Desk Copy

ECE 300
Spring Semester, 2005
HW Set #6

Due: March 1, 2005 Name GREEN
wlg AM PM 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 5 points.**

6.13 $v_1 = 30$ V, $v_2 = 40$ V

6.18 $C_{eq} = 10$ micro farads

6.26 $w = 393.8$ mJ

6.32 $v_1 = [-1250e^{-2t} + 1300]$ V, $v_2 = [-250e^{-2t} + 270]$ V

$w_{12} = 4.235$ J, $w_{20} = 0.316$ J, $w_{40} = 0.6339$ J

6.46 $v_c = 0$, $I_L = 2$ A, $w_c = 0$ J, $w_L = 1$ J

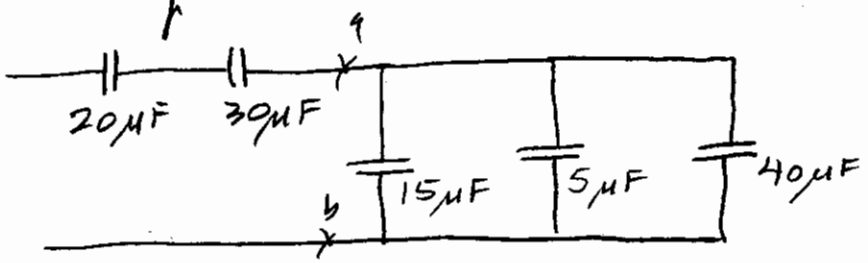
6.48 $i_{L1} = i_{L2} = 3$ A, $v_{c1} = 18$ V, $v_{c2} = 0$ V

6.52 $L_{ab} = 0.8$ H

6.62 $i_2(0) = -3.33$ mA, $i_1 = [-75e^{-3t} + 65]$ mA, $i_2(t) = [-25e^{-3t} + 21.67]$ mA

6.18

Find C_{eq}



Right of a-b

$$C_{eq_1} = 15\mu F + 5\mu F + 40\mu F$$

$$C_{eq_1} = 60\mu F$$

$$C_{eq_2} = \frac{30\mu F \times 60\mu F}{90\mu F} = 20\mu F$$

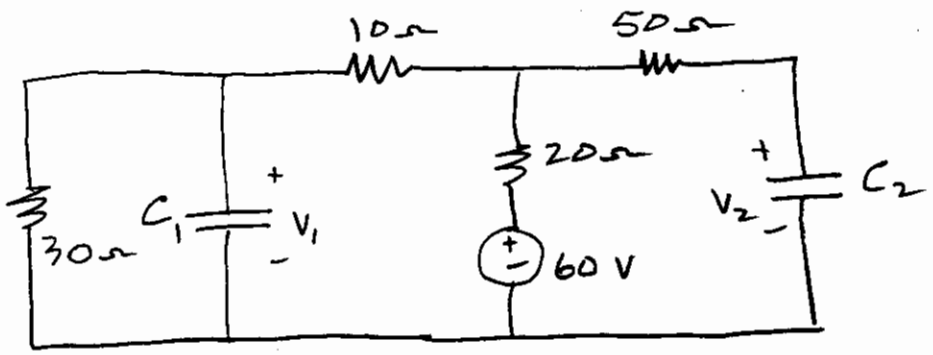
$$C_{eq} = \frac{20\mu F \times 20\mu F}{40\mu F}$$

$$\boxed{C_{eq} = 10\mu F}$$

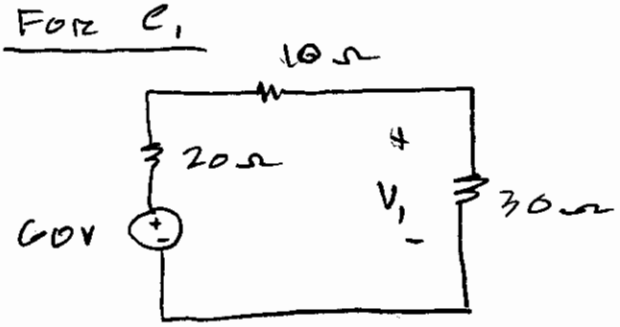
Home Work # 6

6.13

FIND the voltage across the capacitors in the following circuit, under D.C. conditions



For C_1



$$V_1 = \frac{60 \times 30}{30+10+20}$$

$$\boxed{V_1 = 30V}$$

For C_2

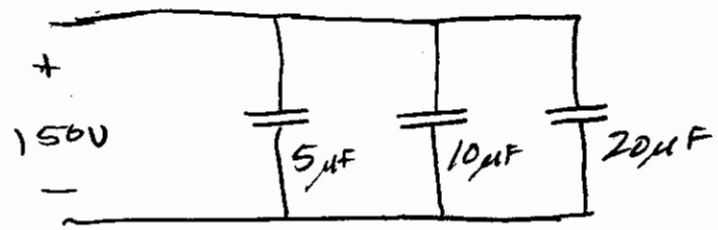
$$V_2 = 60 - i \times 20 \quad ; \quad i = \frac{60}{20+10+30}$$

$$i = 1A$$

$$\therefore V_2 = 60 - 20$$

$$\boxed{V_2 = 40\ V}$$

6.26



(a) Determine total capacitance

$$C_T = (5 + 10 + 20)\mu F = 35\mu F$$

(b) Q on each capacitor

$$Q = CV$$

$$Q_{TOTAL} = 35\mu F \times 150 = .00525\ C$$

$$Q_1 = C_1 V = 5\times10^{-6} \times 150 = 0.00075\ C$$

$$Q_2 = C_2 V = 10\times10^{-6} \times 150 = 0.0015\ C$$

$$Q_3 = C_3 V = 20\times10^{-6} \times 150 = 0.003\ C$$

(c)

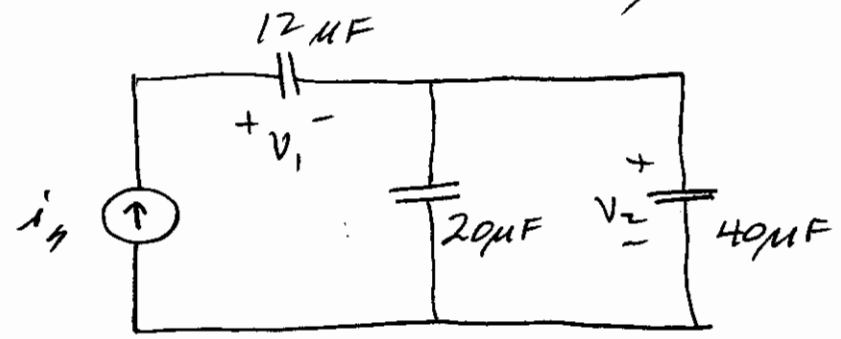
$$W = \frac{1}{2} C V^2 \qquad C = C_T = 35\mu F$$

$$W = \frac{1}{2} \times 35\times10^{-6} \times (150)^2$$

$$\boxed{W = 0.393.8\ J}$$

6.32

Given: $i_s = 30e^{-2t}$ mA, $V_1(0) = 50$V, $V_2(0) = 20$V



Determine (a) $V_1(t)$ & $V_2(t)$

(b) energy in each capacitor at $t = 0.5$

(a)

$$V_1 = \frac{1\times10^{-3}}{C_1}\int_0^t 30e^{-2t}\,dt + 50$$

$$V_1 = \frac{30\times10^{-3}}{12\times10^{-6}}\int_0^t e^{-2t}\,dt + 50$$

$$V_1 = -1250e^{-2t}\Big|_0^t + 50$$

$$V_1(t) = -1250e^{-2t} + 1250 + 50$$

$$\boxed{V_1(t) = (-1250e^{-2t} + 1300)\,V}$$

6.32 cont

$$C_{eq_1} = 20\mu F + 40\mu F = 60\mu F$$

$$V_2(t) = \frac{1}{60\times10^{-6}} \int_0^t 30e^{-2t}\,dt + 20$$

$$V_2(t) = \frac{-30\times10^{-3}}{120\times10^{-6}} e^{-2t}\Big|_0^t + 20$$

$$V_2(t) = -250e^{-2t}\Big|_0^t + 20$$

$$V_2(t) = \left[-250e^{-2t} + 270\right] V$$

(c) Energy in each capacitor

$$W_{12} = \frac{1}{2} C_{12} V_1^2 \Big|_{t=0.5}$$

$$= \frac{1}{2} \times 12\times10^{-6} \times \left(-1250e^{-1} + 1300\right)^2$$

$$= \frac{1}{2} \times 12e^{-6} \times (840.15)^2$$

$$\boxed{W_{12} = 4.235\ J}$$

6.32 cont.

(c)

$$W_{20} = \frac{1}{2} 20\times10^{-6}(-250e^{-1}+270)^2$$

$$W_{20} = \frac{1}{2}\times 20\times10^{-6}(178)^2$$

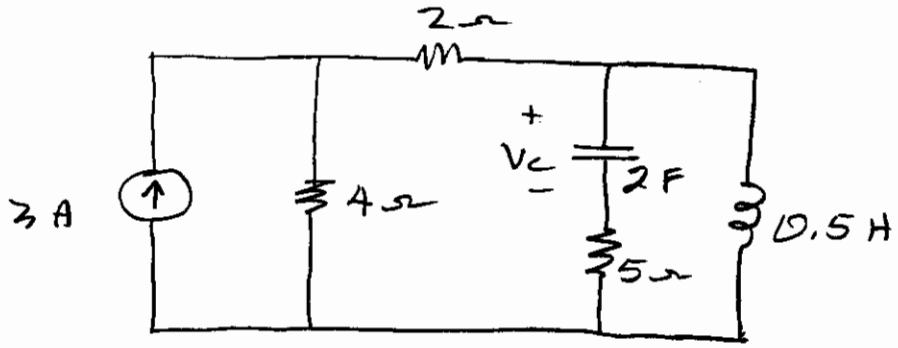
$$\boxed{W_{20} = 0.3168\ J}$$

$$W_{40} = \frac{1}{2}\times 40\left[176\right]^2$$

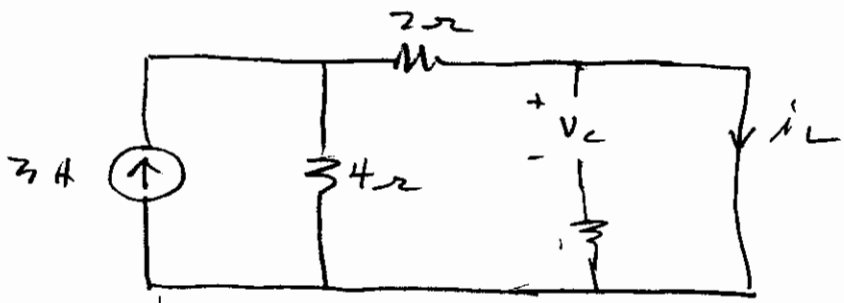
$$\boxed{W_{40} = 0.63368\ J}$$

Ex 4.6

Find V_c, i_L and the energy stored in the capacitor & inductor under d.c. conditions.



Under steady conditions we have



(a) $V_c = 0$ by inspection above

$$i_L = \frac{3 \times 4}{4+2}$$ current splitting rule

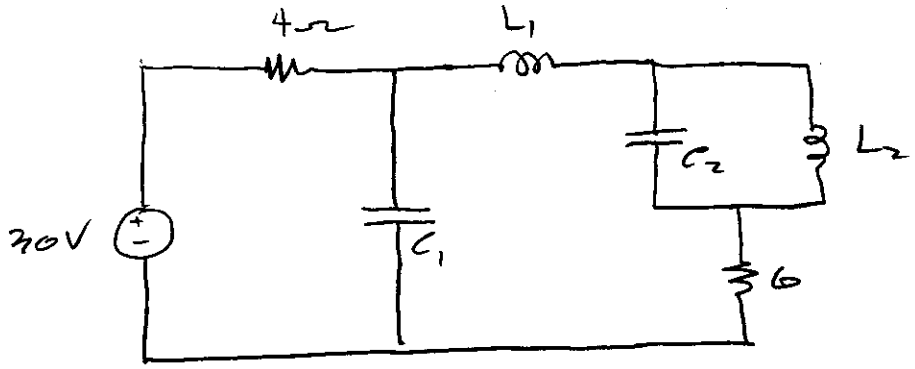
$$i_L = 2\ A$$

(b) $$W_c = \frac{1}{2} C V^2 = 0 \quad (V = 0)$$

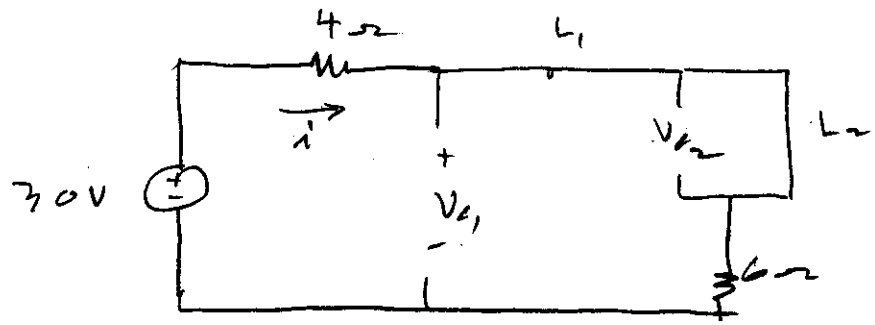
$$W_L = \frac{1}{2} L i^2 = \frac{1}{2} \times 0.5 (2)^2$$

$$W_L = 1\ J$$

6.48 Under dc conditions find the voltage across the capacitor and the current through the inductors in the following circuit.



Under d.c. conditions the circuit becomes as shown below:



$$i = \frac{30}{10} = 3\,A$$

$$V_{C_1} = 3 \times 6 = 18\,V$$

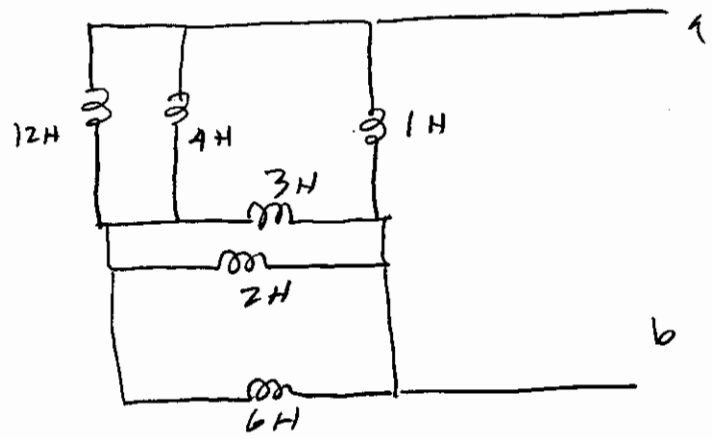
$$V_{C_2} = 0\,V$$

$$i_{L_1} = 3\,A$$

$$i_{L_2} = 3\,A$$

6.52

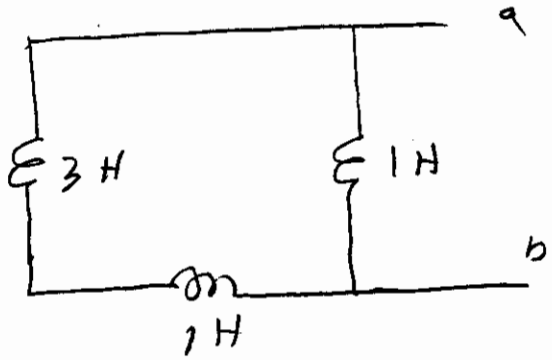
Find L_{eq} for the following

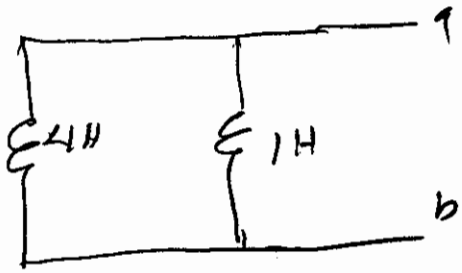


$\frac{4 \times 12}{16} = 3$

$\Downarrow$

$\frac{6 \times 3}{9} = 2H, \quad 2H \,//\, 2H = 1H$





$$L_{ab} = \frac{4 \times 1}{5} = 0.8\,H$$

6.62

(a) $L_{eq} = 25 + 20 \| 60 = 40\ mH$

$$v = L_{eq}\frac{di}{dt} \longrightarrow i = \frac{1}{L_{eq}}\int v(t)\,dt + i(0) = \frac{10^{-3}}{40\times10^{-3}}\int_0^1 12e^{-3t}\,dt + i(0)$$

$$= -0.1(e^{-3t} - 1) + i(0)$$

Using current division and the fact that all the currents were when the circuit was put together, we got

$$i_1 = \frac{60}{80}i = \frac{3}{4}i, \quad i_2 = \frac{1}{4}i$$

$$i_1(0) = \frac{3}{4}i(0) \longrightarrow 0.75\,i(0) = -0.01 \longrightarrow i(0) = -0.01333$$

$$i_2 = \frac{1}{4}(-0.1e^{-3t} + 0.08667)\,A = (-25e^{-3t} + 21.67)\,mA$$

$$i_2(0) = -25 + 21.67 = -3.33\ mA$$

(b) $i_1 = \frac{3}{4}(-0.1e^{-3t} + 0.08667)\,A = (-75e^{-3t} + 65)\,mA$

$i_2 = (-25e^{-3t} + 21.67)\,mA$