Desk Copy

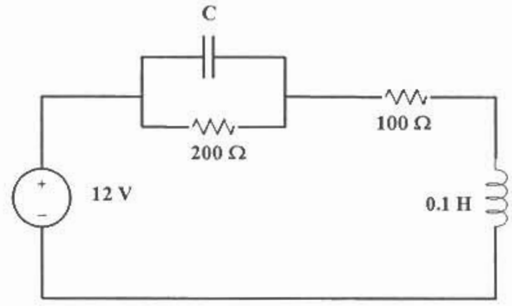
ECE 301
Fall Semester 2005
HW # 3

wlg Due: October 4, 2005

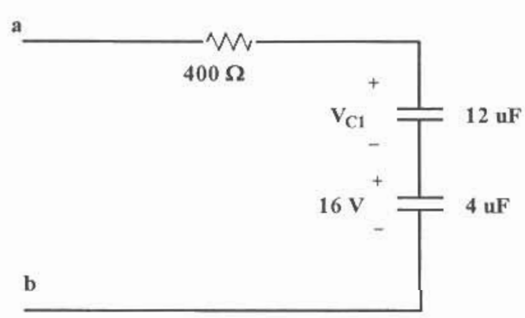
Name GREEN
Print (last, first)

Use engineering paper. Work only on one side of the paper. Use this sheet as your cover sheet, placed on top of your work and stapled in the top left-hand corner. Number the problems at the top of the page, in the center of the sheet. **Do neat work. Underline your answers. Show how you got your equations. Be sure to show how you got your answers.** Each problem counts 10 points.

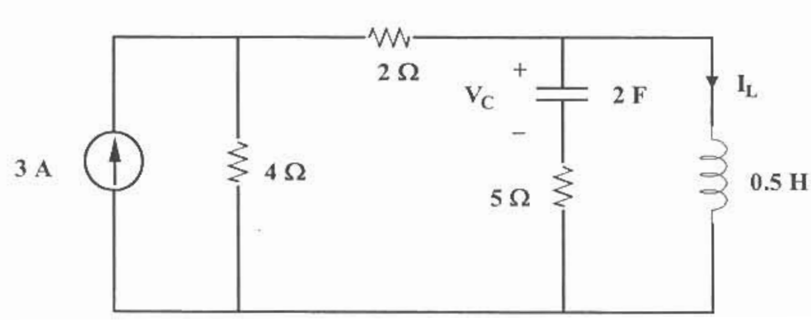
(1) You are given the circuit shown below. Find C (capacitor value) so that the energy stored in the capacitor equals the energy stored in the inductor. Assume the circuit is in steady state. Ans: On your own.



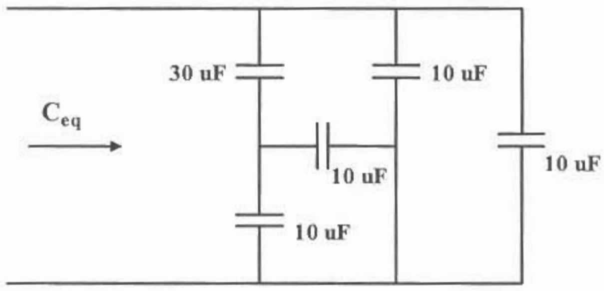
(2) A certain DC voltage has been applied to terminals a-b in the circuit below. The circuit has reached steady state. (a) Determine V_{C1}. (b) Determine the voltage V_{ab}. Ans: V_{C1}=5.33V V_{ab}= 21.55V.



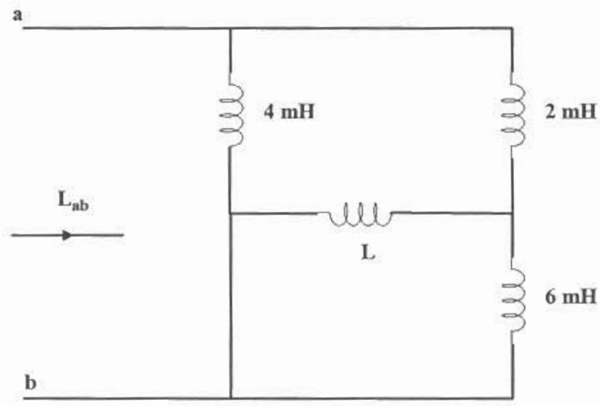
(3) You are given the circuit below. The circuit has reached steady state. Find the following: (a) V_c, (b) I_L, (c) W_c, (d) W_L. Ans: $V_c = 0$, $I_L = 2A$, $W_c = 0$, $W_L = 1$ J



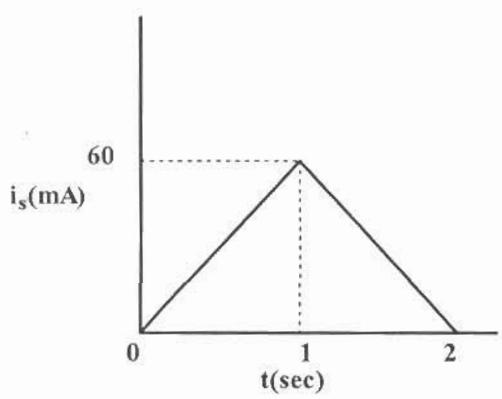
(4) You are given the circuit shown below. Find C_{eq}. Ans: On your own.

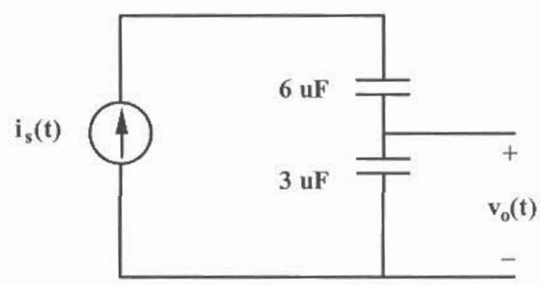


(5) You are given the following circuit. Find L so that L_{ab} = 2 mH. Ans: On your own.



(6) You are given the circuit below. Assume the capacitors are initially uncharged. Find $v_o(t)$ for t > 0.





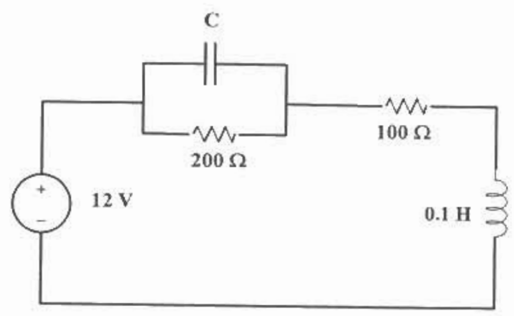
Ans:

$$v_o(t)=10t^2 10^3\ V \qquad 0 \le t \le 1$$

$$v_o(t)=\left(40t-10t^2-20\right)10^3\ V \qquad 1 \le t \le 2$$

ECE 301
HW#3

(1) You are given the circuit shown below. Find C (capacitor value) so that the energy stored in the capacitor equals the energy stored in the inductor. Assume the circuit is in steady state.
Ans: On your own.



In steady state, I from the soure is

$$I = \frac{12}{300} = 0.04\,A$$

$$W_L = \frac{1}{2} L I^2 = \frac{1}{2} \times 0.1 \times (.04)^2 = 8 \times 10^{-5} \text{ Joules}$$

$$W_L = W_c$$

capacitor looks like an open ckt
inductor looks like short circuit.

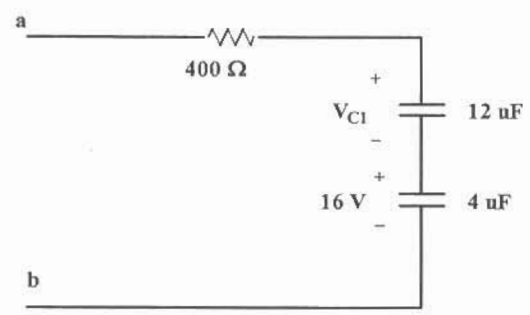
$$V_c = I \times 200 = .04 \times 200 = 8\,V$$

$$W_c = 8 \times 10^{-5} = \frac{1}{2} C V_c^2$$

$$C = \frac{2 \times 8 \times 10^{-5}}{8^2} = 0.25 \times 10^{-5}\ F$$

$$C = 2.5\,\mu F$$

(2) A certain DC voltage has been applied to terminals a-b in the circuit below. The circuit has reached steady state. (a) Determine V_{C1}. (b) Determine the voltage V_{ab}. Ans: V_{C1}=5.33V V_{ab}= 21.55V.



Key:

$$q_{4\mu F} = q_{12\mu F}$$

$$q_{4\mu F} = CV = (4\times10^{-6})\times 16 = 64\times10^{-6}$$

$$q_{12\mu F} = 64\times10^{-6} = 12\times10^{-6}\times V_{c1}$$

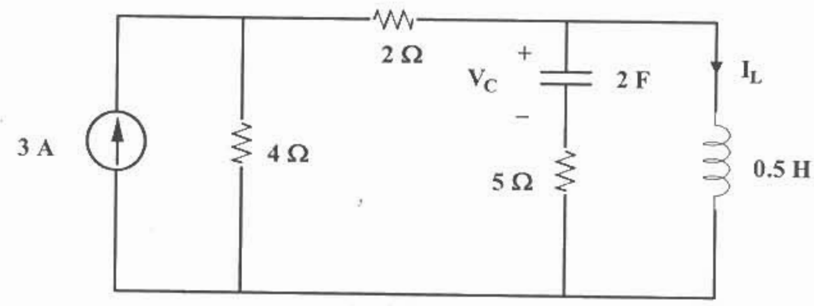
$$\boxed{V_{c1} = \frac{64}{12} = 5.33V}$$

$$V_{ab} = V_{c1} + 16$$

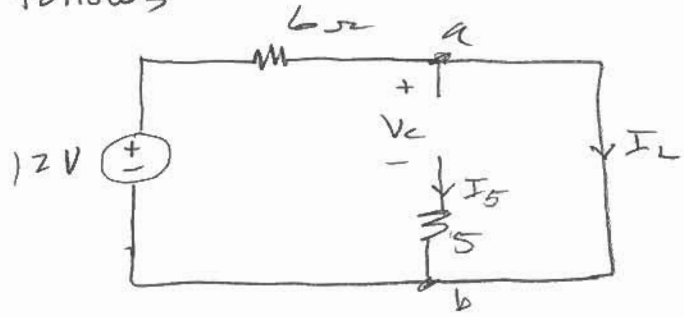
$$V_{ab} = 5.33 + 16$$

$$\boxed{V_{ab} = 21.33\ V}$$

(3) You are given the circuit below. The circuit has reached steady state. Find the following:
(a) V_c, (b) I_L, (c) W_c, (d) W_L. Ans: $V_c = 0$, $I_L = 2A$, $W_c = 0$, $W_L = 1$ J



In steady state the circuit appears as follows



(a) By inspection, since $I_5 = 0$ and $V_{ab} = 0$,

$V_c = 0$

(b) $I_L = \frac{12}{6} = 2A$

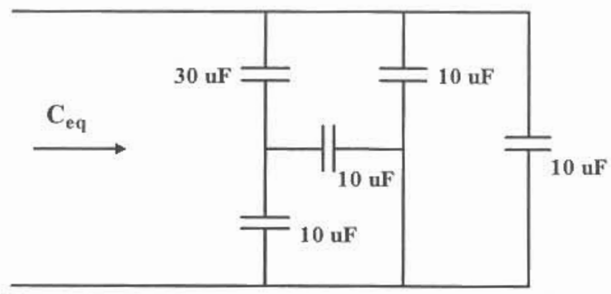
(c) $W_c = \frac{1}{2} C V_c^2$ $(V_c = 0)$

$W_c = 0$

(d) $W_L = \frac{1}{2} L i^2 = \frac{0.5}{2} \times 2^2 = 1$ Joule

$W_L = 1$ J

(4) You are given the circuit shown below. Find C_{eq}. Ans: On your own.



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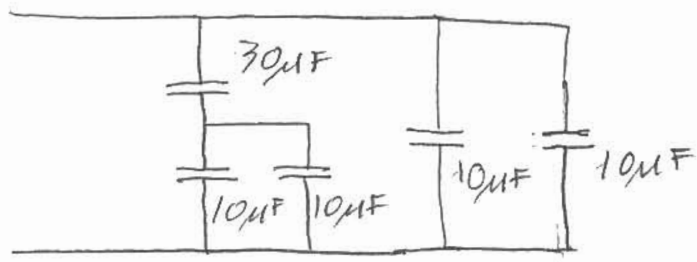
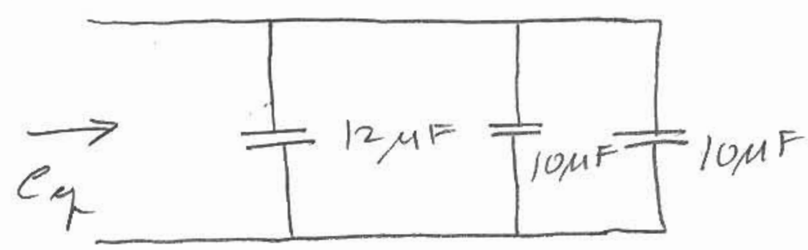


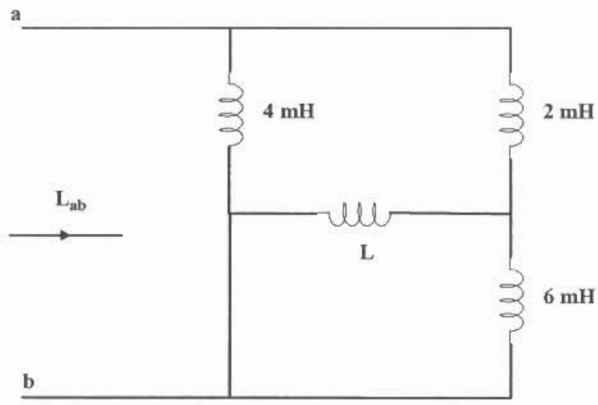
Becomes



$$C_{eq} = (12 + 10 + 10)\,\mu F$$

$$C_{eq} = 32\,\mu F$$

(5) You are given the following circuit. Find L so that $L_{ab} = 2$ mH. Ans: On your own.



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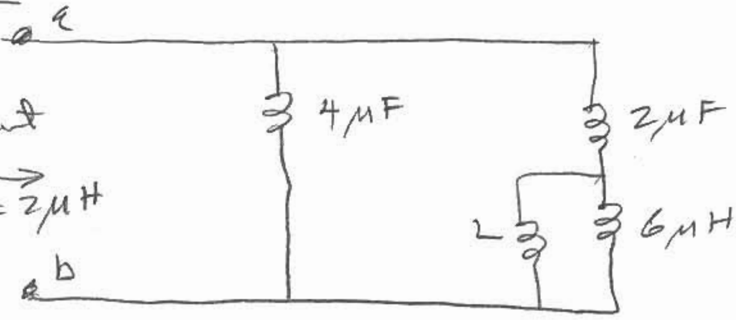
want $L_{eq} = 2\,\mu H$



$$L_{q1} = \frac{6\,mH \times L}{L + 6\,mH} + 2\,\mu H = \frac{6L + 2L + 12}{6 + L}$$

$$L_{eq1} = \left(\frac{8L + 12}{6 + L}\right) mH$$

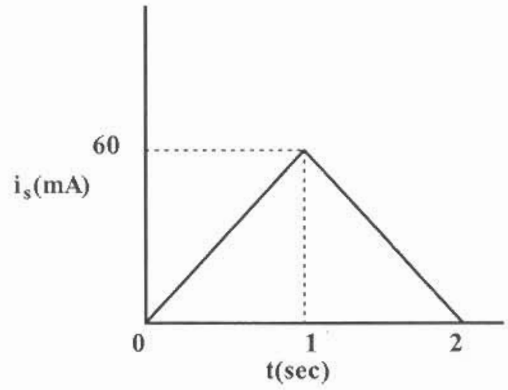
$$L_{ab} = \frac{4 \times \left(\frac{8L+12}{6+L}\right)}{4 + \left(\frac{8L+12}{6+L}\right)} = \left(\frac{32L + 48}{12L + 36}\right) mH$$

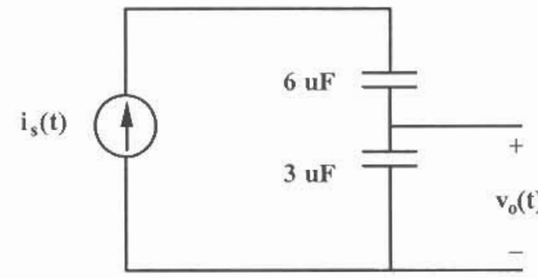
$$\frac{32L + 48}{12L + 36}\ mH = 2\ mH$$

Solve for L

$$\boxed{L = 3\ mH}$$

(6) You are given the circuit below. Assume the capacitors are initially uncharged. Find $v_o(t)$ for $t > 0$.





$1 \geq t > 0$

Equation of the line

$$i(t) = 60 \times 10^{-3} t$$

$$V = \frac{1}{C} \int_0^t i(t)\,dt + V(0) \qquad V(0) = 0$$

$$V = \frac{60 \times 10^{-3}}{3 \times 10^{-6}} \int_0^t t\,dt = \frac{60 \times 10^{-3}}{6 \times 10^{-6}} t^2$$

$$V(t) = 10 \times 10^{3} t^2 \qquad 0 \leq t \leq 1$$

Note;

$$V(1) = 10 \times 10^{3} \text{ V}$$

$2 \geq t \geq 1$

$$i(t) = -60 \times 10^{-3} (t-2)$$

$$\left.\frac{i - i_0}{t - t_0}\right| = \text{slope}$$

$i_0 = 0$, $t_0 = 2$

slope $= -60 \times 10^{-3}$

$$V(t) = \frac{-60 \times 10^{-3}}{3 \times 10^{-6}} \int_1^t (t-2) + V(1)$$

↑ note

(6)

$$v(t) = -20\times10^{3}\left[\frac{t^{2}}{2} - 2t\right]$$
$$+ 20\times10^{3}\left[\tfrac{1}{2} - 2\right] + 10\times10^{3}$$

$$v(t) = \left[-10\times10^{3}t^{2} + 40\times10^{3}t\right]$$
$$- 30\times10^{3} + 10\times10^{3}$$

40

$$v(t) = \left[-10\times10^{3}t^{2} + 40\times10^{3}t - 20\times10^{3}\right] \text{ V}$$

OR

$$v(t) = \left[40t - 10t^{2} - 20\right]\times10^{3} \text{ V}$$