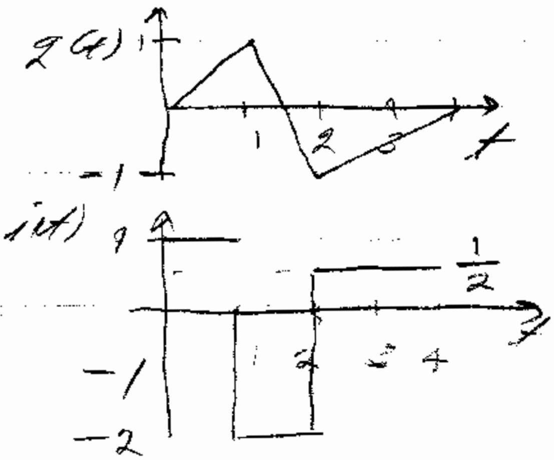
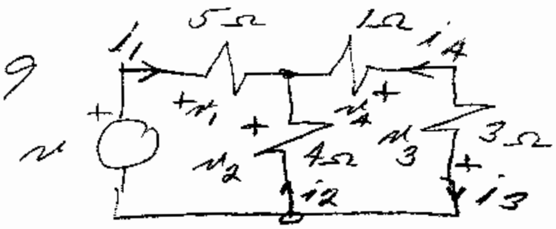
EE 211 Homework 1

1.8



$i(t) = \frac{dq}{dt}$

1.9



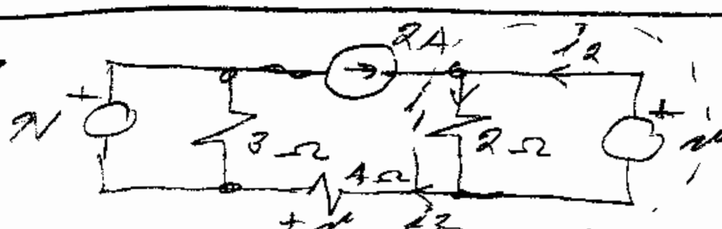
a) $i_1 = 4$; $v_1 = 20V$

b) $i_2 = -2$; $v_2 = 8V$

c) $i_3 = 2$; $v_3 = -6V$

d) $i_4 = -2$; $v_4 = -2V$

1.17



a) $v = 2V$ $\quad i_1 = \frac{v}{2} = 1$; $2 + i_2 - i_1 = 0$ $\therefore i_2 = -1$

$i_3 = i_1 - i_2 = 1 - (-1) = 2A$ $\quad \therefore \underline{v_1 = -2 \times 4 = -8V}$ ←

b) $v = 4V$ $\quad i_1 = \frac{4}{2} = 2$; $i_2 = i_1 - 2 = 0$

$i_3 = i_1 - i_2 = 2$ $\quad \therefore \boxed{v_1 = -2 \times 4 = -8V}$ ←

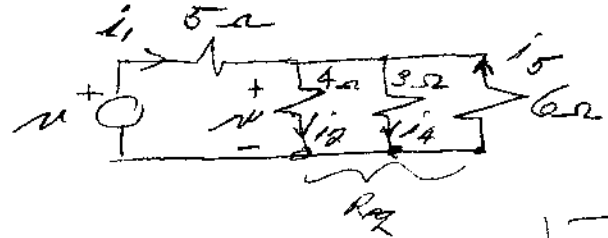
c) $v = 6V$ $\quad i_1 = \frac{6}{2} = 3$; $i_2 = i_1 - 2 = 1$

$i_3 = i_1 - i_2 = 2$ $\quad \therefore \boxed{v_1 = -2 \times 4 = -8}$ ←

[Could work problem by realizing that current into dotted region = 2A ∴ current out of region $i_3 = 2A$ independent of value of v!]

EE 211 Homework 2

1.18



$i_1 = 5A$

$\frac{1}{R_{eq}} = \frac{1}{4} + \frac{1}{3} + \frac{1}{6}$; $R_{eq} = \frac{4}{3}\,\Omega$

$\therefore \quad i_1 = \frac{v}{5+\frac{4}{3}} = \frac{5}{19/3} = \boxed{\frac{15}{19} = 0.789A}$

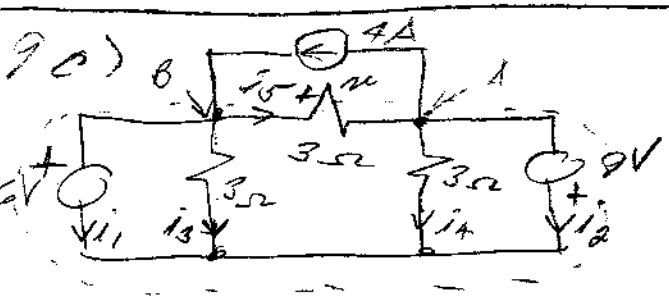
$v = i_1 \times R_{eq} = 5 \times \frac{4}{3} = \frac{20}{3} = 6.67V$

$\boxed{i_2 = \frac{v}{4} = \frac{5}{3}}$; $\boxed{i_4 = \frac{v}{3} = \frac{20}{9}A}$

$\boxed{i_5 = -\frac{v}{6} = -\frac{20}{3\times 6} = -\frac{10}{9}A}$; $\boxed{i_3 = i_4 - i_5 = \frac{30}{9}}$

1.26 a) $i = -0.6A$ b) $i =$ anything

1.29 c)



$i_3 = \frac{6}{3} = 2A$

$i_4 = \frac{9}{3} = -3A$

using KCL @ node A gives:

$4 - i_5 + i_4 + i_2 = 0 \qquad (1)$

KVL around dotted loop gives: $-6 + v - 9 = 0 \therefore v = 15V$

and $i_5 = \frac{v}{3} = 5A$

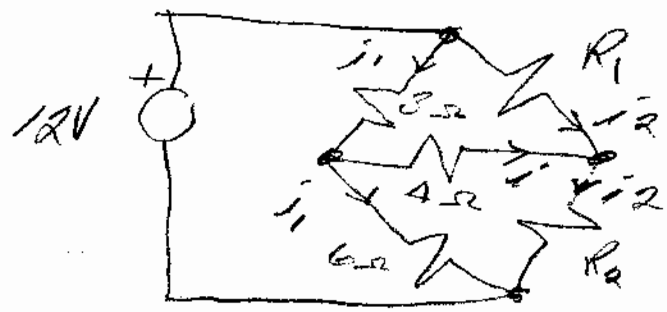
from (1) above $\boxed{i_2 = i_5 - i_4 - 4 = 5 + 3 - 4 = 4\,A}$ ←

KCL @ node B gives: $i_1 + i_3 + i_5 - 4 = 0$

$\therefore \boxed{i_1 = 4 - i_3 - i_5 = 4 - 2 - 5 = -3A}$ ←

EE 211 Homework 3

1.38(c)



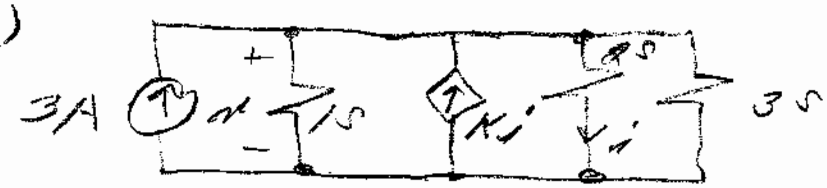
$i = 0$

$\therefore v_{4\Omega} = 0$

for balance $3i_1 = i_2 R_1$ and $6i_1 = i_2 R_2$

dividing these two equations gives: $\boxed{\dfrac{R_2}{R_1} = 2}$

1.41(a)



$K = 2$

$i = 2v$

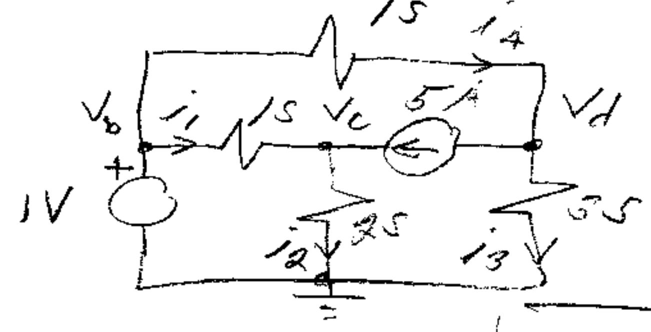
KCL gives: $-3 + v - 2i + 2v + 3v = 0$

$\therefore v - 4v + 2v + 3v = 3$

$\boxed{v = \dfrac{3}{2}}$ V

EE 211 Homework 4

2.1 modified



$\boxed{V_b = 1V}$

$(V_c - 1) + 2V_c = 5$; $3V_c = 6$; $\boxed{V_c = 2V}$

$(V_d - 1) + 3V_d = -5$; $4V_d = -4$; $\boxed{V_d = -1V}$

$i_1 = (V_b - V_c) \times 1 = -1A$

$i_2 = 2V_c = 4A$

$i_3 = 3V_d = -3A$

$i_4 = (V_b - V_d) \times 1 = 2A$

power balance

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

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

$P_{middle_{1S}} = i_1^2 \times 1 = 1W$

$P_{2S} = i_2^2 \left(\frac{1}{2}\right) = 8W$

$P_{3S} = i_3^2 \left(\frac{1}{3}\right) = 3W$

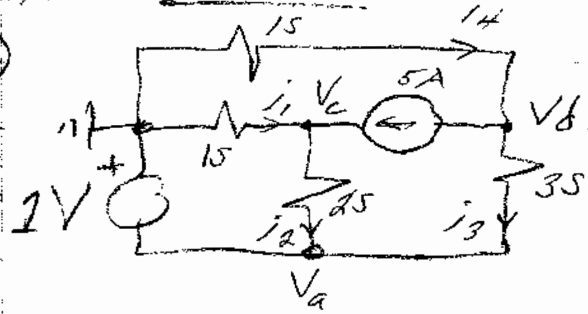
$P_{5A} = 5 \times (V_d - V_c) = 5 \times (-3) = -15W$

$\sum p's = 0$!

EE 211 Homework 5

2.2 modified

a)



$V_a = -1V$

@ node c $\quad V_c + (V_c+1)2 = 5 \quad$ (1)

@ node d $\quad V_d + (V_d+1)3 = -5 \quad$ (2)

from (1) $\quad 3V_c = 3$; $\boxed{V_c = 1 \quad V_d = -2}$

from (2) $\quad 4V_d = -8$

b) $i_1 = -V_c = -1A$

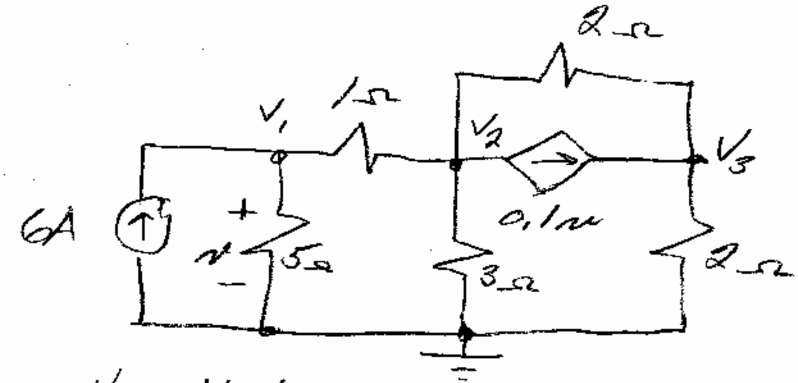
$i_2 = (V_c - V_a)2 = 4A$

$i_3 = (V_d - V_a)3 = -3A$

$i_4 = -V_d = 2A$

EE 211 Homework 6

2.6



$\boxed{v = V_1}$

$$-6 + \frac{V_1}{5} + \frac{V_1 - V_2}{1} = 0$$

$$\frac{V_2 - V_1}{1} + \frac{V_2}{3} + \frac{V_2 - V_3}{2} + 0.1v = 0$$

$$\frac{V_3 - V_2}{2} + \frac{V_3}{2} - 0.1v = 0$$

$$\frac{6}{5}V_1 - V_2 = 6$$

$$\left(\frac{1}{10} - 1\right)V_1 + V_2\left(1 + \frac{1}{3} + \frac{1}{2}\right) - \frac{1}{2}V_3 = 0$$

$$-\frac{2}{10} - \frac{1}{2}V_2 + V_3 - \frac{1}{10}V_1 = 0$$

or

$$\begin{aligned} 6V_1 - 5V_2 &= 30 \\ -54V_1 + 110V_2 - 30V_3 &= 0 \\ -2V_1 - 10V_2 + 20V_3 &= 0 \end{aligned} \Rightarrow \begin{aligned} 6V_1 - 5V_2 &= 30 \\ -27V_1 + 55V_2 - 15V_3 &= 0 \\ -V_1 - 5V_2 + 10V_3 &= 0 \end{aligned}$$

$\therefore$

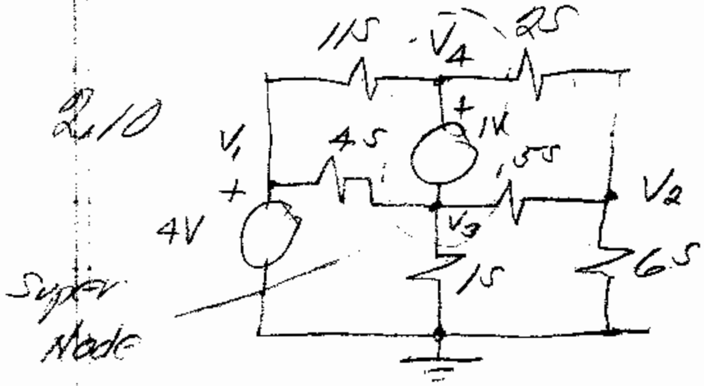
$$V_1 = \frac{\begin{vmatrix} 30 & -5 & 0 \\ 0 & 55 & -15 \\ 0 & -5 & 10 \end{vmatrix}}{\begin{vmatrix} 6 & -5 & 0 \\ -27 & 55 & -15 \\ -1 & -5 & 10 \end{vmatrix}} = \frac{30(550-75)}{6\underbrace{(550-75)}_{475} + 5\underbrace{(-270-15)}_{-285}} = \frac{14,250}{1,425} = \underline{\underline{10}}$$

$$V_2 = \frac{\begin{vmatrix} 6 & 30 & 0 \\ -27 & 0 & -15 \\ -1 & 0 & 10 \end{vmatrix}}{1,425} = \frac{-30(-270-15)}{1425} = \frac{8550}{1425} = \underline{\underline{6V}}$$

$$V_3 = \frac{\begin{vmatrix} 6 & -5 & 30 \\ -27 & 55 & 0 \\ -1 & -5 & 0 \end{vmatrix}}{1,425} = \frac{30(135+55)}{1425} = \underline{\underline{4V}}$$

EE 211 Homework 7

2.10



$\boxed{V_1 = 4V}$ ←

$V_4 - V_3 = 1$ $\quad$ or $V_4 = 1 + V_3$

$(V_4 - V_1)1 + (V_3 - 4)4 + V_3 + (V_3 - V_2).5 + (V_4 - V_2)2 = 0$

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

or $(1 + V_3 - 4)1 + (V_3 - 4)4 + V_3 + (V_3 - V_2).5 + (1 + V_3 - V_2)2 = 0$

$(V_2 - 1 - V_3)2 + (V_2 - V_3).5 + 6V_2 = 0$

$\therefore -7V_2 + 23V_3 = +47$

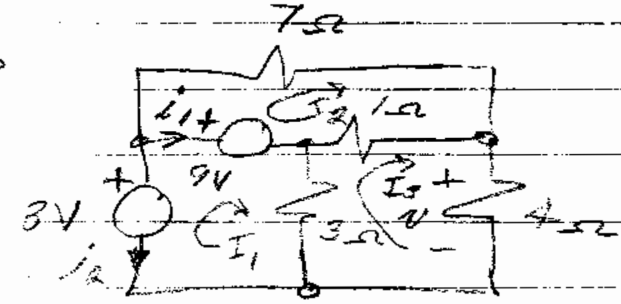
$13V_2 - 7V_3 = 2$

$$V_2 = \frac{\begin{vmatrix} +47 & 23 \\ 2 & -7 \end{vmatrix}}{\begin{vmatrix} -7 & 23 \\ 13 & -7 \end{vmatrix}} = \frac{-375}{-250} = \underline{1.5V} \leftarrow$$

$$V_3 = \frac{\begin{vmatrix} -7 & 47 \\ 13 & 2 \end{vmatrix}}{-250} = \frac{-625}{-250} = \underline{2.5V} \leftarrow$$

EE 211 Homework 8

2.3



$$-3+9+(I_1-I_3)3=0$$
$$-9+7I_2+(I_2-I_3)=0$$
$$(I_3-I_1)3+(I_3-I_2)+4I_3=0$$

or
$$3I_1 \quad -3I_3=-6$$
$$8I_2-I_3=9$$
$$-3I_1-I_2+8I_3=0$$

$$I_1=\frac{\begin{vmatrix}-6 & 0 & -3\\ 9 & 8 & -1\\ 0 & -1 & 8\end{vmatrix}}{\begin{vmatrix}3 & 0 & -3\\ 0 & 8 & -1\\ -3 & -1 & 8\end{vmatrix}}=\frac{-6(\overset{63}{64-1})-3(-9)}{3(64-1)-3(24)}=\frac{-351}{117}=-3A$$

$$I_2=\frac{\begin{vmatrix}3 & -6 & -3\\ 0 & 9 & -1\\ -3 & 0 & 8\end{vmatrix}}{117}=\frac{\overset{216}{3(72)}-\overset{99}{3(6+27)}}{117}=\frac{117}{117}=1A$$

$$I_3=\frac{\begin{vmatrix}3 & 0 & -6\\ 0 & 8 & 9\\ -3 & -1 & 0\end{vmatrix}}{117}=\frac{\overset{27}{3(9)}-\overset{144}{6(24)}}{117}=-\frac{117}{117}=-1A$$

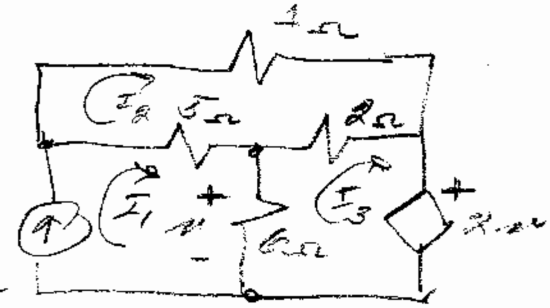
a) $i_2=-I_1=3A$

b) $i_1=(I_1-I_2)=-4A$

c) $v=4I_3=-4V$

EE 211 Homework 9

2.32



Mesh

$I_1 = 1$

$(I_2 - I_1)5 + 4I_2 + 2(I_2 - I_3) = 0$

$(I_3 - I_1)6 + (I_3 - I_2)2 + 2\underset{6(I_1 - I_3)}{v} = 0$

but $v = (I_1 - I_3)6$

$\therefore \quad 11I_2 - 2I_3 = 5$

$-2I_2 - 4I_3 = -6$

$$I_2 = \frac{\begin{vmatrix} 5 & -2 \\ -6 & -4 \end{vmatrix}}{\begin{vmatrix} 11 & -2 \\ -2 & -4 \end{vmatrix}} = \frac{-20-12}{-44-4} = \frac{32}{48} = \frac{2}{3}A$$

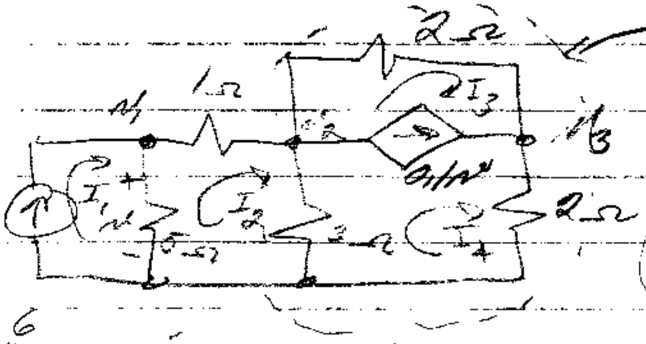
$$I_3 = \frac{\begin{vmatrix} 11 & 5 \\ -2 & -6 \end{vmatrix}}{-48} = \frac{-66+10}{-48} = \frac{56}{48} = \frac{7}{6}A$$

$$v_{source} = (I_1 - I_2)5 + (I_1 - I_3)6 = \frac{5}{3} - \frac{6}{6} = \frac{2}{3}V$$

$$\therefore \quad \boxed{R_{in} = \frac{v_{source}}{1} = \frac{2}{3}\Omega}$$

EE 211 Homework 10

2.30



$v = (I_1 - I_2)5$

$\therefore I_4 - I_3 = \frac{1}{2}(I_1 - I_2)$

$\boxed{\text{with } I_1 = 6}$

$I_3 = I_4 - \frac{1}{2}(I_1 - I_2)$

$(I_2 - \overset{6}{I_1})5 + I_2 + (I_2 - I_4)3 = 0$ $\qquad 9I_2 - 3I_4 = 30$

$(I_4 - I_2)3 + \underbrace{2I_3}_{2I_4 - I_1 + I_2} + 2I_4 = 0$ $\qquad -2I_2 + 7I_4 = 6$

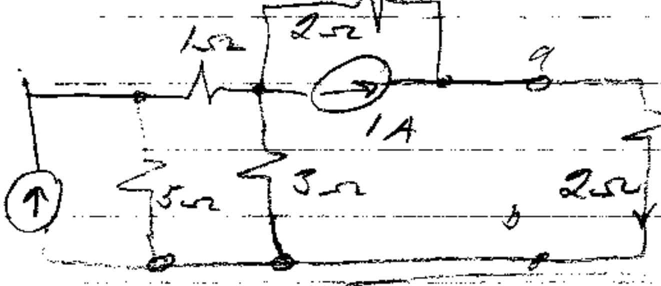
$$I_2 = \frac{\begin{vmatrix} 30 & -3 \\ 6 & 7 \end{vmatrix}}{\begin{vmatrix} 9 & -3 \\ -2 & 7 \end{vmatrix}} = \frac{210+18}{63-6} = \frac{228}{57} = \boxed{4A}$$

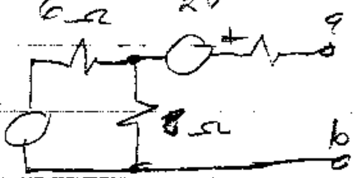
$$I_4 = \frac{\begin{vmatrix} 9 & 30 \\ -2 & 6 \end{vmatrix}}{57} = \frac{54+60}{57} = \frac{114}{57} = \boxed{2A}$$

$$I_3 = I_4 - \frac{1}{2}(I_1 - I_2) = 2 - \frac{1}{2}(2) = \boxed{1A}$$

$\therefore \begin{cases} v_1 = (I_1 - I_2)5 = 10V \ ; \ v_2 = (I_2 - I_4)3 = 6V \\ v_3 = 2I_4 = 4V \end{cases}$

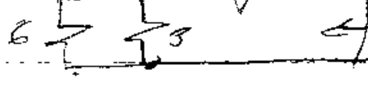
3.28



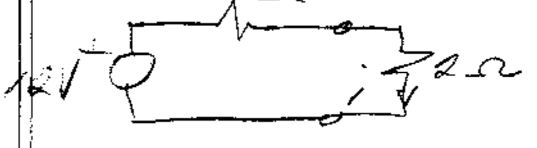


$\therefore \boxed{V_{Th} = V_{oc} = \frac{3}{9} \times 30 + 2 = 12V}$

Sources = 0 gives



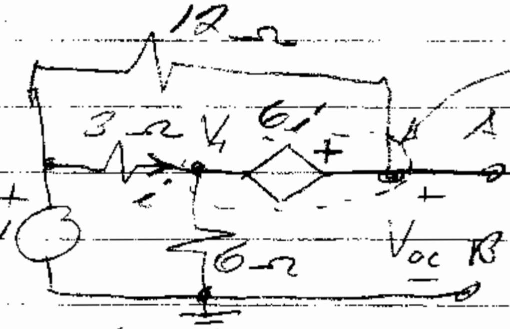
$\boxed{R_{eq} = 2 + 2 = 4\Omega}$



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

EE 211 Homework 11

3.35



$V_{oc} - V_1 = 6i$

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

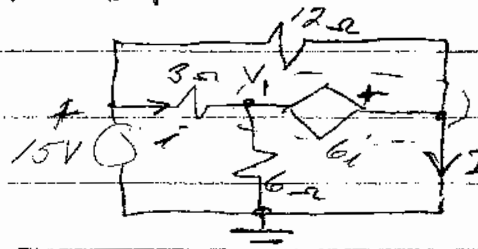
∴ $V_{oc} - V_1 = 30 - 2V_1$

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

Node V_1 $\quad \frac{V_1 - 15}{3} + \frac{V_1}{6} + \frac{V_{oc} - 15}{12} = 0 \Rightarrow \frac{1}{12}V_{oc} + \frac{1}{2}V_1 = \frac{75}{12}$

$$\therefore V_{oc} = \frac{\begin{vmatrix} 30 & 1 \\ 75 & 6 \end{vmatrix}}{\begin{vmatrix} 1 & 1 \\ 1 & 6 \end{vmatrix}} = \frac{180 - 75}{6 - 1} = \frac{105}{5} = \boxed{21V}$$

Find I_{sc}



$-\frac{12}{5}$

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

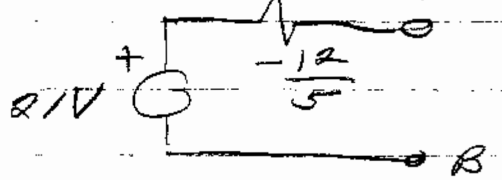
∴ $6i = 30 - 2V_1$

$V_1 = -6i = 2V_1 - 30$ so $\boxed{V_1 = 30}$

KCL @ supernode gives: $\frac{30 - 15}{3} + \frac{30}{6} - \frac{15}{12} + I_{sc} = 0$

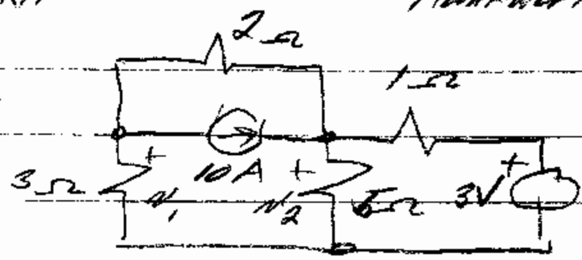
∴ $I_{sc} = -5 - 5 + \frac{5}{4} = -\frac{35}{4}$

and $\boxed{R_{Th} = \frac{-21 \times 4}{35} = -\frac{12}{5}}$

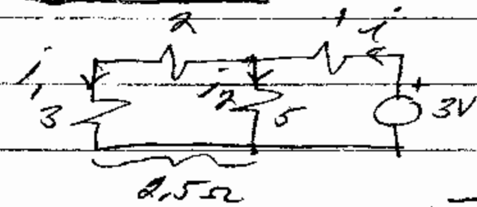


EE 211 Homework 12

3.64



Current Source = 0

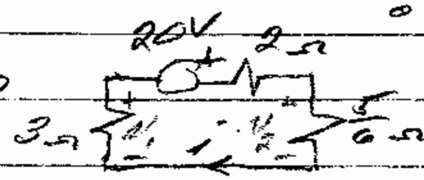


$i = \frac{3}{7/6} = \frac{6}{7}A$

$i_1 = i_2 = \frac{i}{2} = \frac{3}{7}A$

∴ $\boxed{v_1 = \frac{9}{7}V;\ v_2 = \frac{15}{7}V}$

Voltage Source = 0



$20 = \frac{35}{6} i$ or $i = \frac{24}{7}A$

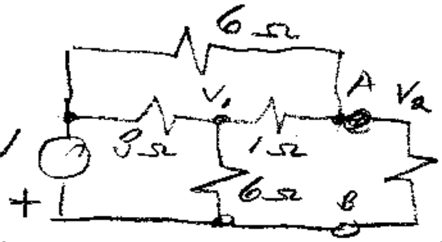
so $v_1 = -3 i_1 = -\frac{3 \times 24}{7} V$; $v_2 = \frac{5}{6} i = \frac{20}{7} V$

∴ total $\boxed{v_1 = \frac{9}{7} - \frac{72}{7} = -9V}$

$\boxed{v_2 = \frac{20}{7} + \frac{15}{7} = \frac{35}{7} = 5V}$

EE 211 Homework 13

3.59 2V



$R_o = R_{Th} = R_{eq}$

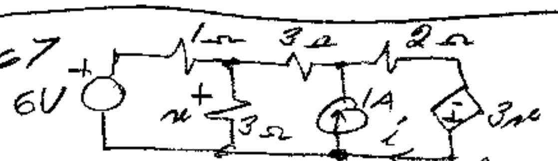
$\leftarrow R_{eq} = 2\,\Omega$

∴ for maximum power $\boxed{R_L = 2\,\Omega}$

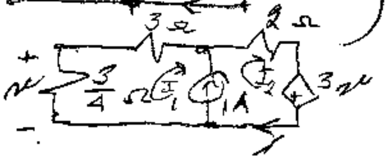
$$\left.\begin{aligned}\frac{V_1-2}{3}+\frac{V_1}{6}+\frac{V_1-V_2}{1}&=0\\ \frac{V_2-2}{6}+\frac{V_2-V_1}{1}+\frac{V_2}{2}&=0\end{aligned}\right\}\quad \begin{aligned}V_1\left(\tfrac{1}{3}+\tfrac{1}{6}+1\right)-V_2&=\tfrac{2}{3}\\ -V_1+V_2\left(\tfrac{1}{6}+1+\tfrac{1}{2}\right)&=\tfrac{1}{3}\end{aligned}\quad \begin{aligned}\tfrac{3}{2}V_1-V_2&=\tfrac{2}{3}\\ -V_1+\tfrac{5}{3}V_2&=\tfrac{1}{3}\end{aligned}$$

$$V_2 = \frac{\begin{vmatrix}\frac{3}{2} & \frac{2}{3}\\ -1 & \frac{1}{3}\end{vmatrix}}{\begin{vmatrix}\frac{3}{2} & -1\\ -1 & \frac{5}{3}\end{vmatrix}} = \frac{\frac{1}{2}+\frac{2}{3}}{\frac{5}{2}-1} = \frac{\frac{7}{6}}{\frac{3}{2}} = \frac{7}{9}\,V\ ;\quad P_{R_{L\,max}} = \frac{1}{2}\left(\frac{7}{9}\right)^2 = \frac{49}{162} = \boxed{0.302\,W}$$

3.67



for voltage source = 0



Supermesh Equation:

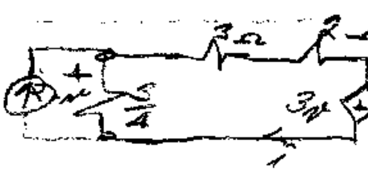
$\frac{15}{4}I_1 + 2I_2 - 3v = 0\ ;\ v = -\frac{3}{4}I_1$

$I_2 - I_1 = 1\ ;\ \boxed{I_2 = 1 + I_1}$

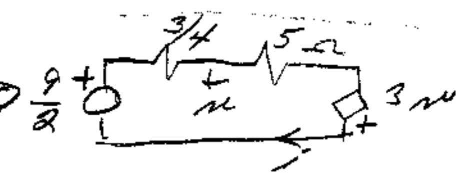
$\frac{15}{4}I_1 + 2(1+I_1) - 3\left(-\frac{3}{4}I_1\right) = 0$

so $I_1\left(\frac{15}{4}+2+\frac{9}{4}\right) = -2\quad ;\ \boxed{I_1 = -2\left(\frac{4}{32}\right) = -\frac{1}{4}A\ ;\ I_2 = \frac{3}{4}A}$

for current source = 0



$\Rightarrow$



$$\frac{9}{2} = \frac{23}{4}i - 3\left(\frac{9}{2}-\frac{3}{4}i\right) = i\left(\frac{23}{4}+\frac{9}{4}\right) - \frac{27}{2}$$

$$i = \frac{36/2}{32/4} = \frac{36\times 4}{32\times 2} = \frac{9\times 4}{8\times 2} = \frac{9}{4}$$

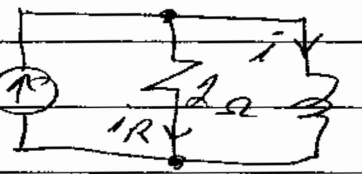
---

so $i_{total} = \frac{9}{4} + \frac{3}{4} = \frac{12}{4} = \boxed{3A} \leftarrow$

$v_{total} = -\frac{3}{4}\left(-\frac{1}{4}\right) + \left(\frac{9}{2}-\frac{27}{16}\right) = \frac{3}{16}+\frac{45}{16} = \boxed{3\,V} \leftarrow$

EE 211 Homework ~~15~~ 14 (16)

4.2 (6)



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

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

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

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

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

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

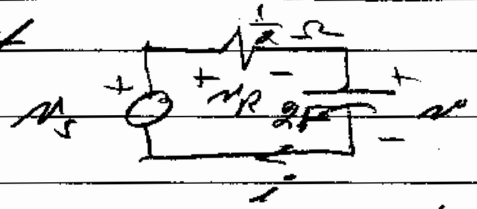
$i_R(t) = \frac{v_L}{2} = e^{-2t}$ for $t \geq 0$

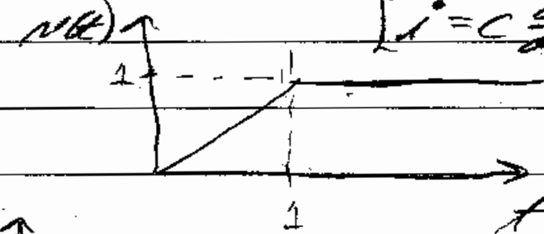
c) $i_s(t) = 0$ for $t<0$

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

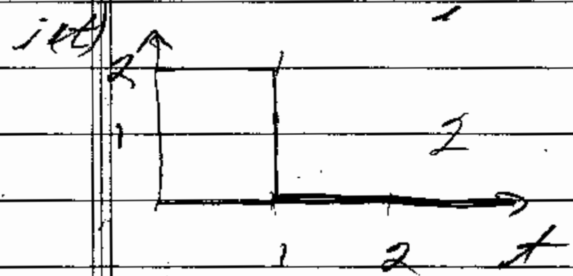
---

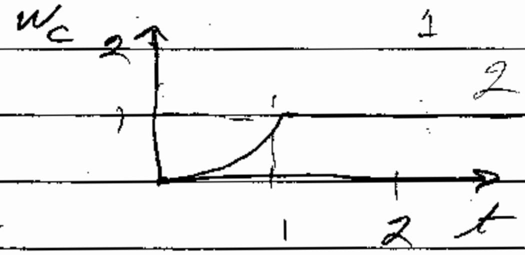
(10) 4.14



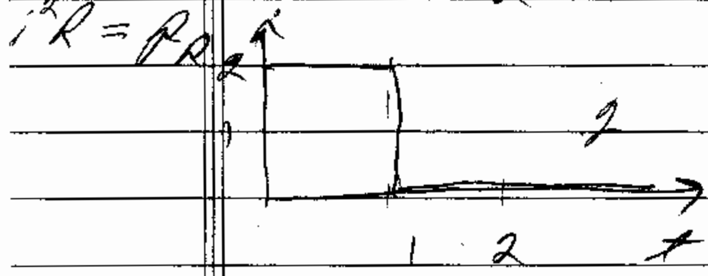


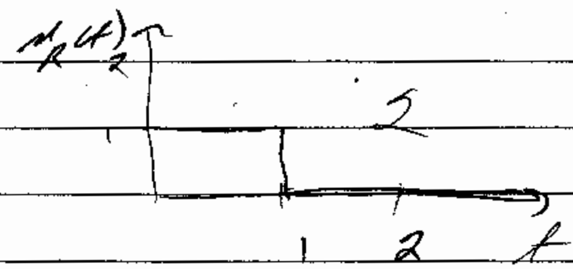
$[i = C\frac{dv}{dt}]$

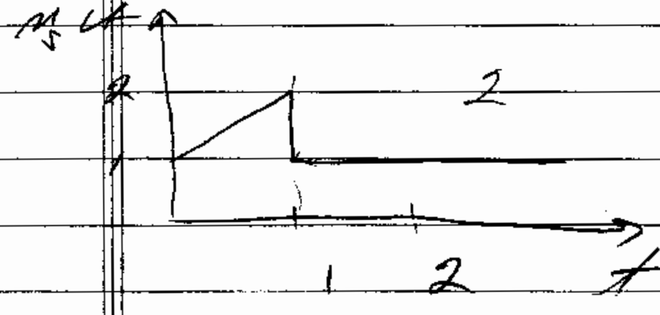




$[w_C = \frac{1}{2}Cv^2]$



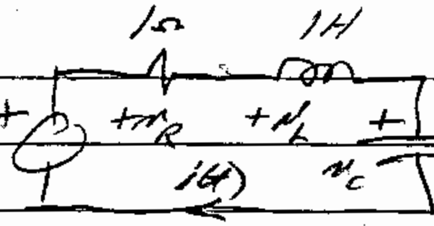


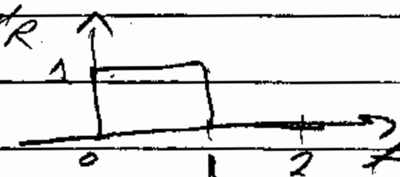


1 point for correct form
1 point for correct value

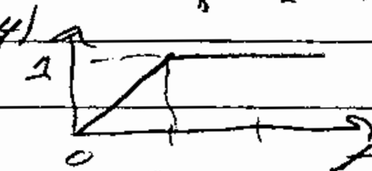
EE 211 Homework 15

4.43 $i(t) = u(t) - u(t-1)$

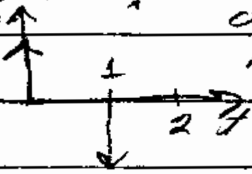




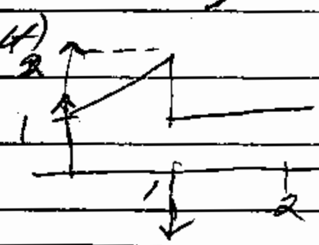
a) $v_R(t) = iR = u(t) - u(t-1)$



b) $v_C(t) = \frac{1}{C}\int_0^t i\,dt + v_C(0)$ [assume $v_C(0)=0$]

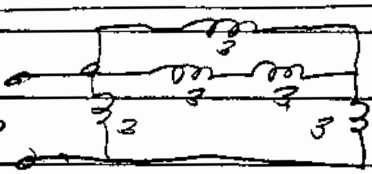


c) $v_L(t) = L\frac{di}{dt}$

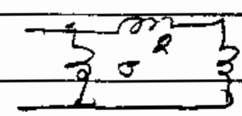


d) $v_S(t) = v_R + v_L + v_C$

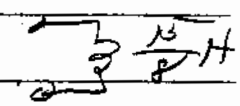
4.53



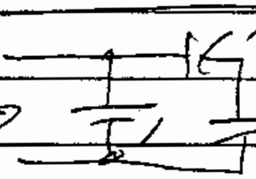
$\equiv$



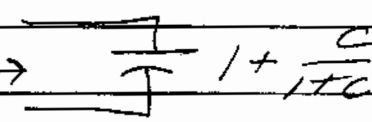
$\equiv$



4.54 a)



$\equiv$



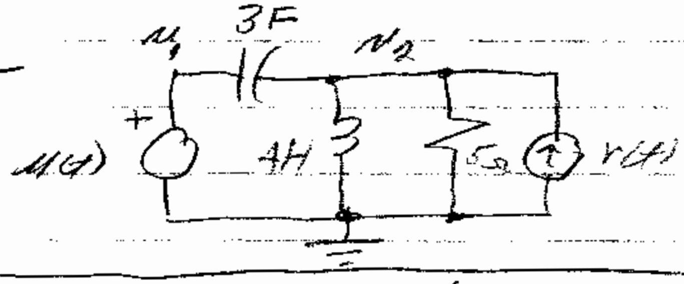
So $C = 1 + \frac{C}{1+C}$ or $C + C^2 = 1 + 2C$

$C^2 - C - 1 = 0$

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

EE 211 Homework 16

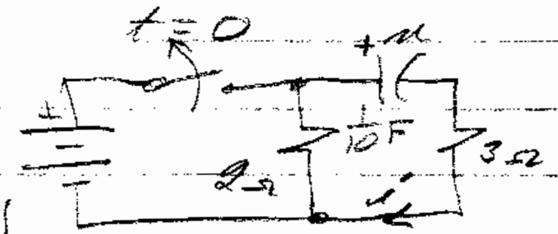
4.55



$$\boxed{v_1 = v(t)}$$

$$\boxed{3\frac{d}{dt}(v_2 - v_1) + \frac{1}{4}\int_{-\infty}^{t} v_2\,dt + \frac{v_2}{5} = r(t)}$$

5.1



$$\boxed{v(0^-) = v(0^+) = 10}$$

$\boxed{\text{for } t > 0}$

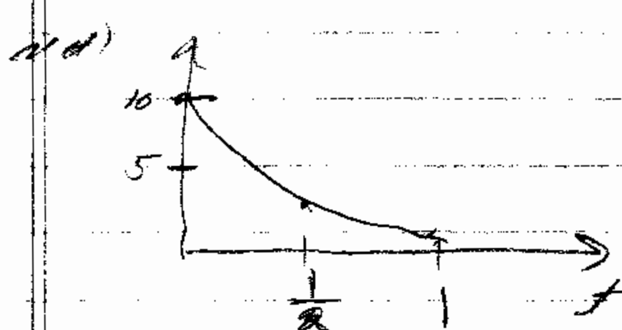
(1) $5i + 10\int_0^t i\,dt + 10 = 0 \Rightarrow \boxed{5\frac{di}{dt} + 10i = 0}$

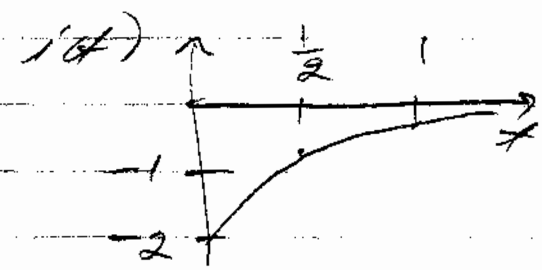
$i = Ae^{st}$ for $s = -2$ so $\boxed{i = Ae^{-2t}}$

from (1) $5i(0) = -10$ or $i(0) = -2$

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

$$\boxed{v(t) = -5i = 10e^{-2t}}$$

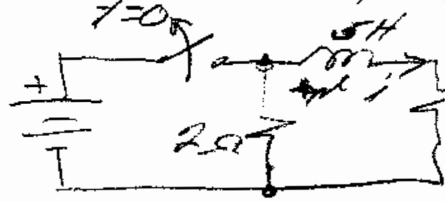




$$\boxed{T = \tfrac{1}{2}\text{ sec}}$$

EE 211 Homework 17

5.2



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

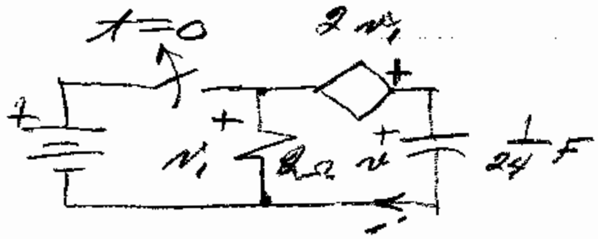
for $t > 0$

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

$s = -1$ ∴ $i = Ae^{-t} \boxed{= \frac{10}{3}e^{-t}}$

$$\boxed{v(t) = 5\frac{di}{dt} = -\frac{50}{3}e^{-t}}$$

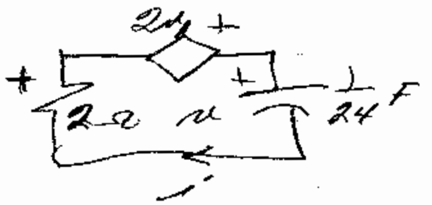
5.6



for $\boxed{t<0}$ $v_1 = 10$

∴ $\boxed{v = 3v_1 = 30V}$, $\boxed{i = 0}$

for $t > 0$ we have:



$2i - 2v_1 + 24\int_0^t i\,dt + 30 = 0$

but $v_1 = -2i$

(1) ∴ we have: $2i + 4i + 24\int_0^t i\,dt + 30 = 0$

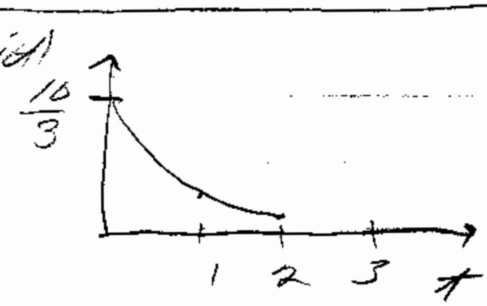
or $6\frac{di}{dt} + 24i = 0$

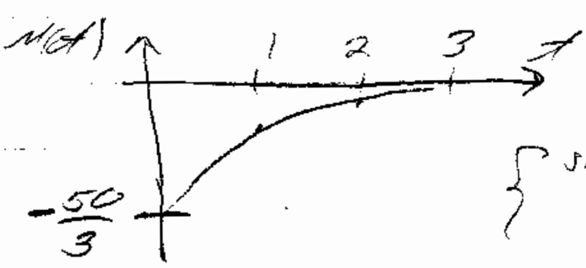
$i = Ae^{st}$; $s = -\frac{24}{6} = -4$ so $i = Ae^{-4t}$

from (1) $6i(0) = -30$ or $i(0) = -5$

∴ $\boxed{i = -5e^{-4t} \text{ for } t > 0}$

$\boxed{v = 3v_1 = -6i = 30e^{-4t}}$



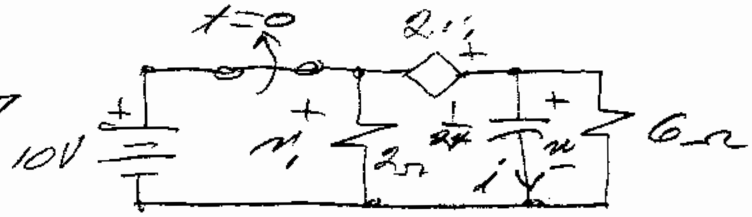


sketches for 5.2

EE 211 Homework 18

5.8

5.7



for $t<0$ $\boxed{v = 30V}$

$\boxed{v = 3v_1}$

for $t>0$ $\frac{v_1}{2} + \frac{3v_1}{6} + \frac{1}{24}\frac{d}{dt}(3v_1) = 0$

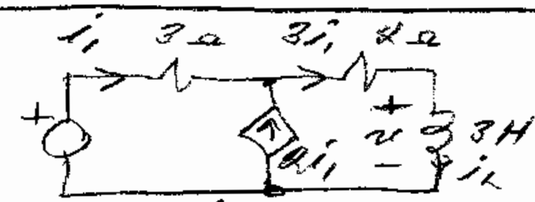
or $\frac{v}{6} + \frac{v}{6} + \frac{1}{24}\frac{dv}{dt} = 0 \Rightarrow 8v + \frac{dv}{dt} = 0$

$v = Ae^{st}$; $s = -8$ so $v(t) = Ae^{-8t}$

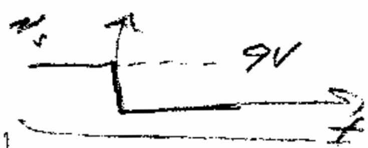
but $v(0) = 30$ $\therefore$ $\boxed{v(t) = 30e^{-8t}}$

$i(t) = \frac{1}{24}\frac{dv}{dt} = \frac{1}{24}(-8)(30)e^{-8t} = \boxed{-10e^{-8t}}$

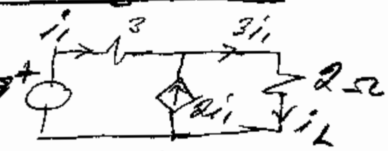
5.8



$v_s(t) = 9 - 9u(t)$

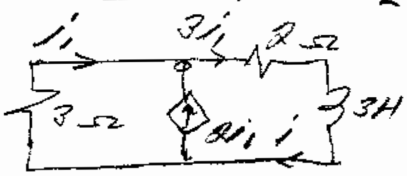


for $t<0$



$\boxed{9 = 3i_1 + 6i_1 \Rightarrow \begin{array}{l} i_1 = 1 \\ i_L(0) = 3 \end{array}}$

for $t>0$



$\boxed{i = 3i_1}$

KVL $\Rightarrow 3i_1 + 6i_1 + 3\frac{d}{dt}(3i_1)$

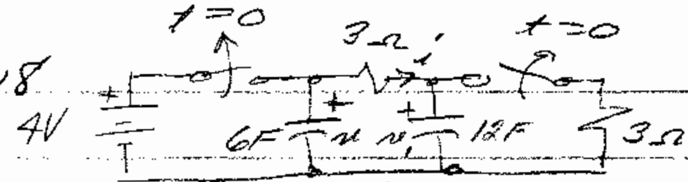
or $3i + 3\frac{di}{dt} = 0$ $i = Ae^{st}$ $s = -1$

so $i = Ae^{-t}$ but $i(0) = 3$ so $\boxed{i = 3e^{-t}}$

$v(t) = 3\frac{di}{dt} = 3(3)(-1)e^{-t} = \boxed{-9e^{-t}}$

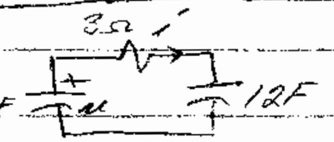
EE 211 Homework 19

5.18



$\boxed{\begin{aligned} v(0) &= 4\text{ V} \\ v_1(0) &= 2\text{ V} \end{aligned}}$

for $t>0$

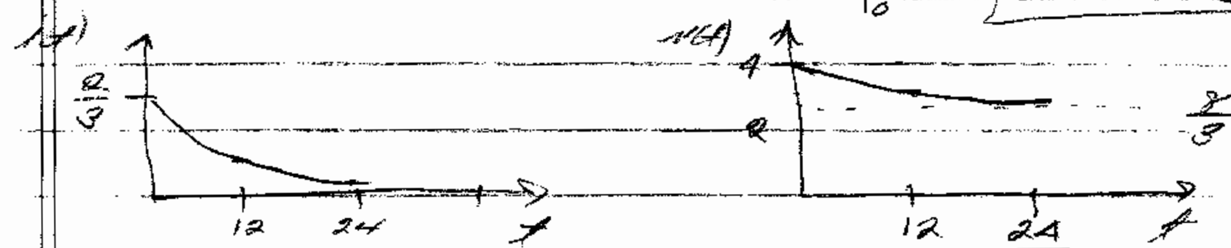


$\frac{1}{6}\int_0^t i\,dt - 4 + 3i + \frac{1}{12}\int_0^t i\,dt + 2 = 0 \quad (1)$

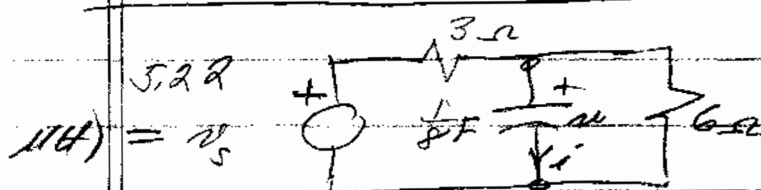
or $\left(\frac{1}{6}+\frac{1}{12}\right)i + 3\frac{di}{dt} = 0 \Rightarrow \frac{1}{4}i + 3\frac{di}{dt} = 0$ $\quad i = Ae^{st};\ s = -\frac{1}{12}$

from (1) $3i(0) = 2$ $\quad \therefore \boxed{i(t) = \frac{2}{3}e^{-\frac{t}{12}}}$

$v(t) = -\frac{1}{6}\int_0^t \frac{2}{3}e^{-\frac{t}{12}}dt + 4 = -\frac{1}{9}(-12)e^{-\frac{t}{12}}\Big|_0^t + 4 = \boxed{\frac{4}{3}e^{-\frac{t}{12}} + \frac{8}{3}}$



5.22



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

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

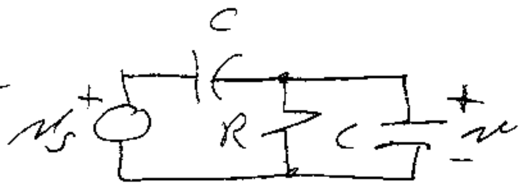
so $v_h = Ae^{-4t}$ $\quad v_p = K \quad \therefore \frac{1}{2}K = \frac{1}{3}$ or $K = \frac{2}{3}$

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

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

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

EE 211 Homework 20

5.35  $v_s = r(t)$; zero state

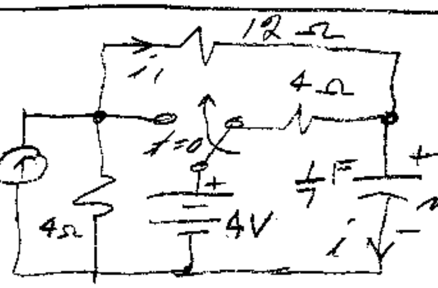
KCL: $C\frac{d}{dt}[v - r(t)] + \frac{v}{R} + C\frac{dv}{dt} = 0$

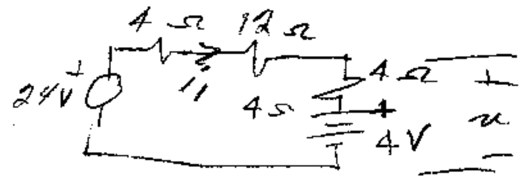
or $2C\frac{dv}{dt} - Cu(t) + \frac{v}{R} = 0 \Rightarrow \left[\frac{dv}{dt} + \frac{1}{2RC}v = \frac{1}{2}u(t)\right]$

$v_{homo} = Ae^{st}$; $s = -\frac{1}{2RC}$; $v_p = K$; $K = RC$

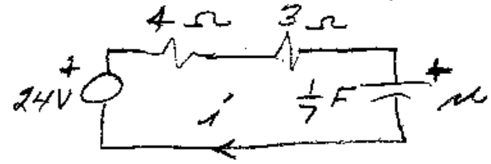
$\therefore v(t) = Ae^{-\frac{t}{2RC}} + RC$

but $v(0) = 0$ $\therefore v(t) = RC\left[1 - e^{-\frac{t}{2RC}}\right]$ } for $t > 0$

5.42 

for $t < 0$ circuit is: 

for $t < 0$ $i = 0$; $i_1 = \frac{20}{20} = 1A$ so $\boxed{v(0) = 8V}$

for $t > 0$ 

(1) so $7\int_0^t i\,dt + 8 + 7i = 24 \Rightarrow 7\frac{di}{dt} + 7i = 0$

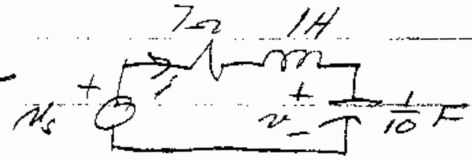
$\boxed{i = Ae^{-t}}$ from (1) $i(0) = \frac{16}{7}$

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

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

EE 211 Homework 21

6.5



$v_s = 1 - u(t)$

$\boxed{\begin{array}{l} i(0) = 0 \\ v(0) = 1\,V \end{array}}$

for $t > 0$ $\quad 7i + \frac{di}{dt} + 10\int_0^t i\,dt + 1 = 0 \qquad \underline{(1)}$

$$\frac{d^2 i}{dt^2} + 7\frac{di}{dt} + 10 i = 0 \;;\; i = Ae^{st} \quad s^2 + 7s + 10 = 0$$

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

so $i(t) = A_1 e^{-5t} + A_2 e^{-2t}$

but $i(0) = 0 \quad \therefore \quad A_2 = -A_1$

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

so $A_1 = \frac{1}{3}$

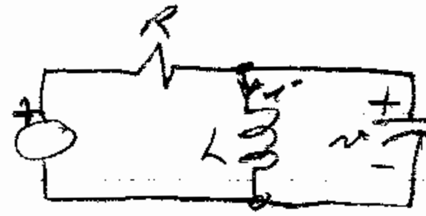
and $\boxed{i(t) = \frac{1}{3}e^{-5t} - \frac{1}{3}e^{-2t}}$ ←

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

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

EE 211 Homework 22

6.8



$R = 1\Omega,\ L = \frac{1}{2}H,\ C = \frac{1}{4}F$

$v_s(t) = 4 - 4u(t)$

for $t<0$; $v_s = 4$ ∴ $i(0) = 4A$ and $v(0) = 0$

for $t \geq 0$ $v_s = 0$ so $\left[v + 2\int_0^t v\,dt + 4 + \frac{1}{4}\frac{dv}{dt} = 0 \right]$ (1)

differentiating gives $\frac{d^2v}{dt^2} + 4\frac{dv}{dt} + 8v = 0$

$v_{homo} = Ae^{st}$ so $s^2 + 4s + 8 = 0$; $S_{1,2} = -2 \pm \sqrt{4-8}$

$v = B_1 e^{-2t}\cos 2t + B_2 e^{-2t}\sin 2t$

$v(0) = 0$ so $B_1 = 0$

from (1) above $v(0) + 4 + \frac{1}{4}\frac{dv}{dt}\Big|_{t=0} = 0$ so $\boxed{\frac{dv}{dt}\Big|_{t=0} = -16}$

so $-16 = B_2\{2e^{-2t}\cos 2t - 2e^{-2t}\sin 2t\}_{t=0}$; $B_2 = -8$

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

$i(t) = -\frac{v}{R} - C\frac{dv}{dt} = +8e^{-2t}\sin 2t + \cancel{\tfrac{8}{4}}^{2}\{2e^{-2t}\cos 2t - 2e^{-2t}\sin 2t\}$

$\boxed{i(t) = 4e^{-2t}\sin 2t + 4e^{-2t}\cos 2t}$ for $t > 0$