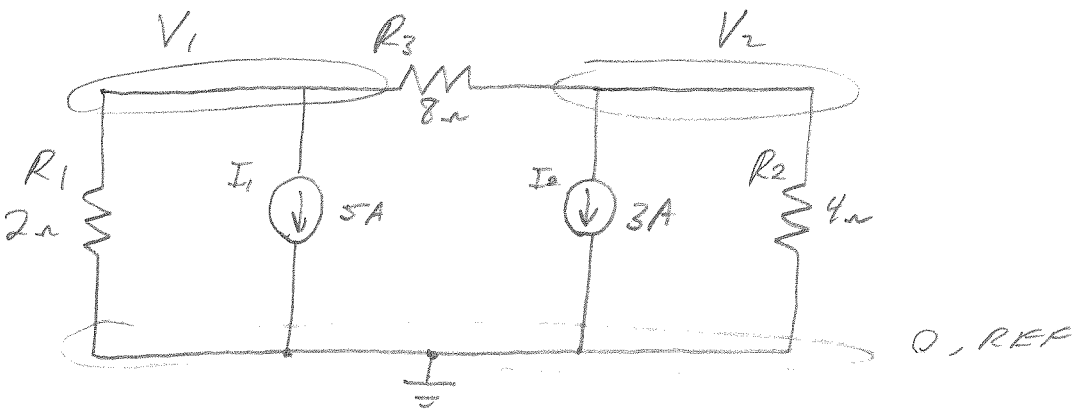
~~(P40)~~ A - WRITE THE NODAL EQS

P41 B - SOLVE



V_1] $\sum I_{ENTERING} = \sum I_{LEAVING}$

$$0A = I_1 + \frac{V_1}{R_1} + \frac{V_1 - V_2}{R_3}$$

$$-I_1 = V_1\left(\frac{1}{R_1} + \frac{1}{R_3}\right) - V_2\left(\frac{1}{R_3}\right)$$

OR: $0.625V_1 - 0.125V_2 = -5$ (1)

V_2] $0 = I_2 + \frac{V_2}{R_2} + \frac{V_2 - V_1}{R_3}$

$$-I_2 = -V_1\left(\frac{1}{R_3}\right) + V_2\left(\frac{1}{R_2} + \frac{1}{R_3}\right)$$

OR: $-0.125V_1 + 0.375V_2 = -3$ (2)

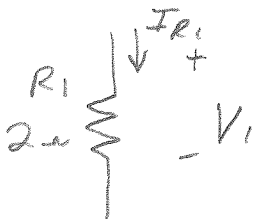
SOLVING YIELDS: $\boxed{V_1 = -10.29V \quad V_2 = -11.43V}$

(C) FIND V_{R_3}

$V_{R_3} = V_1 - V_2 = \boxed{1.14V}$

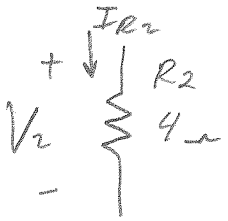
~~(P40~~ **P41** CONTINUED

(d) FIND THE CURRENT THROUGH R_1 & R_2



$$I_{R_1} = \frac{V_1}{R_1} = \frac{-10.29V}{2\Omega} = -5.15A$$

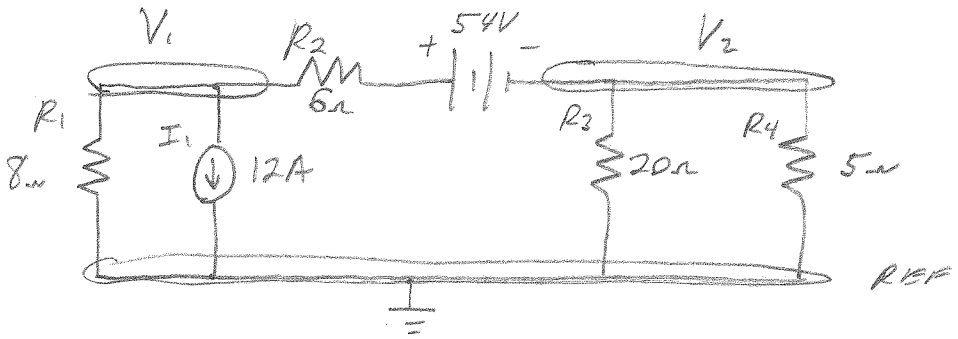
$$\therefore \boxed{I_{R_1} = 5.15A \uparrow \text{ (UP)}}$$



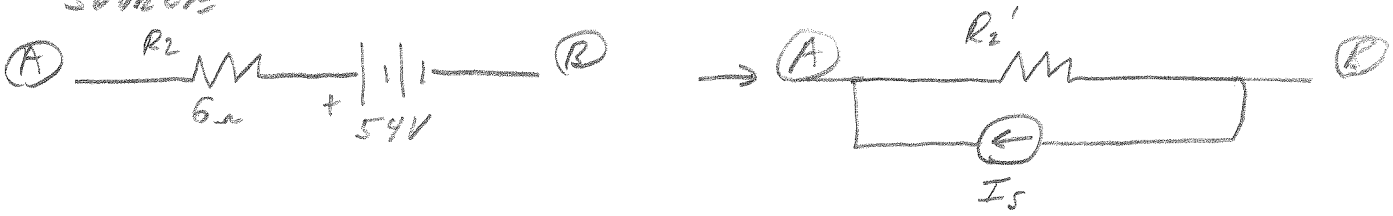
$$I_{R_2} = \frac{V_2}{R_2} = \frac{-11.43V}{4\Omega} = -2.86A$$

$$\therefore \boxed{I_{R_2} = 2.86A \uparrow \text{ (UP)}}$$

(P42) A+B: WRITE THE NODAL EQS & FIND THE NODE VOLTAGES



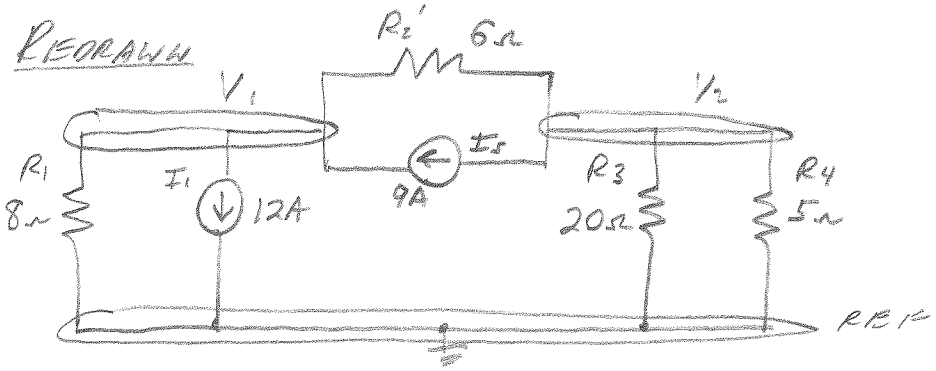
CONVERT R2 / 54V TO A PRACTICAL CURRENT SOURCE



$R_2' = R_2 = 6\Omega$

$I_S = 54V/6\Omega = 9A$

REDRAWN



V1] $I_S = I_1 + \frac{V_1}{R_1} + \frac{V_1 - V_2}{R_2'}$

$I_S - I_1 = V_1\left(\frac{1}{R_1} + \frac{1}{R_2'}\right) - V_2\left(\frac{1}{R_2'}\right)$

OR: $0.2917\,V_1 - 0.1667\,V_2 = -3$ (1)

V2] $0 = I_S + \frac{V_2 - V_1}{R_2'} + \frac{V_2}{R_3} + \frac{V_2}{R_4}$

$-I_S = -V_1\left(\frac{1}{R_2'}\right) + V_2\left(\frac{1}{R_3} + \frac{1}{R_4} + \frac{1}{R_2'}\right)$

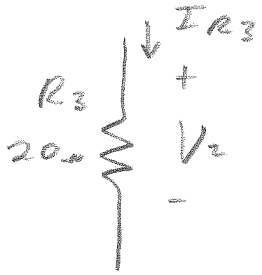
OR: $-0.1667\,V_1 + 0.417\,V_2 = -9$ (2)

P42

(P41) CONTINUED

SOLVING (1) & (2) YIELDS: $\boxed{V_1 = -29.32V \quad V_2 = -33.30V}$

(C) FIND THE CURRENT THROUGH R_3

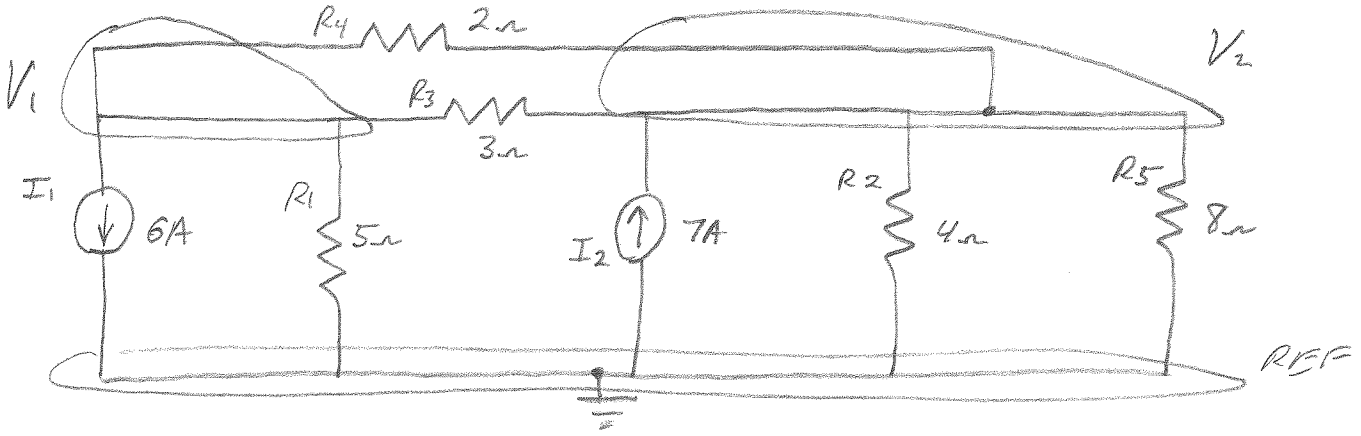


$$I_{R_3} = \frac{V_2}{R_3} = \frac{-33.30V}{20\Omega} = -1.67A \downarrow$$

OR $\boxed{I_{R_3} = 1.67A \uparrow (UP)}$

P44

(~~P 4.3~~) a + b: WRITE THE NODAL EQS + SOLVE



V_1] $0 = I_1 + \frac{V_1}{R_1} + \frac{V_1 - V_2}{R_4} + \frac{V_1 - V_3}{R_3}$

$-I_1 = V_1\left(\frac{1}{R_1} + \frac{1}{R_4} + \frac{1}{R_3}\right) - V_2\left(\frac{1}{R_4} + \frac{1}{R_3}\right)$

OR: $1.033 V_1 - 0.833 V_2 = -5$ (1)

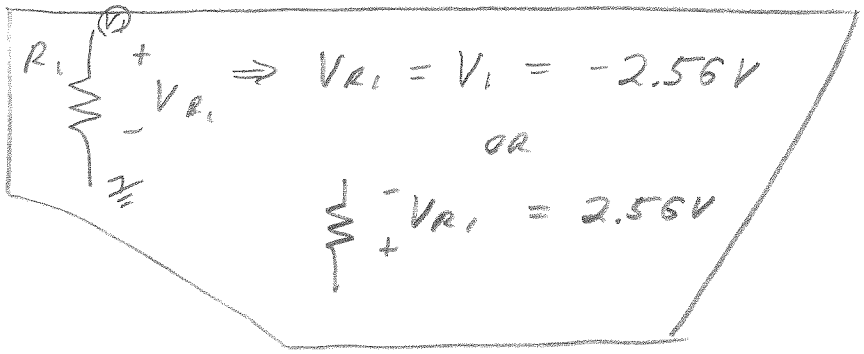
V_2] $I_2 = \frac{V_2 - V_1}{R_4} + \frac{V_2 - V_1}{R_3} + \frac{V_2}{R_2} + \frac{V_2}{R_5}$

$I_2 = -V_1\left(\frac{1}{R_4} + \frac{1}{R_3}\right) + V_2\left(\frac{1}{R_4} + \frac{1}{R_3} + \frac{1}{R_2} + \frac{1}{R_5}\right)$

OR: $-0.833 V_1 + 1.208 V_2 = 7$ (2)

SOLVING YIELDS: $\boxed{\begin{aligned} V_1 &= -2.56\,V \\ V_2 &= 4.03\,V \end{aligned}}$

(c) FIND THE VOLTAGE ACROSS EACH RESISTOR:

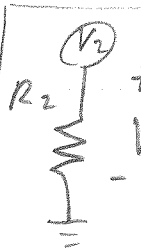


$\Rightarrow V_{R_1} = V_1 = -2.56\,V$

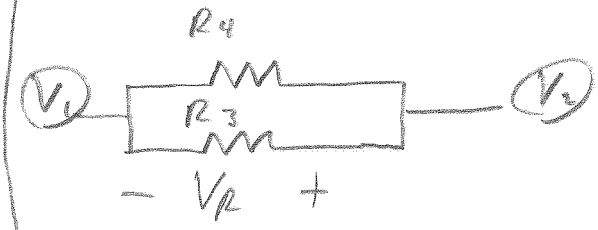
OR

$-V_{R_1} = 2.56\,V$

(P3) CONTINUED



$= V_{R_2} = V_{R_5} = V_2 = 4.03V$



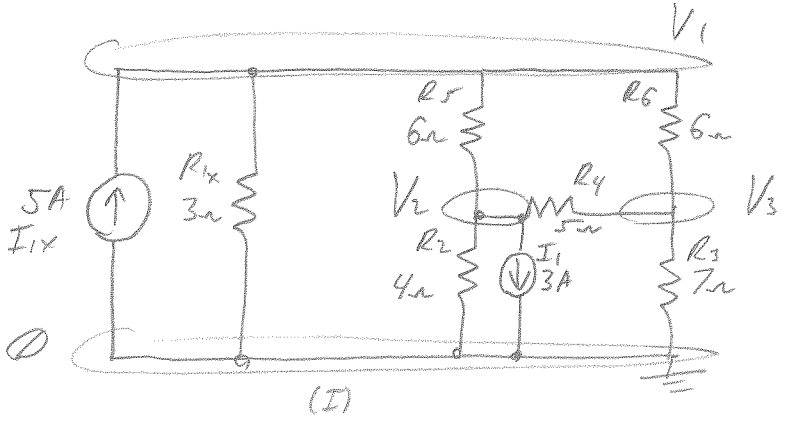
$V_{R_4} = V_{R_3} = V_R = V_2 - V_1$

$= 6.59V$

EXTRA NODAL SAMPLE PROBLEM #1

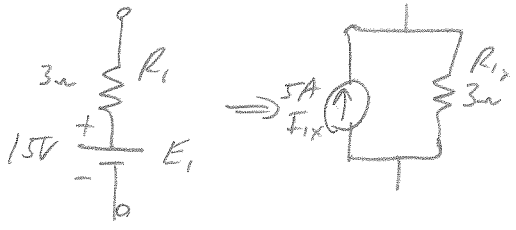
(A+B)

(P45) WRITE THE NODAL EQUATIONS & SOLVE FOR THE NODE VOLTAGES



(1)

(I) REDRAWN



N1 $5 = \frac{V_1}{R_{1x}} + \frac{V_1 - V_2}{R_5} + \frac{V_1 - V_3}{R_6} \rightarrow 0.6667V_1 - 0.1667V_2 - 0.1667V_3 = 5$ (1)

N2 $0 = \frac{V_2 - V_1}{R_5} + \frac{V_2 - V_3}{R_4} + \frac{V_2}{R_2} + 3 \rightarrow -0.1667V_1 + 0.6167V_2 - 0.200V_3 = -3$ (2)

N3 $0 = \frac{V_3 - V_1}{R_6} + \frac{V_3 - V_2}{R_4} + \frac{V_3}{R_3} \rightarrow -0.1667V_1 - 0.200V_2 + 0.5095V_3 = 0$ (3)

SOLVING (1) - (3) YIELDS:

$V_1 = 7.24V$
$V_2 = -2.45V$
$V_3 = 1.41V$

(C) FIND V_{R4}

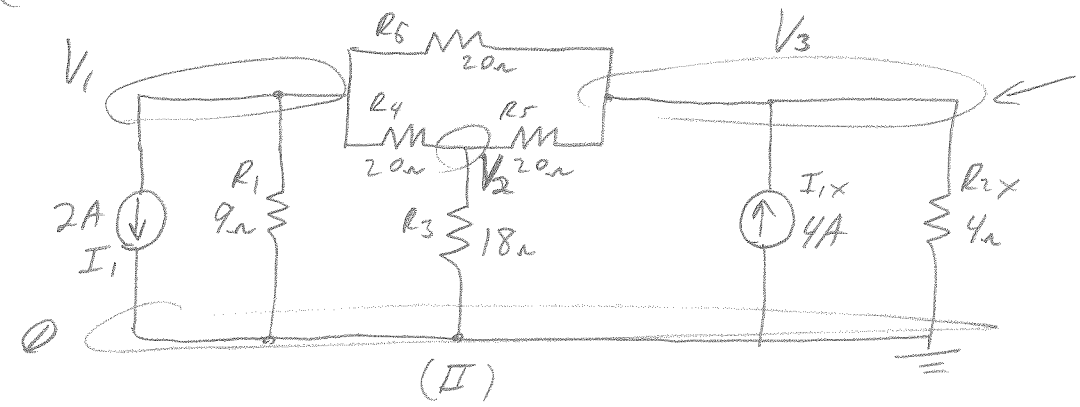
$V_{R4} = V_3 - V_2$

$V_{R4} = 3.86V$

A + B – SOLVE FOR V_1, V_2, V_3

EXTRA NODAL SAMPLE PROBLEM #2

(P46)



REDRAWN W/ E_1/R_2 CONVERTED TO I_{1x} & R_{2x}

N1 $\quad 0 = 2 + \frac{V_1}{R_1} + \frac{V_1 - V_3}{R_6} + \frac{V_1 - V_2}{R_4} \rightarrow 0.2111 V_1 - 0.050 V_2 - 0.050 V_3 = -2 \quad (1)$

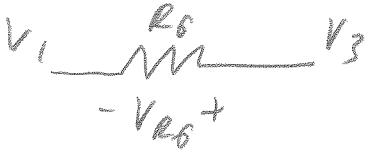
N2 $\quad 0 = \frac{V_2 - V_1}{R_4} + \frac{V_2}{R_3} + \frac{V_2 - V_3}{R_5} \rightarrow -0.050 V_1 + 0.1556 V_2 - 0.050 V_3 = 0 \quad (2)$

N3 $\quad 4 = \frac{V_3}{R_{2x}} + \frac{V_3 - V_2}{R_5} + \frac{V_3 - V_1}{R_6} \rightarrow -0.050 V_1 - 0.050 V_2 + 0.350 V_3 = 4 \quad (3)$

SOLVING YIELDS:

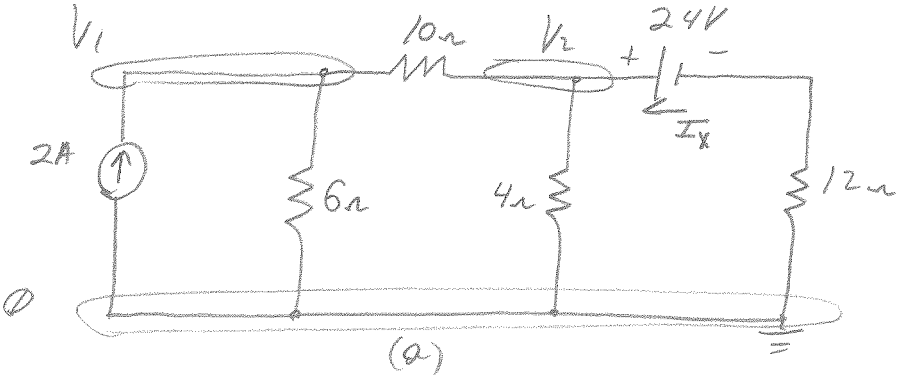
$V_1 = -6.64\,V$
$V_2 = 1.29\,V$
$V_3 = 10.66\,V$

(C) FIND V_{R6}



$V_{R6} = V_3 - V_1 =$ **17.30V**

(P50) **P50** DETERMINE THE NODAL VOLTAGES (USE MODIFIED SUPER-NODE)
- DO NOT PERFORM V → I CONVERSION



(a)

N1: $2 = \frac{V_1}{6} + \frac{V_1 - V_2}{10}$ → $0.2667V_1 - 0.10V_2 + 0I_x = 2$ (1)

N2: $I_x = \frac{V_2 - V_1}{10} + \frac{V_2}{4}$ → $-0.10V_1 + 0.350V_2 - I_x = 0$ (2)

I_x: $I_x = \frac{0 - (V_2 - 24)}{12}$ or $12I_x = -V_2 + 24$

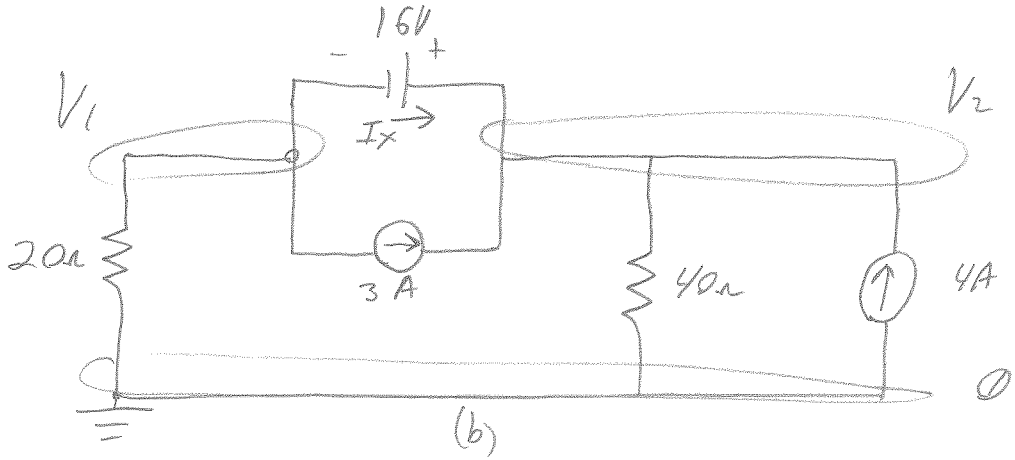
$0V_1 - V_2 - 12I_x = -24$ (3)

Solving (1) - (3):

$V_1 = 10.1V$
$V_2 = 6.95V$
$I_x = 1.42A$

P51

(A5.0) Find the node voltages



N1 $\quad 0 = \frac{V_1}{20} + 3 + I_x \longrightarrow 0.050V_1 + 0V_2 + I_x = -3 \qquad (1)$

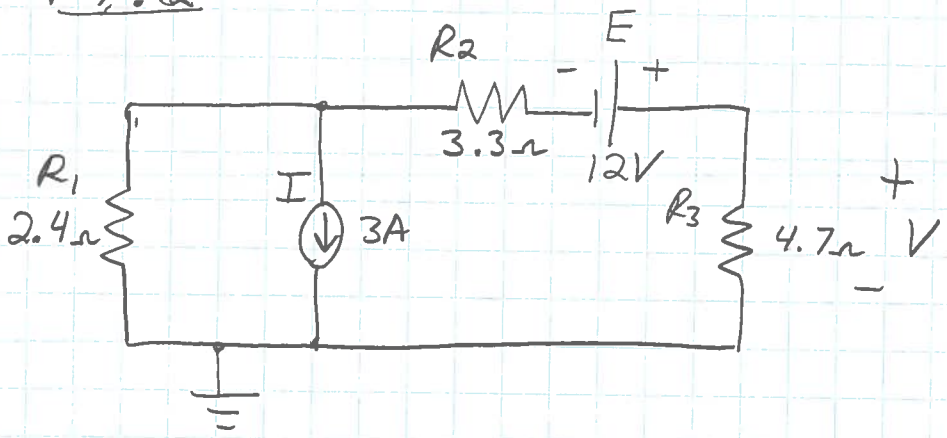
N2 $\quad 3 + 4 + I_x = \frac{V_2}{40} \longrightarrow 0V_1 + 0.025V_2 - I_x = 7 \qquad (2)$

Also know: $V_2 - V_1 = 16 \longrightarrow -V_1 + V_2 + 0I_x = 16 \qquad (3)$

Solving yields:

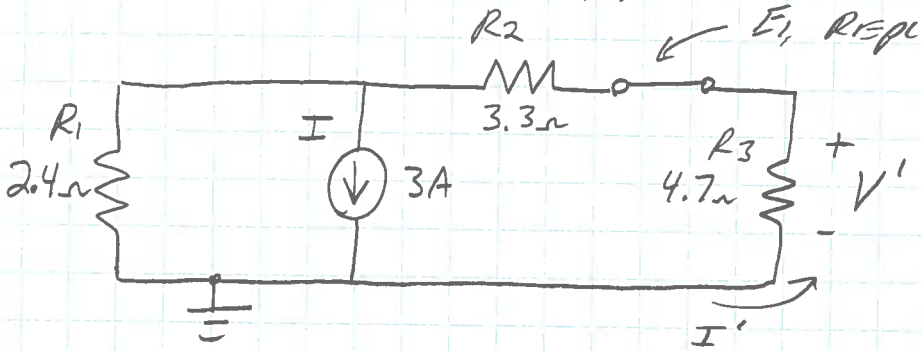
$$\boxed{\begin{aligned} V_1 &= 48.0\,V \\ V_2 &= 64.0\,V \\ I_x &= -5.4\,A \end{aligned}}$$

P9.2



a) FIND V USING SUPERPOSITION

(SOURCE I ACTIVE ONLY)



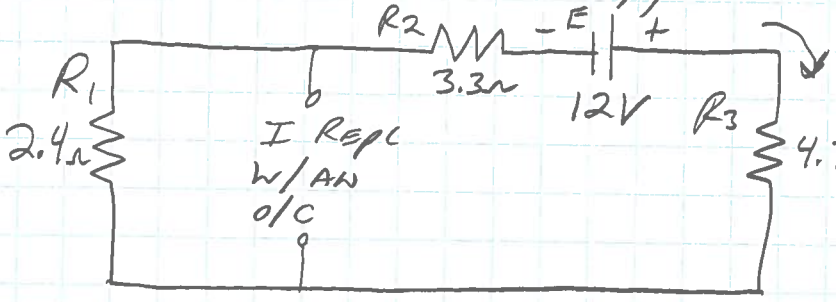
$$I' = I\left(\frac{[R_2+R_3]\,//\,R_1}{[R_2+R_3]}\right) = 3A\left(\frac{8\Omega\,//\,2.4\Omega}{8\Omega}\right)$$

$$I' = 3A\left(\frac{1.85\Omega}{8\Omega}\right) = \underline{692.3\,mA}$$

$$\therefore V' = (-I')(R_3) = (-692.3\,mA)(4.7\Omega)$$

$$= \underline{\underline{-3.25V}}$$

(SOURCE E ACTIVE ONLY)



$$V'' = E\left(\frac{R_3}{R_1+R_2+R_3}\right)$$

$$= 12V\left(\frac{4.7\Omega}{10.4\Omega}\right)$$

$$\underline{\underline{V'' = 5.42V}}$$

$$V = V' + V'' = -3.25V + 5.42V = \boxed{2.17V}$$

(P9.2 CONTINUED)

(b) FIND P_{R_3} DUE ONLY TO SOURCE I

$$P_{R_3}' = \frac{(V')^2}{R_3} = \frac{(-3.25V)^2}{4.7\Omega} = \boxed{2.25W}$$

(c) FIND P_{R_3} DUE ONLY TO SOURCE E

$$P_{R_3}'' = \frac{(V'')^2}{R_3} = \frac{(5.42V)^2}{4.7\Omega} = \boxed{6.25W}$$

(d) FIND P_{R_3} USING THE RESULT FROM PART (a)

$$P_{R_3} = \frac{V^2}{R_3} = \frac{(2.17V)^2}{4.7\Omega} = \boxed{1.00W}$$

(e) COMPARE THE RESULTS OF PART (d) WITH THE SUM OF PARTS (b) + (c)! CAN SUPERPOSITION BE USED W/ POWER LEVELS?

P_{R_3} (ACTUAL) = P_{R_3}, PART(d) = $\underline{\underline{1.00W}}$

P_{R_3} (SUPERPOSITION DIRECT) = P_{R_3}, (b) + P_{R_3}, (c)

= 2.25W + 6.25W

= $\underline{\underline{8.5W}}$

$\therefore$ $\boxed{P_{R_3}\text{ (ACTUAL)} \neq P_{R_3}\text{ (SUPERPOSITION DIRECT)}}$

$\boxed{\underline{\text{SUPERPOSITION}}\text{ CAN }\underline{\text{NOT}}\text{ BE DIRECTLY APPLIED TO POWER LEVELS, ONLY TO VOLTAGE \& CURRENT LEVELS.}}$