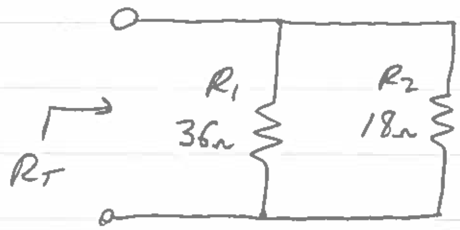
EEET-111 DC LECTURE
HW #5, CHAPTER 6 PROBLEMS

P4) FIND R_T FOR EACH CIRCUIT



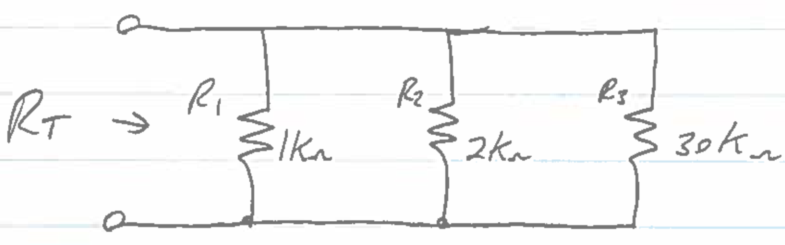
(a)

$$R_T = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2}} = \frac{1}{\frac{1}{36\Omega} + \frac{1}{18\Omega}} = \frac{1}{83.33\,mS}$$

$$\therefore \boxed{R_T = 12\Omega}$$

$$\text{OR} \quad R_T = \frac{R_1 \cdot R_2}{R_1 + R_2} = \frac{(36\Omega)(18\Omega)}{(36+18)\Omega}$$

$$= \frac{684\,\Omega^2}{54\Omega} \rightarrow \underline{\underline{12\Omega}}$$



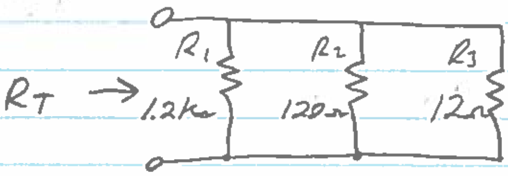
(b)

$$R_T = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}}$$

$$= \frac{1}{1.533\,mS}$$

$$\therefore \boxed{R_T = 652.2\Omega}$$

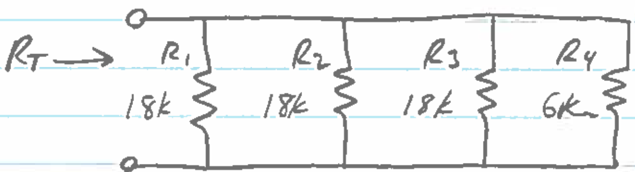
P4) CONTINUED



(c)

$$R_T = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}} = \boxed{10.81\Omega}$$

P5) FIND R_T

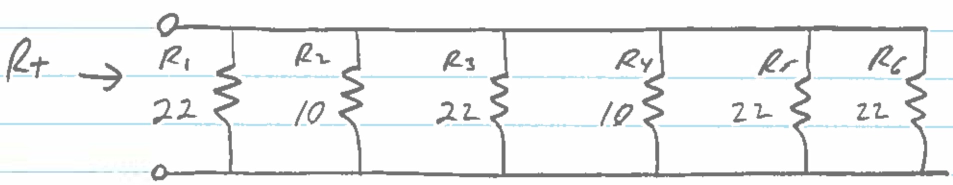


(a)

$$R_T = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \frac{1}{R_4}} = \boxed{3k\Omega}$$

$18k/3 = 6k$

$\leftarrow 6k // 6k = \underline{\underline{3k\Omega}}$



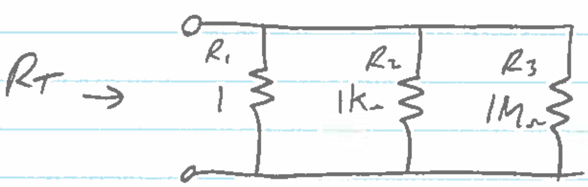
(b)

$$R_T = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2} + \ldots \frac{1}{R_6}}$$

$$\boxed{R_T = 2.619\Omega}$$

$\frac{22}{4} = 5.5\Omega$

$\frac{10}{2} = 5\Omega$

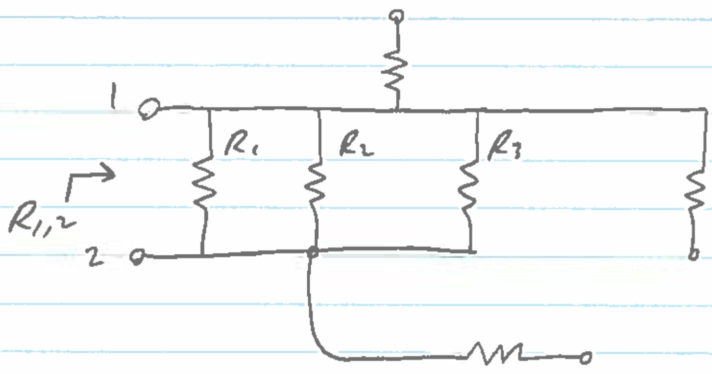


(C)

$$R_T = \frac{1}{\frac{1}{1} + \frac{1}{1k} + \frac{1}{1\times10^6}} = \boxed{0.999\Omega}$$

$R_T \sim 1\Omega$

P6) FIND $R_{1,2}$ IN EACH CASE
(CIRCUIT VALUES FROM COLOR-CODES)



(a)

$$R_{1,2} = R_1 // R_2 // R_3$$

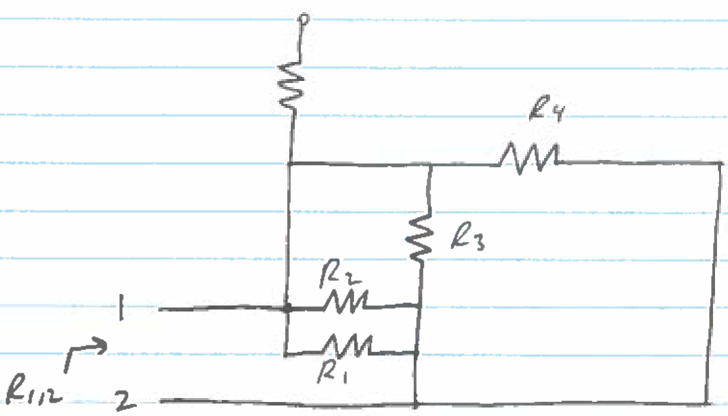
$$= \frac{1}{\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}}$$

$R_1 = 1k\Omega$

$R_2 = 1.2k\Omega$

$R_3 = 300\Omega$

$\therefore \boxed{R_{1,2} = 193.55\Omega}$



(b)

$$R_{1,2} = R_1 // R_2 // R_3 // R_4$$

$R_1 = 1.2k\Omega$

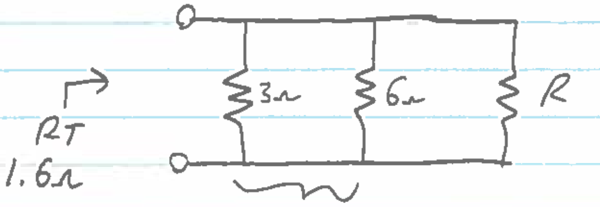
$R_2 = 1k\Omega$

$R_3 = 2.2k\Omega$

$R_4 = 1k\Omega$

$\therefore \boxed{R_{1,2} = 304.15\Omega}$

P7) FIND THE UNKNOWN(S)



$3\Omega // 6\Omega = 2\Omega$

(a)

Special Case of $\dfrac{1}{\frac{1}{R_1}+\frac{1}{R_2}+\dots}$

$$R_T = \frac{2\Omega \cdot R}{2\Omega + R}$$

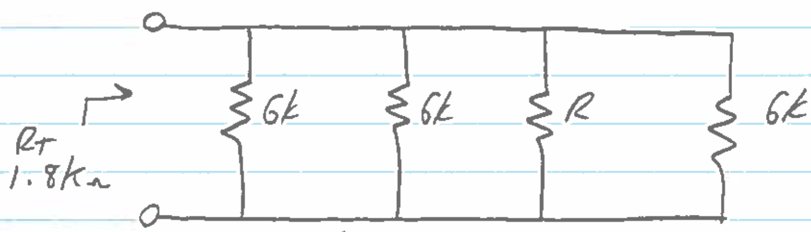
$$1.6 = \frac{2R}{R+2}$$

$$1.6(R+2) = 2R$$

$$1.6R + 3.2 = 2R$$

$$3.2 = 0.4R$$

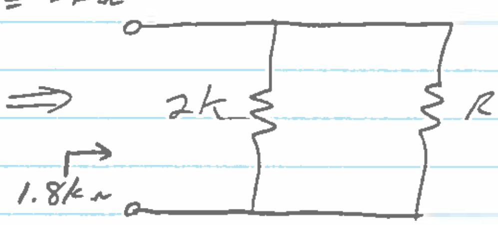
$$R = 3.2/0.4 = \boxed{8\Omega}$$



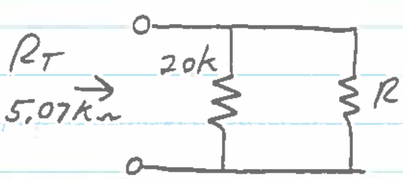
(b)

$\frac{6k\Omega}{3} = 2k\Omega$

$\Rightarrow$



$$1.8k = \frac{(2k)(R)}{R+2k} \quad \therefore \quad \boxed{R = 18k\Omega}$$



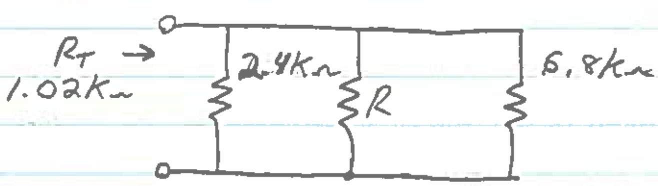
(c)

$$R_T = \frac{(20k)(R)}{20k+R}$$

$$\text{OR} \quad 5.07k\Omega = \frac{20k\Omega(R)}{20k\Omega + R}$$

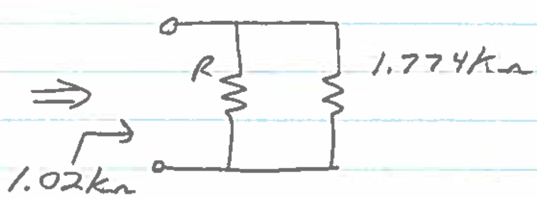
$$\therefore \quad \boxed{R = 6.79k\Omega}$$

P8) FIND THE UNKNOWN(S)



(a)

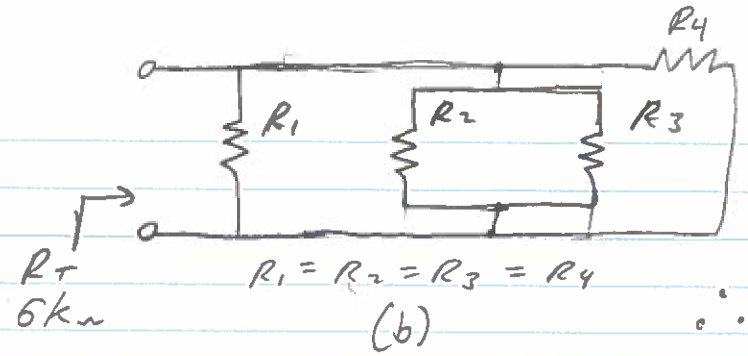
$\Rightarrow$



$$1.02k\Omega = \frac{R(1.774k\Omega)}{1.774k\Omega + R}$$

$$\boxed{R = 2.40k\Omega}$$

P8) CONTINUED



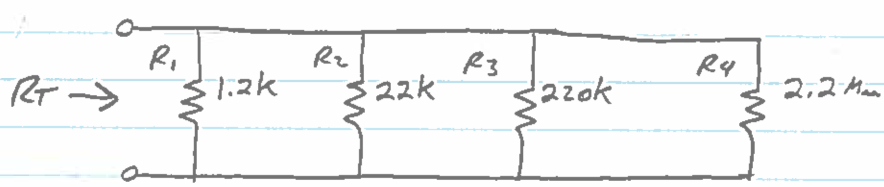
(b)

$R_1 // R_2 // R_3 // R_4$

$= R_T = 6k\Omega = \frac{R_1}{4}$

$\therefore \boxed{R_1 = 24k\Omega}$

P9) ANS a THROUGH e FOR THIS CIRCUIT



(a) WHICH RESISTOR HAS THE MOST IMPACT ON R_T?

$\boxed{R_1, \text{ THE LOWEST}}$

(b) APPROX R_T (W/O CALC):

$\boxed{R_T \sim 1.1k\Omega}$, A LITTLE LESS THAN R_1, SINCE $R_2 // R_3 // R_4 >> R_1$

(c) FIND R_T

$R_T = R_1 // R_2 // R_3 // R_4 = \boxed{1.132k\Omega}$ CLOSE TO MY APPROX

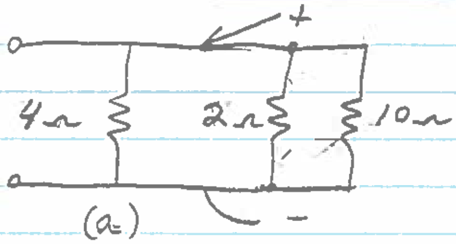
(d) APPROX WHICH RESISTORS CAN WE IGNORE WHEN FINDING R_T?

$\boxed{R >> R_{LOWEST}, \text{ HERE THE } 220k\Omega + 2.2M\Omega}$

(e) IF WE ADD ANOTHER PARALLEL R, WHAT WILL HAPPEN TO R_T?

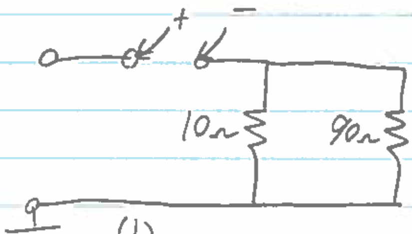
$\boxed{R_T \text{ WILL DECREASE}}$

P10) WHAT IS THE OHMMETER READING?



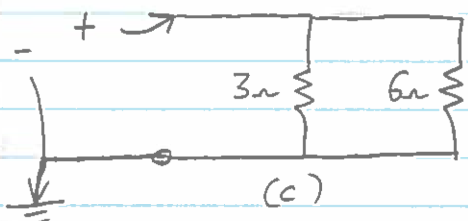
(a)

$R_{ohm} = 4\Omega // 2\Omega // 10\Omega = \boxed{1.18\Omega}$



(b)

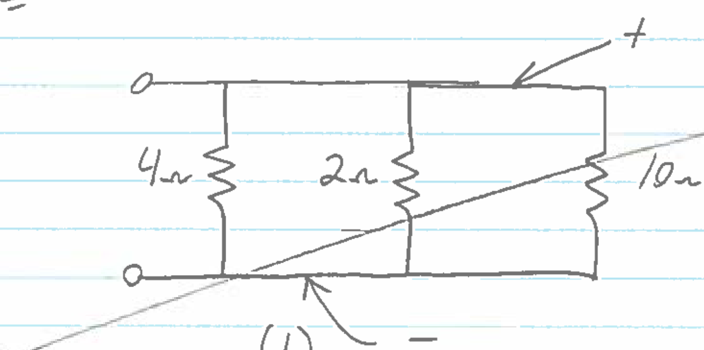
$\boxed{R_{OHM} = \infty\ \Omega}$ (o/c)



(c)

$\boxed{R_{OHM} = 2\Omega}$

$3\Omega // 6\Omega = \underline{\underline{2\Omega}}$

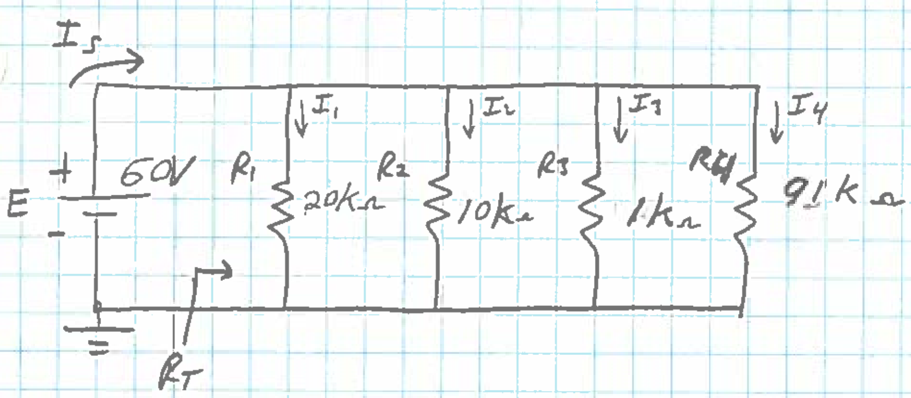


(d)

$R_{OHM} = 4\Omega // 2\Omega // 10\Omega$

$\boxed{R_{OHM} = 1,177\Omega}$

P15) FOR THE CIRCUIT BELOW :



(a) MAKE A GUESS FOR R_T

$\boxed{R_T \sim 900\,\Omega}$: $R_3 = 1k\Omega$
+ R_1, R_2, R_4 ARE ALL $\gg R_3$
R_T MUST BE LESS THAN R_3 + CLOSE IN VALUE

(b) FIND R_T

$$R_T = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \frac{1}{R_4}} = \boxed{861.3\,\Omega}$$

JUST SLIGHTLY LOWER THAN THE "GUESS"

(c) GUESS : WHICH BRANCH CURRENT IS HIGHEST ?
" " " " LOWEST ?

$$\boxed{\left.\begin{array}{l} I_3 : \text{HIGHEST} \\ I_4 : \text{LOWEST} \end{array}\right\} \quad I = \frac{E}{R}}$$

$R \uparrow \quad I \downarrow$
$R \downarrow \quad I \uparrow$

(d) CALCULATE $I_1 - I_4$ + COMPARE THE ANS w/ (c)

$$I_1 = \frac{E}{R_1} = \frac{60V}{20k\Omega} = 3.00\,mA$$

$$I_2 = \frac{60V}{10k\Omega} = 6.00\,mA$$

$$I_3 = \frac{60V}{1\,k\Omega} = 60.00\,mA \quad \leftarrow \text{LARGEST}$$

$$I_4 = \frac{60V}{91k\Omega} = 659.3\,\mu A \quad \leftarrow \text{LOWEST}$$

CONTINUED

15) (e) FIND I_S & VERIFY $I_S = \sum I_{BRANCH}$

$$I_S = \frac{E}{R_T} = \frac{60V}{861.3\Omega} = \boxed{69.7\,mA}$$

$$I_1 + I_2 + I_3 + I_4 = \boxed{69.7\,mA}$$

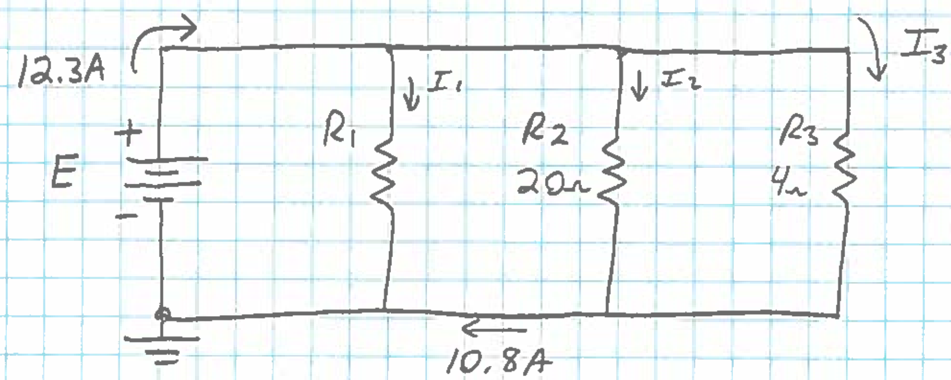
EQUAL (KCL)

(f) COMPARE $|I_S|$ TO $|I_{BRANCH}|$

$$|I_S| = |\sum I_{BRANCH}| \quad , \underline{KCL}$$

$$> |I_{BRANCH}|$$

18) FIND E, R_1, & I_3



$I_2 + I_3 = 10.8A$, GIVEN

$I_3 = 10.8A \dfrac{R_T}{R_3}$, $R_T = R_2 // R_3 = 3.33\Omega$
$R_3 = 4\Omega$

$$\boxed{I_3 = 9.00A}$$

$$E = (I_3)(R_3) = (9A)(4\Omega) = \boxed{36V}$$

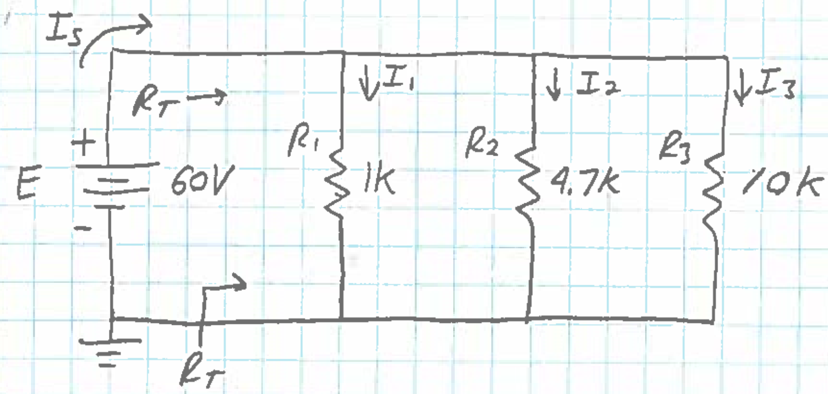
$$R_1 = \frac{E}{I_1}$$

$I_1 = 12.3A - (I_2 + I_3)$, KCL

$I_1 = 12.3A - 10.8A$

$I_1 = 1.50A$ $\quad \therefore R_1 = \dfrac{36V}{1.5A} = \boxed{24\Omega}$

P22) FOR THE CIRCUIT SHOWN:



(a) FIND R_T, I_1, I_2, I_3

$$R_T = R_1 // R_2 // R_3 = \boxed{761.8\,\Omega}$$

$$I_X = I_T \frac{R_T}{R_X}, \quad I_T = E/R_T = \frac{60V}{761.8\,\Omega} = \underline{78.8\,mA}$$

$$I_1 = 78.8mA \left(\frac{761.8\,\Omega}{1k\,\Omega}\right) = \boxed{60.0mA}$$

$$I_2 = 78.8mA \left(\frac{761.8\,\Omega}{4.7k\,\Omega}\right) = \boxed{12.8\ mA}$$

$$I_3 = 78.8mA \left(\frac{761.8\,\Omega}{10k\,\Omega}\right) = \boxed{6.00\,mA}$$

(b) FIND P_{R_1}, P_{R_2}, P_{R_3}

$$P_{R_1} = (I_1)^2 R_1 = (60\,mA)^2 (1k\,\Omega) = \boxed{3.60W}$$

$$P_{R_2} = \frac{(E)^2}{R_2} = \frac{(60)^2}{4.7k\,\Omega} = \boxed{766\ mW}$$

$$P_{R_3} = (E)(I_3) = (60V)(6.00mA) = \boxed{360\,mW}$$

3 APPROACHES (TAKE YOUR PICK)

(c) FIND P_{SOURCE}

$$P_{SOURCE} = (E)(I_S)$$

$$= (60V)(78.8\,mA) = \boxed{4.73\ W}$$

THE SAME

(d) COMPARE P_{SOURCE} TO $\sum_X P_{R_X}$

$$\sum_X P_{R_X} = P_{R_1} + P_{R_2} + P_{R_3} = \boxed{4.73W}$$

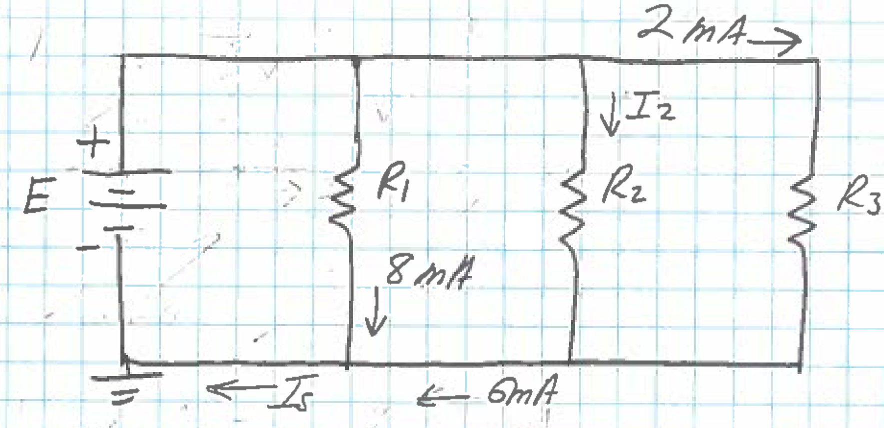
(e) R_1 R_X THE MOST POWER, LOWEST R W/E CONSTANT $(I = E/R)$

(e) WHICH RESISTOR RECEIVED THE MOST POWER? WHY?

$\boxed{R_1}$ THE LOWEST R IN A PARALLEL BRANCH

$$P = \frac{V^2}{R} = \frac{\overbrace{E}^{\text{SAME}}{}^2}{R} \qquad \boxed{\text{AS } \therefore R\downarrow \quad P\uparrow}$$

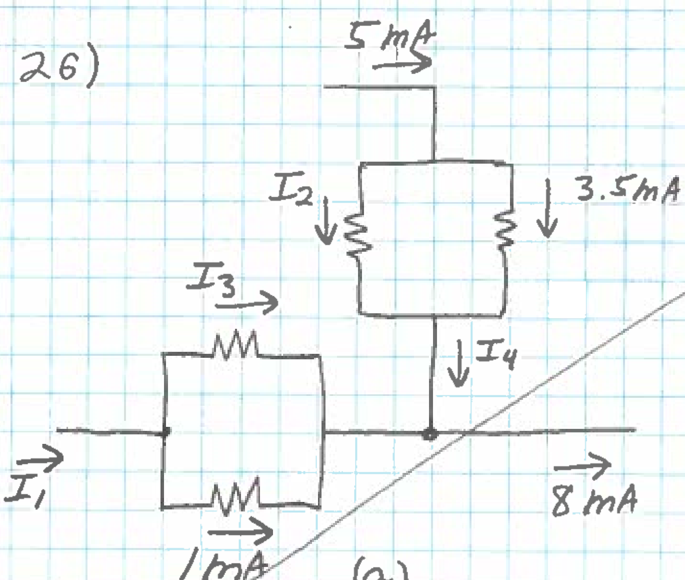
P27) FIND I_s + I_2:



KCL: $8\text{ mA} + 6\text{ mA} = I_s \quad \therefore \boxed{I_s = 14\text{ mA}}$

KCL: $I_2 + 2\text{ mA} = 6\text{ mA} \quad \therefore \boxed{I_2 = 4\text{ mA}}$

26)



FIND THE UNKNOWN CURRENTS

ALL KCL

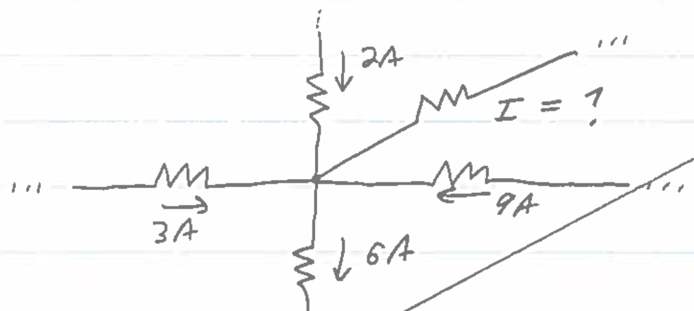
$I_2 = 5\text{mA} - 3.5\text{mA} = \boxed{1.5\text{ mA}}$

$I_4 = I_2 + 3.5\text{ mA} = \boxed{5\text{ mA}}$

$I_3 = 8\text{ mA} - I_4 - 1\text{ mA} = \boxed{2\text{ mA}}$

$I_1 = 1\text{ mA} + I_3 = \boxed{3\text{ mA}}$

FIND THE UNKNOWN CURRENTS



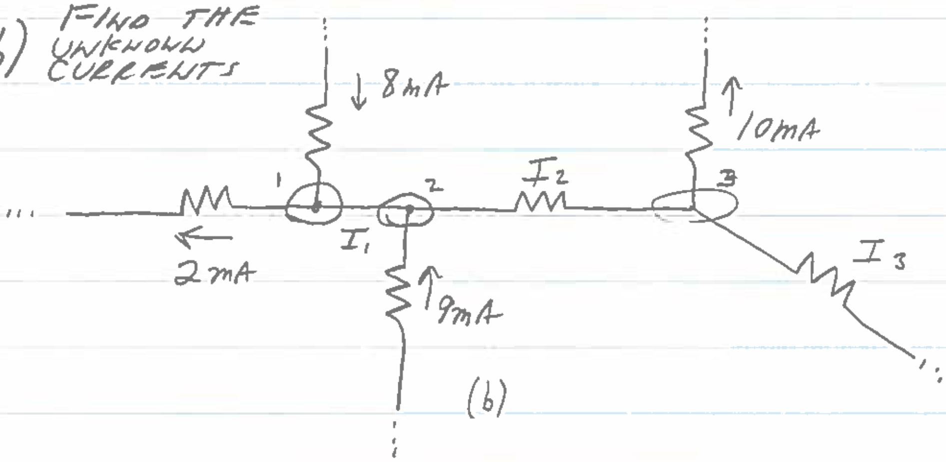
(a)

ASSUME I LEAVING ($\nearrow$ DIRECTION)

KCL: $2A + 3A + 9A = I + 6A$

$\therefore I = 14 - 6 = \boxed{8A}$, LEAVING, OR

P28b) FIND THE UNKNOWN CURRENTS



(b)

KCL @ 1: $8\,mA = 2\,mA + I_1$ $\therefore$ $\boxed{I_1 = 6\,mA, \text{ TO THE RIGHT}}$

ASSUME
$I_1 \rightarrow$ (LEAVING 1)

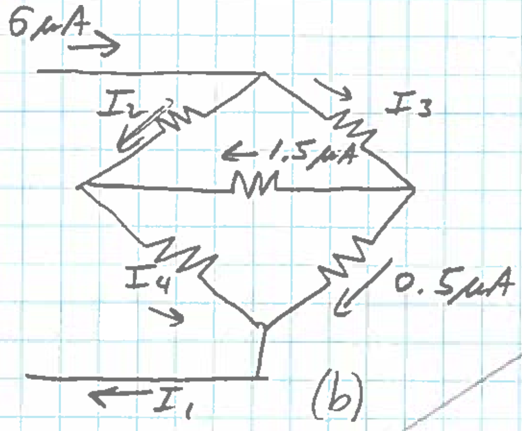
KCL @ 2: $6\,mA + 9\,mA = I_2$ $\therefore$ $\boxed{I_2 = 15\,mA, \text{ TO THE RIGHT}}$

ASSUME
$I_2 \rightarrow$ (LEAVING 2)

KCL @ 3: $15\,mA = 10\,mA + I_3$ $\therefore$ $\boxed{I_3 = 5\,mA, \text{ TO THE RIGHT}}$

ASSUME
$I_3 \searrow$ (LEAVING 3)

26)



KCL

$\boxed{I_1 = 6\mu A}$

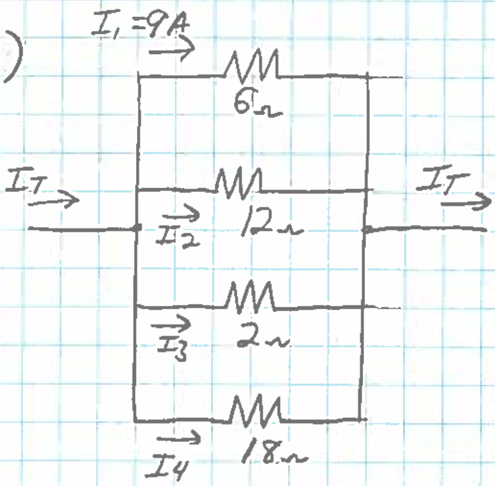
$I_4 = 6\mu A - 0.5\mu A = \boxed{5.5\mu A}$

$I_2 + 1.5\mu A = I_4$

$\therefore \quad I_2 = I_4 - 1.5\mu A = \boxed{4\mu A}$

$I_3 = 6\mu A - I_2 = \boxed{2\mu A}$

P33)



FIND I_2, I_3, I_4 USING THE RESISTOR VALUES (NOT OHM'S LAW)

$I_2 = \left(\frac{1}{2}\right) I_1 = \boxed{4.5A}$

$I_3 = 3 I_1 = \boxed{27A}$

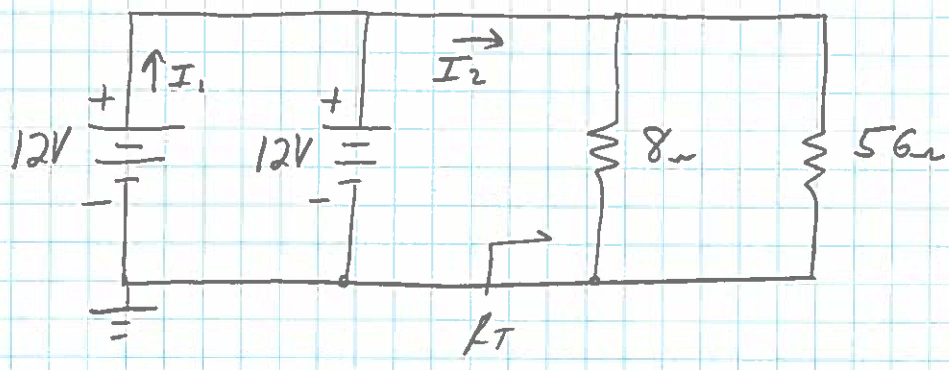
$I_4 = \left(\frac{1}{3}\right) I_1 = \boxed{3A}$

THE CURRENT DIVIDES IN INVERSE PROPORTION TO R

$I_T = I_1 + I_2 + I_3 + I_4$, KCL

$\therefore \boxed{I_2 = 43.5A}$

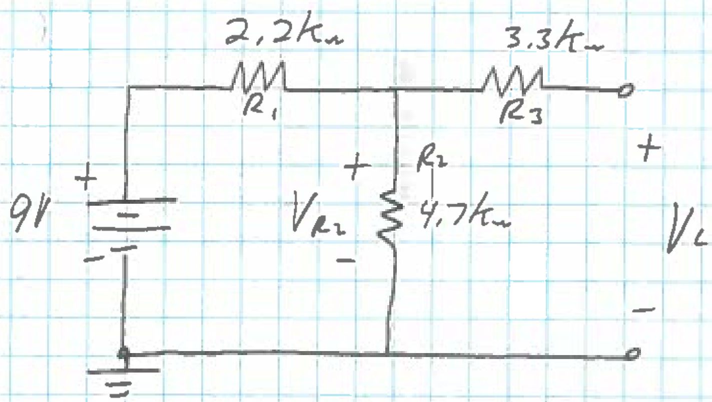
P41) FIND I_1 & I_2



$R_T = 8\Omega \,//\, 56\Omega = \underline{7\Omega}$

$\therefore I_2 = \frac{12V}{7\Omega} = \boxed{1.714\,A}$

& $I_1 = \frac{I_2}{2} = \boxed{857.1\,mA}$ ← IDENTICAL SUPPLIES ASSUMED



(a) FIND V_L

$V_L = V_{R_2}$ (R_3 IS o/c)

$\therefore V_L = V_{R_2} = 9V\left(\frac{4.7k\Omega}{6.9k\Omega}\right) = \boxed{6.13V}$

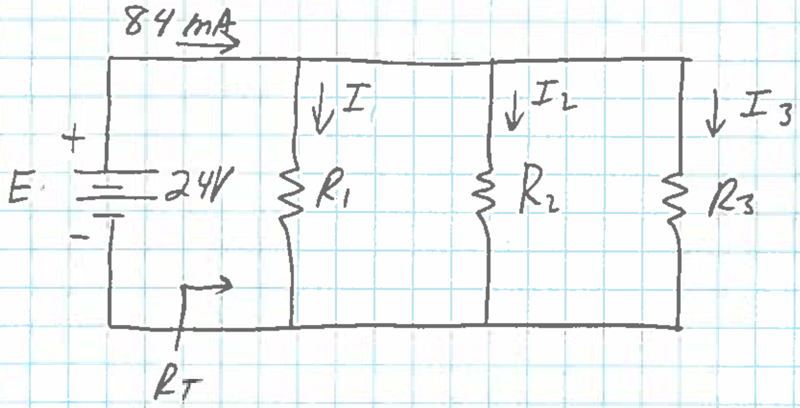
(b) IF R_1 IS s/c, FIND V_L

$\boxed{V_L = 9V}$ SINCE $V_{R_2} = 9V$ & R_3 IS o/c

(c) IF R_2 IS o/c, FIND V_L

$\boxed{V_L = 9V}$ SINCE R_1 & R_3 ARE o/c

38) DESIGN FOR $I_2 = 2I_1$ & $I_3 = 2I_2$



$$R_T = \frac{24V}{84\ mA} = \underline{285.7\,\Omega}$$

IF $I_2 = 2I_1$, $R_2 = \frac{1}{2}R_1$

IF $I_3 = 2I_2$, $I_3 = 4I_1$ & HENCE $R_3 = \frac{1}{4}R_1$

$$R_T = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}} = 285.7\,\Omega$$

OR

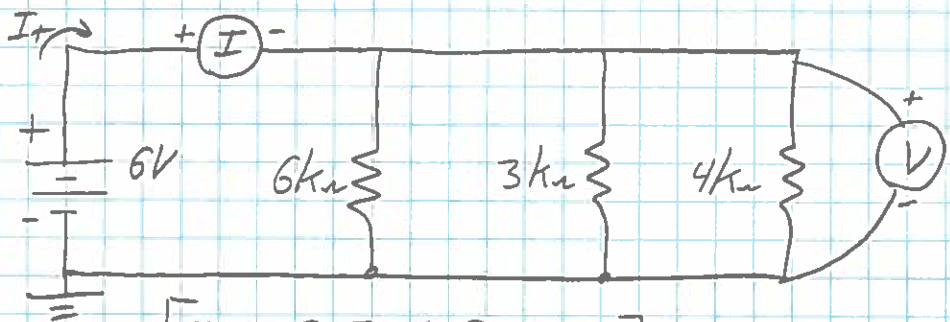
$$285.7\,\Omega = \frac{1}{\frac{1}{R_1} + \frac{1}{0.5R_1} + \frac{1}{0.25R_1}}$$

$\therefore$ $\boxed{R_1 = 2k\Omega}$

& $\boxed{R_2 = 1k\Omega}$

$\boxed{R_3 = 500\,\Omega}$

P45)



$\left[\begin{array}{l} I = 3.5\,mA \\ V = 6V \end{array}\right\}$ MEAS$\Big]$

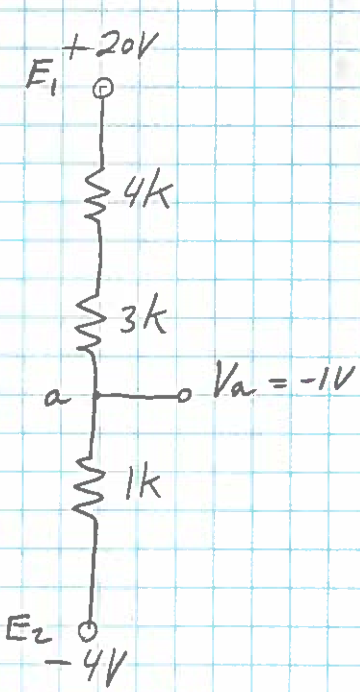
IS THE CIRCUIT WORKING PROPERLY? EXPLAIN.

V = 6V, looks Good SINCE E = 6V & IT'S A PARALLEL CIRCUIT

$I_T = \frac{E}{R_T} = \frac{6V}{1.33k\Omega} = $ $\boxed{4.5\,mA \text{ CALCULATED} \neq 3.5\,mA \text{ MEAS}}$

IF THE 6kΩ RESISTOR IS o/c, IT WOULD EXPLAIN THE DISCREPENCY

P 47)



(a) IF V_a JUMPS TO 20V, WHAT HAPPENED?

THE 1kΩ RESISTOR WENT o/c

(b) IF V_a IS 6V, WHAT IS WRONG w/ THE NETWORK CONSTRUCTION?

USED A 4V SOURCE INSTEAD OF -4V
OR
INC RESISTOR VALUE FOR THE 1kΩ