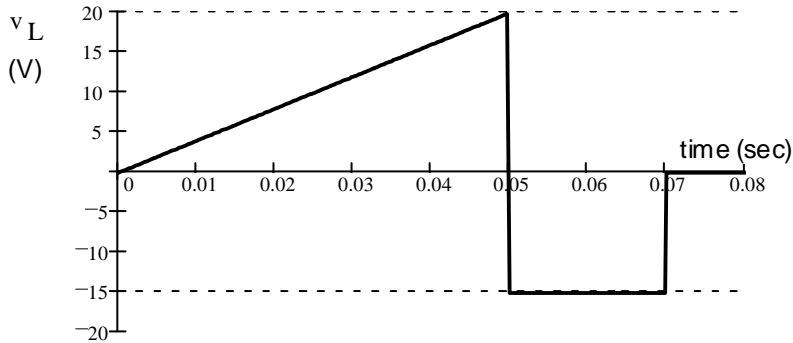
Answers

1. $.4 \cdot A$ $4 \cdot mJ$

   $4 \cdot V$ $0.8 \cdot mJ$ 2. a) $15.2 \cdot V - 9.6 \cdot V \cdot e^{-\frac{t}{68.6 \cdot \mu s}}$

   b) $13.9 \cdot V$ c) $25.26 \cdot \mu s$

3. $49.2 \ \Omega \ \underline{/ \text{-}35.6^o}$ 4. $28.9 \ \underline{/ \ 39.2^o}$

5. a) $100 \cdot \Omega$ b) $593 \cdot mH$ c) $11.9 \cdot \mu F$ d) C e) 48.2^o

6.   0 - 50ms: curves from 0 (flat) to 10A (+slope)   50ms - 70ms: ramps down from 10 to 4A   Beyond 70ms: flat at +4A