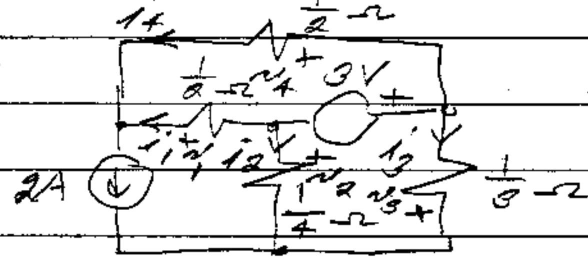
EE 211 Homework 1

1.4 $q = 4e^{-2t}$ $\therefore i = \frac{dq}{dt} = \boxed{-8e^{-2t}}$

1.11



a) $i_1 = -2A$ $\therefore v_1 = -i_1(\frac{1}{2}) = 1\ V$

b) $v_2 = -\frac{11}{7}V$ $\therefore i_2 = \frac{v_2}{\frac{1}{4}} = -\frac{44}{7}A$

c) $i_3 = \frac{30}{7}A$ $\therefore v_3 = -i_3(\frac{1}{3}) = -\frac{10}{7}V$

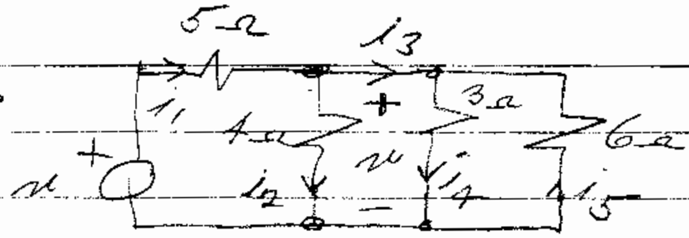
d) $v_4 = 2V$ $\therefore i_4 = v_4 \times 2 = 4A$

$v_1 - 3 + v_4 \stackrel{?}{=} 0$

$1 - 3 + 2 = 0$ ✓

EE 211 Homework 2

1.19



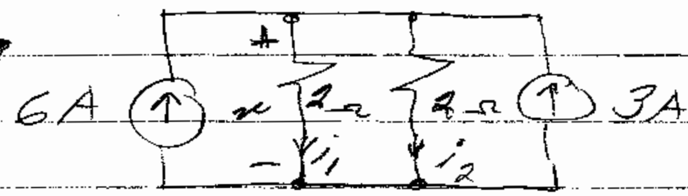
$i_4 = 4A$

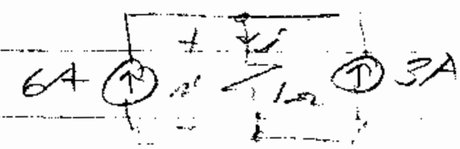
$v = 3 \times i_4 = 12V$

$\therefore\ i_2 = \frac{12}{4} = 3A$, $i_5 = -\frac{12}{6} = -2A$, $i_3 = i_4 - i_5 = 6A$

$i_1 = i_2 + i_3 = 9A$

1.30a





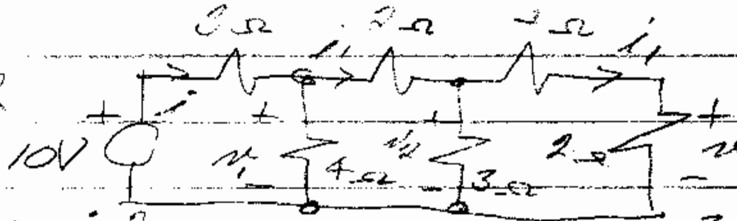
$R_{eq} = 1\Omega$

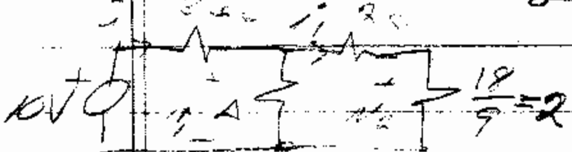
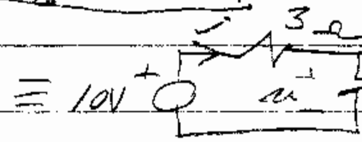
$i = 6 + 3 = 9A$

$\therefore\ \boxed{v = 9V}$

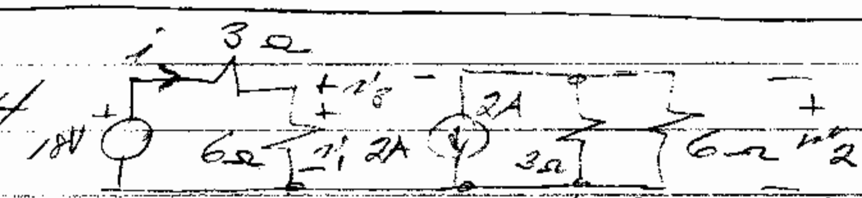
and $\boxed{i_1 = i_2 = \frac{v}{2} = \frac{9}{2}A}$

EE 211 Homework 3

1.32 

 $\equiv$  $\therefore$ $\boxed{i=\frac{10}{5}=2A}$

$v_1=10\times\frac{2}{5}=4V$; $v_2=4\times\frac{2}{4}=2V$; $i_1=\frac{1}{3}A$ and $\boxed{v=\frac{2}{3}V}$

1.34 

$R_{eq}=2\Omega$

a) $\boxed{i=\frac{18}{9}=2A}$ $\therefore$ $\boxed{v_1=12V}$, $\boxed{v_2=-2\times R_{eq}=-4V}$

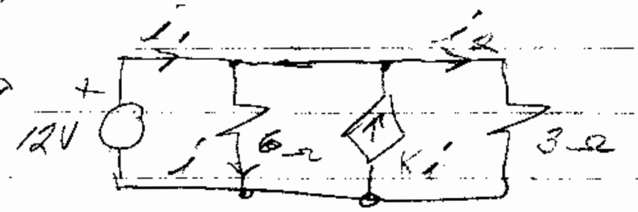
$v_3=v_1-v_2=12+4=16V$

b) for ab connection removed

i, v_1, v_2 do not change but v_3 can be anything!

EE 211 Homework 4

1-39



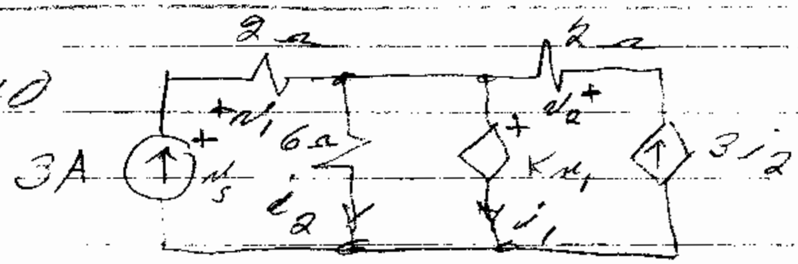
a) $K=2$; $i = 2A$; $i_2 = 4A$ $\therefore$ $i_1 = 2+4-K2$

$\boxed{i_1 = 6-4 = 2A}$

b) $K=3$; $\boxed{i_1 = 6-6 = 0}$

c) $K=4$; $\boxed{i_1 = 6-8 = -2A}$

1-40



$\boxed{v_1 = 6V}$

a) $K=2$

$$i_2 = \frac{Kv_1}{6} = K \; ; \; -3 + \frac{Kv_1}{6} + i_1 - 3i_2 = 0$$

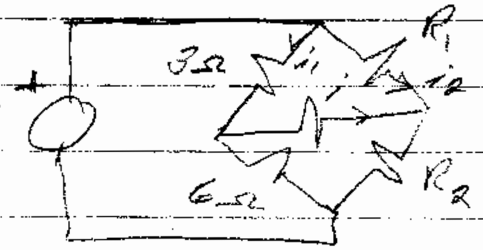
or $i_1 = 3 - K + 3K = 3 + 2K = 7A$

b) $i_1 = 3 + 2(3) = 9A$

c) $i_1 = 3 + 2(4) = 11A$

EE 211 Homework 5

1.38c

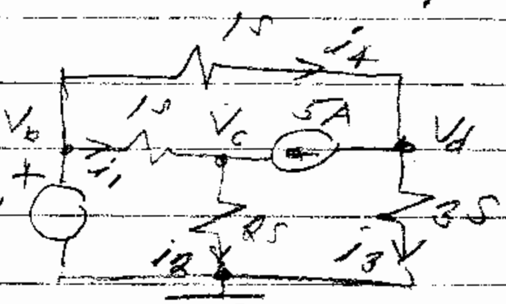


$i = 0$ i.e. $3i_1 = i_2 R_1$ (1)

$6i_1 = i_2 R_2$ (2)

dividing $\frac{(1)}{(2)}$ ⟹ $\boxed{\frac{R_1}{R_2} = \frac{1}{2}}$

2.1 (modified)



$\boxed{V_b = 1}$

$$\left.\begin{array}{l}(V_c - 1) + 2V_c = 5 \\ (V_d - 1) + 3V_d = -3\end{array}\right\} \begin{array}{l}3V_c = 6 \\ 4V_d = -4\end{array} \; ; \boxed{\begin{array}{l}V_c = 2 \\ V_d = -1\end{array}}$$

$\boxed{i_1 = 1 - V_c = -1\text{A}}$; $\boxed{i_2 = 2V_c = 4}$; $\boxed{i_3 = 3V_d = -3}$; $\boxed{i_4 = 1 - V_d = +2}$

---

power balance

$P_{1V} = -(i_1 + i_4) \times 1 = -2$ Watt

$P_{top\,1S} = i_4^2 \times 1 = 4$ W

$P_{left\,1S} = i_1^2 = 1$ W

$P_{2S} = \frac{i_2^2}{2} = 8$ W

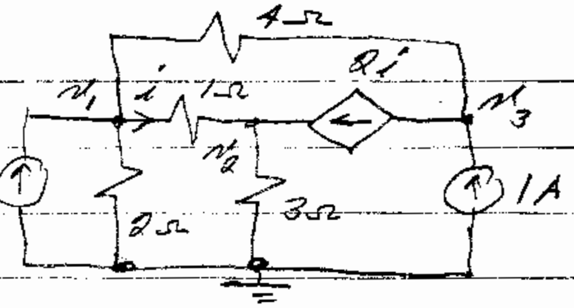
$P_{3S} = \frac{i_3^2}{3} = 3$ W

$P_{5A} = (V_d - V_c) \times 5 = -15$ W

$\Sigma = 0$!

EE 211 Homework 6

2.5



$$\boxed{i = \frac{v_1 - v_2}{1}}$$

$$\frac{v_1}{2} + \frac{v_1 - v_3}{4} + \frac{v_1 - v_2}{1} = 7 \qquad \frac{7}{4}v_1 - v_2 - \frac{1}{4}v_3 = 7$$

$$\frac{v_2 - v_1}{1} + \frac{v_2}{3} - 2i = 0 \qquad -3v_1 + \frac{10}{3}v_2 = 0$$

$$\frac{v_3 - v_1}{4} + 2i = 1 \qquad \frac{7}{4}v_1 - 2v_2 + \frac{1}{4}v_3 = 1$$

$$v_1 = \frac{\begin{vmatrix} 7 & -1 & -1/4 \\ 0 & 10/3 & 0 \\ 1 & -2 & \frac{1}{4} \end{vmatrix}}{\begin{vmatrix} \frac{7}{4} & -1 & -\frac{1}{4} \\ -3 & \frac{10}{3} & 0 \\ \frac{7}{4} & -2 & \frac{1}{4} \end{vmatrix}} = \frac{10/3\left(\frac{7}{4} + \frac{1}{4}\right)}{-\frac{1}{4}\left(6 - \frac{70}{12}\right) + \frac{1}{4}\left(\frac{70}{12} - 3\right)} = \frac{\frac{80}{3}}{\frac{34}{12} - \frac{2}{12}}$$

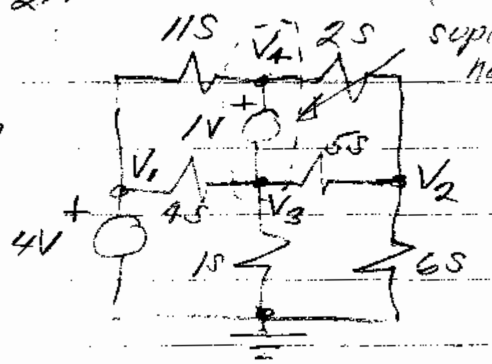
$$\boxed{v_1 = \frac{80}{3} \times \frac{12}{32} = 10\text{ V}}$$

$$v_2 = \frac{\begin{vmatrix} \frac{7}{4} & 7 & -\frac{1}{4} \\ -3 & 0 & 0 \\ \frac{7}{4} & 1 & \frac{1}{4} \end{vmatrix}}{2/3} = \frac{3\left(\frac{7}{4} + \frac{1}{4}\right)}{2/3} = \frac{6 \times 3}{2} \boxed{= 9\text{V}}$$

$$v_3 = \frac{\begin{vmatrix} \frac{7}{4} & -1 & 7 \\ -3 & \frac{10}{3} & 0 \\ \frac{7}{4} & -2 & 1 \end{vmatrix}}{2/3} = \frac{7\overbrace{\left(6 - \frac{70}{12}\right)}^{\frac{2}{12}} + \overbrace{\left(\frac{70}{12} - 3\right)}^{\frac{34}{12}}}{2/3} = \frac{48}{12} \times \frac{3}{2} \boxed{= 6\text{V}}$$

EE 211 Homework 7

2.10



$V_4 - V_3 = 1$; $\boxed{V_1 = 4V}$

$(V_4-4)11 + (V_4-V_2)2 + (V_3-4)4 + V_3 + (V_3-V_2)5 = 0$

$(V_2-V_4)2 + (V_2-V_3)5 + V_2 6 = 0$

$-V_3 + V_4 = 1$

or $-7V_2 + 10V_3 + 13V_4 = 60$

$13V_2 - 5V_3 - 2V_4 = 0$

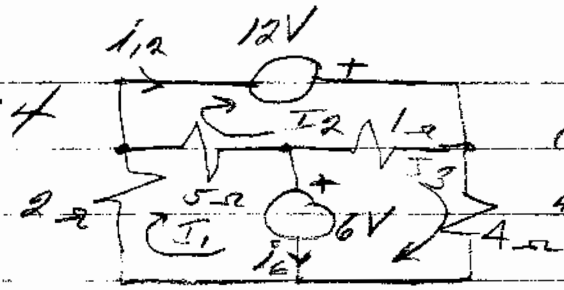
$$V_2 = \frac{\begin{vmatrix} 1 & -1 & 1 \\ 60 & 10 & 13 \\ 0 & -5 & -2 \end{vmatrix}}{\begin{vmatrix} 0 & -1 & 1 \\ -7 & 10 & 13 \\ 13 & -5 & -2 \end{vmatrix}} = \frac{\overset{45 \quad - \quad 420}{1(-20+65) - 60(2+5)}}{\underset{-155 \quad - 95}{1(14-169) + 1(35-130)}} = \frac{\overset{15}{-375}}{\underset{10}{-250}} \boxed{= 1.5\ V}$$

$$V_3 = \frac{\begin{vmatrix} 0 & 1 & 1 \\ -7 & 60 & 13 \\ 13 & 0 & -2 \end{vmatrix}}{-250} = \frac{\overset{+155 \quad -780}{-1(14-169) + 1(-780)}}{-250} = \frac{\overset{25}{-625}}{\underset{10}{-250}} \boxed{= 2.5 V}$$

$$V_4 = \frac{\begin{vmatrix} 0 & -1 & 1 \\ -7 & 10 & 60 \\ 13 & -5 & 0 \end{vmatrix}}{-250} = \frac{1(-780) + 1(35-130)}{-250} = \frac{\overset{35}{-875}}{\underset{10}{-250}} = \boxed{3.5 V}$$

EE 211 Homework 8

2.24



$I_1 2 + (I_1 - I_2)5 = -6$

$(I_2 - I_1)5 + (I_2 - I_3)1 = 12$

$4I_3 + (I_3 - I_2)\times 1 = 6$

or

$$\left\{\begin{aligned} 7I_1 - 5I_2 &= -6 \\ -5I_1 + 6I_2 - I_3 &= 12 \\ -I_2 + 5I_3 &= 6 \end{aligned}\right.$$

$$I_1 = \frac{\begin{vmatrix} -6 & -5 & 0 \\ 12 & 6 & -1 \\ 6 & -1 & 5 \end{vmatrix}}{\begin{vmatrix} 7 & -5 & 0 \\ -5 & 6 & -1 \\ 0 & -1 & 5 \end{vmatrix}} = \frac{-6(29)+5(66)}{7(29)+5(-25)} = \frac{156}{78}$$

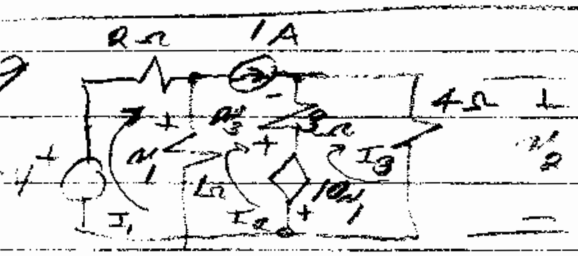
$\boxed{I_1 = 2A}$

$$I_2 = \frac{\begin{vmatrix} 7 & -6 & 0 \\ -5 & 12 & -1 \\ 0 & 6 & 5 \end{vmatrix}}{78} = \frac{7(66)+6(-25)}{78} = \frac{312}{78} = \boxed{4A}$$

$$I_3 = \frac{\begin{vmatrix} 7 & -5 & -6 \\ -5 & 6 & 12 \\ 0 & -1 & 6 \end{vmatrix}}{78} = \frac{7(48)+5(-36)}{78} = \frac{156}{78} = \boxed{2A}$$

$\boxed{a)\ i_{12} = I_2 = 4A}$ $\boxed{b)\ i_6 = I_1 - I_3 = 0}$

2.29



$2I_1 + (I_1 - I_2) = 5$; $\boxed{I_2 = 1A}$

$10v_1 + (I_3 - I_2)3 + 4I_3 = 0$

$v_1 = (I_1 - I_2)$

$3I_1 = 6 \Rightarrow \boxed{I_1 = 2A}$

or

$10(1) + (I_3 - 1)3 + 4I_3 = 0 \Rightarrow 7I_3 = -7$; $\boxed{I_3 = -1}$

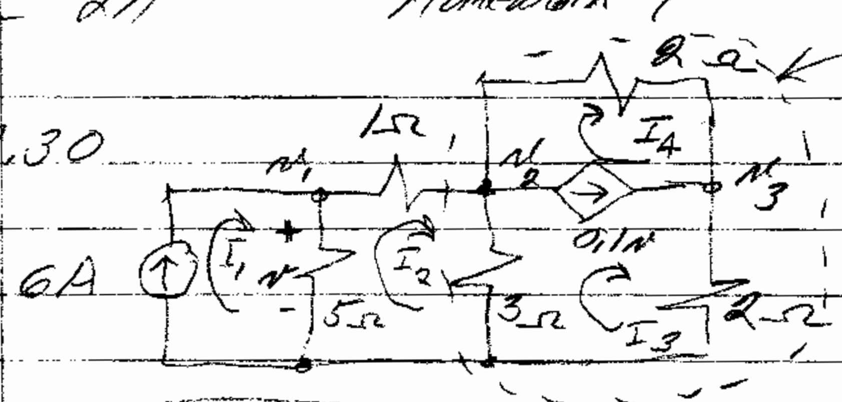
$\boxed{v_1 = (I_1 - I_2)\times 1 = 1V}$

$\boxed{v_2 = 4I_3 = 4V}$

$\boxed{v_3 = (I_3 - I_2)3 = -6V}$

EE 211 Homework 9

2.30



super mesh

$\boxed{I_1 = 6A}$

$I_3 - I_4 = 0.1v$

$v = 5(I_1 - I_2)$

I_2 mesh: $(I_2 - I_1)5 + I_2 + (I_2 - I_3)3 = 0$ $\qquad -5\overset{6}{I_1} + 9I_2 - 3I_3 = 0$

super mesh: $(I_3 - I_2)3 + 2I_4 + 2I_3 = 0$ $\qquad -3I_2 + 5I_3 + 2I_4 = 0$

$I_3 - I_4 = \frac{1}{2}(I_1 - I_2)$ $\qquad \overset{6}{I_1} - I_2 - 2I_3 + 2I_4 = 0$

$$\left\{\begin{array}{l} 9I_2 - 3I_3 = 30 \\ -3I_2 + 5I_3 + 2I_4 = 0 \\ -I_2 - 2I_3 + 2I_4 = -6 \end{array}\right.$$

$$I_2 = \frac{\begin{vmatrix} 30 & -3 & 0 \\ 0 & 5 & 2 \\ -6 & -2 & 2 \end{vmatrix}}{\begin{vmatrix} 9 & -3 & 0 \\ -3 & 5 & 2 \\ -1 & -2 & 2 \end{vmatrix}} = \frac{30(14) + 3(12)}{9(14) + 3(-4)} = \frac{456}{114} = 4A$$

$$I_3 = \frac{\begin{vmatrix} 9 & 30 & 0 \\ -3 & 0 & 2 \\ -1 & -6 & 2 \end{vmatrix}}{114} = \frac{9(12) - 30(-4)}{114} = \frac{228}{114} = 2A$$

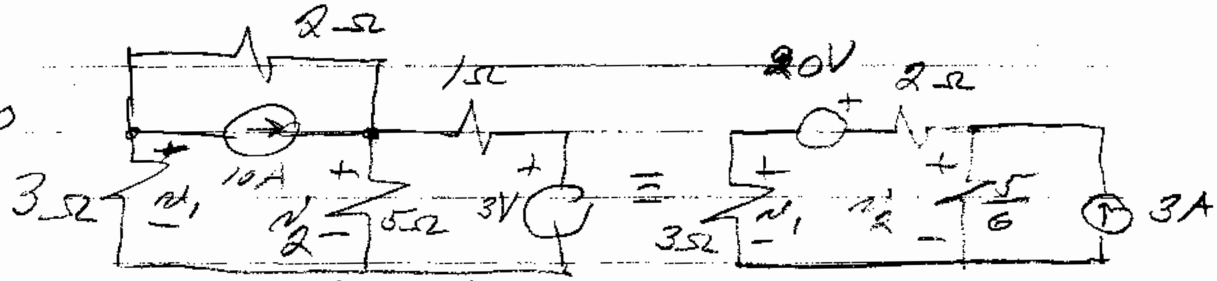
$$I_4 = \frac{\begin{vmatrix} 9 & -3 & 30 \\ -3 & 5 & 0 \\ -1 & -2 & -6 \end{vmatrix}}{114} = \frac{3(78) + 5(-24)}{114} = \frac{114}{114} = 1A$$

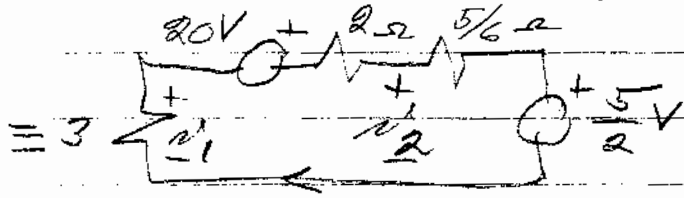
$\boxed{v_1 = (I_1 - I_2)5 = 10V}$; $\boxed{v_2 = (I_2 - I_3)3 = 6V}$

$\boxed{v_3 = 2I_3 = 4V}$

EE 211 Homework 10

3.20



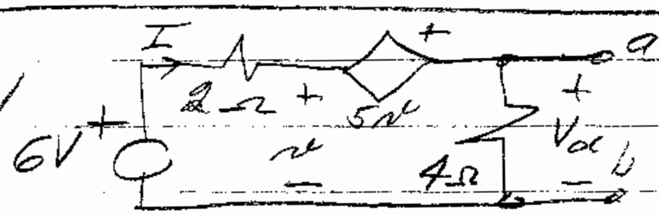


$20 - \frac{5}{2} = I\left(5 + \frac{5}{6}\right)$

$I = \frac{35/2}{35/6} = 3A$

$\therefore$ $\boxed{v_1 = -3 \times 3 = -9V}$; $\boxed{v_2 = \frac{5}{6}I + \frac{5}{2} = 5V}$

3.31

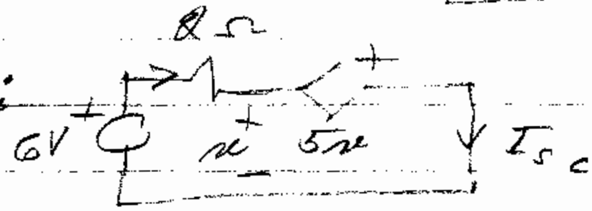


$v = -2I + 6$

$-6 + 2I - 5v + 4I = 0$

or $16I = 36$; $I = \frac{36}{16} = \frac{9}{4}$ and $\boxed{V_{oc} = V_{Th} = 9V}$

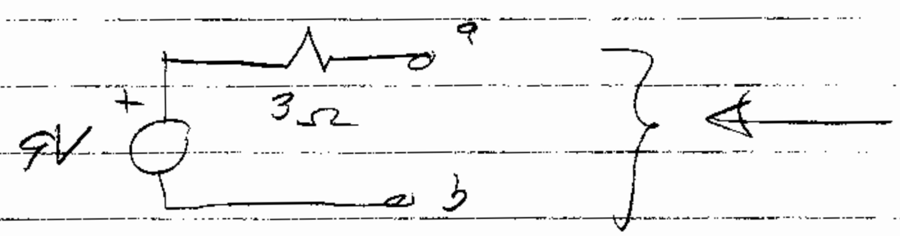
for I_{sc} we have:



$v = -I_{sc}2 + 6$; $-6 + 2I_{sc} - 5(-2I_{sc} + 6) = 0$

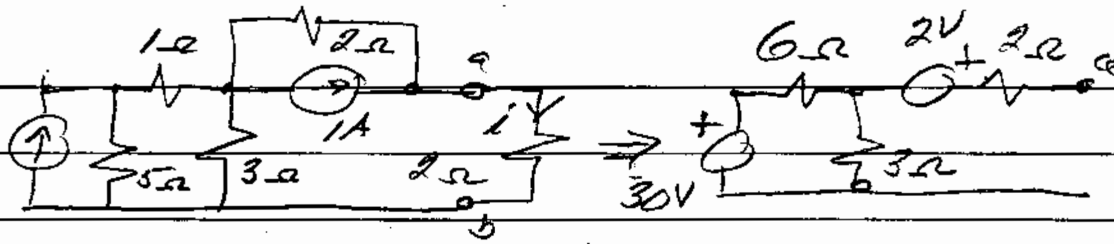
or $12I_{sc} = 36$; $I_{sc} = 3A$

$\therefore R_{Th} = \frac{V_{oc}}{I_{sc}} = \frac{9}{3} = 3\Omega$

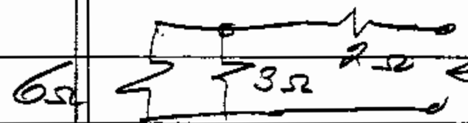


EE 211 Homework 11

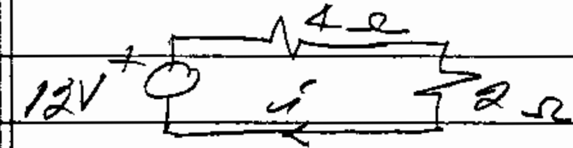
3.28



$$\boxed{V_{Th} = V_{oc} = \frac{3}{9} \times 30 + 2 = 12V}$$



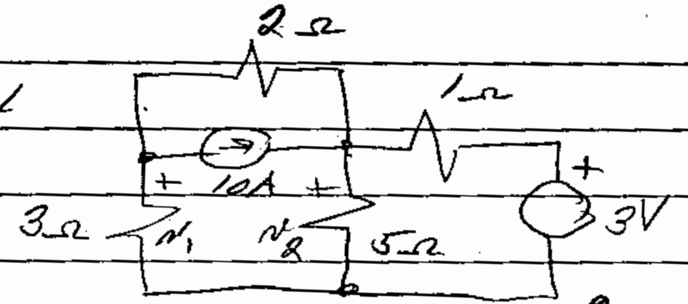
$\leftarrow R_{eq} = R_{Th} = 4\,\Omega$



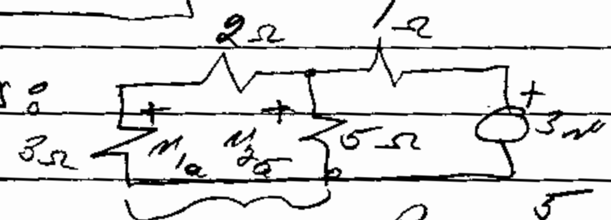
$$\boxed{i = \frac{12}{6} = 2A} \leftarrow$$

EE 211 Homework 12

3.64



current source = 0 gives:

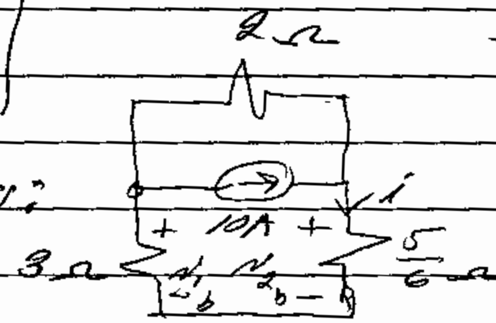


$R_{eq} = \frac{5}{2}$

$$\therefore \boxed{\begin{aligned} v_{2a} &= 3 \times \frac{\frac{5}{2}}{\frac{7}{2}} = \frac{15}{7}\,V \\ v_{1a} &= v_{2a} \times \frac{3}{5} = \frac{9}{7}\,V \end{aligned}}$$

$5 + \frac{5}{6}$

voltage source = 0 gives:



using current division $i = 10 \frac{2}{35/6} = \frac{20 \times 6}{35} = \frac{24}{7}$

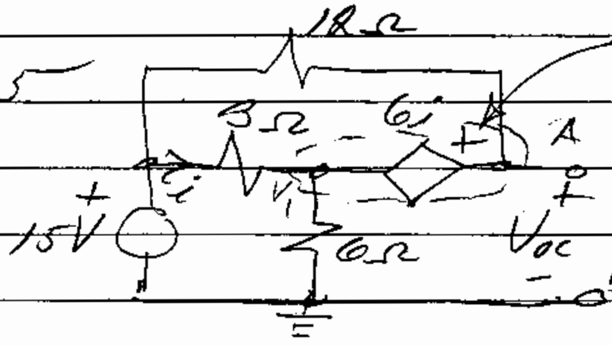
$$\therefore \boxed{\begin{aligned} v_{2b} &= i \times \frac{5}{6} = \frac{24}{7} \times \frac{5}{6} = \frac{20}{7} \\ v_{1b} &= -i \times 3 = -\frac{72}{7} \end{aligned}}$$

$$\therefore \boxed{v_{2\,total} = \frac{15}{7} + \frac{20}{7} = \frac{35}{7} = 5V}$$

$$\boxed{v_{1\,total} = \frac{9}{7} - \frac{72}{7} = -\frac{63}{7} = -9V}$$

EE 21 Homework 13

3.35



$V_{oc}-V_1=6i$

$i=\frac{15-V_1}{3}=5-\frac{V_1}{3}$

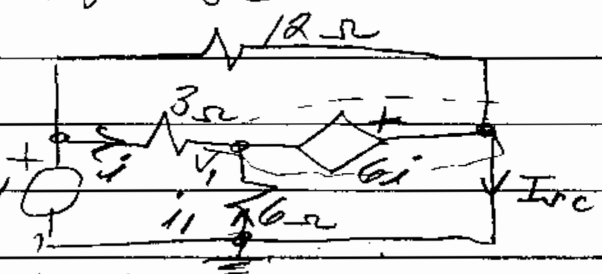
so $V_{oc}-V_1=30-2V_1$

or $\boxed{V_{oc}+V_1=30}$

$$\frac{V_1-15}{3}+\frac{V_1}{6}+\frac{V_{oc}-15}{12}=0 \Rightarrow \boxed{\frac{1}{12}V_{oc}+\frac{1}{2}V_1=\frac{25}{4}}$$

$$V_{oc}=\frac{\begin{vmatrix}30 & 1\\ \frac{25}{4} & \frac{1}{2}\end{vmatrix}}{\begin{vmatrix}1 & 1\\ 1/12 & 1/2\end{vmatrix}}=\frac{15-\frac{25}{4}}{\frac{1}{2}-\frac{1}{12}}=\frac{\frac{35}{4}}{\frac{5}{12}}=\frac{35\times 12}{4\times 5}=\boxed{21V}$$

Finding I_{sc}



$i=\frac{15-V_1}{3}$

$\therefore 6i=30-2V_1$

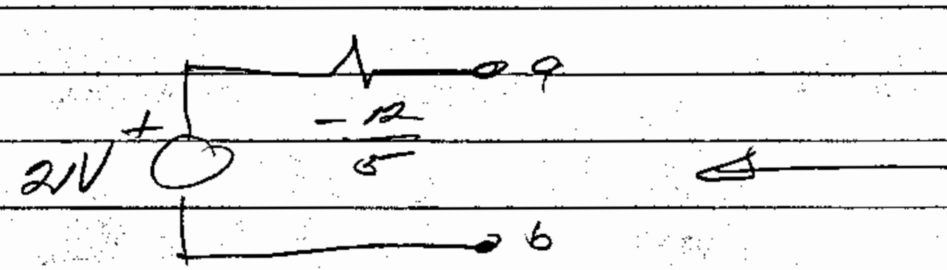
$i_1=\frac{6i}{6}=5-\frac{1}{3}V_1=\frac{-V_1}{6}$

$5=\frac{1}{6}V_1$ or $\boxed{V_1=30V}$

$$\frac{V_1-15}{3}+\frac{V_1}{6}+\frac{0-15}{12}+I_{sc}=0$$

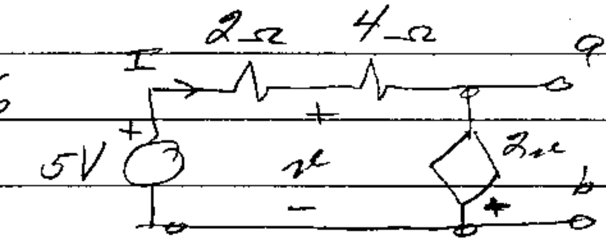
or $15+5-\frac{5}{4}=-I_{sc}$ $\therefore$ $\boxed{I_{sc}=-\frac{35}{4}A}$

$$\therefore R_{Th}=\frac{-21\times 4}{35}=-\frac{12}{5}\,\Omega$$



EE 211 Homework 14

336



$6I - 2v = 5$

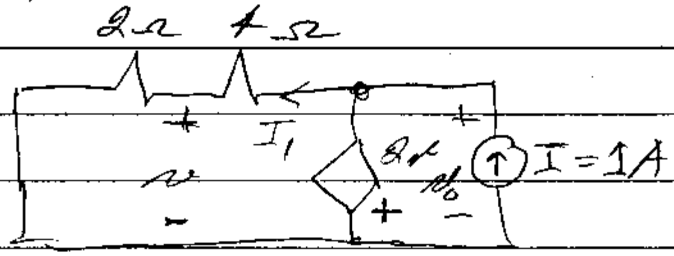
but $v = -2I + 5$

$\therefore 6I + 4I - 10 = 5$

$10I = 15$

so $I = \frac{3}{2}$; $v = -3 + 5$; $\boxed{V_{oc} = V_{Th} = -2v = -4}$

Using hint our circuit is:



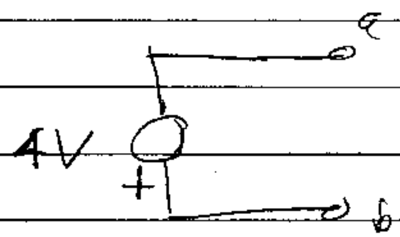
$I_1 = -\frac{2v}{6}$

but $v = 2I_1$

$\therefore I_1 = -\frac{2}{3} I_1$

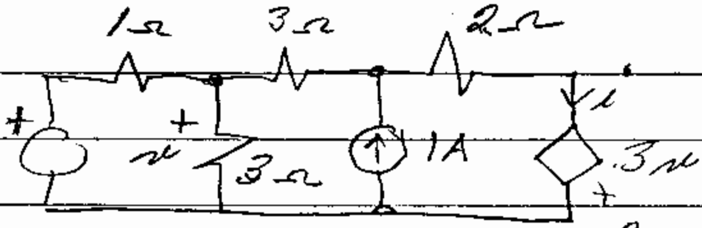
so $I_1 = 0$; $v = 0$

$\therefore v_o = 0$ and $\boxed{R_{Th} = \frac{v_o}{1} = 0}$

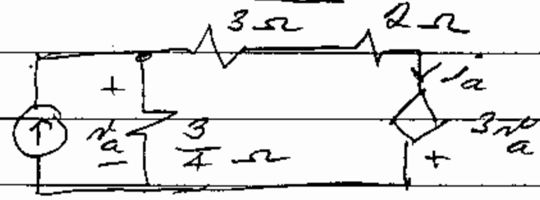


EE 211 Homework 15

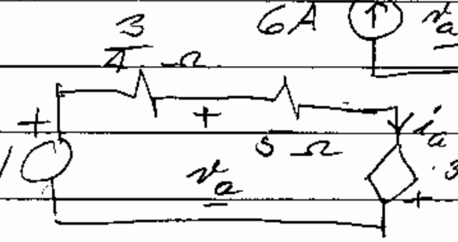
3.67



Voltage Source Only



or



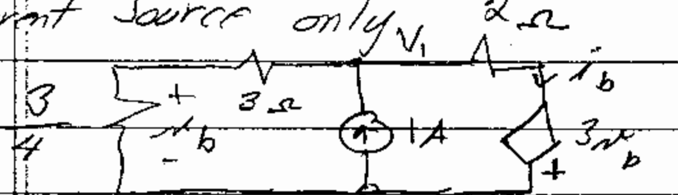
$$i_a'\left(\frac{3}{4}+5\right)-3v_a=\frac{9}{2}$$

but $v_a=-\frac{3}{4}i_a'+\frac{9}{2}$

so $i_a\left(\frac{3}{4}+5\right)+\frac{9}{4}i_a=\frac{27}{2}+\frac{9}{2}$; $8i_a=18$; $\boxed{i_a=\frac{9}{4}}$

and $v_a=-\frac{3}{4}\left(\frac{9}{4}\right)+\frac{9}{2}=\frac{72-27}{16}\boxed{=\frac{45}{16}}$

Current Source only



$$\frac{4V_1}{15}+\frac{V_1+3v_b}{2}=1$$

but $v_b=V_1\frac{\frac{3}{4}}{\frac{15}{4}}=\frac{V_1}{5}$

$\therefore V_1\left(\frac{4}{15}+\frac{1}{2}+\frac{3}{10}\right)=1=V_1\left(\frac{8+15+9}{30}\right)=1=\frac{16}{15}V_1$

so $\boxed{V_1=\frac{15}{16}}$; $\boxed{v_b=\frac{V_1}{5}=\frac{3}{16}V}$

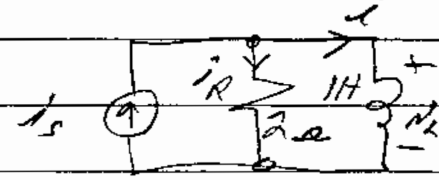
$$i_b=\frac{V_1+3v_b}{2}=\frac{V_1+\frac{3}{5}V_1}{2}=\frac{4}{5}V_1=\frac{4}{5}\cdot\frac{15}{16}\boxed{=\frac{3}{4}A}$$

$\therefore i=i_a+i_b=\frac{9}{4}+\frac{3}{4}=3A$

$v=v_a+v_b=\frac{45}{16}+\frac{3}{16}=3V$

EE 211 Homework 16

4.2



$i(t) = 0$ for $t < 0$

$i(t) = 1 - e^{-2t}$ $t \geq 0$

$v_L(t) = L\frac{di}{dt}$

a) $v_L(t) = 0$ for $t < 0$

$v_L(t) = 2e^{-2t}$ for $t \geq 0$

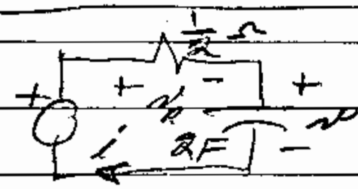
b) $i_R(t) = 0$ for $t < 0$

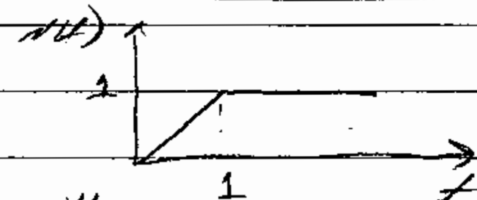
$i_R(t) = \frac{v_L(t)}{2} = e^{-2t}$ for $t \geq 0$

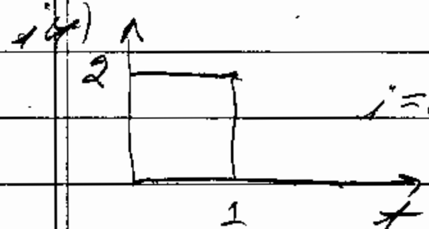
c) $i_s(t) = 0$ for $t < 0$

$i_s(t) = i + i_R = 1 - e^{-2t} + e^{-2t} = 1A$ for $t \geq 0$

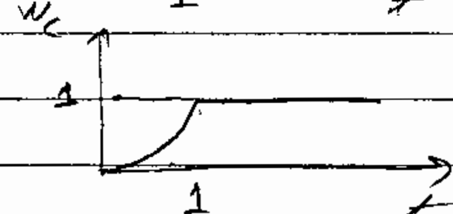
4.14



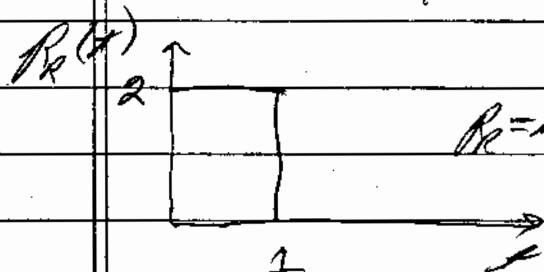




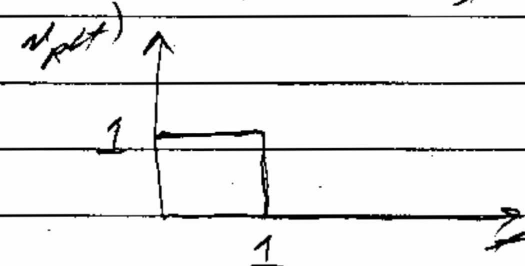
$i = C\frac{dv}{dt}$



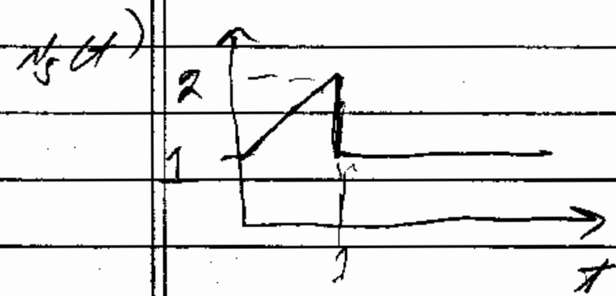
$w_c = \frac{1}{2}Cv^2$



$p_R = i^2 R$



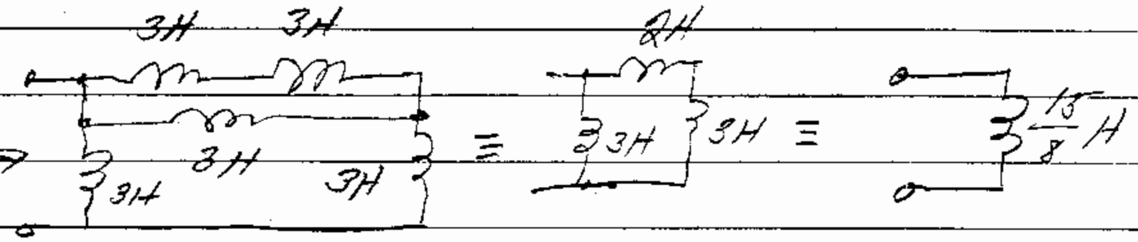
$v_R(t) = iR$



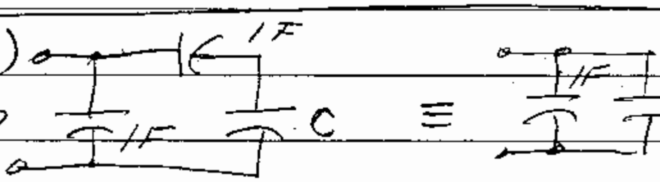
$v_s(t) = v_R(t) + v(t)$

EE 211 Homework 17

4.53



4.54a)

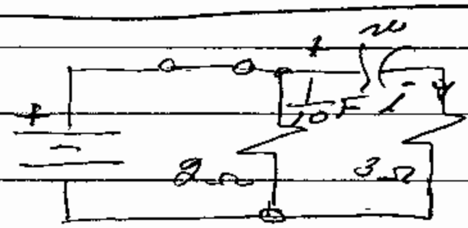


$C_{eq} = 1 + \frac{C}{1+C} = C$

so $1+C+C = C(C+1)$; $C^2 - C - 1 = 0$

$$C = \frac{1 \pm \sqrt{1+4}}{2} = \frac{1}{2} \pm \frac{\sqrt{5}}{2} = \boxed{1.618\,F}$$

5.1



$i(0) = 0$

$v(0) = 10$

for $t > 0$ $\quad 5i + 10\int_0^t i\,dt + 10 = 0$

$\therefore \quad 5\frac{di}{dt} + 10i = 0$; $i = Ae^{st}$

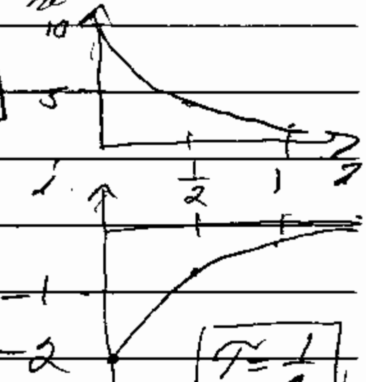
$$5sAe^{st} + 10Ae^{st} = 0 \;;\; 5s = -10 \text{ or } s = -2$$

and $\boxed{i = Ae^{-2t}}$

from (1) evaluated @ $t=0$; $5i(0) + 10 = 0$; $i(0) = -2$

$\therefore \boxed{i = -2e^{-2t} \text{ for } t > 0}$

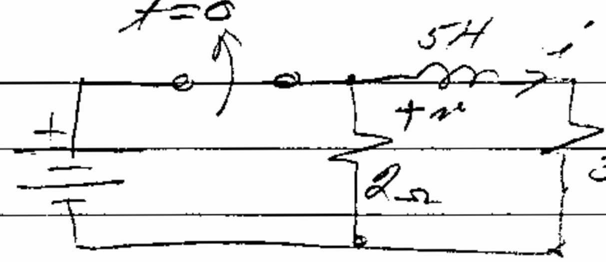
$\boxed{v = -5i = 10e^{-2t} \text{ for } t > 0}$



$\boxed{\tau = \frac{1}{2}}$

EE 211 Homework 18

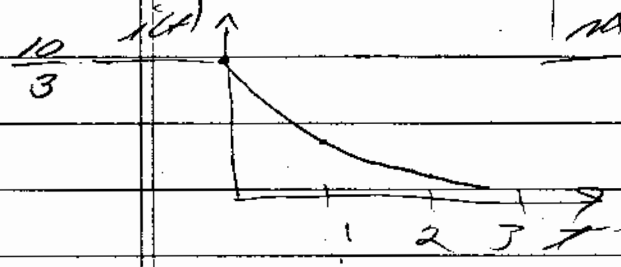
5.2

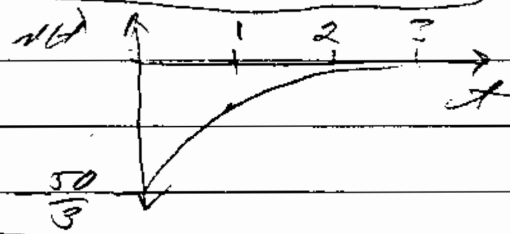


$i(0) = \frac{10}{3}$

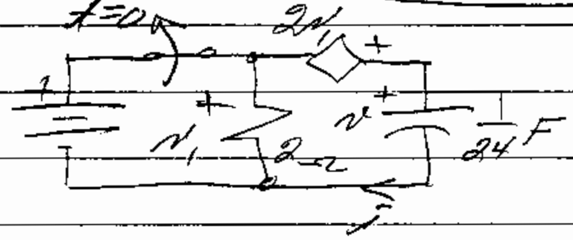
for $t>0$ $\quad 5i + 5\frac{di}{dt} = 0$; $\boxed{i = \frac{10}{3}e^{-t}}$

$$\boxed{v(t) = -3i = -\frac{50}{3}e^{-t}}$$





5.6



for $t<0$ $\quad v_1 = 10$

$\therefore v(0) = 30V$

$i(0) = 0$

for $t>0$ $\quad 2i - 2v_1 + 24\int_0^t i\,dt + 30 = 0$; but $v_1 = -2i$

$\therefore \boxed{6i + 24\int_0^t i\,dt + 30 = 0}$ or $6\frac{di}{dt} + 24i = 0$

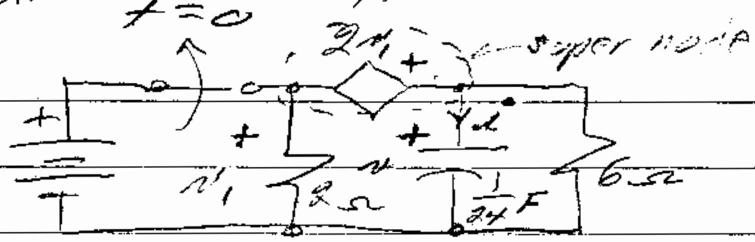
$i = Ae^{-4t}$

but from above $6i(0) = -30$ or $i(0) = -5$

$$\therefore \left\{ \begin{array}{l} i = -5e^{-4t} \quad \text{for } t>0 \\ v = 3v_1 = -6i = 30e^{-4t} \end{array} \right\}$$

EE 211 Homework 19

5.7



$v(0) = 30V$

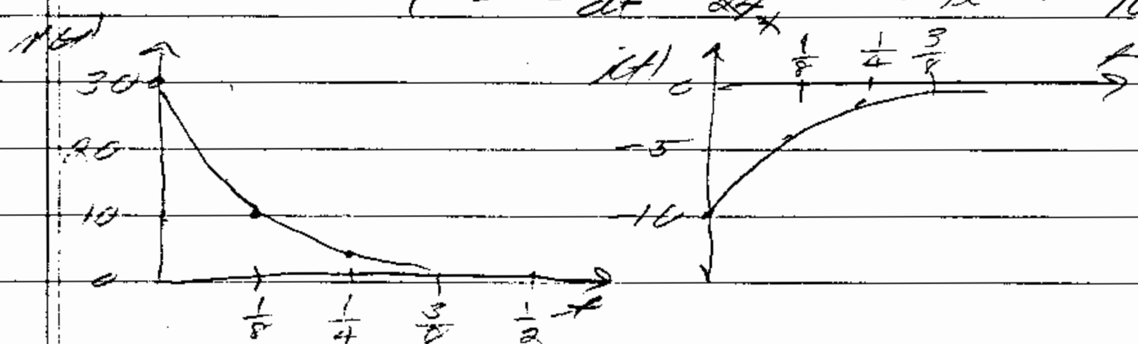
$v = 3v_1$

so $v_1(0) = 10V$

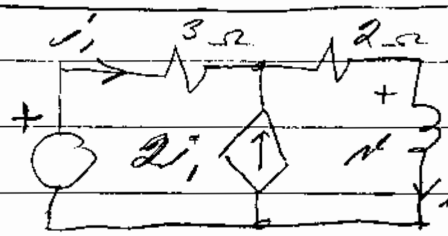
$$\frac{v_1}{2} + \frac{3v_1}{6} + \frac{1}{24}\frac{d(3v_1)}{dt} = 0 \; ; \quad v_1 + \frac{1}{8}\frac{dv_1}{dt} = 0$$

$$v_1 = Ae^{-8t} \quad \text{or} \quad v_1 = 10e^{-8t}$$

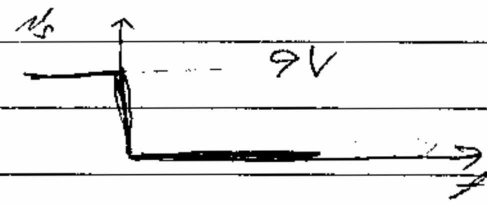
$$\therefore \text{ for } t>0 \left\{ \begin{array}{l} v = 3v_1 = 30e^{-8t} \\ i = C\frac{dv}{dt} = \frac{1}{24} \times 30(-8)e^{-8t} = -10e^{-8t} \end{array} \right\}$$



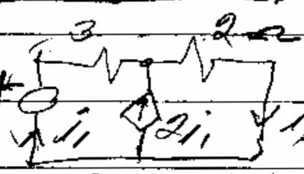
5.8



$v_s(t) = 9[1-u(t)]$



for $t<0$

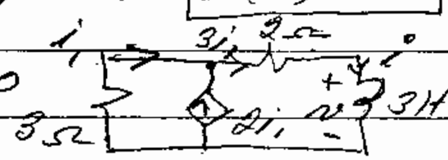


$3i_1 + 2i = 9$

but $3i_1 = i$

$\therefore\ 3i = 9$ or $\boxed{i(0) = 3}$

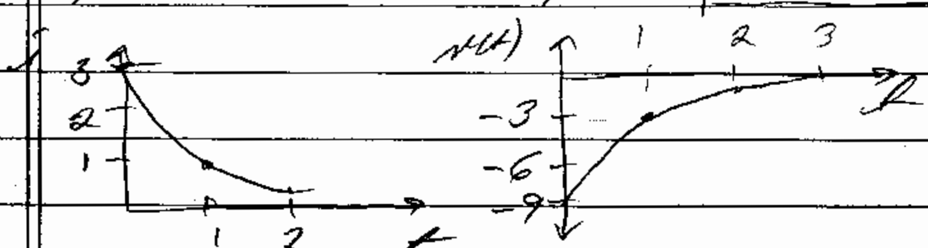
for $t>0$



supermesh again

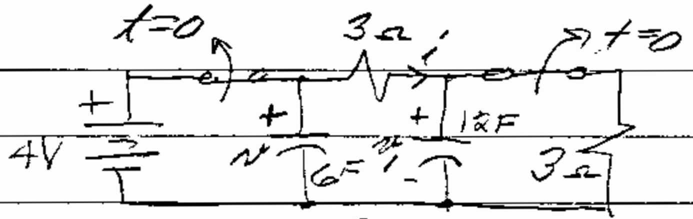
$$3i_1 + 6i_1 + 3\frac{d(3i_1)}{dt} = 0$$

$i_1 = Ae^{-t}$ but $i = 3i_1$ so $\boxed{i = 3e^{-t}}$ $\boxed{v = 3\frac{di}{dt} = -9e^{-t}}$



EE 211 Homework 20

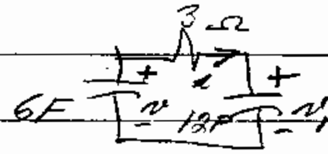
5.18



$v(0) = 4\,V$

by voltage division $v_1(0) = 2$

for $t>0$



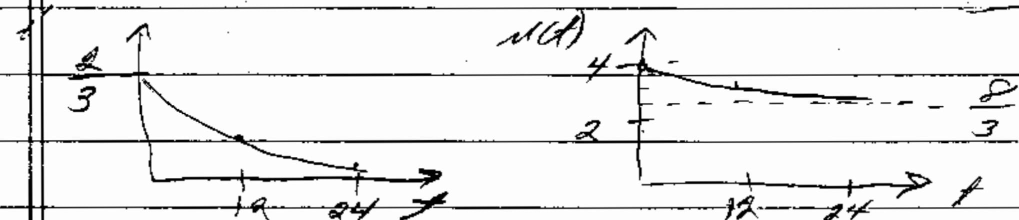
$$3i + \frac{1}{6}\int_0^t i\,dt - 4 + \frac{1}{12}\int_0^t i\,dt + 2 = 0$$

or $\boxed{3\frac{di}{dt} + \left(\frac{1}{6}+\frac{1}{12}\right)i = 0} \Rightarrow \boxed{\frac{di}{dt} + \frac{1}{12}i = 0}$

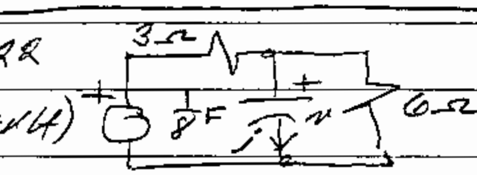
so $i = Ae^{-\frac{t}{12}}$ and from integral equation $i(0) = \frac{2}{3}$

$\therefore \boxed{i = \frac{2}{3}e^{-\frac{t}{12}}}$ and $v = -\frac{1}{6}\int_0^t \frac{2}{3}e^{-\frac{t}{12}}dt + 4$

$$v = -\frac{2}{3\times 18}\times(-12)e^{-\frac{t}{12}}\Big|_0^t + 4 = \frac{4}{3}e^{-\frac{t}{12}} - \frac{4}{3} + 4 = \boxed{\frac{4}{3}e^{-\frac{t}{12}} + \frac{8}{3}}$$



5.22



zero state (i.e. $v(0)=0$)

for $t>0$ $\frac{v-1}{3} + \frac{v}{6} + \frac{1}{8}\frac{dv}{dt} = 0 \Rightarrow \frac{1}{8}\frac{dv}{dt} + \frac{1}{2}v = \frac{1}{3}$

so $v_h = Ae^{-4t}$; $v_p = K = \frac{2}{3}$

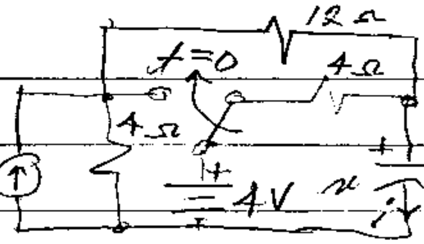
$v = v_h + v_p = Ae^{-4t} + \frac{2}{3}$ but $v(0) = 0$

$\therefore \boxed{v(t) = \frac{2}{3}(1-e^{-4t})}$

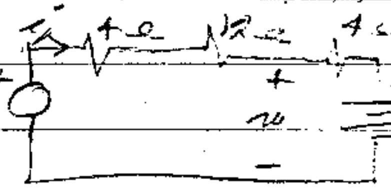
$i(t) = \frac{1}{8}\frac{dv}{dt} = \frac{1}{8}(4)e^{-4t}\left(\frac{2}{3}\right) = \boxed{\frac{1}{3}e^{-4t}}$

EE 211 Homework 21

5.42

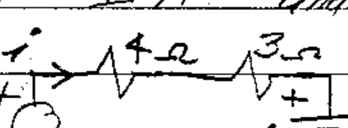


For $t<0$ this becomes



so $i_1 = \frac{24-4}{20} = 1\,A$ and $\boxed{v(0) = 4i_1 + 4 = 8V}$

for $t>0$



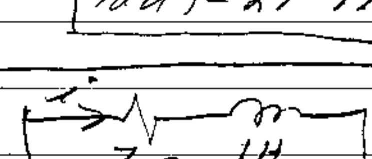
$7i + 7\int_0^t i\,dt + 8 = 24$ or $\boxed{7\frac{di}{dt} + 7i = 0}$

$i = Ae^{-t}$ from initial equation $\boxed{i(0) = \frac{16}{7}}$

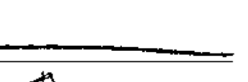
$$\therefore \boxed{i(t) = \frac{16}{7}e^{-t} \quad \text{for } t>0}$$

$$\boxed{v(t) = 24 - 7i = 24 - 16e^{-t}}$$

6.5



$v_s = 1 - u(t)$



$\left\{ \begin{array}{l} i(0) = 0 \\ v(0) = 1 \end{array} \right\}$

For $t>0$ $\quad 7i + \frac{di}{dt} + 10\int_0^t i\,dt + 1 = 0$ or $\frac{d^2i}{dt^2} + 7\frac{di}{dt} + 10i = 0$

$$s_{1,2} = \frac{-7 \pm \sqrt{49-40}}{2} = -\frac{7}{2} \pm \frac{3}{2} = -2, -5$$

so $i(t) = A_1e^{-2t} + A_2e^{-5t}$ but $i(0) = 0$ so $A_2 = -A_1$

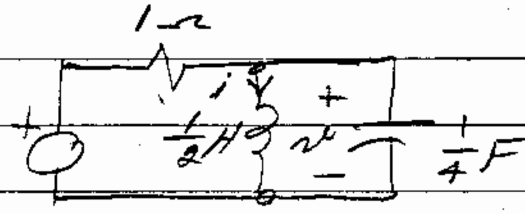
$\left.\frac{di}{dt}\right|_{t=0} = -1 = -2A_1 - 5A_2 = -2A_1 + 5A_1$; $A_1 = -\frac{1}{3}$

and $\boxed{i(t) = \frac{1}{3}e^{-5t} - \frac{1}{3}e^{-2t}}$

$v(t) = -7i - \frac{di}{dt} = -\frac{7}{3}e^{-5t} + \frac{7}{3}e^{-2t} + \frac{5}{3}e^{-5t} - \frac{2}{3}e^{-2t}$

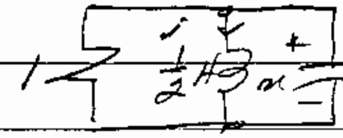
$$\boxed{v(t) = \frac{5}{3}e^{-2t} - \frac{2}{3}e^{-5t}}$$

EE 211 Homework 22

6.8 

$v_s = 4 - 4u(t)$

$\left\{ \begin{array}{l} i(0) = 4 \\ v(0) = 0 \end{array} \right\}$

For $t > 0$ 

$0 = \frac{v}{1} + \frac{1}{4}\frac{dv}{dt} + 2\int_0^t v\,dt + 4$

or $\frac{d^2v}{dt^2} + 4\frac{dv}{dt} + 8v = 0$; $s^2 + 4s + 8 = 0$

$s_{1,2} = \frac{-4 \pm \sqrt{16-32}}{2} = \boxed{-2 \pm j2}$

$v = A_1 e^{-2t}\cos 2t + A_2 e^{-2t}\sin 2t$

but $v(0) = 0$ so $A_1 = 0$

$\left.\frac{dv}{dt}\right|_{t=0} = -16 = A_2\left[2e^{-2t}\cos 2t - 2e^{-2t}\sin 2t\right]_{t=0}$

$\therefore A_2 = -8$

and $\boxed{v = -8e^{-2t}\sin 2t}$ for $t > 0$

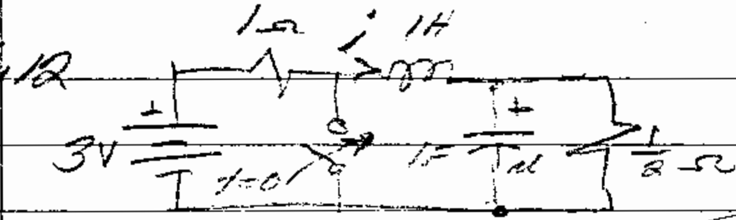
$i = -\frac{v}{R} - C\frac{dv}{dt} = 8e^{-2t}\sin 2t - \frac{1}{4}\left[16e^{-2t}\sin 2t - 8\times 2e^{-2t}\cos 2t\right]$

$\boxed{i(t) = 4e^{-2t}\sin 2t + 4e^{-2t}\cos 2t}$

EE 211 Homework 23 (15 total)

6.12

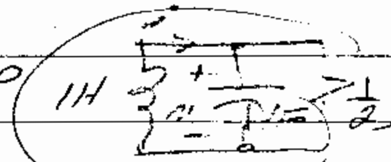
9



$\boxed{v(0) = 1V}$ ✓

$\boxed{i(0) = \frac{3}{3/2} = 2A}$ ✓

for $t>0$



$$\therefore 2v + \frac{dv}{dt} + \int_0^t v\,dt - 2 = 0 \quad (1)$$

$$\text{or } \frac{d^2v}{dt^2} + 2\frac{dv}{dt} + v = 0$$

$v = Ae^{st}$; $s^2+2s+1=0$ $\therefore S_{1,2} = \frac{-2 \pm \sqrt{4-4}}{2} = -1$

$v = A_1 e^{-t} + A_2 t e^{-t}$ but $v(0)=1$ $\boxed{\text{so } A_1 = 1}$

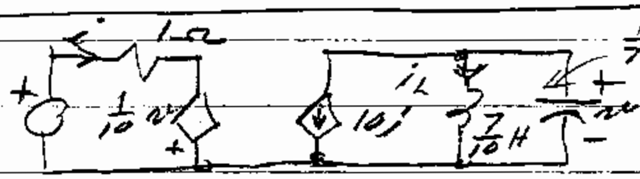
from (1) above $\left.\frac{dv}{dt}\right|_{t=0} = 0 = \left[-e^{-t} + A_2 e^{-t} - A_2 t e^{-t}\right]_{t=0}$

$0 = -1 + A_2$; $A_2 = 1$ and $\boxed{v = e^{-t} + te^{-t}}$

$i = 2v + \frac{dv}{dt} = 2e^{-t} + 2te^{-t} - e^{-t} - te^{-t} + e^{-t} = \boxed{2e^{-t} + te^{-t}}$

6.20

6

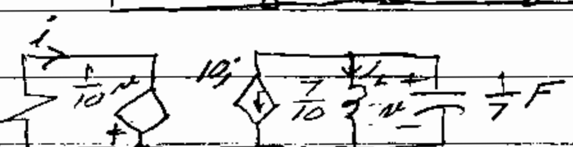


for $t<0$ $\boxed{v=0}$

$\boxed{i_L = -10i}$ but $i=3$

so $\boxed{i_L(0) = -30}$

for $t>0$



$\left\{ \begin{array}{l} i = \frac{1}{10}v \\ \therefore 10i = v \end{array} \right\}$

KCL: $v + \frac{1}{7}\frac{dv}{dt} + \frac{10}{7}\int_0^t v\,dt - 30 = 0$; $\left.\frac{dv}{dt}\right|_{t=0} = 210$

$\frac{d^2v}{dt^2} + 7\frac{dv}{dt} + 10v = 0$; $S_{1,2} = \frac{-7 \pm \sqrt{49-40}}{2} = -\frac{7}{2} \pm \frac{3}{2} = -2, -5$

$v(t) = A_1 e^{-2t} + A_2 e^{-5t}$ but $v(0) = 0$ so $\boxed{A_2 = -A_1}$

$\left.\frac{dv}{dt}\right|_{t=0} = -2A_1 - 5A_2 = 210$ so $-2A_1 + 5A_1 = 210$; $\boxed{A_1 = 70}$

$\boxed{v(t) = 70e^{-2t} - 70e^{-5t}}$

EE 211 Homework 24

2.17 a) $\frac{-j6}{1+j} = \frac{6e^{-j90°}}{\sqrt{2}\,e^{j45°}} = 3\sqrt{2}\,e^{-j135°} \leftarrow$

b) $\frac{-8}{2+j3} = \frac{8e^{j180°}}{3.6069e^{j56.31°}} = 2.22\,e^{j123.7°} \leftarrow$

c) $\frac{j3}{-2+j} = \frac{3e^{j90°}}{2.236e^{j153.43°}} = 1.34e^{-j63.43°} \leftarrow$

d) $\frac{85}{-1-j4} = \frac{85}{4.123e^{j255.96°}} = 20.62e^{-j255.96°} \leftarrow$

e) $\frac{200(1-j)}{4+j3} = \frac{200\sqrt{2}\,e^{-j45°}}{5e^{j36.87°}} = 40\sqrt{2}\,e^{-j81.87°} \leftarrow$

f) $\frac{20(1+j)e^{-j30°}}{4+j3} = \frac{20\sqrt{2}\,e^{j45°}e^{-j30°}}{5e^{j36.87°}} = 4\sqrt{2}\,e^{-j21.87°} \leftarrow$

g) $37.1e^{j14°} + 20.6e^{-j166°}$

$= 35.998 + j8.975 - 19.988 - j4.984 = 16.01 + j3.99$

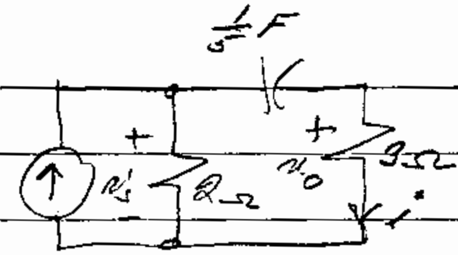
$= 16.5\,e^{j13.99°} \leftarrow$

h) $16.5e^{j14°} + 4.12e^{-j76°}$

$= 16 + j3.99 + 0.997 - j3.998 \cong 17e^{j0°} \leftarrow$

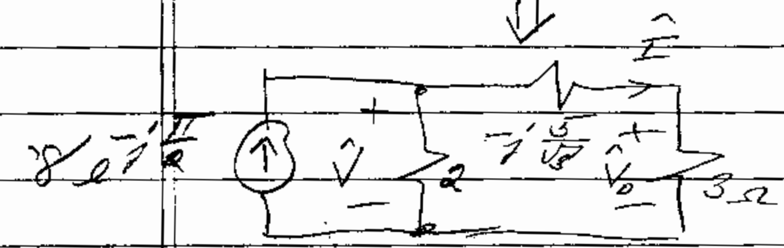
EE 211 Homework 25

8.21



$i_s(t) = 8\sin\sqrt{3}t$
$= 8\cos(\sqrt{3}t - \frac{\pi}{2})$

$\Downarrow$



$\hat{I} = 8e^{-j\frac{\pi}{2}} \dfrac{2}{5 - j\frac{5}{\sqrt{3}}}$

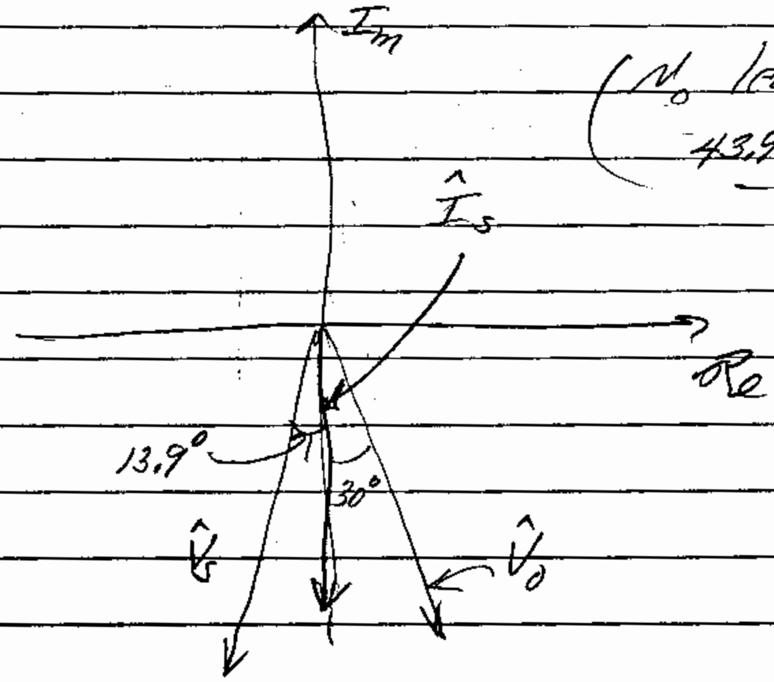
$\hat{V}_o = 3\hat{I} = \dfrac{48e^{-j\frac{\pi}{2}}}{5 - j\frac{5}{\sqrt{3}}}$

so $\hat{V}_o = \dfrac{48e^{-j90^\circ}}{5.77e^{-j30^\circ}} = 8.32e^{-j60^\circ}$

$\therefore v_o(t) = Re\{\hat{V}_o e^{j\sqrt{3}t}\} = 8.32\cos(\sqrt{3}t - 60^\circ)$

$\hat{V}_s = \hat{I}(3 - j\frac{5}{\sqrt{3}}) = \dfrac{16e^{-j90^\circ}\, 4.16e^{-j43.9^\circ}}{5.77e^{-j30^\circ}} = 11.53\,e^{-j103.9^\circ}$

or $v_s(t) = 11.53\cos(\sqrt{3}t - 103.9^\circ)$

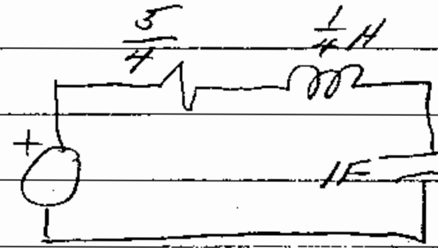


(v_o leads v_s by 43.9°)

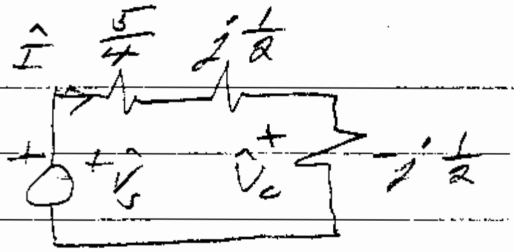
EE 211 Homework 26

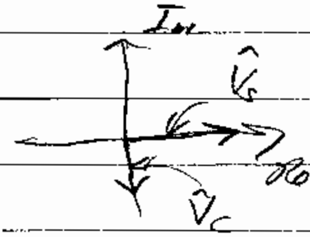
8.24

$4\cos 2t$



$\Rightarrow$ 4



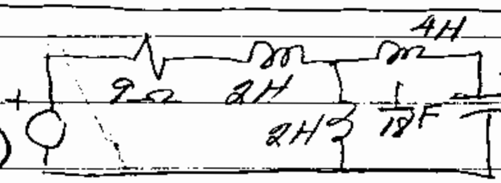


$$\hat{I} = \frac{4}{5/4} = \frac{16}{5} \; ; \; \hat{V}_C = \left(-j\tfrac{1}{2}\right)\hat{I} = -j\frac{8}{5}$$

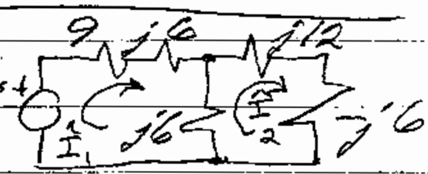
$$\therefore\; v_C(t) = \frac{8}{5}\cos(2t - 90^\circ) \leftarrow$$

8.27

$36\cos(3t-60^\circ)$



$\Rightarrow 36e^{-j60^\circ}$



$$36e^{-j60^\circ} = \hat{I}_1(9+j6) + (\hat{I}_1 - \hat{I}_2)j6 \qquad (1)$$

$$0 = (\hat{I}_2 - \hat{I}_1)j6 + \hat{I}_2 j6 \Rightarrow \hat{I}_2 j12 = \hat{I}_1 j6 \quad \text{or} \quad \boxed{\hat{I}_1 = 2\hat{I}_2} \quad (2)$$

substituting (2) into (1) gives:

$$36e^{-j60^\circ} = 2\hat{I}_2(9+j6) + \hat{I}_2 j6 = \hat{I}_2(18+j18)$$

$$\text{so } \hat{I}_2 = \frac{36e^{-j60^\circ}}{\sqrt{2}\,18\,e^{j45^\circ}} = \sqrt{2}\,e^{-j105^\circ}$$

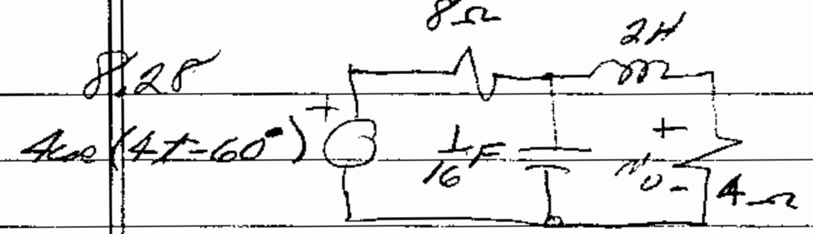
$$\text{and } \hat{V}_0 = -j6\hat{I}_2 = 6\sqrt{2}\,e^{-j195^\circ}$$

$$\boxed{\text{or } v_0(t) = 6\sqrt{2}\cos(3t - 195^\circ)} \leftarrow$$

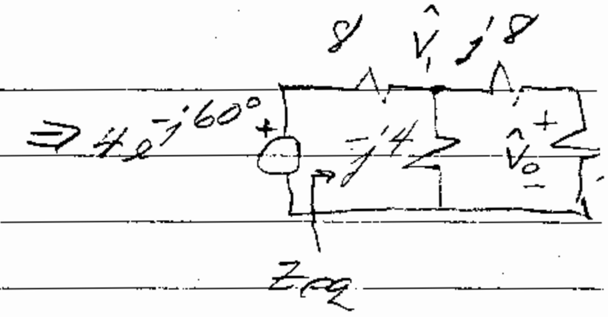
$$Z_{eq} \text{ (seen by source)} = 9 + j6 + \frac{j6(j6)}{j12} \boxed{= 9 + j9} \leftarrow$$

EE 211 Homework 27

8.28



$\Rightarrow$



$$\frac{\hat{V}_1 - 4e^{-j60°}}{8} + \frac{\hat{V}_1}{-j4} + \frac{\hat{V}_1 - \hat{V}_o}{j8} = 0 \qquad (1)$$

$$\frac{\hat{V}_o - \hat{V}_1}{j8} + \frac{\hat{V}_o}{4} = 0 \Rightarrow \hat{V}_o\left(\frac{1}{4} + \frac{1}{j8}\right) = \frac{\hat{V}_1}{j8}$$

or $\hat{V}_1 = \hat{V}_o(1+j2)$

substituting into (1) $\frac{\hat{V}_o(1+j2) - 4e^{-j60°}}{8} + \hat{V}_o(1+j2)\left[\frac{j}{4} - \frac{j}{8}\right] \underbrace{}_{+j\frac{\hat{V}_o}{8}} = 0$

$$\hat{V}_o\left[\frac{1}{8} + j\frac{1}{4} + j\frac{1}{4} - \cancel{\frac{j}{8}} + \cancel{\frac{j}{8}} - \frac{1}{2} + \frac{1}{4}\right] = \frac{1}{2}e^{-j60°}$$

or $\hat{V}_o\left[-\frac{1}{8} + j\frac{1}{2}\right] = \frac{1}{2}e^{-j60°}$; $\boxed{\hat{V}_o = \frac{4e^{-j60°}}{-1+j4}}$

$$\hat{V}_o = \frac{4e^{-j60°}}{\sqrt{17}\,e^{j104.04°}} = 0.97\,e^{-j164.04°}$$

$$\boxed{v_o(t) = 0.97\cos(4t - 164.04°)}$$

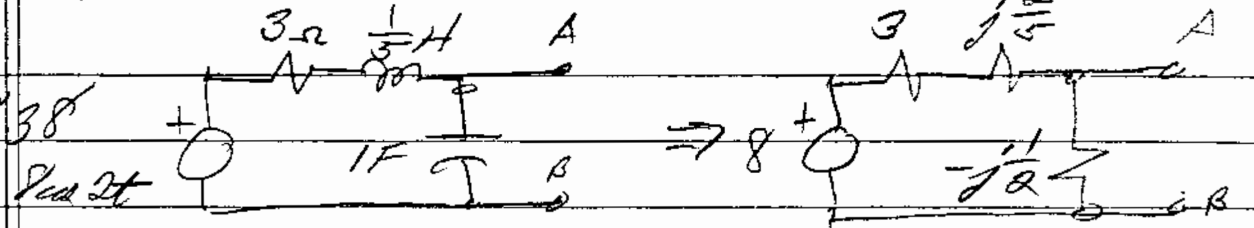
b) $Z_{eq} = 8 + \frac{-j4(4+j8)}{4+j4} = \frac{32 + j32 - j16 + 32}{4+j4}$

$$Z_{eq} = \frac{64 + j16}{4+j4} = \boxed{\frac{16+j4}{1+j}} = \frac{16.49\,e^{j14.04°}}{\sqrt{2}\,e^{j45°}}$$

$$\boxed{Z_{eq} = 11.65\,e^{-j31°}}$$

EE 211 Homework 28

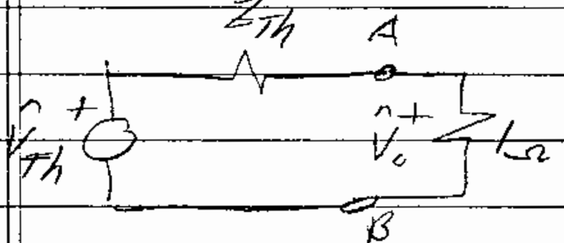
8.38



$$\hat{V}_{oc} = \hat{V}_{Th} = 8\,\frac{-j\frac{1}{2}}{3-j\frac{1}{10}} = \boxed{\frac{-j40}{30-j}}$$

$$\hat{I}_{sc} = \frac{8}{3+j\frac{2}{5}} = \frac{40}{15+j2}$$

$$\therefore\ Z_{Th} = \frac{-j40}{30-j} \times \frac{15+j2}{40} = \frac{2-j15}{30-j}$$



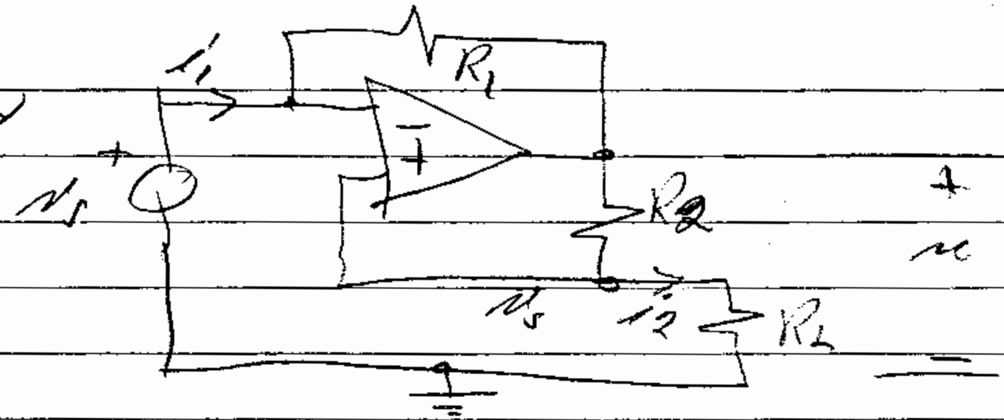
$$\hat{V}_o = \hat{V}_{Th}\,\frac{1}{1+Z_{Th}} = \frac{-j40}{30-j} \times \frac{1}{1+\frac{2-j15}{30-j}} = \frac{-j40}{32-j16}$$

$$\hat{V}_o = \frac{-j5}{4-j2} = \frac{5e^{-j90^\circ}}{4.472e^{-j26.57^\circ}} = \boxed{1.12e^{-j63.43^\circ}}$$

$$\boxed{v_o(t) = 1.12\cos(2t - 63.43^\circ)}$$

EE 211 Homework 29

3.8



$$v \frac{R_L}{R_L+R_2} = v_s \quad \text{or} \quad \boxed{v = v_s \left\{\frac{R_L+R_2}{R_L}\right\}}$$

$$i_2 = \frac{v_s}{R_L} \quad ; \quad i_1 = \frac{v_s - v}{R_1}$$

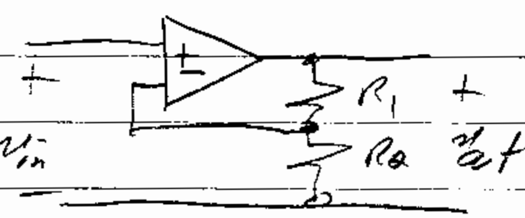
so $$\frac{i_2}{i_1} = \frac{\frac{v_s}{R_L}}{\frac{v_s - v}{R_1}} = \frac{R_1}{R_L} \frac{v_s}{v_s - v_s\left[\frac{R_L+R_2}{R_L}\right]}$$

$$\boxed{\frac{i_2}{i_1} = R_1 \frac{1}{R_L - R_L - R_2} = -\frac{R_1}{R_2}}$$

EE 211 Homework 30 (handout)

Inverting Op-Amp has input resistance equal to R_{in}. We are limited to using Resistors $\leq 200k\Omega$ so to obtain $R_{in} > 250k\Omega$ I will use a non inverting first stage. This will give me the necessary R_{in}

Make 1st stage gain = 20

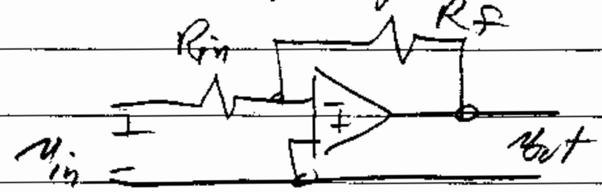


$$Gain = \frac{R_2+R_1}{R_2} = 20$$

let $\boxed{R_2 = 10k\Omega}$

Then $1+\frac{R_1}{10^4}=20$; $R_1 = (20-1)\times 10^4 = \boxed{190k\Omega}$

2nd stage gain = -100

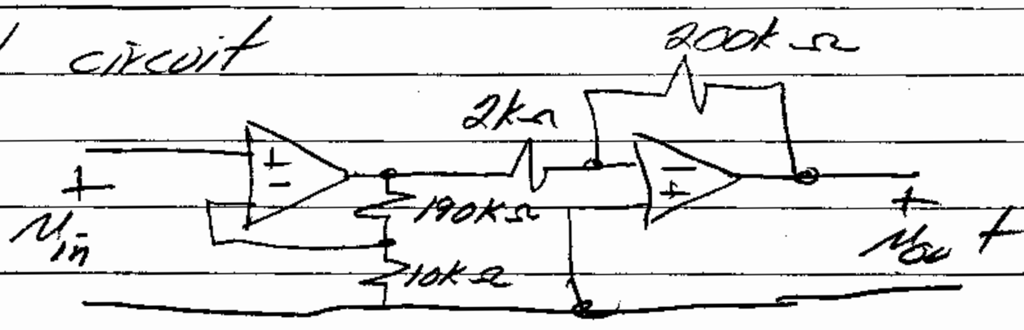


$$Gain = -\frac{R_f}{R_{in}}$$

pick $R_f = 200k\Omega$

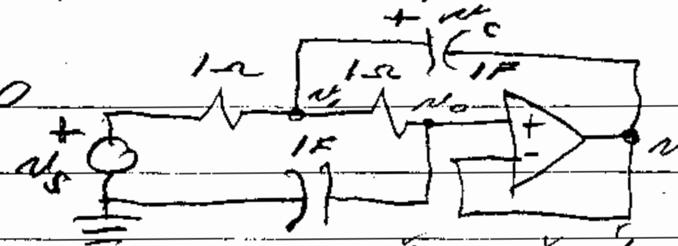
then $R_{in} = 2k\Omega$

total circuit



EE 211 Homework 31

6.30



$v_s(t) = u(t)$

"zero state" ∴ $v_c(0)=$

Node voltage eq. $\frac{v_1-1}{1}+\frac{v_1-v_o}{1}+\frac{d}{dt}(v_1-v_o)=0$ (1)

$$\frac{v_o-v_1}{1}+\frac{dv_o}{dt}=0 \quad (2)$$

from (2) $v_1 = v_o + \frac{dv_o}{dt}$

substituting into (1) gives: $2(v_o+\frac{dv_o}{dt})-v_o+\frac{d}{dt}(v_o+\frac{dv_o}{dt})-\frac{dv_o}{dt}=1$

or $\frac{d^2v_o}{dt^2}+2\frac{dv_o}{dt}+v_o=1$; $v_{o_h}=Ae^{st}$

$s^2+2s+1=0$ $\quad S_{1,2}=\frac{-2\pm\sqrt{4-4}}{2}=-1$

$v_{o_{particular}}=K=1$ ∴ $\boxed{v_o=A_1e^{-t}+A_2te^{-t}+1}$

but $v_o(0)=0$ ∴ $A_1=-1$

also $v_1(0)=0$ so from (2) $\left.\frac{dv_o}{dt}\right|_{t=0}=0$

$\left.\frac{dv_o}{dt}\right|_{t=0}=1+A_2$ $\quad [v_o(t)=-e^{-t}-te^{-t}+1]$

8.44

$$\frac{6-\hat{V}_o}{2}+\frac{6-\hat{V}_o}{-j2}+\frac{6}{1}=0$$

$$\hat{V}_o(+\tfrac{1}{2}+j\tfrac{1}{2})=6(+1+j\tfrac{1}{2}+\tfrac{1}{2})$$

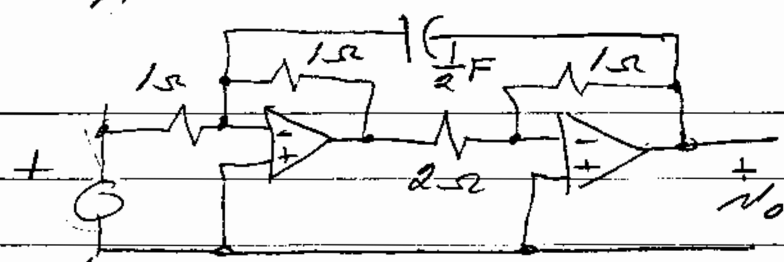
or $\hat{V}_o=\frac{9+j3}{\frac{1}{2}+j\frac{1}{2}}=\frac{18+j6}{1+j}=\frac{18.97e^{j18.43^\circ}}{\sqrt{2}\,e^{j45^\circ}}=13.41e^{-j26.57}$

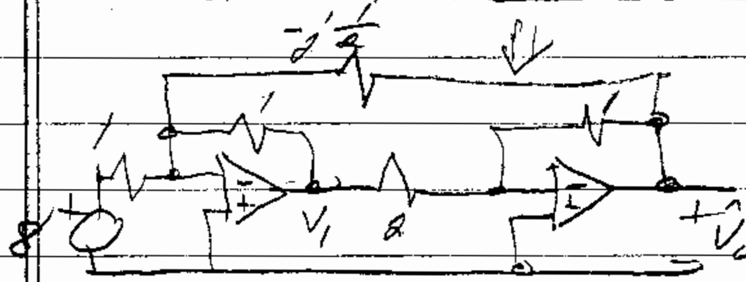
$$v_o(t)=\mathrm{Im}\{\hat{V}_oe^{j2t}\}=13.41\sin(2t-26.57^\circ)$$

or $v_o(t)=13.41\cos(2t-116.57^\circ)$

EE 211 Homework 32

8.47





KCL @ 1st inverting node $-\frac{8}{1}-\frac{V_1}{1}-\frac{\hat{V}_o}{-j\frac{1}{2}}=0$

KCL @ 2nd inverting node $-\frac{V_1}{2}-\frac{V_o}{1}=0$

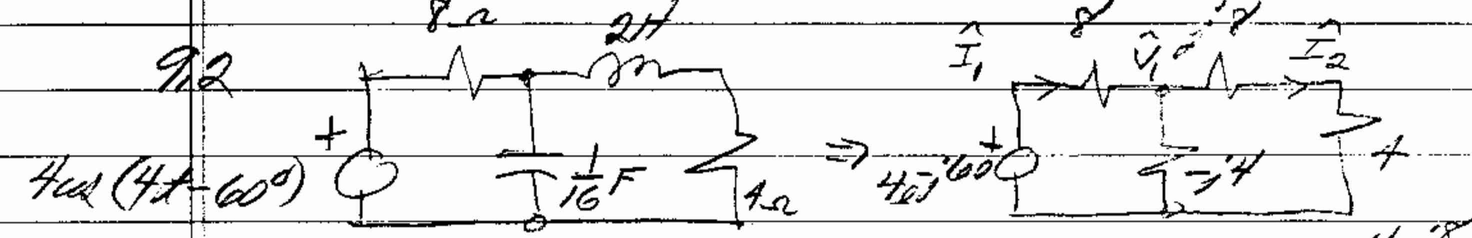
$$\left.\begin{array}{l}\hat{V}_o(-2j)-\hat{V}_1=8\\ \hat{V}_1=-2\hat{V}_o\end{array}\right.$$

$\therefore \hat{V}_o(-2j+2)=8$; $\hat{V}_o=\frac{8}{2-2j}=\frac{4}{1-j}=\frac{4}{\sqrt{2}}e^{j45^\circ}$

$\boxed{\text{or } v_o(t)=2\sqrt{2}\cos(4t+45^\circ)}$

EE 211 Homework 33

9.2



$\frac{\hat V_1 - 4e^{-j60°}}{8} + \frac{\hat V_1}{-j4} + \frac{\hat V_1}{4+j8} = 0$; $\hat V_1\left(\frac{1}{8} + j\frac{1}{4} + \frac{1}{4+j8}\right) = \frac{1}{2}e^{-j60°}$

$\frac{4-j8}{80}$

multiplying by 80 gives $\hat V_1(14+j12) = 40e^{-j60°}$

so $\hat V_1 = \frac{40e^{-j60°}}{18.439e^{j40.60°}} = 2.169e^{-j100.6°}$

$\hat I_1 = \frac{4e^{-j60°} - 2.169e^{-j100.6°}}{8} = \frac{2 - j3.464 + 0.399 + j2.132}{8}$

$\hat I_1 = 0.2999 - j0.1665 = 0.343e^{-j29°}$

$\hat I_2 = \frac{\hat V_1}{4+j8} = \frac{2.169e^{-j100.6°}}{8.944e^{j63.43°}} = 0.242e^{-j164°}$

so $P_{ave_{8\Omega}} = \frac{1}{2}|\hat I_1|^2 8 = \boxed{470.6\ mW}$

$P_{ave_{4\Omega}} = \frac{1}{2}|\hat I_2|^2 4 = \boxed{117\ mW}$

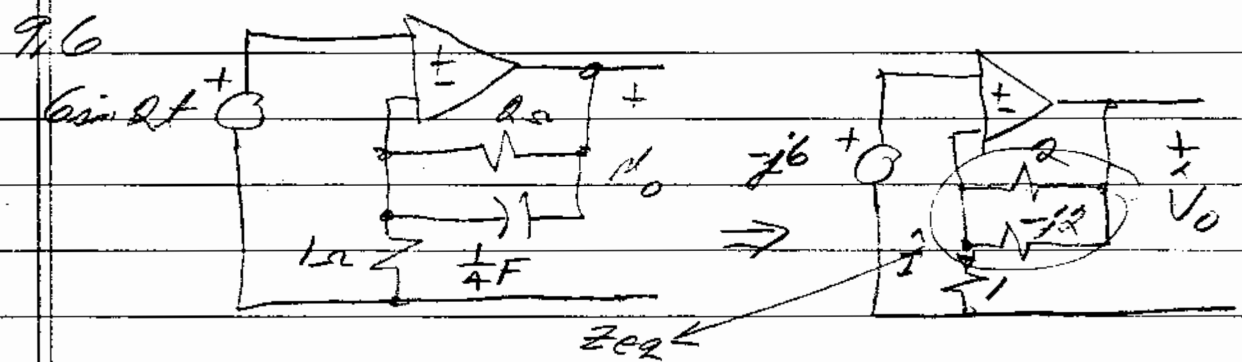
$P_{ave_{source}} = -\frac{1}{2}\mathrm{Re}\{4e^{-j60°} \times 0.343e^{j29°}\} = \boxed{-588\ mW}$

$\boxed{P_{ave} \text{ for capacitor and inductor } = 0}$

$\boxed{\Sigma P_{ave}\text{'s} = -0.4\ mW \approx 0}$

EE 211 Homework 34

9.6



$\hat{I} = -j6 \; ; \; \hat{V}_0 = \hat{I}\left[\frac{-j4}{2-j2} + 1\right] = -j6\left[\frac{2-j6}{2-j2}\right]$

$\boxed{\hat{V}_0} = \frac{-36-j12}{2-j2} = \frac{-18-j6}{1-j} = \frac{18.974\,e^{j198.4}}{\sqrt{2}\,e^{-j45^\circ}} = 13.42\,e^{j243.4}$

or $13.42\,e^{-j116.6}$

$\therefore P_{ave_{1\Omega}} = \frac{1}{2}Re\{-j6 \times j6\} = \boxed{18 \text{ Watts}}$

$P_{ave_{2\Omega}} = \frac{1}{2}\left|\hat{V}_0 + j6\right|^2 \times \frac{1}{2} = \frac{1}{4}\left|\frac{-18-j6+j6+6}{1-j}\right|^2$

$P_{ave_{2\Omega}} = \frac{1}{4}\left|\frac{12}{\sqrt{2}}\right|^2 = \frac{1}{4} \times \frac{144}{2} = \boxed{18 \text{ Watts}}$

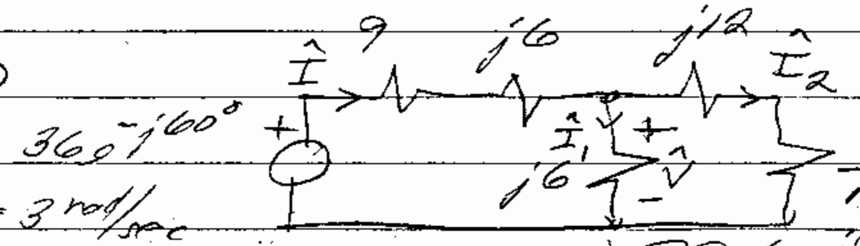
$\boxed{P_{ave_{capacitor}} = 0}$

$P_{ave_{\text{out of amplifier}}} = \frac{1}{2}Re\{\hat{V}_0\,\hat{I}^*\} = \frac{1}{2}Re\{13.42\,e^{-j116.6^\circ}\,6\,e^{j90^\circ}\}$

$= 36 \text{ Watts}$

EE 211 Homework 35

9.30



$\omega = 3$ rad/sec

$$Z_{eq} = \frac{(j6)(j6)}{j12} = j3$$

$$\boxed{\hat{I} = \frac{36e^{-j60^\circ}}{9+j9} = \frac{4}{\sqrt{2}}e^{-j105^\circ}}$$

$$\hat{V} = \hat{I}Z_{eq} = \frac{12}{\sqrt{2}}e^{-j15^\circ}$$

$$\hat{I}_1 = \hat{V}/j6 = \frac{2}{\sqrt{2}}e^{-j105^\circ}\ ;\ \hat{I}_2 = \frac{\hat{V}}{j6} = \frac{2}{\sqrt{2}}e^{-j105^\circ}$$

$$S_{\text{left inductor}} = \frac{1}{2}\cdot\frac{24}{\sqrt{2}}e^{-j15}\frac{4}{\sqrt{2}}e^{+j105} = 24j \leftarrow$$

$$S_{\text{middle inductor}} = \frac{1}{2}\cdot\frac{12}{\sqrt{2}}e^{-j15}\frac{2}{\sqrt{2}}e^{+j105} = 6j \leftarrow$$

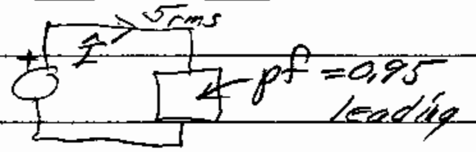
$$S_{\text{right inductor}} = \frac{1}{2}\cdot\frac{2}{\sqrt{2}}e^{-j105}\,12\,e^{+j90^\circ}\frac{2}{\sqrt{2}}e^{+j105} = 12j \leftarrow$$

$$S_{\text{capacitor}} = \frac{1}{2}\cdot\frac{2}{\sqrt{2}}e^{-j105}\,6e^{-j90^\circ}\frac{2}{\sqrt{2}}e^{+j105^\circ} = -6j \leftarrow$$

$$S_{\text{resistor}} = \frac{1}{2}\cdot 9\,\frac{4}{\sqrt{2}}e^{-j105^\circ}\frac{4}{\sqrt{2}}e^{+j105^\circ} = 36 \leftarrow$$

$$S_{\text{source}} = -\frac{36}{2}e^{-j60^\circ}\frac{4}{\sqrt{2}}e^{+j105} = -\frac{72}{\sqrt{2}}e^{j45^\circ} = \boxed{-36-j36}$$

9-32



$$\hat{I} = 5e^{j18.19^\circ}$$

a) $\hat{S} = 440\times 5e^{-j18.19^\circ} = 2090 - j686.8 \leftarrow$

b) $|\hat{S}| = 5\times 440 = 2200 \leftarrow$

c) $Z = \frac{\hat{V}}{\hat{I}} = \frac{440}{5e^{j18.19}} = 88e^{-j18.19^\circ} = 83.6 - j27.47 \leftarrow$