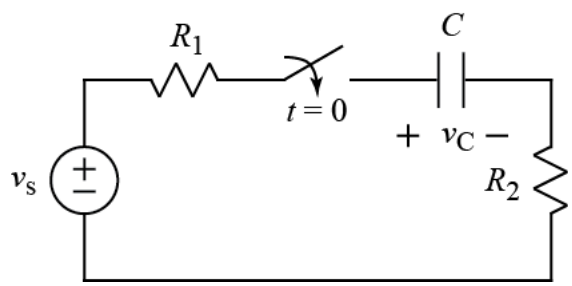
Homework 9

1.



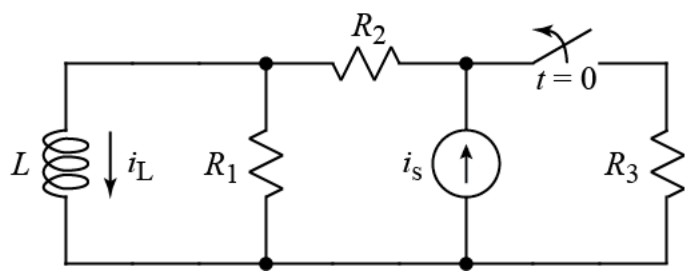
$R_1 = 1.5\ \text{M}\Omega$ $R_2 = 1\ \text{M}\Omega$ $C = 3.3\ \text{nF}$ $v_s = 2.3\ \text{V}$

After being open for a long time, the switch closes at $t = 0$. The initial voltage on the capacitor is $v_C(t = 0^+) = 1.5$ V. Hint: think Thevenin equivalent for the circuit the capacitor is connected to.

a) Find an expression for $v_C(t)$ for $t \geq 0$.

b) Find the energy stored in the capacitor as t approaches infinity.

2.



$R_1 = 12\ \text{k}\Omega$ $R_2 = 24\ \text{k}\Omega$ $R_3 = 36\ \text{k}\Omega$ $L = 5\ \text{nH}$ $i_s = 6\ \text{mA}$

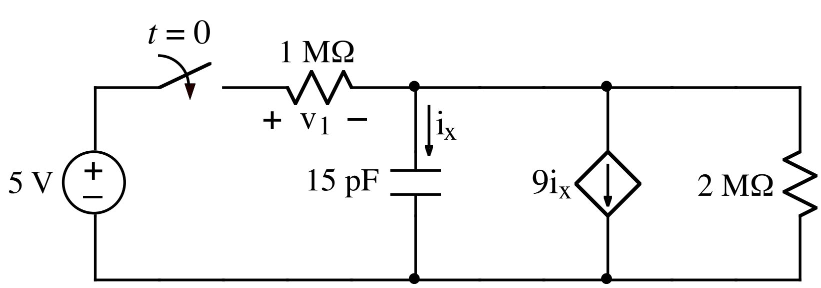
After being closed for a long time, the switch opens at $t = 0$.

a) Find $i_L(t = 0^+)$.

b) Find $i_L(t)$ for $t > 0$.

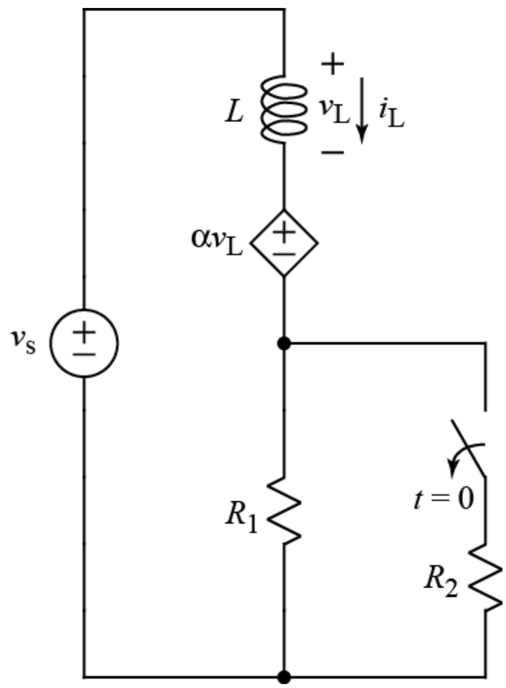
c) Find the time t when $i_L(t) = 4.5$ mA.

3.



After being open for a long time, the switch closes at $t = 0$. Find $v_1(t)$ for $t > 0$.

4.



After being closed for a long time, the switch opens at $t = 0$.

a) Find an expression for $i_L(0^-)$.

b) Find an expression for $i_L(t)$ for $t > 0$.

5. For the circuit in problem 4, determine whether the dependent source acts like an *R,* an *L,* or both. Explain your answer by finding the equivalent value of the *R*, *L*, or both that give(s) the same solution as the original problem.

Answers:

1.a. $v_C(t) = 2.3 + -0.8e^{-t/8.25\,\text{ms}}$ V   b. $w_C \approx 8.73$ nJ

2. a. $i_L(t = 0^+) = 3.6\,\text{mA}$ b. $i_L(t > 0) = 6 - 2.4e^{-t/0.417\,\text{ps}}$ mA   c. $t = 0.196$ ps

3. $v_1(t) = \frac{5}{3} + \frac{10}{3}e^{-t/100\,\mu\text{s}}$ V

4.a. $i_L(0^-) = \frac{v_s}{R_1 \parallel R_2}$ b. $i_L(t > 0) = \frac{v_s}{R_1} + \left(\frac{v_s}{R_1 \parallel R_2} - \frac{v_s}{R_1}\right)e^{-t/[(1+\alpha)L/R_1]}$

5. Hint: think about *v* versus *i*.