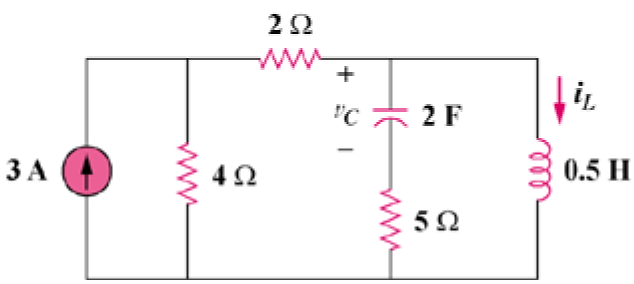
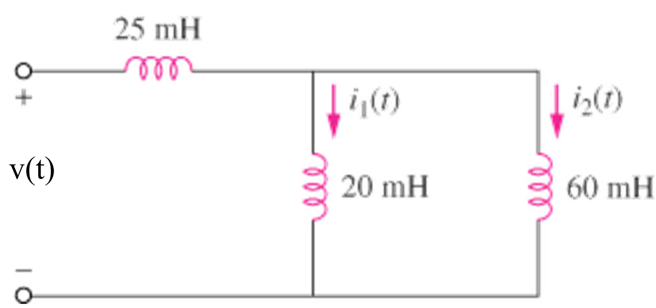
EE1002 Principles of Electrical Engineering   Assignment 3

(Questions from the Textbook by Alexander & Sadiku, 7th edition Problems 6.46, 6.62, 6.64, 9.65, 9.89, 9.90, 10.41, 10.47, 11.24, and 11.36)

1. Find $\boldsymbol{v_C}$, $\boldsymbol{i_L}$, and the energy stored in the capacitor and inductor in the following circuit under dc conditions.



2. Consider the circuit in the following figure. Given that $v(t) = 12e^{-3t}$ mV for $t > 0$ and $i_1(0) = -10$ mA, find:
   (a) $i_2(0)$ [Hint: Use the current divider rule to solve the problem, without the need of doing any differentiation or integration.]
   (b) $i_1(t)$ and $i_2(t)$. [Hint: use the following formula
   $$i = \frac{1}{L_{eq}}\int v(t)dt + i(0)$$
   where $i(0)$ is the initial current. The lower and upper limits of the integration are 0 and t, respectively.]



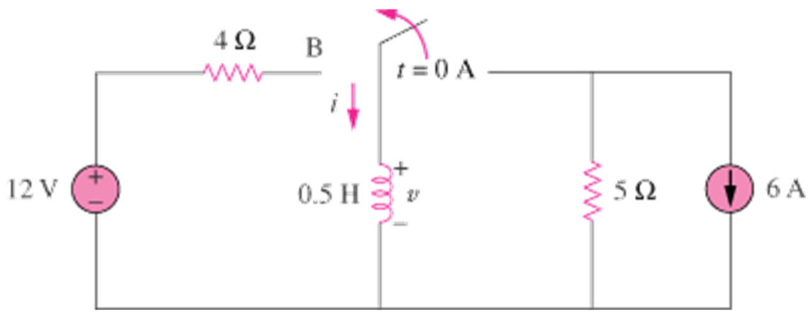
3. The switch in the following figure has been in position A for a long time. At $t = 0$, the switch moves from position A to B. The switch is a make-before-break type so that there is no interruption in the inductor current. Find:

   (a) $i(t)$ for $t > 0$,
   [Hint: Use the Integrating factor method on p. 12 of the lecture notes to solve $Ri(t) + L\frac{di(t)}{dt} = Vs$. However, now you need to include the initial current $i(0^-)$ because it is no longer zero in this question (the initial current is zero for the case in the lecture

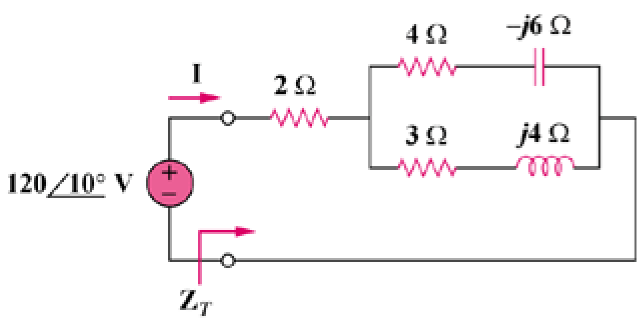
notes). In this question, $i(0^{-}) = -6$ A, which is the initial current right before $t = 0$, i.e., the time right before the switch moves from position A to position B.:

$$i(t) = \frac{1}{\mu}\int_{0-}^{t} \mu Q dt = \frac{1}{\mu}[\int_{0-}^{t} \mu Q dt + i(0^{-})]$$

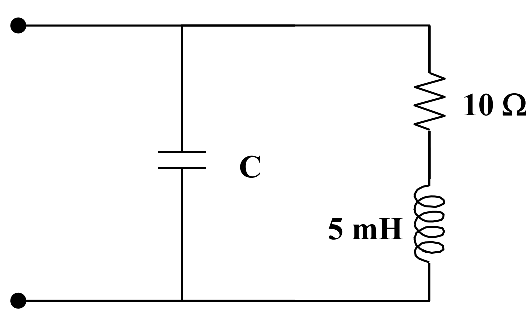
(b) *v just after* the switch has been moved to position *B*
[Hint: Evaluate $v = L\frac{di(t)}{dt}$ at t =0.]
(c) $v(t)$ long after the switch is in position *B*.



4. Determine **I** and $\mathbf{Z_T}$ for the following circuit.



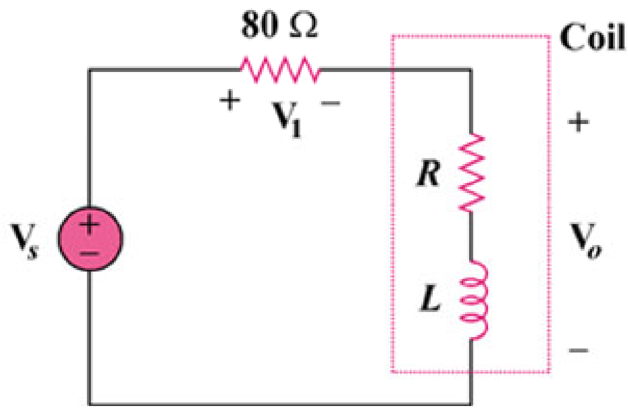
5. An industrial load is modeled as a series combination of an inductor and a resistance as shown in Fig. 9.89. Calculate the value of a capacitor C across the series combination so that the net impedance is resistive at a frequency of 2 kHz.



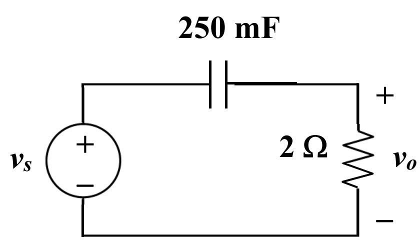
6. An industrial coil is modeled as a series combination of an inductance L and resistance R, as shown in the following figure. Since an ac voltmeter measures only the magnitude of a sinusoid, the following measurements are taken at 60 Hz when the circuit operates in the steady state:

$$|V_s| = 145\text{V}, \qquad |V_1| = 50\text{V}, \qquad |V_o| = 110\text{V}$$

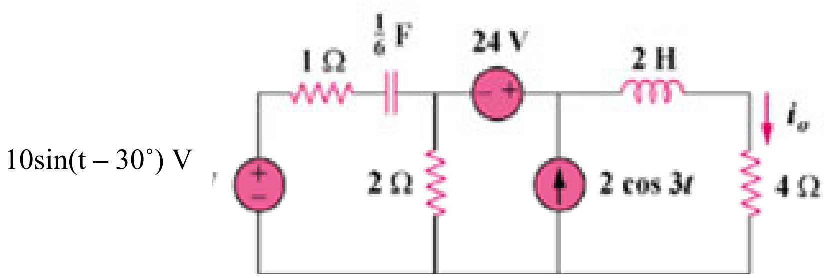
Use these measurements to determine the values of L and R.



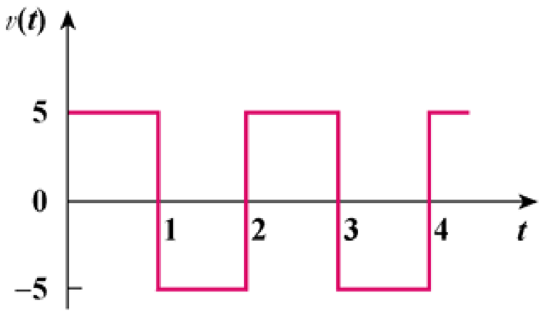
7. Find v_o for the circuit in the following figure assuming that $v_s = [6\cos(2t) + 4\sin(4t)]$ V.



8. Determine i_o in the circuit of the following figure using the superposition principle.



9. Determine the rms value of the waveform in the following.



10. Calculate the rms value for each of the following functions:

(a) $i(t) = 10$ A

(b) $v(t) = 4 + 3 \cos 5t$ V

(c) $i(t) = 8 - 6 \sin 2t$ A

(d) $v(t) = 5 \sin t + 4 \cos t$ V