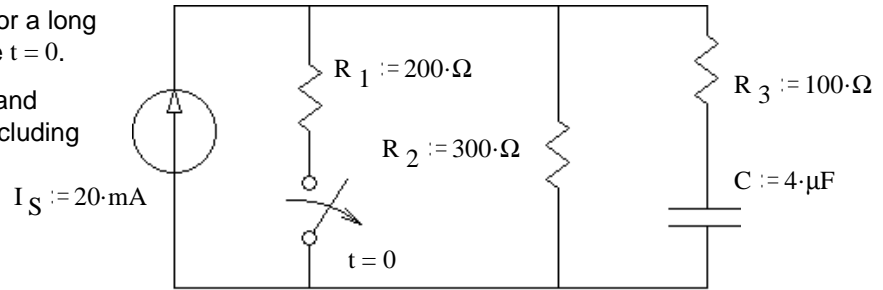# ECE 2210/00 Exam 2 given: Fall 15

(The space between problems has been removed.)

1. (32 pts) The switch has been closed for a long time and is opened (as shown) at time $t = 0$.

   a) Find the initial and final conditions and write the full expression for $v_C(t)$, including all the constants that you find.

$I_S := 20 \cdot mA$

$R_1 := 200 \cdot \Omega$

$R_2 := 300 \cdot \Omega$

$R_3 := 100 \cdot \Omega$

$C := 4 \cdot \mu F$

$t = 0$

   b) What is v_C when $t = 2\tau$? $v_C(2 \cdot \tau) = ?$

   c) At time $t = 2\tau$ the switch is closed again. Find the complete expression for $v_C(t')$, where t' starts when the switch closes. Be sure to clearly show the time constant.
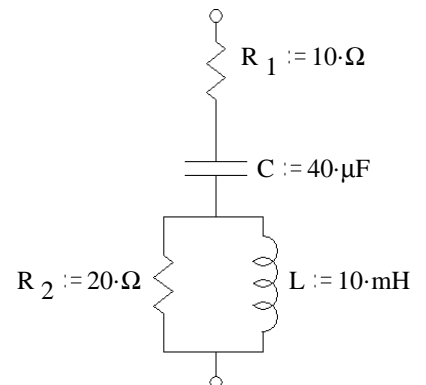
2. (9 pts) $\mathbf{Z} := |\mathbf{Z}| \cdot e^{j \cdot 50 \cdot deg}$ We don't know its magnitude, but its "phase" angle is $+50°$. $\omega := 2000 \cdot \dfrac{rad}{sec}$

   $\mathbf{Z}$ is made of a 100Ω resistor in series with one other part. What is the part? Give type and value.

$\mathbf{Z} =$

$R := 100 \cdot \Omega$

$= ?$
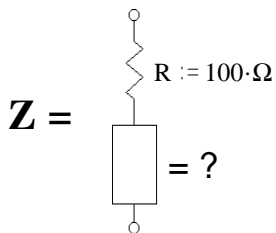
3. (18 pts) Find $\mathbf{Z_{eq}}$ in simple polar form (give me numbers). $f := 159.155 \cdot Hz$

   For partial credit, you must show work and/or intermediate results.

$R_1 := 10 \cdot \Omega$

$C := 40 \cdot \mu F$

$R_2 := 20 \cdot \Omega$

$L := 10 \cdot mH$

$I_T := 50 \cdot mA \underline{/0^o}$

4. (23 pts)

a) Find I_1

Z_1 $Z_1 := (78 - 50 \cdot j) \cdot \Omega$

$R := 300 \cdot \Omega$

b) Find V_{in} in polar form.

$I_2 = 17.321 + 10j \quad \cdot mA$
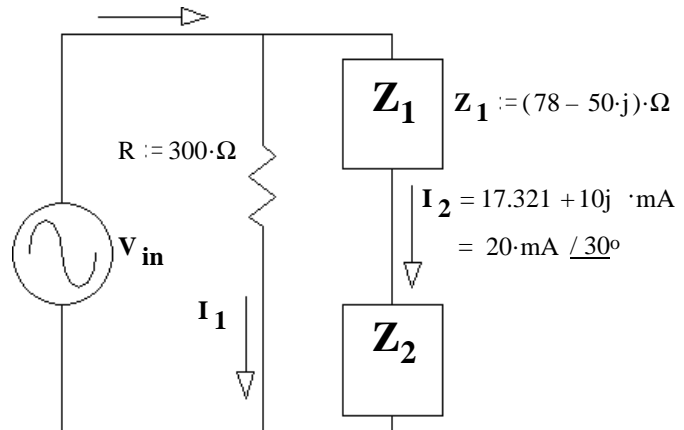
V_{in} $= 20 \cdot mA \underline{/30^o}$

I_1

Z_2

c) Find Z_2

d) Circle 1:   i) The source current leads the source voltage
            ii) The source voltage leads the source current
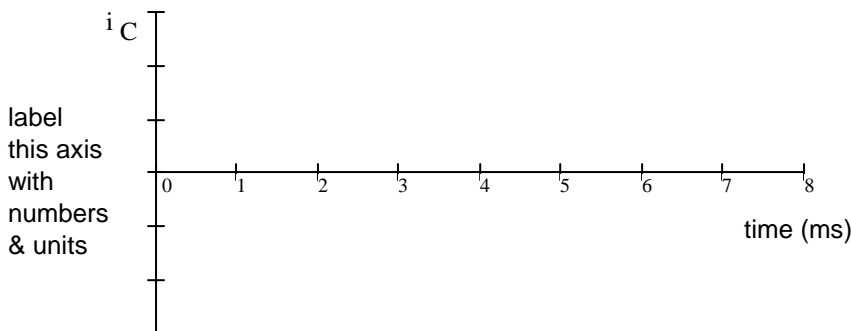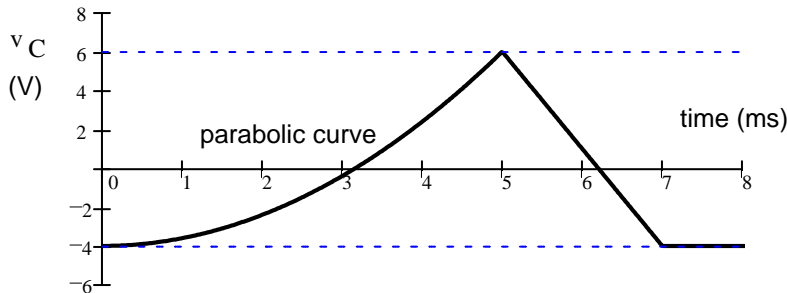e) By how much? I.E. what is the phase angle between the voltage and current?

5. (18 pts) The voltage across a 6 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 $0, 5, 7$ and 8 ms, 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! $C := 6 \cdot \mu F$

v_C (V)

parabolic curve

time (ms)

i_C

label this axis with numbers & units

time (ms)

Answers

5.

24mA

1. a) $6 \cdot V - 3.6 \cdot V \cdot e^{\frac{-t}{1.6 \cdot ms}}$

b) $5.51 \cdot V$ c) $2.4 \cdot V + 3.11 \cdot V \cdot e^{-\frac{t'}{880 \cdot \mu s}}$

2. $59.6 \cdot mH$

i_C (mA)

time (ms)

3. $22.0 \, \Omega \underline{/-50.5^o}$

4. a) $32.7 - 10 \cdot j \quad mA$ b) $10.25V \underline{/-17.01^o}$

c) $423.5 \, \Omega \underline{/-50.1^o}$ d) i)   e) $17.01 \cdot deg$