Folder no. _____ Name: _____

ECE 2210 / 00
Spring 2020 Exam 2

Useful Information

$C = \frac{Q}{V}$ $\quad v_C = \frac{1}{C}\cdot\int_{-\infty}^{t} i_C\,dt = \frac{1}{C}\cdot\int_{0}^{t} i_C\,dt + v_C(0)$ (initial voltage) $\quad \Delta V_C = \frac{1}{C}\cdot\int_{t_1}^{t_2} i_C\,dt$

$\text{farad} = \frac{\text{coul}}{\text{volt}} = \frac{\text{amp}\cdot\text{sec}}{\text{volt}}$ $\quad i_C = C\cdot\frac{d}{dt}v_C$

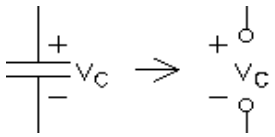
parallel: $C_{eq} = C_1 + C_2 + C_3 + \ldots$ $\quad$ **series:** $C_{eq} = \frac{1}{\frac{1}{C_1}+\frac{1}{C_2}+\frac{1}{C_3}+\ldots}$

$W_C = \frac{1}{2}\cdot C\cdot V_C^2$ Capacitor voltage **cannot** change instantaneously

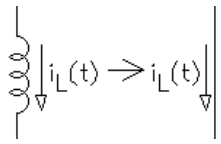
$\text{henry} = \frac{\text{volt}\cdot\text{sec}}{\text{amp}}$ $\quad i_L = \frac{1}{L}\cdot\int_{-\infty}^{t} v_L\,dt = \frac{1}{L}\cdot\int_{0}^{t} v_L\,dt + i_L(0)$ (initial current) $\quad \Delta I_L = \frac{1}{L}\cdot\int_{t_1}^{t_2} v_L\,dt$

$W_L = \frac{1}{2}\cdot L\cdot I_L^2$ $\quad v_L = L\cdot\frac{d}{dt}i_L$ Inductor current **cannot** change instantaneously

Final Conditions:



Replace capacitors with opens



Replace inductors with wires

For all first order transients: $x(t) = x(\infty) + (x(0) - x(\infty))\cdot e^{-\frac{t}{\tau}}$ $\quad \tau = R_{Th}\cdot C$ OR $\frac{L}{R_{Th}}$

Resonance: $\omega_o = \frac{1}{\sqrt{L_{eq}\cdot C_{eq}}}$

Steady-state sinusoidal AC Impedances: $Z_C = \frac{1}{j\cdot\omega\cdot C} = \frac{-j}{\omega\cdot C}$ $\quad Z_L = j\cdot\omega\cdot L$ $\quad \omega = 2\cdot\pi\cdot f$

$A = |\mathbf{A}| = \sqrt{a^2+b^2}$ $\quad \theta = \arg(\mathbf{A}) = \operatorname{atan}\left(\frac{b}{a}\right)$ $\quad a = A\cdot\cos(\theta)$ $\quad b = A\cdot\sin(\theta)$

March 4, 2020

Closed Book, Closed notes, Calculators OK

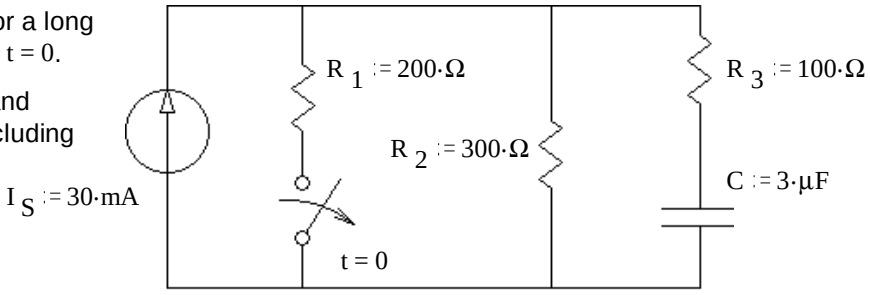
Show all work to receive credit

Circle answers, show units, and round off reasonably

ECE 2210/00 Exam 2 given: Spring 20 (Some space 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.

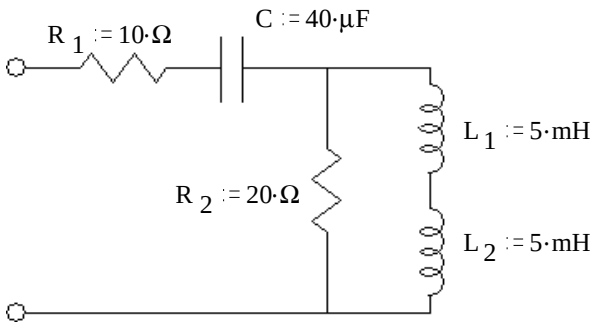


   b) What is v_C when $t = 2\tau$?

   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.

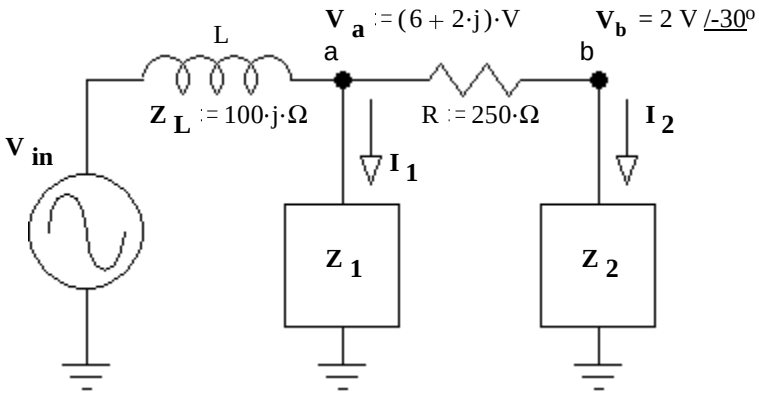
3. (22 pts) Find $\mathbf{Z_{eq}}$ in simple polar form (give me numbers).

   For partial credit, you must show work and/or intermediate results. $f := 159.155 \cdot Hz$



3. (28 pts) $\mathbf{V_a}$ is the nodal voltage at node a and $\mathbf{V_b}$ is the nodal voltage at node b.

   a) Find $\mathbf{Z_2}$ in polar form

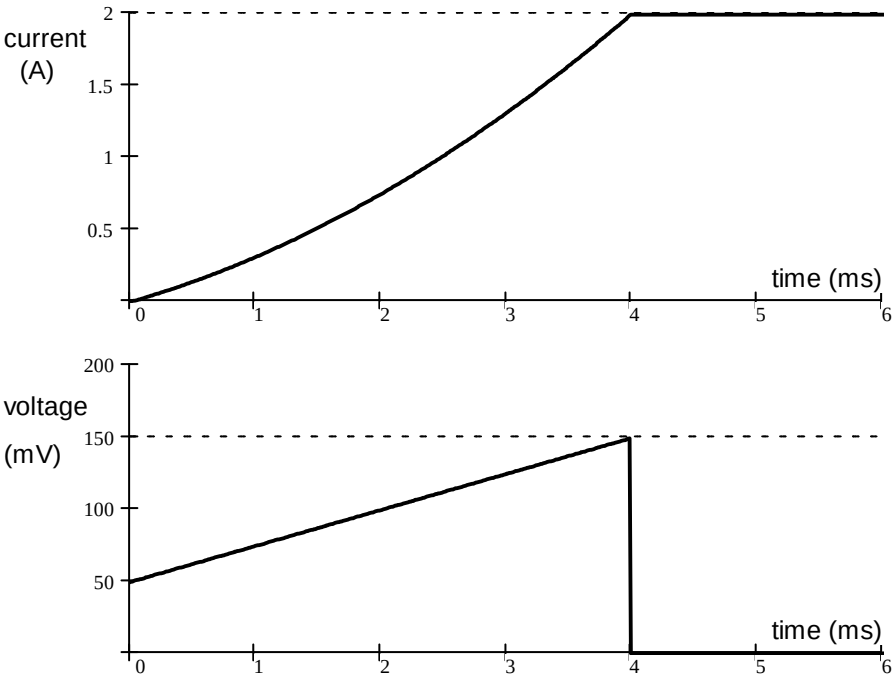


   b) $\mathbf{I_1} := (20 - 25 \cdot j) \cdot mA$ Find $\mathbf{V_{in}}$.

ECE 2210/00 Exam 2 Spring 20 p3

4. (18 pts) The current through some part and the voltage across the same part are shown below.

a) Tell me what kind of part it is.



b) Find the part's value.

Answers

1. a) $9 \cdot V - 5.4 \cdot V \cdot e^{\frac{-t}{1.2 \cdot ms}}$ b) $8.27 \cdot V$ c) $3.6 \cdot V + 4.67 \cdot V \cdot e^{-\frac{t'}{660 \cdot \mu s}}$ 2. $22.0\ \Omega\ \angle -50.5^{o}$

3. a) $95.8\ \Omega\ \angle -65.1^{o}$ b) $7.3 + 5.71j\ V = 9.27\ V \angle 38.0^{o}$ 4. a) inductor b) $0.2 \cdot mH$