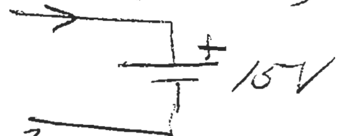
EE 211 Assignment 1 Chapter 2

4. 100mA → for 3 hours



$$W = \int_{t=0}^{3\times60^2} 0.1\times15\,dt = 1.5t\Big|_0^{3\times60^2} = 1.5\times3\times60^2 = \boxed{16.2\times10^3 \text{ Joules}}$$

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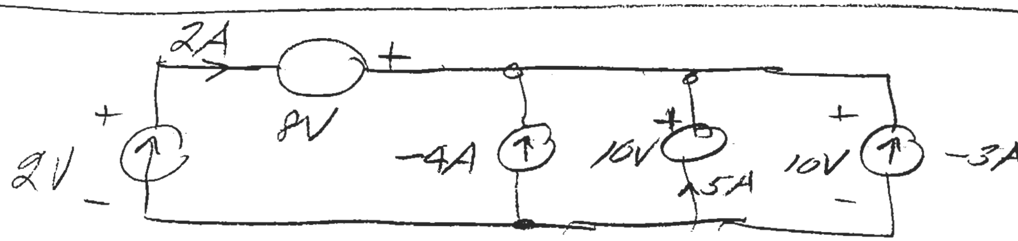
14. $\boxed{2.86 \text{ Volts}}$

20.



$$\left.\begin{array}{l} P_{2V} = -4\,W \\ P_{8V} = -16\,W \\ \boxed{P_{4A} = -(-4)(10) = 40W \text{ absorbing}} \\ P_{10V} = -50W \\ \boxed{P_{-3A} = -(-3)(10) = 30W} \text{ absorbing} \end{array}\right\} \Sigma = 0 \checkmark$$

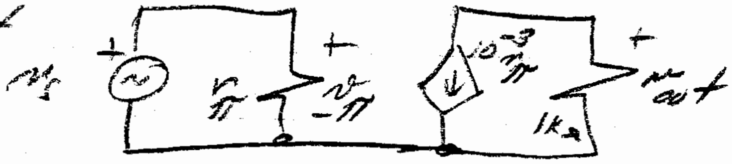
EE 211 Assignment 2

2-28 $470\Omega \pm 5\%$ $(446.5 \rightarrow 493.5\Omega)$

for 2 mA $P_{max} = (2\times10^{-3})^2\, 493.5 = 1.974\times10^{-3}$

$\boxed{\text{resistor must be able to dissipate} \geq 2\text{ mW}}$

2-34

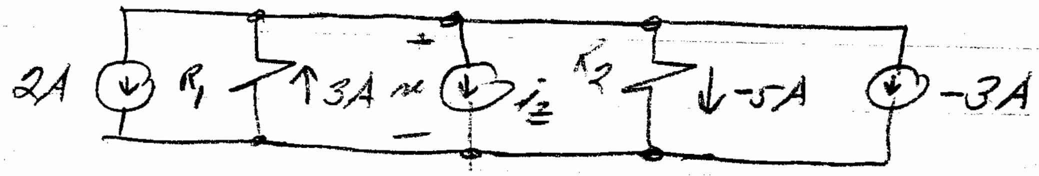


$v_s = 0.01 \cos 1000t = v_\pi$ ←

$\boxed{\therefore \text{ dependent current source } = 10^{-5}\cos 10^3 t}$

$\boxed{\text{and } v_{out} = -10^3\times10^{-5}\cos 10^3 t = -10^{-2}\cos 10^3 t}$ ←

3-6



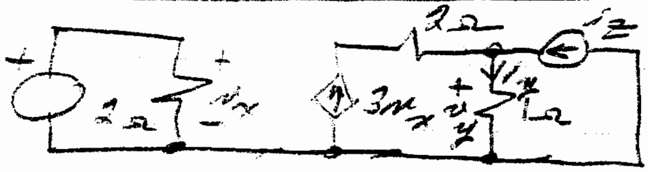
a) $\sum i\text{'s} = 0$ $\therefore$ $2 - 3 + i_z - 5 - 3 = 0$

$\boxed{i_z = 9A}$ ←

b) if $R_1 = 1\Omega$ then $v = -3R_1 = -3$ Volts

so $-5R_2 = -3$ or $\boxed{R_2 = \frac{3}{5}\Omega}$ ←

3-13



$v_x = 5$ Volts

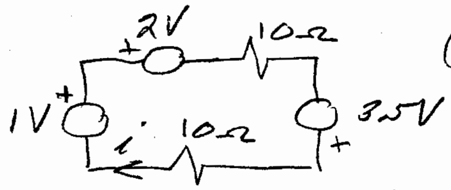
a) $i_z = -3A$; $i_y = 3v_x + i_z = 15 - 3 = 12A$ $\therefore$ $\boxed{v_y = 1\times i_y = 12 \text{ Volts}}$ ←

b) $i_z = 0.5A$, $v_y = -6V$, $v_s = ?$; $i_y = -6 = 3v_x + i_z = 3v_x + \frac{1}{2}$

$v_x = \dfrac{-6-\frac{1}{2}}{3} = \boxed{-\dfrac{13}{6} = -2.167}$ ←

EE 211 Assignment 3

3.16 a)

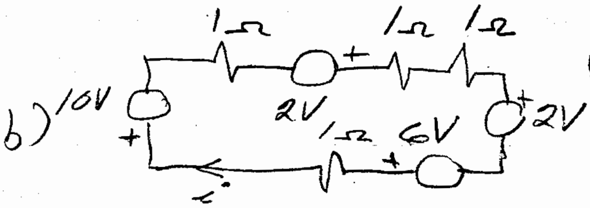


KVL $-1+2+10i-3.5+10i=0$

$20i=2.5$

$\boxed{i=0.125A}$

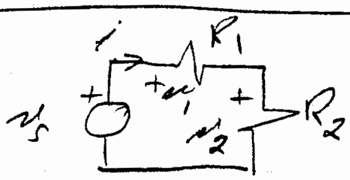
b)



KVL $10+4i-\cancel{2}+\cancel{2}-6=0$

$\boxed{i=-1}$

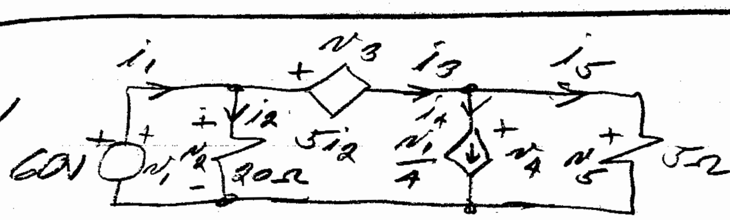
3-18



$i=\frac{v_s}{R_1+R_2}$ $\therefore$ $v_1=iR_1=v_s\frac{R_1}{R_1+R_2}$

and $v_2=iR_2=v_s\frac{R_2}{R_1+R_2}$

3-21



$\boxed{v_1=60V=v_2}$

$\therefore$ $\boxed{i_4=\frac{60}{4}=15}$

a) $\boxed{i_2=\frac{60}{20}=3A}$ $\therefore$ $\boxed{v_3=5i_2=15V}$

KVL $-60+v_3+v_4=0$ $\therefore$ $\boxed{v_4=60-15=45V=v_5}$

$\boxed{i_5=v_4/5=9A}$

$\boxed{i_3=i_4+i_5=\frac{v_1}{4}+i_5=15+9=24A}$

$\boxed{i_1=i_2+i_3=3+24=27A}$

b) $P_{60V}=-60i_1=-60\times27=-1620W$

$P_{20\Omega}=v_2i_2=60\times3=180W$

$P_{5i_2\,source}=v_3i_3=15\times24=360W$

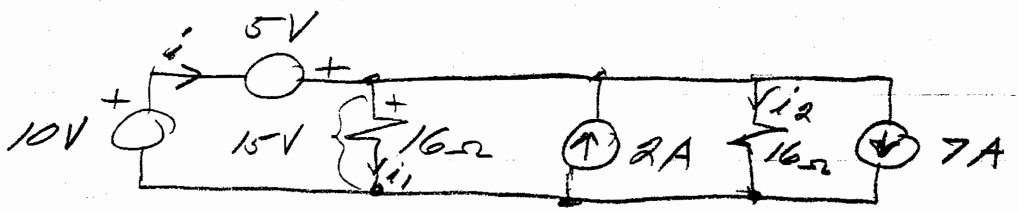
$P_{(\frac{v_1}{4}\,source)}=v_4i_4=45\times15=675W$

$P_{5\Omega}=v_5i_5=45\times9=\underline{405W}$

$\Sigma=0$!

EE 211 Assignment 4

3-48



$$P_{16\Omega} = \frac{15^2}{16} = \frac{225}{16}\ W \leftarrow \text{(Two of these)}$$

$$P_{2A} = -15 \times 2 = -30$$

$$P_{7A} = 15 \times 7 = 105$$

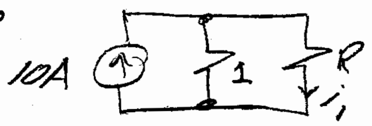
$$i = i_1 + i_2 + 7 - 2 = \frac{15}{8} + 5 = \frac{55}{8}\ A$$

$$\therefore P_{10V} = -\frac{550}{8}$$

$$P_{5V} = -\frac{275}{8}$$

$$\Sigma p\text{'s} = \frac{225 - 480 + 1680 - 1100 - 550 + 225}{16} = 0$$

3-43

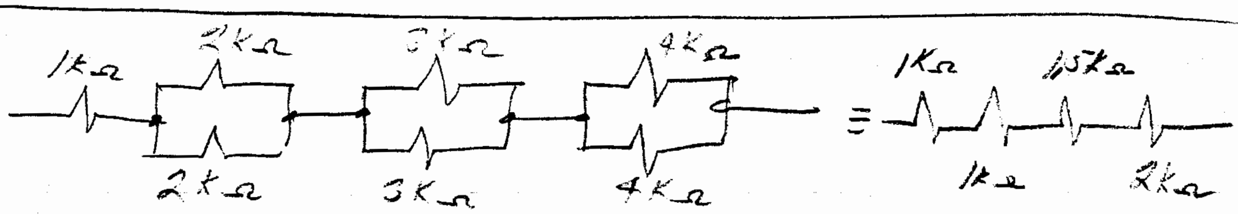


$$i_1 = 10\frac{1}{1+R} = 5 \quad \therefore R = 1$$

28AWG solid resistance $= 0.5\,\Omega$ $(65.3\,\Omega/1000')$

$$\therefore \text{length} = \frac{0.5}{65.3} \times 10^3\ ft \times \frac{1\ mile}{5280\ ft} = \boxed{1.45 \times 10^{-3}\ miles} \leftarrow$$

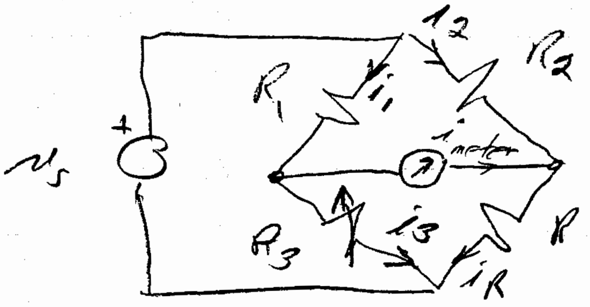
3-57



$$\boxed{R_{eq} = 5.5\ k\Omega}$$

EE 211 Assignment 5

3-65



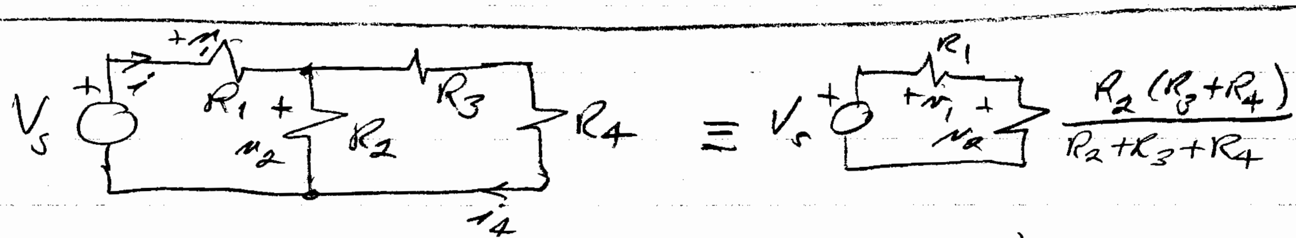
@ balance $i_{meter} = 0$

so $i_2 = i_R$ and $i_1 = i_3$

so $i_1 R_1 = i_2 R_2$ and $i_1 R_3 = i_2 R \Rightarrow \dfrac{R_1}{R_3} = \dfrac{R_2}{R}$

$$\boxed{\text{or } R = \frac{R_2 R_3}{R_1}}$$

3-77

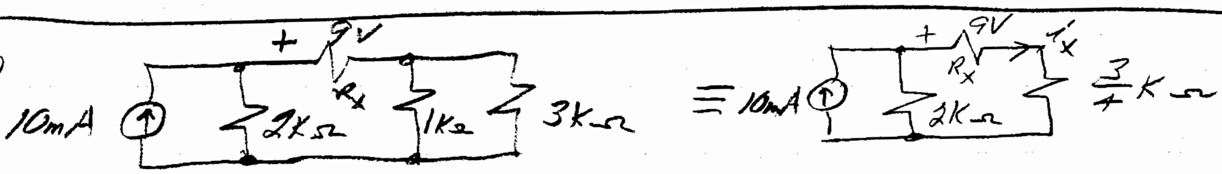


a) $v_2 = V_s \dfrac{\dfrac{R_2(R_3+R_4)}{R_2+R_3+R_4}}{R_1 + \dfrac{R_2(R_3+R_4)}{R_2+R_3+R_4}} = V_s \dfrac{R_2(R_3+R_4)}{R_1R_2+R_1R_3+R_1R_4+R_2R_3+R_2R_4}$

b) $v_1 = V_s \dfrac{R_1}{R_1 + \dfrac{R_2(R_3+R_4)}{R_2+R_3+R_4}} = V_s \dfrac{R_1(R_2+R_3+R_4)}{R_1R_2+R_1R_3+R_1R_4+R_2R_3+R_2R_4}$

c) $i_4 = i \dfrac{R_2}{R_2+R_3+R_4} = \dfrac{V_s}{R_1 + \dfrac{R_2(R_3+R_4)}{R_2+R_3+R_4}} \cdot \dfrac{R_2}{R_2+R_3+R_4} = V_s \dfrac{R_2}{R_1R_2+R_1R_3+R_1R_4+R_2R_3+R_2R_4}$

3-80



$i_x = \dfrac{2 \times 10^3}{2.75 \times 10^3 + R_x} \times 10\,mA$ but $i_x R_x = 9 = \dfrac{20 R_x}{2.75 \times 10^3 + R_x}$

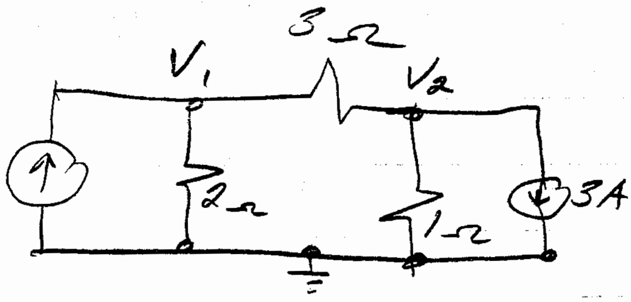
or $\boxed{R_x = 2{,}250\,\Omega}$

$$\boxed{P_{R_x} = \frac{9^2}{R_x} = 0.036 = 36\,mW}$$

EE 211 Assignment 6

4-9

4-4



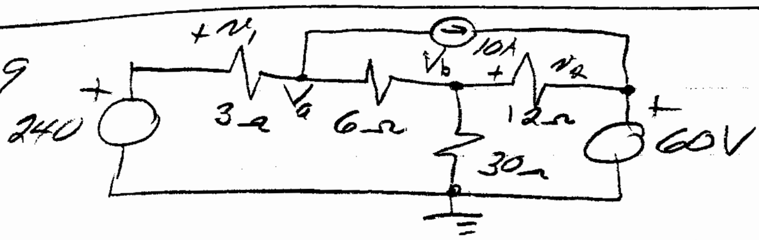
$$\frac{V_1}{2}+\frac{V_1-V_2}{3}=1 \qquad \frac{V_2-V_1}{3}+\frac{V_2}{1}=-3$$

$$V_1\left(\frac{5}{6}\right)-V_2\left(\frac{1}{3}\right)=1 \qquad -V_1\left(\frac{1}{3}\right)+V_2\left(\frac{4}{3}\right)=-3$$

$$\begin{bmatrix}5 & -2\\ -1 & 4\end{bmatrix}\begin{bmatrix}V_1\\ V_2\end{bmatrix}=\begin{bmatrix}6\\ -9\end{bmatrix}$$

$$V_1=\frac{\begin{vmatrix}6 & -2\\ -9 & 4\end{vmatrix}}{\begin{vmatrix}5 & -2\\ -1 & 4\end{vmatrix}}=\frac{24-18}{20-2}=\boxed{\frac{6}{18}=\frac{1}{3}V}$$

4-9



$$\frac{V_a-240}{3}+\frac{V_a-V_b}{6}=-10$$

$$\frac{V_b-V_a}{6}+\frac{V_b}{30}+\frac{V_b-60}{12}=0$$

or $V_a\left(\frac{1}{2}\right)-V_b\left(\frac{1}{6}\right)=70$

$$-V_a\left(\frac{1}{6}\right)+V_b\left(\frac{1}{6}+\frac{1}{30}+\frac{1}{12}\right)=5$$

$$3V_a-V_b=420 \qquad -10V_a+17V_b=300$$

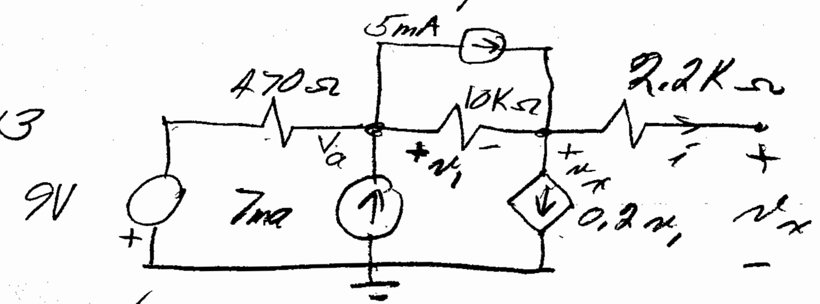
$$V_a=\frac{\begin{vmatrix}420 & -1\\ 300 & 17\end{vmatrix}}{\begin{vmatrix}3 & -1\\ -10 & 17\end{vmatrix}}=\frac{7440}{41}=\boxed{181.46\ V}; \quad V_b=\frac{\begin{vmatrix}3 & 420\\ -10 & 300\end{vmatrix}}{41}=\frac{5100}{41}=\boxed{124.39V}$$

$$\boxed{v_1=240-V_a=58.54V} \qquad \boxed{v_2=V_b-60=64.39V}$$

$$\boxed{P_{6\Omega}=\frac{(V_a-V_b)^2}{6}=542.89\text{ Watts}}$$

EE 211 Assignment 7

4-13



$i = 0$

$\therefore v_x$ = voltage across the dependent source

@ V_a $\quad \dfrac{V_a+9}{470} + \dfrac{V_a - v_x}{10{,}000} = 2\times10^{-3}$

@ v_x $\quad \dfrac{v_x - V_a}{10{,}000} + 0.2(V_a - v_x) = 5\times10^{-3}$

$V_a\, 10{,}470 - 470 v_x = -9\times10^4 + 20\times470$

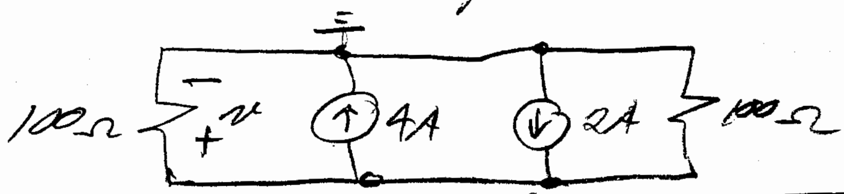
$V_a(2\times10^3 - 1) + v_x(1 - 2\times10^3) = 50$

$10{,}470 V_a - 470 v_x = -80{,}600$

or $1.999\times10^3 V_a - 1.999\times10^3 v_x = 50$

$$v_x = \frac{\begin{vmatrix} 10.470\times10^3 & -80.6\times10^3 \\ 1.999\times10^3 & 50 \end{vmatrix}}{\begin{vmatrix} 10.470\times10^3 & -470 \\ 1.999\times10^3 & -1.999\times10^3 \end{vmatrix}} = \frac{\overset{161.64\times10^6}{523.5\times10^3 + 161.12\times10^6}}{\underset{-19.99\times10^6}{-20.93\times10^6 + 939.5\times10^3}} = \boxed{-8.086\text{V}}$$

4-14 no current flows from top to bottom part of circuit $\therefore$ problem reduces to

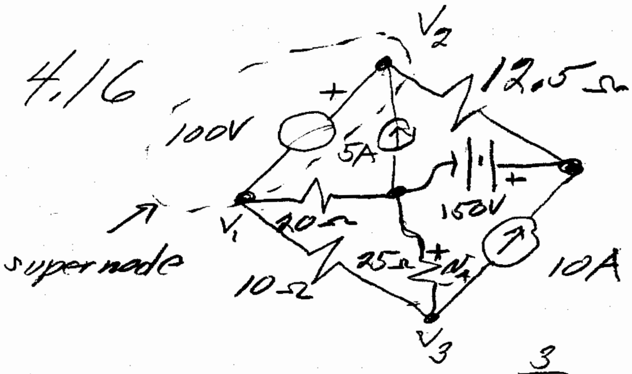


$\dfrac{v}{100} + \dfrac{v}{100} = 2 - 4$

$\boxed{\text{so } v = \dfrac{-2\times100}{2} = -100\text{V}}$

EE 211 Assigment 8 4.16, 4.20

4.16



Use center as reference

$V_1 - V_2 = -100 \Rightarrow V_1 = V_2 - 100$

$\frac{V_2 - 150}{12.5} + \frac{V_1}{20} + \frac{V_1 - V_3}{10} = 5$

$\frac{V_3 - V_1}{10} + \frac{V_3}{25} = -10$

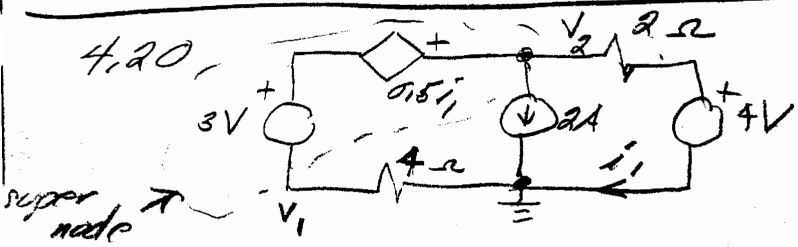
or $\frac{V_2}{12.5} + (V_2 - 100)\overbrace{\left(\frac{1}{20} + \frac{1}{10}\right)}^{\frac{3}{20}} - \frac{V_3}{10} = 5 + 12$

$-(V_2 - 100)\frac{1}{10} + V_3\left(\frac{1}{10} + \frac{1}{25}\right) = -10$

$\left.\begin{array}{l} V_2 0.23 - V_3 0.1 = 32 \\ -V_2 0.1 + V_3 0.14 = -20 \end{array}\right\}$

$V_3 = -v_A = \frac{\begin{vmatrix} 0.23 & 32 \\ -0.1 & -20 \end{vmatrix}}{\begin{vmatrix} 0.23 & -0.1 \\ -0.1 & 0.14 \end{vmatrix}} = \frac{-1.4}{0.0222} = -63.06\,V$ or $\boxed{v_A = 63.06\,V}$

4.20



$V_2 - V_1 = 0.5 i_1 + 3 = 0.5\left(\frac{V_2 - 4}{2}\right) + 3$

@ supernode

$\frac{V_1}{4} + \frac{V_2 - 4}{2} = -2$

$\left.\begin{array}{l} V_2\left(1 - \frac{1}{4}\right) - V_1 = 2 \\ \frac{V_1}{4} + \frac{V_2}{2} = 0 \end{array}\right\}$

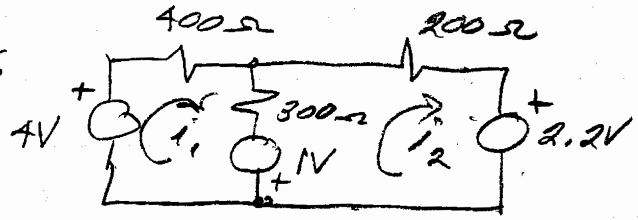
$\left.\begin{array}{l} -V_1 + \frac{3}{4}V_2 = 2 \\ V_1 + 2V_2 = 0 \end{array}\right\}$ $\boxed{\begin{array}{l} -4V_1 + 3V_2 = 8 \\ V_1 + 2V_2 = 0 \end{array}}$

$V_2 = \frac{\begin{vmatrix} -4 & 8 \\ 1 & 0 \end{vmatrix}}{\begin{vmatrix} -4 & 3 \\ 1 & 2 \end{vmatrix}} = \frac{-8}{-8-3} = \frac{8}{11}$

$\boxed{i_1 = \frac{V_2 - 4}{2} = \frac{\frac{8}{11} - \frac{44}{11}}{2} = -\frac{36}{22} = -1.636\,A}$

EE 211 Assignment 9 4.26, 4.29

4.26



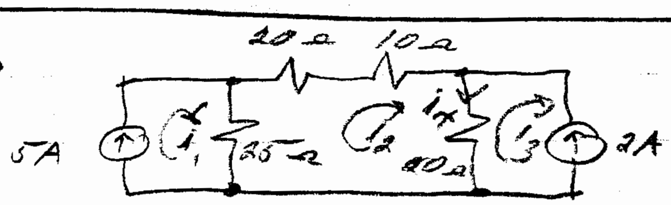
$$400 i_1 + 300(i_1 - i_2) = 5$$
$$300(i_2 - i_1) + 200 i_2 = -3.2$$

$$700 i_1 - 300 i_2 = 5$$
or
$$-300 i_1 + 500 i_2 = -3.2$$

$$i_1 = \frac{\begin{vmatrix} 5 & -300 \\ -3.2 & 500 \end{vmatrix}}{\begin{vmatrix} 700 & -300 \\ -300 & 500 \end{vmatrix}} = \frac{2500 - 960}{350{,}000 - 90{,}000} = \frac{1540}{260 \times 10^3} = 5.92 \times 10^{-3}$$

$$i_2 = \frac{\begin{vmatrix} 700 & 5 \\ -300 & -3.2 \end{vmatrix}}{260 \times 10^3} = \frac{-2240 + 1500}{260 \times 10^3} = -\frac{740}{260 \times 10^3} = -2.85 \times 10^{-3}$$

4.29



$$i_1 = 5$$
$$i_3 = -2$$

$$25(i_2 - i_1) + 30 i_2 + 20(i_2 - i_3) = 0 \Rightarrow 75 i_2 = 125 - 40$$

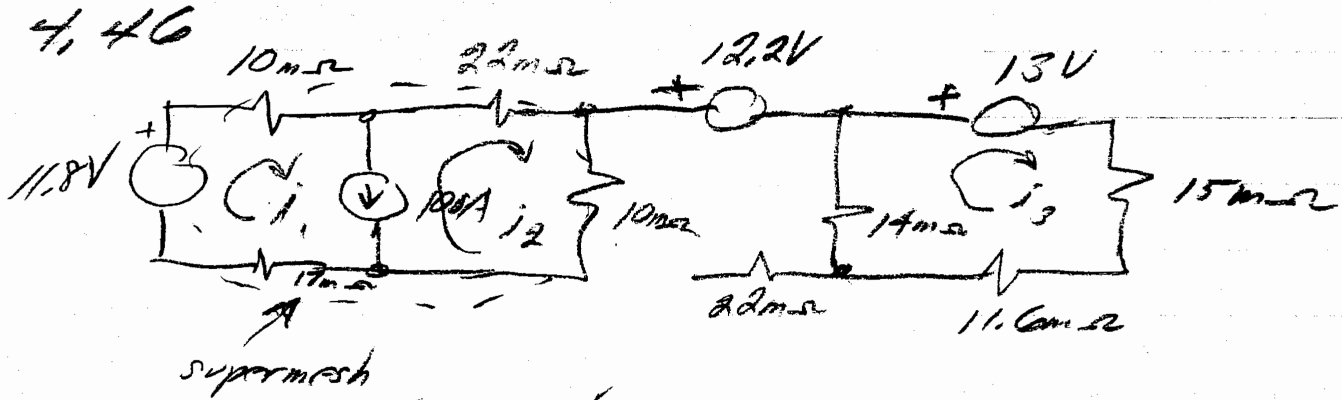
$$\boxed{i_2 = 1.133\,A}$$

so $\boxed{i_x = i_2 - i_3 = 3.133A}$

$$\boxed{P_{25\Omega} = (i_1 - i_2)^2 25 = (5 - 1.133)^2 \times 25 = 373.77 \text{ Watts}}$$

EE 211 Assignment 10

4.46



$i_1 10\times10^{-3} + i_2 32\times10^{-3} + 17\times10^{-3} i_1 = 11.8$; $i_1 - i_2 = 100$

$i_3 (14+15+11.6)\times10^{-3} = -13 \Rightarrow i_3 = -\frac{13}{40.6\times10^{-3}} = -0.32\times10^{3}$

$\boxed{i_3 = -320A}$

$\Rightarrow 27\times10^{-3} i_1 + 32\times10^{-3} i_2 = 11.8$

$i_1 - i_2 = 100 \Rightarrow i_1 = i_2 + 100$

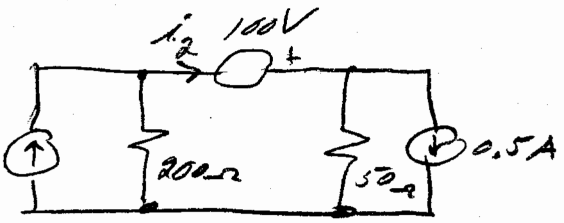
so $(27\times10^{-3} + 32\times10^{-3}) i_2 = 11.8 - 2.7$

$i_2 = \frac{9.1}{59\times10^{-3}} = 154.2A$

$i_1 = 254.2A$

EE 211 Assignment 11

5.9



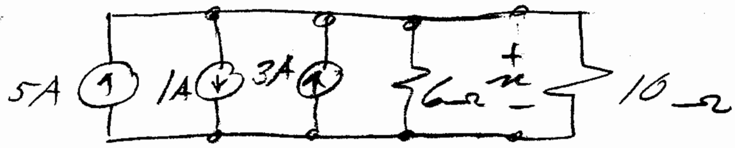
Voltage source only $\quad i_{2_V} = \frac{100}{250} = \frac{2}{5}A$

left current source $\quad i_{2_{A_1}} = 1 \times \frac{200}{250} = \frac{4}{5}A$

right current source $\quad i_{2_{A_2}} = \frac{1}{2} \times \frac{50}{250} = \frac{25}{250} = \frac{1}{10}A$

$$\therefore i_2 = i_{2_V} + i_{2_{A_1}} + i_{2_{A_2}} = \frac{13}{10}A = \boxed{1.3A}$$

5.21



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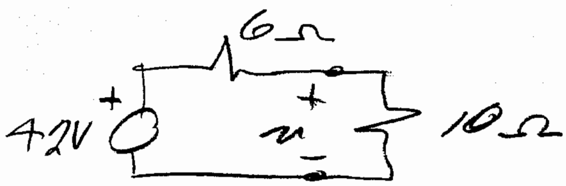
a) or

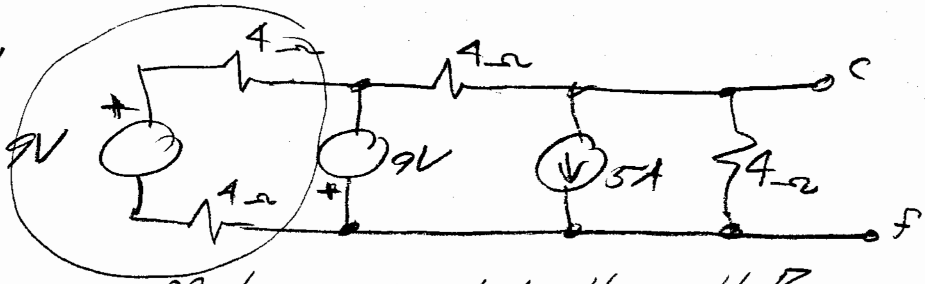


b) $v = 42\,\frac{10}{16} = \frac{420}{16} = 26.25\,V$

c) If we include 10Ω resistor we lose v!

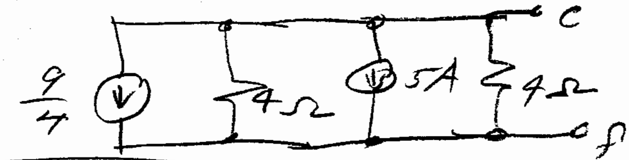
EE 211 — Assignment 12

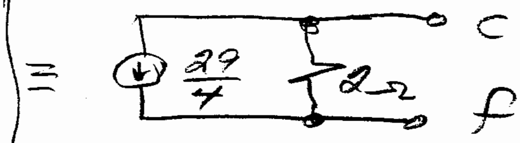
5-31



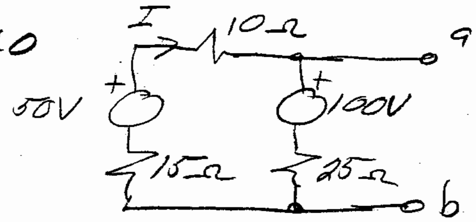
no effect on circuit to the right!

∴ equivalent is





5-40

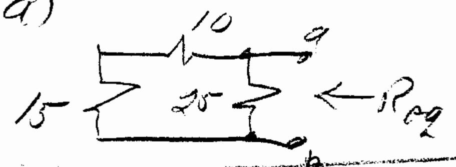


KVL $15I - 50 + 10I + 100 + 25I = 0$

$50I = -50$

$\boxed{I = -1\,A}$

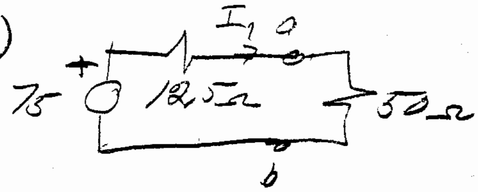
a)



∴ $\boxed{V_{oc} = V_{Th} = 100 - 25 = 75V}$

$\boxed{R_{Th} = R_{eq} = \frac{25(25)}{50} = 12.5\Omega}$

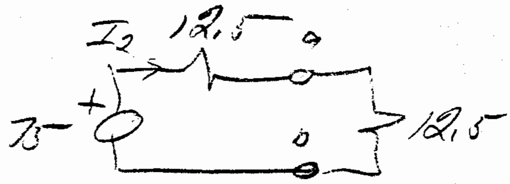
b)



$I_1 = \frac{75}{62.5}$

$\boxed{P_{50\Omega} = I_1^2\, 50 = 72W}$

c)

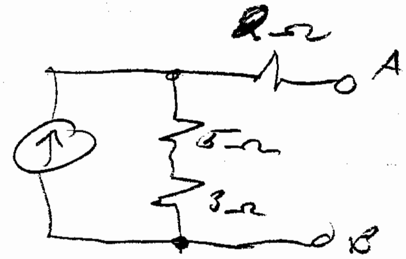


$I_2 = \frac{75}{25} = 3$

$\boxed{P_{12.5} = 9 \times 12.5 = 112.5}$

EE 211 Assigment 13

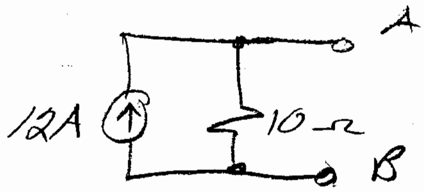
5.42



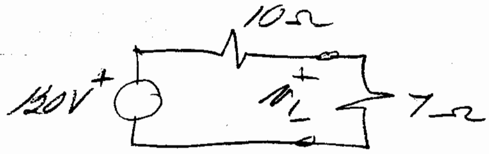
$V = IR$

a) $\left\{ \begin{array}{l} V_{Th} = V_{oc} = 15 \times 8 = 120\,V \\ R_{Th} = R_{eq} = 10\,\Omega \end{array} \right\}$

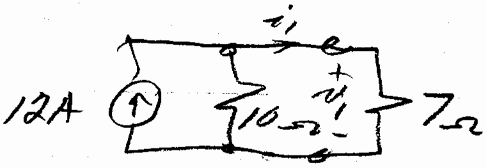
b)



c)



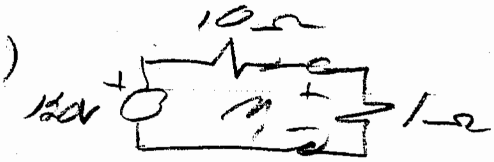
$\boxed{v_1 = \frac{7}{17} \times 120 = 49.41\,V}$



$i_1 = \frac{10}{17} \times 12$

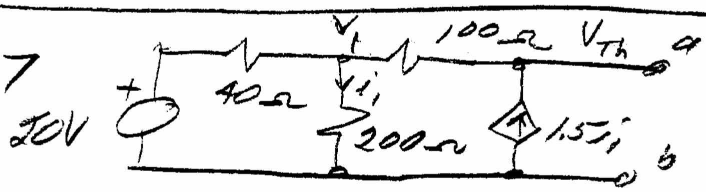
$\therefore \boxed{v_1 = \frac{10}{17} \times 12 \times 7 = \frac{7}{17} \times 120 = 49.41\,V}$

d)



$\boxed{v_1 = \frac{1}{11} \times 120 = 10.9\,V}$

5.47



$\frac{V_1 - 20}{40} + \frac{V_1}{200} + \frac{V_1 - V_{Th}}{100} = 0$ $\qquad \frac{3}{2} \times \frac{1}{200} = \frac{3}{400}$

$\frac{V_{Th} - V_1}{100} - 1.5\,i_1 = 0$ but $i_1 = \frac{V_1}{200}$

$\frac{8}{200}$

$\therefore V_1\left(\frac{1}{40} + \frac{1}{200} + \frac{1}{100}\right) - \frac{1}{100} V_{Th} = \frac{1}{2}$ $\qquad 8V_1 - 2V_{Th} = 100$

$V_1\left(-\frac{1}{100} - \frac{3}{400}\right) + \frac{1}{100} V_{Th} = 0$ $\qquad -7V_1 + 4V_{Th} = 0$

$V_{Th} = \frac{\begin{vmatrix} 8 & 100 \\ -7 & 0 \end{vmatrix}}{\begin{vmatrix} 8 & -2 \\ -7 & 4 \end{vmatrix}} = \frac{700}{32 - 14} = \boxed{\frac{700}{18} = 38.89\,V}$

I_{sc} $\quad \frac{V_1 - 20}{40} + \frac{V_1}{200} + \frac{V_1}{100} = 0$ $\qquad V_1\left(\frac{8}{200}\right) = \frac{1}{2};\ V_1 = \frac{100}{8} = \frac{25}{2}$

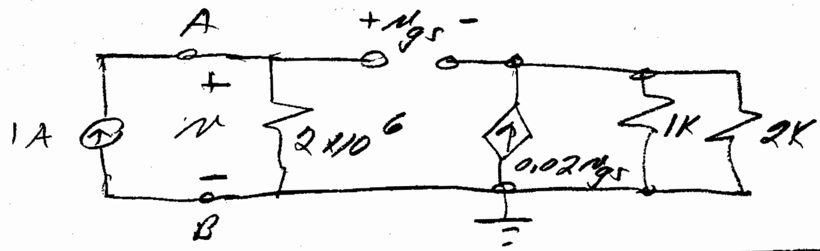
$-\frac{V_1}{100} - \frac{3}{2}\left(\frac{V_1}{200}\right) + I_{sc} = 0$ $\qquad \therefore \boxed{I_{sc} = V_1\left(\frac{4}{400} + \frac{3}{400}\right) = \frac{25}{2} \cdot \frac{7}{400} = \frac{7}{32}}$

$R_{Th} = \frac{V_{oc}}{I_{sc}} = \frac{700}{18} \cdot \frac{32}{7} = \frac{1600}{9} = \boxed{177.8\,\Omega}$

$P_{100\Omega\ @\ ab} = V^2/R = \left[38.89 \frac{100}{277.8}\right]^2 \times \frac{1}{100} = \boxed{1.96\,W}$

EE 211 — Assignment 14

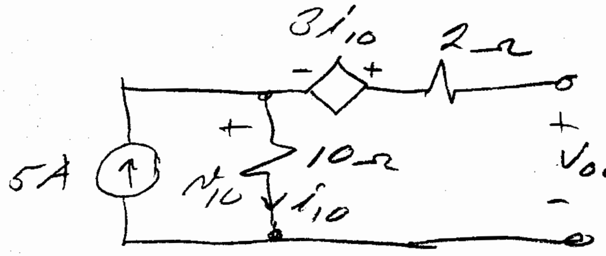
5.57



$$R_{Th} = \frac{v}{1}$$

$$v = 2\times10^{6} \quad \therefore \quad \boxed{R_{Th} = 2\times10^{6}\,\Omega}$$

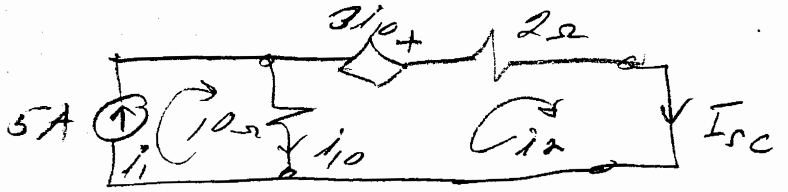
5.63



$$V_{oc} = 3i_{10} + v_{10}$$

but $v_{10} = 50$
$i_{10} = 5$

$$\therefore \boxed{V_{oc} = V_{Th} = 15 + 50 = 65\,V}$$

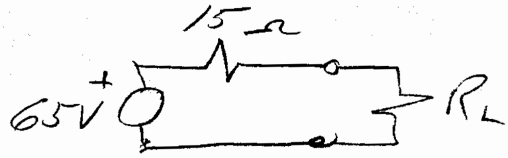


$i_2 = I_{sc}$
$i_1 = 5$

$$10(i_2 - i_1) - 3i_{10} + 2i_2 = 0 \qquad \text{but } i_{10} = i_1 - i_2$$

$$\therefore \quad 15i_2 - 13i_1 = 0 \text{ giving } \boxed{i_2 = \frac{13\times5}{15} = \frac{13}{3} = I_{sc}}$$

$$R_{Th} = \frac{V_{oc}}{I_{sc}} = \frac{65\times3}{13} = 15\,\Omega$$



b) maximum power to R_L for $R_L = 15\,\Omega$

$$P_{max} = \frac{V_{Th}^2}{4R_{Th}} = \frac{65^2}{60} = 70.42 \text{ Watts}$$

EE 211 Assignment 15

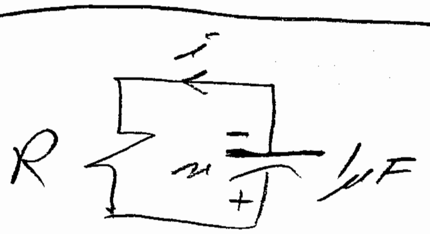
7.1 $\boxed{10\mu F}$ a) $v = 5\,V$ $\therefore$ $\boxed{i = C\frac{dv}{dt} = 0}$

b) $v = 115\sqrt{2}\cos 120\pi t$ $i = -115\sqrt{2} \times 10^{-5} \times 120\pi \sin 120\pi t$

or $i = -0.613 \sin 120\pi t$

c) $v = 4e^{-t} \times 10^{-3}$; $\boxed{i = -4\times 10^{-8} e^{-t}}$

7.13



for $t \geq 0$ $W_c = \frac{1}{2} C v^2 = 20 e^{-10^3 t} \times 10^{-3}$

$\therefore$ $v^2 = \frac{40}{10^{-6}} e^{-10^3 t} \times 10^{-3}$

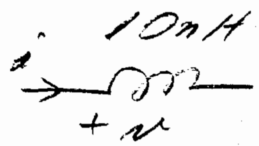
$v = \pm\ 200\, e^{-500t}$

$i = C\frac{dv}{dt} = \pm 10^{-6} \times (200) \times (-500) e^{-500t} = \mp\ 0.1\, e^{-500t}$

$$\boxed{R = -\frac{v}{i} = +\frac{200}{0.1} = 2\times 10^3\,\Omega}$$

$$W_R = \int_0^\infty vi\,dt = \int_0^\infty 20 e^{-10^3 t} dt = \frac{20}{-10^3} e^{-10^3 t}\Big|_0^\infty = \boxed{0.02\,J}$$

7.15



a) $i = 5\,mA$; $v = L\frac{di}{dt} = 0$

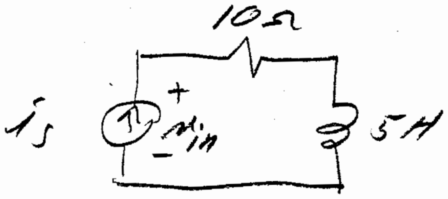
b) $i = 115\sqrt{2}\cos 120\pi t$; $v = 10^{-8} \times 115\sqrt{2}(-1) 120\pi \sin 120\pi t$

$\boxed{i = -6.13\times 10^{-4} \sin 120\pi t}$

c) $i = 4e^{-6t}$; $v = 10^{-8} \times 4(-6) e^{-6t} = \boxed{-24\times 10^{-8} e^{-6t}}$

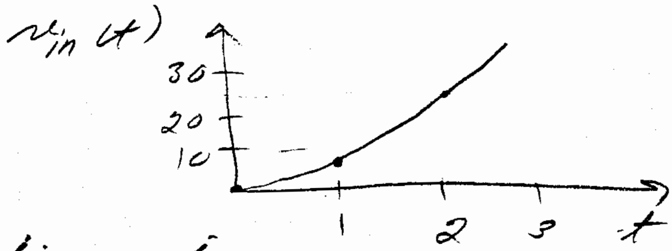
EE 211 Assignment 16

7.21

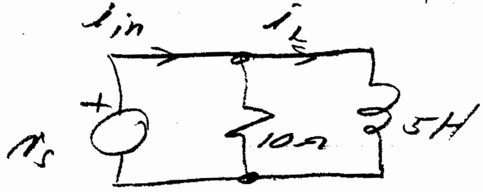


a) $i_s = 0.4t^2$

$$\boxed{v_{in} = 10 i_s + 5\frac{di_s}{dt} = 4t^2 + 4t}$$



b)



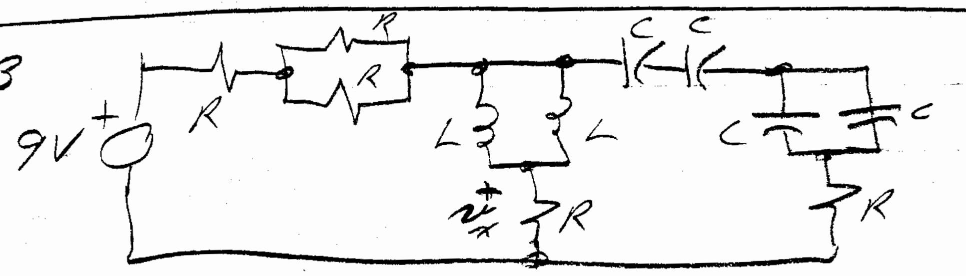
$v_s = 40t$; $i_L(0) = 5$

$$i_{in} = \frac{v_s}{10} + \frac{1}{5}\int_0^t v_s\,dt + 5$$

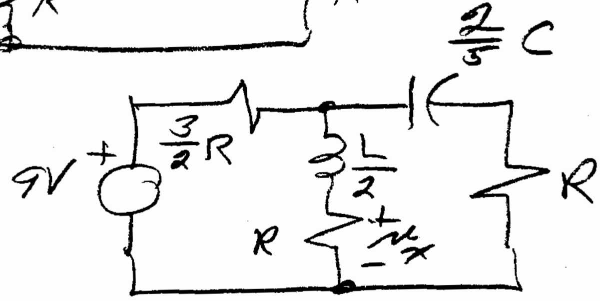
or $\boxed{i_{in} = 4t + 4t^2 + 5}$

[sketch same as above shifted up by 5]

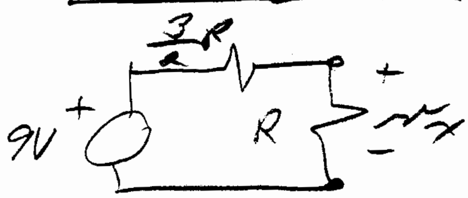
7.33



⟹



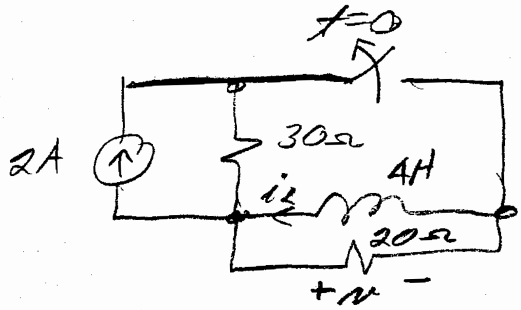
@ dc reduces to:



so $\boxed{v_x = 9\,\frac{R}{\frac{5}{2}R} = \frac{18}{5}\,\text{V}}$ ←

EE 211 Assignment 17

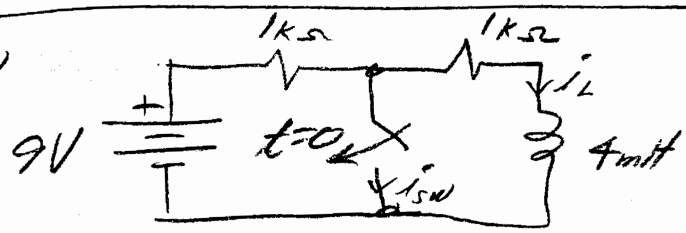
8.6



a) $i_L(0^-) = i_L(0^+) = 2A$ ←

b) $v(0^+) = 2 \times 20 = 40V$ ←

8.8



$i_L(0^-) = i_L(0^+) = \frac{9}{2 \times 10^3}$

for $t > 0$ $\quad i_L \times 10^3 + 4 \times 10^{-3} \frac{di_L}{dt} = 0$

$i_L = Ae^{s_1 t} \Rightarrow 10^3 + 4 \times 10^{-3} s_1 = 0$

$s_1 = -\frac{10^3}{4 \times 10^{-3}} = -\frac{1}{4} \times 10^6$

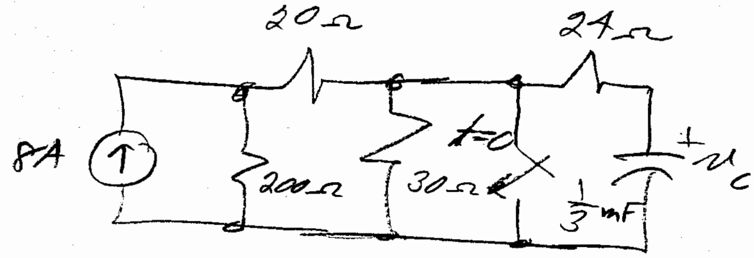
$\therefore \boxed{i_L = \frac{9}{2} \times 10^{-3} e^{-\frac{t \times 10^6}{4}}}$

a) $t = 5\mu s \quad i_L = \frac{9}{2} \times 10^{-3} e^{-\frac{5}{4}} = \boxed{1.289 \times 10^{-3}}$ ←

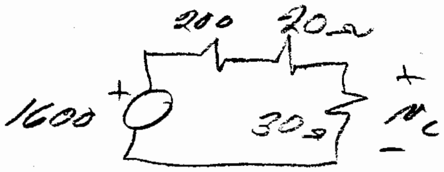
b) $i_{SW}(t = 5 \times 10^{-6}) = -i_L + \frac{9}{10^{+3}} = \boxed{7.71 \times 10^{-3}}$ ←

EE 211 Assignment 18

8.22



a) before $t=0$



$\therefore$ $\boxed{v_c(0) = 1600\frac{30}{250} = 192\,V}$

for $t > 0$ $\boxed{v_c(t) = 192\,e^{-\frac{t}{24\times\frac{1}{3}\times 10^{-3}}} = 192\,e^{-\frac{10^3 t}{8}} = 192\,e^{-125t}}$

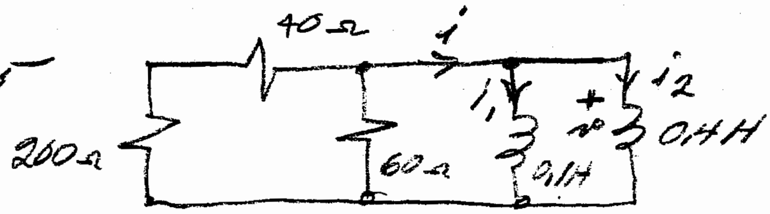
b) $0.1 = e^{-125t}$

$\ln 0.1 = -125t$

or $\boxed{t = -\frac{1}{125}\ln 0.1 = 0.0184\,\text{sec} = 18.4\,\text{msec}}$ ←

EE 211 Assigment 19

8.35



$i_1(0^-) = 10\,A$

$i_2(0^-) = 20\,A$

a) $i_1(0^+) = 10\,A$; $i_2(0^+) = 20\,A$; $i(0^+) = 30\,A$

b) $$T = \frac{L_{eq}}{R_{eq}} = \frac{\frac{0.04}{0.5}}{\frac{240(60)}{300}} = \frac{0.04 \times \cancel{300}^{5}}{\cancel{0.5}_{0.1} \times 240 \times \cancel{60}} = \frac{0.4}{240} = \frac{5}{3} \times 10^{-3}$$

c) $$\boxed{i(t) = 30 e^{-\frac{3 \times 10^{3}}{5} t} = 30 e^{-600t}}$$ for $t > 0$

d) $$\boxed{v(t) = -R_{eq}\, i(t) = -1440\, e^{-600t}}$$

e) $$i_1(t) = 10 \int_0^t (-1440) e^{-600t}\, dt + 10 = \frac{+\cancel{10} \times 1440}{+\cancel{600}} e^{-600t} \Big|_0^t + 10$$

$$\boxed{i_1(t) = 24 e^{-600t} - 14}$$

$$\boxed{i_2(t) = 2.5 \int_0^t (-1440) e^{-600t}\, dt + 20 = 6 e^{-600t} + 14}$$

f) Energy delivered to resistor $= \int_0^\infty i^2 R_{eq}\, dt = \int_0^\infty 900\, e^{-1200t}\, 48\, dt$

$$W_R = \frac{48 \times 900}{-1200} e^{-1200t} \Big|_0^\infty = 36 \text{ Joules}$$

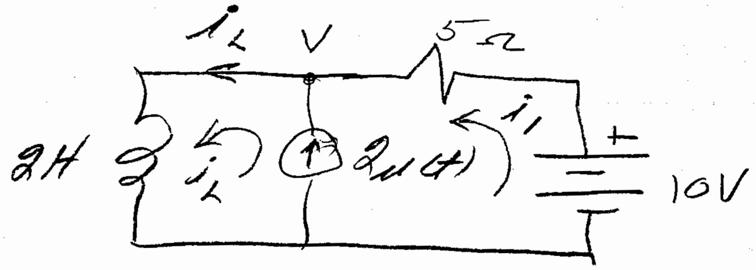
$$W_L(t=\infty) = \left[\tfrac{1}{2}(0.1) + \tfrac{1}{\cancel{2}}\, 0.4\right] 14^2 = 49 \text{ Joules}$$

$$W_L(t=0) = \tfrac{1}{2}(0.1)10^2 + \tfrac{1}{2}(0.4)20^2 = 5 + 80 = 85 \text{ Joules}$$

$$\boxed{W_L(t=0) - W_L(t=\infty) = 85 - 49 = 36 \text{ Joules} = W_R}$$ ✓

EE 211 Assignment 20

8.62



a) $t=-0.5\,sec$ for $t<0$ $\boxed{i_L = \frac{10}{5} = 2A}$

b) + c) for $t>0$ supermesh eq. is:

$$-10+5i_1+2\frac{di_L}{dt}=0 \ ; \ i_L - i_1 = 2 \ \text{ or } \ i_1 = i_L - 2$$

$$\therefore \boxed{5i_L + 2\frac{di_L}{dt} = 20}$$

$$i_{L_h} = Ae^{st} \ ; \ s = -\frac{5}{2} \quad \left(\tau = \frac{2}{5} = 0.4\,sec\right)$$

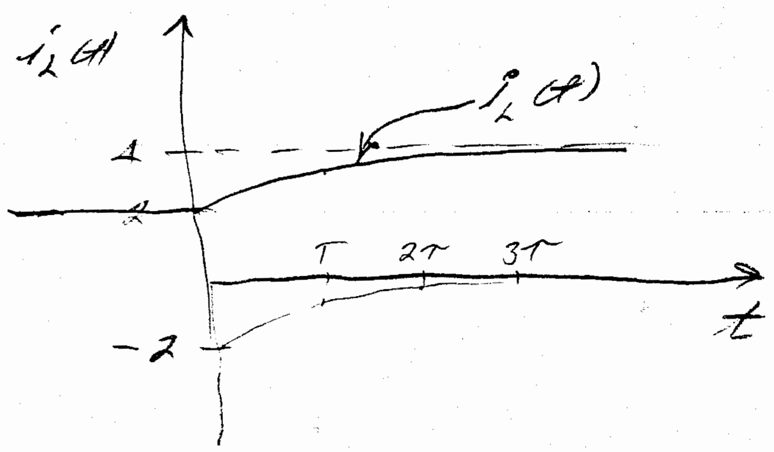
$$i_{L_p} = K = 4$$

so $i_L = Ae^{-\frac{5}{2}t} + 4$ but $i_L(0)=2$

$$\therefore \boxed{i_L = 4 - 2e^{-\frac{5}{2}t}}$$

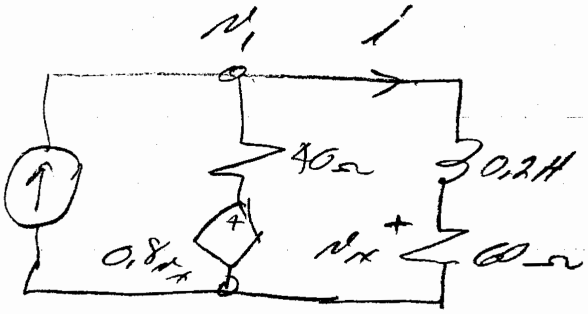
$$i_L(t=0.5) = 4-2e^{-\frac{5}{4}} = 3.427A$$

$$i_L(t=1.5) = 4-2e^{-\frac{15}{4}} = 3.95A$$



EE 211 Assignment 21

8.76



for $t<0$
current source $= \phi$
$\therefore v_x = 0$; $i = 0$

for $t>0$

$$\text{Node}\begin{cases} \dfrac{v_1 - 0.8v_x}{40} + 5\int_0^t (v_1 - v_x)\,dt = \dfrac{1}{10} \\ 5\int_0^t (v_x - v_1)\,dt + \dfrac{v_x}{60} = 0 \end{cases}$$

could solve but not straight forward

$$\text{Mesh}\begin{cases} 40\left(i - \frac{1}{10}\right) + \frac{1}{5}\frac{di}{dt} + 60i = \frac{4}{5}v_x \\ v_x = 60i \end{cases}$$

$$\therefore \frac{1}{5}\frac{di}{dt} + 52i = 4$$

$$i_h = Ae^{st} \; ; \; s = -52\times 5 = -260 \quad \therefore \boxed{i_h = Ae^{-260t}}$$

$$i_p = K = \frac{4}{52}$$

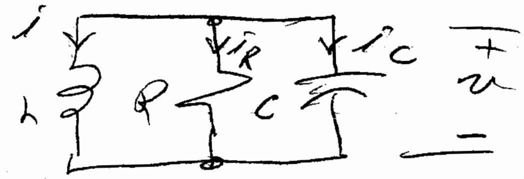
$$\text{so } i = i_h + i_p = \frac{4}{52} + Ae^{-260t}$$

$$\text{but } i(0) = 0 \quad \therefore \quad A = -\frac{4}{52}$$

$$\text{so } i = \frac{4}{52}\left(1 - e^{-260t}\right)u(t)$$

$$\text{and } v_x(t) = 60i = 4.615\left(1 - e^{-260t}\right)u(t)$$

EE 211 Assigment 22

9.6 

$i_C = 40e^{-100t} - 30e^{-200t}$ mA

$C = 1mF$, $v(0) = -0.5V$

a) $v = \frac{1}{C}\int_0^t i\,dt + v(0) = \left[-\frac{2}{5}e^{-100t} + \frac{3}{20}e^{-200t}\right]_0^t - 0.5$

$$v(t) = -\frac{2}{5}e^{-100t} + \frac{3}{20}e^{-200t} + \underbrace{\frac{2}{5} - \frac{3}{20} - \frac{1}{2}}_{-\frac{1}{4}} \leftarrow$$

b) $i_R(t) = \frac{v}{R}$ need R

$s_{1,2} = -100, -200$

$s_1 = -\alpha + \sqrt{\alpha^2 - \omega_0^2} = -100$

$s_2 = -\alpha - \sqrt{\alpha^2 - \omega_0^2} = -200$

$\left[s_1 + s_2 = -2\alpha = -300 \quad \text{or} \quad \frac{2}{2RC} = 300\right]$

$R = \frac{1}{300 \times 10^{-3}} = 3.33\,\Omega \leftarrow$

$\therefore \boxed{i_R(t) = \frac{v(t)}{3.33}} \leftarrow$

c) $\boxed{i(t) = -i_R(t) - i_C(t)} \leftarrow$

[Extra credit if they realize $v(0)$ must equal $-\frac{1}{4}$]

---

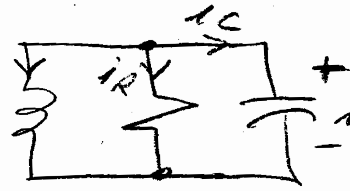
could find L $\quad s_1 - s_2 = 2\sqrt{\alpha^2 - \omega_0^2} = 100$

$\alpha^2 - \omega_0^2 = 50^2 \Rightarrow \omega_0^2 = \frac{1}{LC} = \alpha^2 - 50^2$

$$L = \frac{1}{C(\underbrace{\alpha^2 - 50^2}_{\omega_0^2})} = \frac{1}{10^{-3}(150^2 - 50^2)} = \frac{\cancel{10^3}}{20 \times \cancel{10^3}} = \boxed{0.05\ H}$$

EE 211 Assignment 23

9.10



$L = 5H$, $R = 8\Omega$, $C = 12.5mF$

$v(0+) = 40V$

a) $i(0+) = 8A$ find $v(t)$

$$\frac{v}{R} + C\frac{dv}{dt} + \frac{1}{L}\int_0^t v\,dt + i(0) = 0 \Rightarrow \frac{d^2v}{dt^2} + \frac{1}{RC}\frac{dv}{dt} + \frac{1}{LC}v = 0$$

$$v = Ae^{st} \quad \text{so} \quad s^2 + \frac{1}{RC}s + \frac{1}{LC} = 0 \quad \text{or} \quad s_{1,2} = -\frac{1}{2RC} \pm \sqrt{\left(\frac{1}{2RC}\right)^2 - \frac{1}{LC}}$$

$$\frac{1}{2RC} = \frac{1}{16\times 12.5\times 10^{-3}} = 5, \quad \frac{1}{LC} = \frac{1}{5\times 12.5\times 10^{-3}} = 16$$

$$\therefore s_{1,2} = -5 \pm \sqrt{25-16} = -5 \pm 3 = -2, -8$$

$$\boxed{v = A_1e^{-2t} + A_2e^{-8t}}; \quad v(0) = \boxed{40 = A_1 + A_2}$$

$$i(t) = -i_R - i_C = -\frac{A_1}{8}e^{-2t} - \frac{A_2}{8}e^{-8t} - 12.5\times10^{-3}\left(-2A_1e^{-2t} - 8A_2e^{-8t}\right)$$

$$i(0) = 8 = \overset{.025}{25\times10^{-3}}A_1 - 0.125A_1 + 0.1A_2 - 0.125A_2 = \boxed{-0.1A_1 - \overset{\frac{1}{40}}{0.025}A_2}$$

$$\therefore 8 = -\frac{1}{10}(40 - A_2) - \frac{1}{40}A_2 = -4 + A_2\left(\frac{1}{10} - \frac{1}{40}\right); \quad A_2 = \frac{12\times40}{3} = 160$$

$$\boxed{v(t) = -120e^{-2t} + 160e^{-8t}}$$

---

b) $i_C(0) = 8A$; find $i(t)$; $v(0) = 40$ $\therefore$ $i_R(0) = 5$

$$i(t) = A_3e^{-2t} + A_4e^{-8t} \qquad \text{but } i(0) = -i_C(0) - i_R(0) = -13$$

so $\boxed{-13 = A_3 + A_4}$

but $v(0) = L\frac{di}{dt}\Big|_{t=0}$ so $\frac{di}{dt}\Big|_{t=0} = \frac{40}{5} = \boxed{8 = -2A_3 - 8A_4}$

$$\therefore 8 = -2(-13 - A_4) - 8A_4 \quad \text{or} \quad 8 = 26 - 6A_4 \Rightarrow \boxed{A_4 = 3}$$

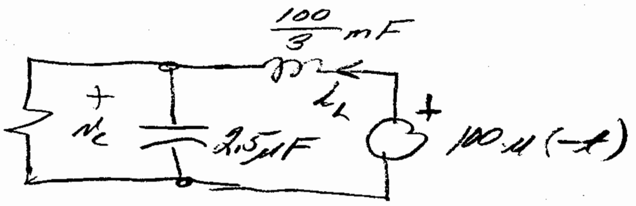
$$\boxed{A_3 = -13 - 3 = -16}$$

so $\boxed{i(t) = -16e^{-2t} + 3e^{-8t}}$

EE 211 Assignment 24

$$\boxed{v_C(0) = 100 \qquad i_L(0) = \frac{100}{R}}$$

9.28 $R = ?$



for $t > 0$ we have
a // RLC circuit

a) $\alpha = \omega_0$ if $\left(\frac{1}{2RC}\right)^2 = \frac{1}{LC}$ or $\frac{1}{4R^2C^{\cancel{2}}} = \frac{1}{L\cancel{C}}$; $R^2 = \frac{L}{4C}$

$$\therefore \boxed{R = \sqrt{\frac{0.1 \times 10^6}{3 \times 4 \times 2.5}} = 57.59\,\Omega}$$

$$\omega_0 = \alpha = \sqrt{\frac{1}{LC}} = \sqrt{\frac{3 \times 10^6}{0.1 \times 2.5}} = \boxed{3464}$$

so $v_C(t) = A_1 e^{-3464t} + A_2 t e^{-3464t}$

$$\therefore \boxed{100 = A_1}$$

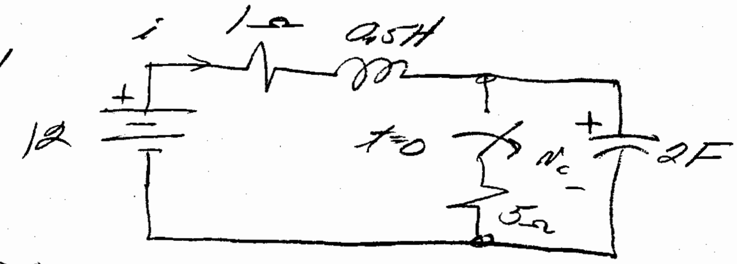
$$\frac{v_C}{R} + C\frac{dv_C}{dt} + \frac{1}{L}\int_0^t v_C\,dt - i_L(0) = 0 \quad \therefore \left.\frac{dv_C}{dt}\right|_{t=0} = -\frac{100}{RC} + \frac{100}{RC} = 0!$$

giving $-100 \times 3464 + A_2 = 0$; or $A_2 = 3.464 \times 10^5$

$$\boxed{v_C(t) = 100e^{-3464t} + 3.464 \times 10^5 te^{-3464t}}$$

EE 211 Assignment 25

9.61



$i(0) = \frac{12}{6} = 2A$

$v_c(0) = 12\frac{5}{6} = 10V$

for $t>0$

$$12 = i + \frac{1}{2}\frac{di}{dt} + \frac{1}{2}\int_0^t i\,dt + 10 \qquad (1)$$

$$\therefore \quad \frac{d^2 i}{dt^2} + 2\frac{di}{dt} + i = 0 \qquad i = Ae^{st}; \; s_{1,2} = \frac{-2 \pm \sqrt{4-4}}{2} = -1$$

$$\boxed{i(t) = A_1 e^{-t} + A_2 t e^{-t}}$$

$$\boxed{i(0) = 2 = A_1}$$

and from (1) $2 + \frac{1}{2}\left.\frac{di}{dt}\right|_{t=0} = 2 \quad \therefore \left.\frac{di}{dt}\right|_{t=0} = 0$

$$\left.\frac{di}{dt}\right|_{t=0} = -A_1 + A_2 = 0 \quad \Rightarrow A_1 = A_2$$

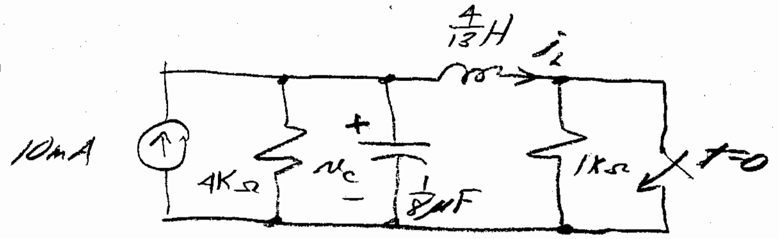
$$\boxed{i(t) = 2e^{-t} + 2te^{-t}}$$

$$v_c(t) = 12 - i - \frac{1}{2}\frac{di}{dt} = 12 - 2e^{-t} - 2te^{-t} - \frac{1}{2}\left\{-2e^{-t} - 2te^{-t} + 2e^{-t}\right\}$$

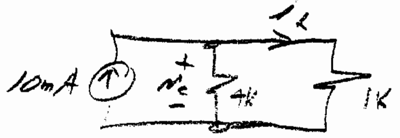
$$\boxed{v_c(t) = 12 - 2e^{-t} - te^{-t}} \qquad t > 0$$

EE 211 Assignment 26

9.60



for $t<0$



so $v_c(0) = 10^{-2}\frac{4}{5}\times 10^3 = 8$

$i_L(0) = 10^{-2}\frac{4}{5} = 8mA$

$$10^{-2} = \frac{v_c}{4\times 10^3} + \frac{1}{8}\times 10^{-6}\frac{dv_c}{dt} + \frac{13}{4}\int_0^t v_c dt + 8\times 10^{-3} \qquad (1)$$

$$\therefore \quad 0 = \frac{d^2 v_c}{dt^2} + 2\times 10^3 \frac{dv_c}{dt} + 26\times 10^6 v_c$$

$$s_{1,2} = -1\times 10^3 \pm \sqrt{10^6 - 26\times 10^6} = -10^3 \pm j\,5\times 10^3$$

$$\left[v_c(t) = A_1 e^{-10^3 t}\cos 5\times 10^3 t + A_2 e^{-10^3 t}\sin 5\times 10^3 t \right]$$

but $\boxed{v_c(0) = 8 = A_1}$

from (1) $\quad 10^{-2} = 2\times 10^{-3} + \frac{1}{8}\times 10^{-6}\left.\frac{dv_c}{dt}\right|_{t=0} + 8\times 10^{-3} \Rightarrow \left.\frac{dv_c}{dt}\right|_{t=0} = 0$

$$\text{so } \left[\cancel{-8\times 5\times 10^3 e^{-10^3 t}\sin 5\times 10^3 t} - 8\times 10^3 e^{-10^3 t}\cos 5\times 10^3 t + A_2\, 5\times 10^3 \times e^{-10^3 t}\cos 5\times 10^3 t \cancel{- A_2\times 10^3 e^{-10^3 t}\sin 5\times 10^3 t} \right]_{t=0} = 0$$

giving $\quad -8\times 10^3 + 5\times 10^3 A_2 = 0 \quad \Rightarrow A_2 = \frac{8}{5}$

$$v_c(t) = e^{-10^3 t}\left[8\cos(5\times 10^3)t + \frac{8}{5}\sin(5\times 10^3)t \right]$$

$$\left[\begin{array}{l} T = \frac{1}{f} = \frac{2\pi}{5\times 10^3} = 1.26\,msec \\ \tau = 1msec \end{array} \right]$$

$\boxed{\text{see attached plot}}$

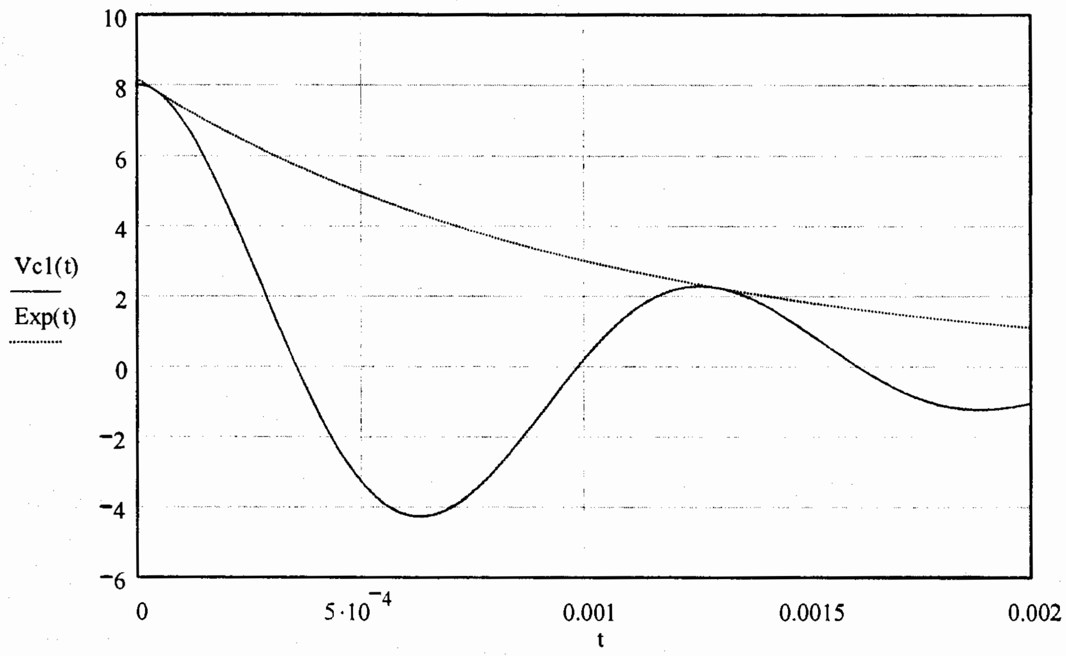
$$\text{or } v_c(t) = \sqrt{8^2 + \left(\frac{8}{5}\right)^2}\, e^{-10^3 t}\cos\left(5000t - \tan^{-1}\frac{1}{5}\right)$$

EE 211 Hayt problem 9.60

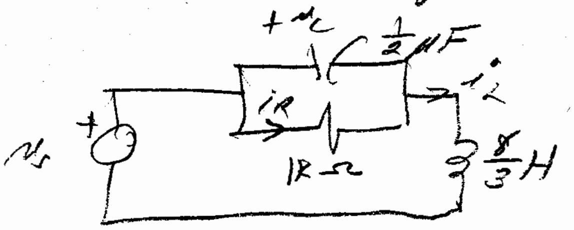
$t := 0, 10^{-8} .. 2 \times 10^{-3}$

$$Vc(t) := e^{-1000 \cdot t}\left(\frac{8}{5} \cdot \sin(5000 \cdot t) + 8 \cdot \cos(5000 \cdot t)\right)$$

$$Exp(t) := \left[\sqrt{8^2 + \left(\frac{8}{5}\right)^2}\right] \cdot e^{-1000 \cdot t} \qquad Vc1(t) := Exp(t) \cdot \cos\left(5000 \cdot t - \operatorname{atan}\left(\frac{1}{5}\right)\right)$$



EE 211 Assignment 27

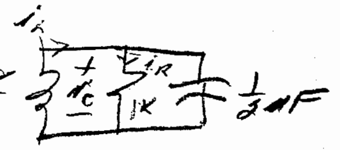
9.62 

$v_c(0)=10$

$i_L(0)=\frac{10}{10^3}=10^{-2}$

a) $v_s = 10u(-t)$ or for $t<0$ $v_s=10$

$t>0$ $v_s=0$

for $t>0$ 

$$\boxed{\therefore \frac{v_c}{10^3}+\frac{10^{-6}}{2}\frac{dv_c}{dt}+\frac{3}{8}\int_0^t v_c\,dt-10^{-2}=0 \quad (1)}$$

or $\frac{d^2v_c}{dt^2}+2\times10^{+3}\frac{dv_c}{dt}+\frac{3}{4}\times10^6 v_c=0$; $s^2+2\times10^3 s+\frac{3}{4}\times10^6=0$

$$S_{1,2}=\frac{-2\times10^3\pm\sqrt{4\times10^6-3\times10^6}}{2}=-1\times10^3\pm\frac{1}{2}\times10^3.$$

$$S_{1,2}=-\frac{3}{2}\times10^3,\ -\frac{1}{2}\times10^3$$

$v_c(t)=A_1e^{-\frac{3}{2}\times10^3t}+A_2e^{-\frac{1}{2}\times10^3t}$ but $v_c(0)=10$

$\therefore$ $\boxed{10=A_1+A_2}$

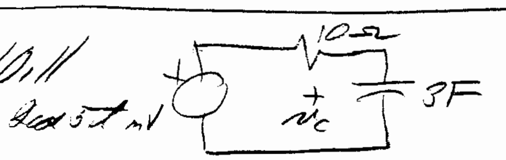
from (1) $10^{-2}+\frac{10^{-6}}{2}\left.\frac{dv_c}{dt}\right|_{t=0}-10^{-2}=0$ $\therefore$ $\left.\frac{dv_c}{dt}\right|_{t=0}=0$

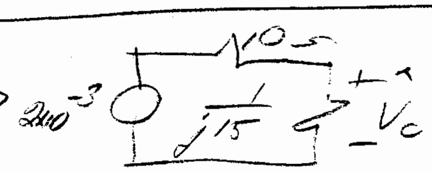
giving $0=A_1(-\frac{3}{2}\times10^3)+A_2(-\frac{1}{2}\times10^3)$ or $\boxed{0=-3A_1-A_2}$

so $0=-3(10-A_2)-A_2=-30+2A_2$ $\therefore$ $A_2=15$

and $A_1=10-A_2=-5$

$$\boxed{\text{so } i_R=\frac{v_c(t)}{10^3}=-5\times10^{-3}e^{-\frac{3}{2}\times10^3t}+15\times10^{-3}e^{-\frac{1}{2}\times10^3t}}$$

10.11 

$\Rightarrow$ 

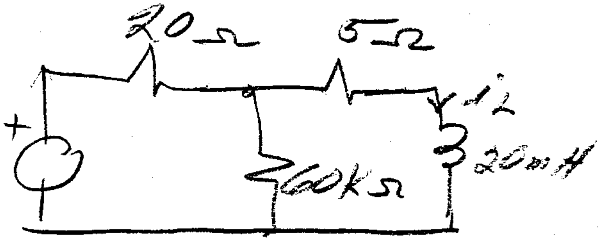
$$\hat{V}_c=2\times10^{-3}\frac{\frac{1}{j15}}{10+\frac{1}{j15}}=2\times10^{-3}\frac{1}{1+j150}=\frac{2\times10^{-3}}{150e^{j89.62°}}=1.33\times10^{-5}e^{-j89.62°}$$

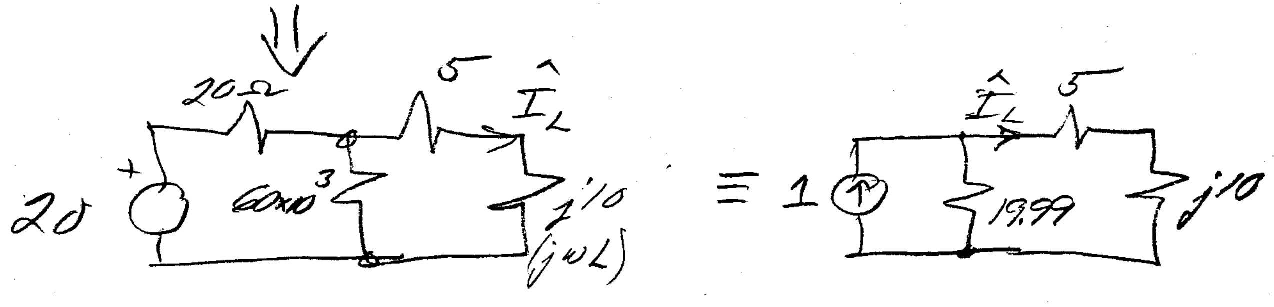
so $v_c(t)=13.33\times10^{-6}\cos(5t-89.62°)$

EE 211 Assignment 28

10.13

$20\cos 500t = v_s$





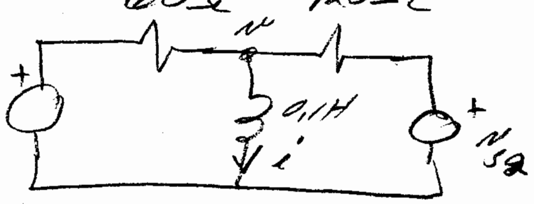
so by current division $\hat{I}_L = 1\,\frac{19.99}{24.99 + j10} = \frac{19.99}{26.92\,e^{j21.8^\circ}}$

$\hat{I}_L = 0.7426\,e^{-j21.8^\circ}$

$\boxed{\therefore\ i_L(t) = 0.7426\cos(500t - 21.8^\circ)}$

EE 211 Assignment 29 10.21

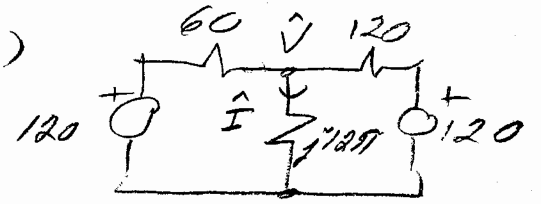
10.18



$v_{s1} = v_{s2} = 120\cos 120\pi t$

$j\omega L = j\,120\pi \times 0.1$

a)



$$\frac{\hat{V}-120}{60} + \frac{\hat{V}}{j12\pi} + \frac{\hat{V}-120}{120} = 0$$

$$\hat{V}\left(\frac{1}{60}+\frac{1}{120}-j\frac{1}{12\pi}\right) = 1+2 = 3$$

or $\hat{V}(3\pi - j10) = 360\pi$; $\hat{V} = \dfrac{360\pi}{3\pi - j10}$; $\hat{I} = \dfrac{\hat{V}}{j12\pi} = \dfrac{-j30}{3\pi - j10}$

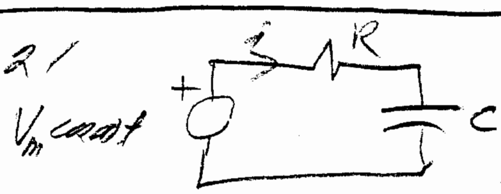
$$\hat{I} = \frac{30}{10+j3\pi} = \frac{30}{13.74\,e^{j43.3^\circ}} ; \boxed{2.183\cos(120\pi t - 43.3^\circ) = i(t)}$$

$$W_L = \frac{1}{2}Li^2 = 0.05 \times 4.765\cos^2(120\pi t - 43.3^\circ)$$

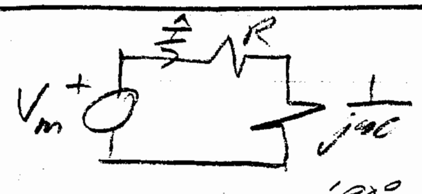
or $\boxed{W_L = 0.2383\cos^2(120\pi t - 43.3^\circ)\ \text{J}}$

b) $\boxed{W_{L\,ave} = \frac{1}{2}\times 0.2383 = 0.119\ \text{J}}$

10.21



$\Rightarrow$



$$\hat{I} = \frac{V_m}{R+\frac{1}{j\omega C}} = \frac{V_m\,j\omega C}{1+j\omega RC} = \frac{\omega C V_m\,e^{j90^\circ}}{\sqrt{1+(\omega RC)^2}\,e^{j\tan^{-1}(\omega RC)}}$$

$$\hat{I} = \frac{\omega C V_m}{\sqrt{1+(\omega RC)^2}}\,e^{j[90^\circ - \tan^{-1}(\omega RC)]}$$

$$\therefore\ i(t) = \frac{\omega C V_m}{\sqrt{1+(\omega RC)^2}}\cos\left[\omega t + 90^\circ - \tan^{-1}(\omega RC)\right]$$

$$\text{or } i(t) = \frac{\omega C V_m}{\sqrt{1+(\omega RC)^2}}\cos\left[\omega t + \tan^{-1}\left(\frac{1}{\omega RC}\right)\right]$$

EE211 Assigment 30

10.26 a) $5e^{-j110°} = -1.71 - j4.698$ ←

b) $6e^{j160°} = -5.638 + j2.052$ ←

c) $(3+j6)(2e^{j50°}) = (3+j6)(1.285+j1.532) = -5.337 + j12.31$ ←

d) $-100 - j40 = \underline{107.7e^{j201.8°}} = \underline{107.7e^{-j158.2°}}$ ←

e) $2e^{j50°} + 3e^{j120°} = 1.2856 + j1.532 - 1.5 - j2.598 = -0.2144 - j1.066$

$= 1.087e^{-j101.37°}$

10.27 a) $40e^{-j50°} - 18e^{j25°} = 25.712 - j30.64 - 16.31 - j7.607$

$= -j38.247 + 9.402 = \underline{39.39e^{-j76.19°}}$ ←

b) $3 - j2 + \dfrac{2-j5}{1+j2} = \dfrac{3+j6-j2+4+2-j5}{1+j2} = \dfrac{9-j}{1+j2} = \dfrac{(9-j)(1-j2)}{5}$

$= \dfrac{7-j19}{5} = 1.4 - j3.8 = \underline{4.05e^{-j69.78°}}$ ←

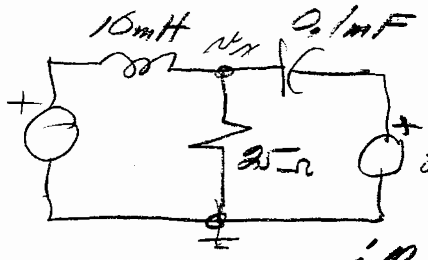
c) $[2.1e^{j25°}]^3 = 9.261e^{j75°} = \underline{2.397 + j8.945}$ ←

d) $0.7e^{j0.3} = 0.669 + j0.207$ ←

EE 211 Assignment 31

10.65

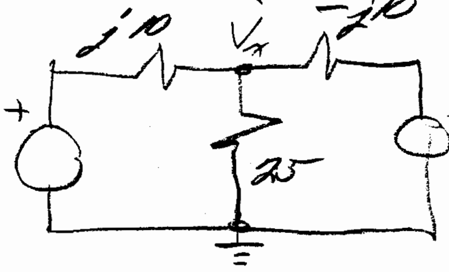
$20\cos 10^3 t$



$20\sin 10^3 t = 20\cos(10^3 t - 90^\circ)$

so we have:

20



$20e^{-j90^\circ} = -j20$

$\frac{j20}{-j10}$

$$\frac{\hat{V}_x - 20}{j10} + \frac{\hat{V}_x}{25} + \frac{\hat{V}_x - 20e^{-j90^\circ}}{-j10} = 0$$

$$\hat{V}_x\left(\cancel{-j\frac{1}{10}} + \frac{1}{25} \cancel{+j\frac{1}{10}}\right) = -j2 + 2 \quad \Rightarrow \quad \hat{V}_x = 50(1-j)$$

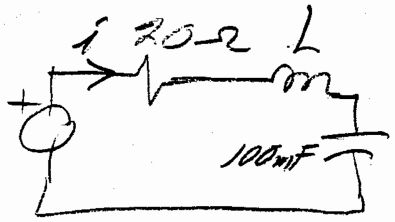
$$\hat{V}_x = 50\sqrt{2}\, e^{-j45^\circ}$$

so $v_x(t) = \underbrace{50\sqrt{2}}_{70.71} \cos(10^3 t - 45^\circ)$ ←

EE 211 Assignment 32

10.74

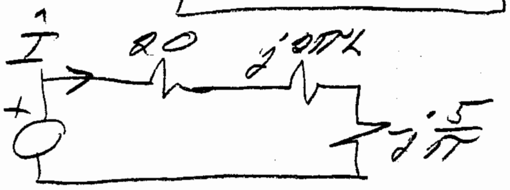
$115\sqrt{2}\cos(2\pi t)$



$i = 8.132\cos 2\pi t$

$$\frac{1}{j\omega C} = \frac{1}{j2\pi\times 0.1} = -j\frac{5}{\pi}$$

$115\sqrt{2}$



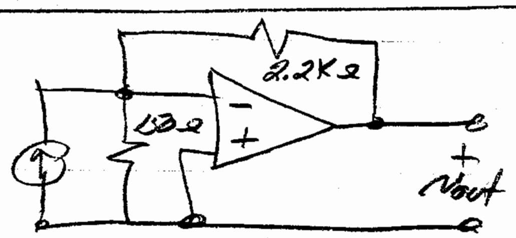
$$\hat{I} = \frac{115\sqrt{2}}{20 + j\left(2\pi L - \frac{5}{\pi}\right)}$$

$$|\hat{I}| = 8.132 = \frac{115\sqrt{2}}{\sqrt{400 + \left(2\pi L - \frac{5}{\pi}\right)^2}} \quad \text{or} \quad 400 + \left(2\pi L - \frac{5}{\pi}\right)^2 = \left(\frac{115\sqrt{2}}{8.132}\right)^2 = 400$$

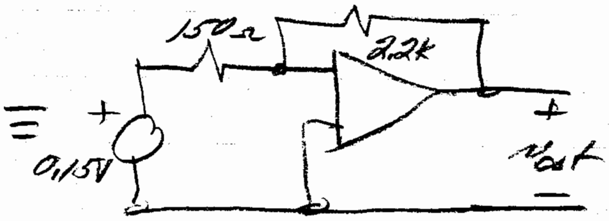
$$\text{or} \quad \left(2\pi L - \frac{5}{\pi}\right)^2 = 0 \; ; \; \boxed{L = \frac{5}{2\pi^2} = 0.253\,H}$$

6.13

1mA



$\equiv$

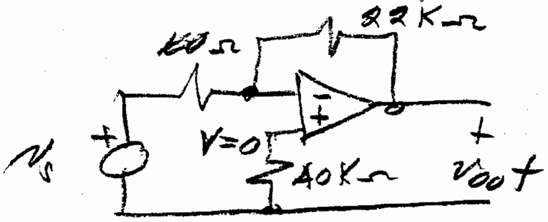


inverting amp

$$\therefore v_{out} = -\frac{2.2\times 10^3}{150}\times 0.15 = -2.2 \text{ volts}$$

EE 211 Assignment 33

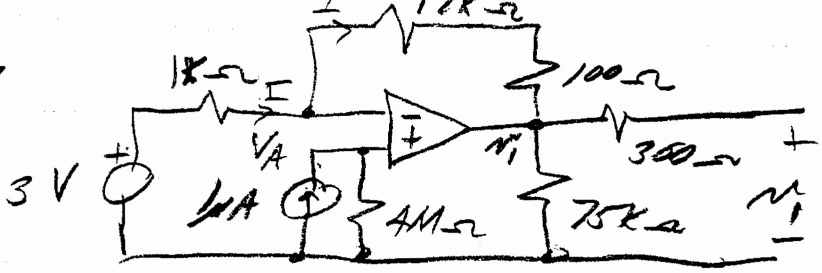
6.16



40K Ω resistor has no current so it has no effect on the circuit.

$$\boxed{v_{out} = -\frac{22\times10^3}{10^2} v_s = -220\, v_s}$$

6.17



$$V_A = 10^{-6}\times4\times10^6 = 4V \quad \therefore \; -3+10^3 I+4=0$$

or $\boxed{I = -10^{-3} A}$

and $$\frac{4-3}{10^3} + \frac{4-v_1}{17.1\times10^3} = 0$$

$$\frac{1}{10^3} + \frac{4}{17.1\times10^3} = \frac{v_1}{17.1\times10^3}$$

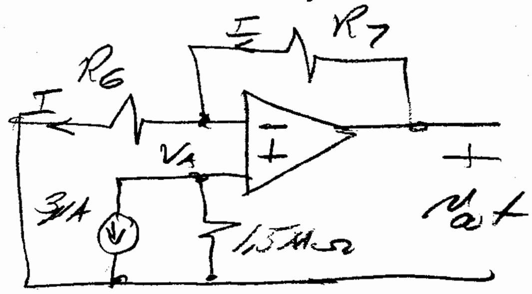
$$\boxed{v_1 = 4 + 17.1 = 21.1\,V}$$

$\boxed{\text{could find } v_1 = -I(17.1\times10^3)+4 = 17.1+4 = 21.1\,V}$

2nd method

EE 211 Assignment 34

6.22



$$-V_A = 3\times10^{-6}\times 1.5\times10^{6} = 4.5$$

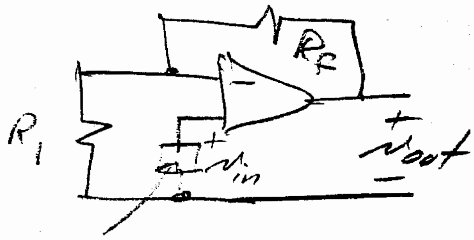
$$\therefore I = \frac{-4.5}{R_6}$$

and $$v_{out} = IR_7 - 4.5 = \frac{-4.5}{R_6}R_7 - 4.5 = -4.5\left(1+\frac{R_7}{R_6}\right)$$

Special problem ... need a non-inverting amplifier with a gain of:

$$0.01\ \mathrm{V/degree} \times 100\ \mathrm{degrees} = 1\ \mathrm{V}$$

∴ 1 volt in should give 10 volts out or a gain of 10.

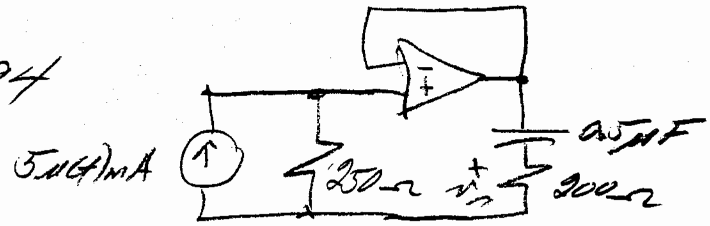


Thermal sensor

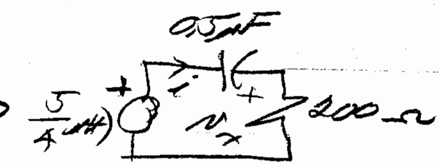
$$\frac{v_{out}}{v_{in}} = 10 = 1 + \frac{R_f}{R_1}\ ;\ \text{so}\ \boxed{\frac{R_f}{R_1} = 9}$$

EE 211 Assignment 35

8.94



$\Rightarrow$

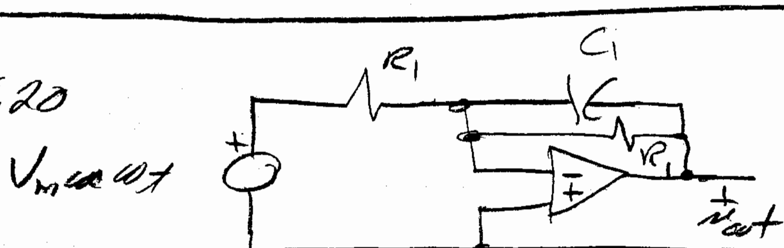


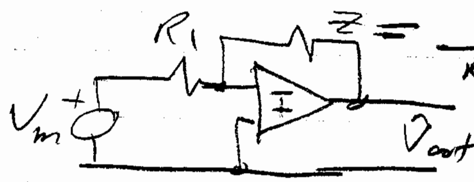
$$\frac{5}{4} = 200i + 2\times10^6\int_0^t i\,dt \quad \text{or} \quad 0 = 200\frac{di}{dt} + 2\times10^6 i$$

$$i = Ae^{st} \;;\; 200s + 2\times10^6 = 0 \quad \therefore \boxed{s = -10^4}$$

$$i(0) = \frac{5}{4\times200} \quad \therefore \quad i(t) = \frac{5}{4\times200}e^{-10^4 t} \text{ and } \boxed{v_x = 200i = \frac{5}{4}e^{-10^4 t}}$$

10.20





$$Z = \frac{R_1\frac{1}{j\omega C_1}}{R_1 + \frac{1}{j\omega C_1}} = \frac{R_1}{1 + j\omega R_1 C_1}$$

$$\hat{V}_{out} = -V_m \frac{1}{1 + j\omega R_1 C_1} \quad \text{(inverting amp)} \quad \text{Gain} = -\frac{Z_F}{Z_{in}}$$

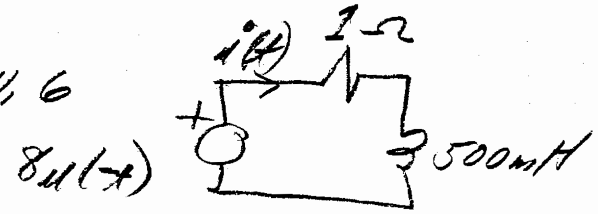
$$\hat{V}_{out} = -V_m \frac{e^{-j\tan^{-1}\omega R_1 C_1}}{\sqrt{1 + (\omega R_1 C_1)^2}}$$

$$\boxed{v_{out}(t) = -\frac{V_m}{\sqrt{1 + (\omega R_1 C_1)^2}}\cos(\omega t - \tan^{-1}\omega R_1 C_1)}$$

Low Pass Filter!

EE 211 Assignment 36

11.6



@ t=0 i(t) = 8A

for t>0 $0 = i + \frac{1}{2}\frac{di}{dt}$

$i = Ae^{st}$; $0 = 1 + \frac{1}{2}s$ or $s = -2$

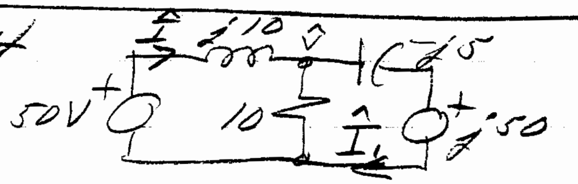
and $i(t) = 8e^{-2t}$

a) $P_R = i^2R$ ∴ $P_R(0^+) = 8^2 \times 1 = \boxed{64 \text{ Watts}}$

b) $P_R(1) = [8e^{-2}]^2 = \boxed{1.17 \text{ watts}}$

c) $P_R(2) = [8e^{-4}]^2 = \boxed{21.47 \text{ mWatts}}$

11.14



$\frac{\hat{V}-50}{j10} + \frac{\hat{V}}{10} + \frac{\hat{V}-j50}{-j5} = 0$

$\hat{V}\left(-j\frac{1}{10} + \frac{1}{10} + j\frac{1}{5}\right) = -j5 - 10$ or $\hat{V}(1+j) = -50(2+j)$

$\hat{V} = \frac{-50(2+j)}{1+j} = \frac{50e^{j180°}\sqrt{5}\,e^{j26.57°}}{\sqrt{2}\,e^{j45°}} = 79.06e^{j161.57°}$

$\hat{I} = \frac{50-\hat{V}}{j10} = \frac{50+75-j25}{j10} = \frac{127.48e^{-j11.31°}}{10e^{j90°}} = 12.75e^{-j101.31°}$

$P_{avg_{50V}} = \ominus\frac{1}{2}\,12.75 \times 50 \cos(101.31°) = \boxed{+62.51 \text{ Watts}}$

$P_{avg_{10\Omega}} = \frac{1}{2}\frac{|\hat{V}|^2}{10} = \frac{(79.06)^2}{20} = \boxed{312.52 \text{ watts}}$

$\hat{I}_1 = \frac{\hat{V}-j50}{-j5} = \frac{-75+j25-j50}{-j5} = \frac{+75+j25}{+j5} = 5-j15 = 15.81e^{-j71.57°}$

$P_{avg_{j50V}} = \frac{1}{2}\,50 \times 15.81 \cos(90+71.57°) = 395.25 \times (-0.949) = \boxed{-375 \text{ Watts}}$

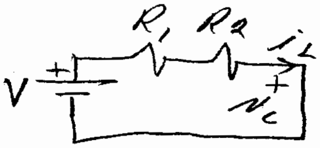
$\Sigma = 0.05 \approx 0$

(1)

EE 211 Final (Solutions)

10:54
10:27
27 min

1. a)



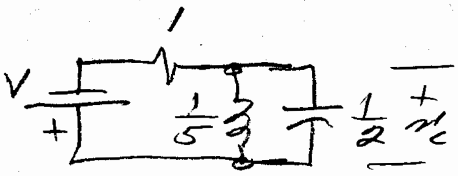
$v_c(0) = 0$

$i_L(0) = \frac{V}{R_1+R_2} = \frac{4}{2} = 2A$

$v = L\frac{di}{dt}$

$i = C\frac{dv}{dt}$

b)



$v_c + 4 + 5\int_0^t v_c\,dt + 2 + \frac{1}{2}\frac{dv_c}{dt} = 0$

or $\frac{d^2v_c}{dt^2} + 2\frac{dv_c}{dt} + 10v_c = 0$; $v_c = Ae^{st}$

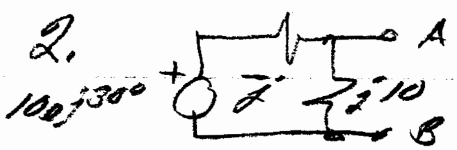
$s^2 + 2s + 10 = 0$ $\therefore$ $s_{1,2} = \frac{-2 \pm \sqrt{4-40}}{2} = -1 \pm j3$

$v_c(t) = B_1 e^{-t}\cos 3t + B_2 e^{-t}\sin 3t$ but $v_c(0) = 0$ $\therefore$ $\boxed{B_1 = 0}$

$\left.\frac{dv_c}{dt}\right|_{t=0} = -12 = 3B_2$; $\boxed{v_c(t) = -4e^{-t}\sin 3t}$

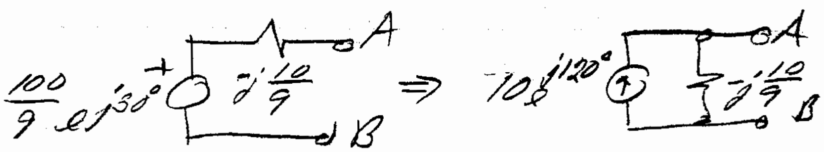
c) Underdamped

2.

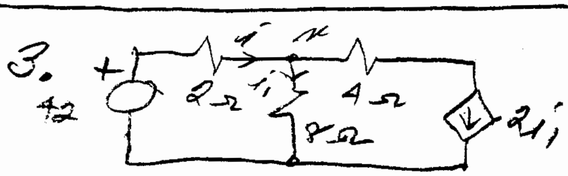


a) $\hat{V}_{Th} = \hat{V}_{oc} = \frac{-j10}{-j9} \cdot 10e^{j30°} = \frac{100}{9}e^{j30°}$

$Z_{Th} = Z_{eq} = \frac{-j(j10)}{-j9} = -j\frac{10}{9}$



3.



$\frac{v-42}{2} + \frac{v}{8} + 2i_1 = 0$; $i_1 = \frac{v}{8}$

$\therefore v\underbrace{\left(\frac{1}{2} + \frac{1}{8} + \frac{1}{4}\right)}_{\frac{7}{8}} = 21$ so $\boxed{v = 24V}$

$\boxed{i = 3i_1 = 9A}$

---

4. $-V_1 + I(2R_1) + V_2 = 0$; $I = \frac{V_1 - V_2}{2R_1}$ $\therefore$ $V_+ = V_- = IR_1 + V_2 = \frac{V_1 - V_2}{2} + V_2 = \frac{V_1+V_2}{2}$

$V_- = \frac{V_{out}\cancel{R}}{2\cancel{R}}$ so $\boxed{V_{out} = 2V_- = V_1 + V_2}$

EE 211 Final (solutions)

5, a)

$$\left.\begin{aligned} -5+2i_1+i_2+4+3i_2&=0 \\ i_2-i_1&=2 \end{aligned}\right\} \quad \begin{aligned} 2i_1+4i_2&=1 \\ -i_1+i_2&=2 \end{aligned} \quad \Bigg| \quad \begin{bmatrix} 2 & 4 \\ -1 & 1 \end{bmatrix}\begin{bmatrix} i_1 \\ i_2 \end{bmatrix} = \begin{bmatrix} 1 \\ 2 \end{bmatrix}$$

b)

$$\left.\begin{aligned} \frac{V_1-5}{2}-2+\frac{V_1-V_2}{1}&=0 \\ \frac{V_2-V_1}{1}+\frac{V_3}{3}&=0 \\ V_2-V_3&=4 \end{aligned}\right\} \quad \begin{aligned} \frac{3}{2}V_1-V_2&=\frac{9}{2} \\ -V_1+V_2+\frac{1}{3}V_3&=0 \\ V_2-V_3&=4 \end{aligned} \quad \Bigg| \quad \begin{bmatrix} 3 & -2 & 0 \\ -3 & 3 & 1 \\ 0 & 1 & -1 \end{bmatrix}\begin{bmatrix} V_1 \\ V_2 \\ V_3 \end{bmatrix} = \begin{bmatrix} 9 \\ 0 \\ 4 \end{bmatrix}$$

c) from a)

$$i_1 = \frac{\begin{vmatrix} 1 & 4 \\ 2 & 1 \end{vmatrix}}{\begin{vmatrix} 2 & 4 \\ -1 & 1 \end{vmatrix}} = \frac{1-8}{2+4} = -\frac{7}{6}$$

$$i_2 = \frac{\begin{vmatrix} 2 & 1 \\ -1 & 2 \end{vmatrix}}{6} = \frac{4+1}{6} = \frac{5}{6}$$