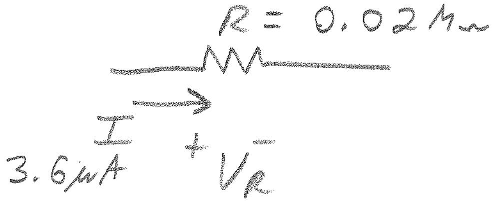
EEET 111 HW#3

(4-2) WHAT IS THE CURRENT THROUGH A 6.8Ω RESISTOR IF THE VOLTAGE DROP ACROSS IT IS 24V?

$$\frac{V}{I \mid R} \longrightarrow I = \frac{V}{R} = \frac{24V}{6.8\Omega} = \boxed{3.5\ A}$$

(4-5) GIVEN:



FIND: V_R

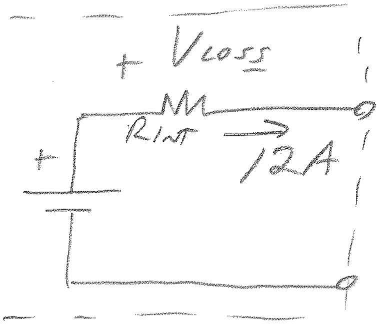
$$V_R = I \cdot R = (3.6\mu A)(0.02M\Omega)$$
$$= (3.6\times10^{-6}A)(0.02\times10^{6}\Omega)$$
$$= \boxed{72.0mV}$$

(4-10) IF A CD PLAYER DRAWS 125 mA WHEN 4.5V IS APPLIED, FIND ITS INTERNAL RESISTANCE.

$$R_{INT} = \frac{V_{appl}}{I_{DRAWN}} = \frac{4.5V}{125\,mA} = \boxed{36\Omega}$$

(4-12)
$\left.\begin{array}{l} R_{INT} = 0.5\Omega \\ I = 12A \end{array}\right\}$ DC GENERATOR

FIND V_{LOSS}:



$$V_{LOSS} = R_{INT} \cdot I$$
$$= (0.5\Omega)(12A)$$
$$\boxed{V_{LOSS} = 6.0V}$$

USE EXCEL

(4-15) a) PLOT I VS. V FOR A 120Ω RESISTOR. USE 0 - 100V & 0 - 1A SCALES

* - SEE ATTACHED

b) USE THE GRAPH FROM PART a, FIND THE CURRENT AT V = 20V & V = 50V

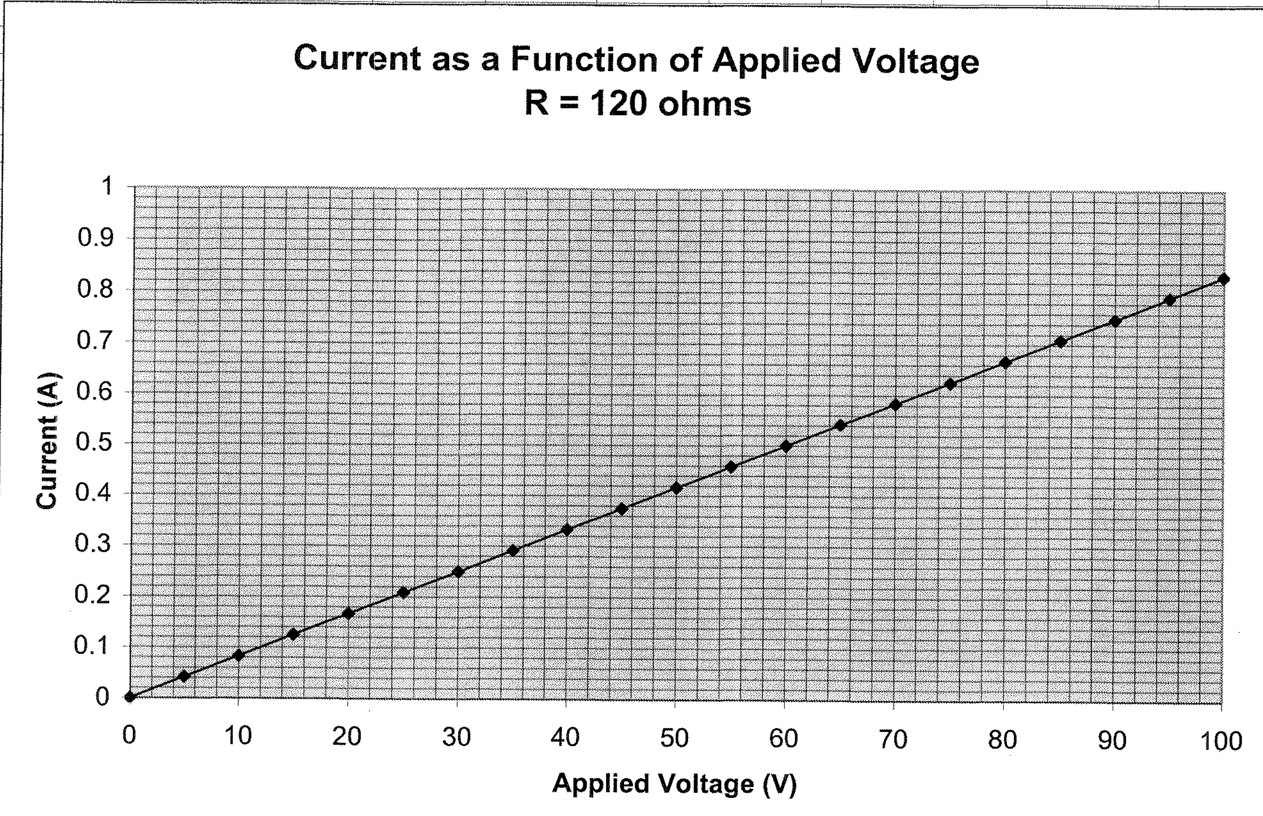
* - SEE ATTACHED

FROM PLOT: @ V = 20V, I ≅ 0.165A

$$R = \frac{20V}{165mA} = 121.1\Omega$$

R (ohms)	120

Vr (V)	Ir (A)
0	0
5	41.7E-3
10	83.3E-3
15	125.0E-3
20	166.7E-3
25	208.3E-3
30	250.0E-3
35	291.7E-3
40	333.3E-3
45	375.0E-3
50	416.7E-3
55	458.3E-3
60	500.0E-3
65	541.7E-3
70	583.3E-3
75	625.0E-3
80	666.7E-3
85	708.3E-3
90	750.0E-3
95	791.7E-3
100	833.3E-3



(4-19) (a) PLOT THE I-V CHARACTERISTICS OF A 2 KΩ, 1 MΩ, & A 100Ω RESISTOR ON THE SAME GRAPH. USE SCALES OF 0-20V & 0-10mA.

* - SEE ATTACHED

(b) COMMENT ON THE STEEPNESS OF THE CURVES W/ DECREASING R.

R = 1MΩ, "FLAT"

$\downarrow$

R = 100Ω, VERY STEEP

AS R $\downarrow$ SLOPE $\uparrow$

$$\underbrace{I}_{y} = \underbrace{m}_{\text{slope}}\underbrace{V}_{x} + \underbrace{b}_{\text{intercept}} \Rightarrow I = \left(\frac{\Delta I}{\Delta V}\right)V + 0$$

$$I = \left(\frac{1}{R}\right)V$$

(c) ARE THE CURVES LINEAR OR NON-LINEAR? Why?

<u>LINEAR</u>, SEE (b) ABOVE

OHMS LAW $\rightarrow$ LINEAR RELATIONSHIP BETWEEN V & I:

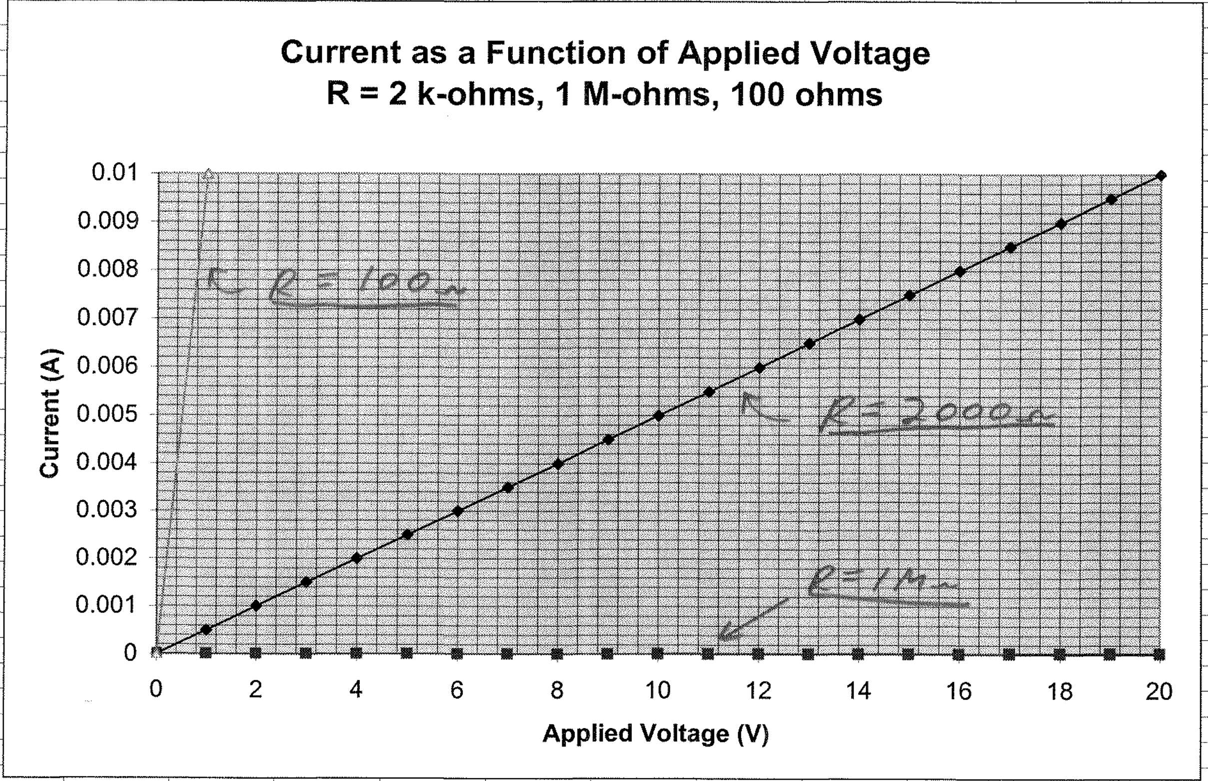
$$V = I \cdot R$$

$$\downarrow$$

$$I = \left(\frac{1}{R}\right)V$$

P4-19a

R (ohms)	2000	1.00E+06	100
Vr (V)	Ir (A)		
0	0	0	0
1	500.0E-6	1.0E-6	10.0E-3
2	1.0E-3	2.0E-6	20.0E-3
3	1.5E-3	3.0E-6	30.0E-3
4	2.0E-3	4.0E-6	40.0E-3
5	2.5E-3	5.0E-6	50.0E-3
6	3.0E-3	6.0E-6	60.0E-3
7	3.5E-3	7.0E-6	70.0E-3
8	4.0E-3	8.0E-6	80.0E-3
9	4.5E-3	9.0E-6	90.0E-3
10	5.0E-3	10.0E-6	100.0E-3
11	5.5E-3	11.0E-6	110.0E-3
12	6.0E-3	12.0E-6	120.0E-3
13	6.5E-3	13.0E-6	130.0E-3
14	7.0E-3	14.0E-6	140.0E-3
15	7.5E-3	15.0E-6	150.0E-3
16	8.0E-3	16.0E-6	160.0E-3
17	8.5E-3	17.0E-6	170.0E-3
18	9.0E-3	18.0E-6	180.0E-3
19	9.5E-3	19.0E-6	190.0E-3
20	10.0E-3	20.0E-6	200.0E-3



(4-21) THE POWER TO A DEVICE IS 40 J/S. HOW LONG WILL IT TAKE TO DELIVER 640J?

$$\frac{640\,J}{40\,J/s} = \boxed{16 \text{ SECONDS}}$$

(4-25) ~~FIND P_{DELIV} FOR A 6V BATTERY IF THE CHARGE RATE IS 48C/MIN?~~

$$\cancel{48\frac{C}{MIN}\cdot\left(\frac{1\,MIN}{60\,SEC}\right) = 800\ mC/s}$$

$\cancel{\text{BUT } 1A = 1\,C/s \quad \therefore \quad I = \underline{800\,mA}}$

$$\cancel{P = I\cdot V = (800\,mA)(6V) = \boxed{4.8W}}$$

(4-34) A CALCULATOR W/ A 3V BATTERY DRAWS 0.4 mW.

(a) FIND I_{supply}

$$P = I\cdot E$$

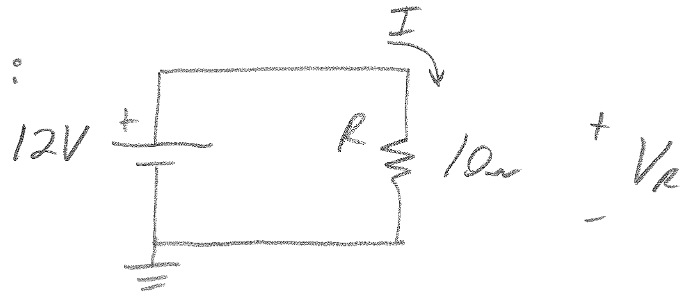
$$\therefore \quad I_{supply} = \frac{0.4\,mW}{3V}$$

$$\boxed{I_{supply} = 133.3\,\mu A}$$

(b) IF THE CALCULATOR CAN RUN FOR 500h ON THE BATT, FIND THE A·h RATING.

$$(500h)(133.3\,\mu A) = \boxed{66.7\ mA\cdot h}$$

(4-37) GIVEN:



(a) HOW MANY JOULES WILL R DISSIPATE IN 1 MINUTE?

$$P_R = \frac{(V_R)^2}{R} = \frac{(12V)^2}{10\Omega} = 14.4W \Rightarrow \underline{14.4\ J/sec}$$

$$\left(14.4\ J/SEC\right)\left(\frac{60\ SEC}{MIN}\right) = \underline{864\ J/MIN}$$

$\boxed{\text{864 JOULES}}$

(b) IF R IS LEFT CONNECTED FOR 2 MIN, WILL THE ENERGY USE INCREASE? WILL P_R INCREASE?

<u>YES</u>, THE <u>ENERGY</u> USE WILL DOUBLE TO 1728 JOULES

<u>NO</u>, P_R <u>STAYS THE SAME</u> AT 14.4 WATTS

48. $$\text{kWh} = \frac{(1600\text{ W})(8\text{ h}) + (1200\text{ W})(1/3\text{ h}) + (4800\text{ W})(1\text{ h}) + (900\text{ W})(1/4\text{ h}) + (200\text{ W})(1.2\text{ h}) + (50\text{ W})(3.5\text{ h})}{1000}$$

$$= \frac{12,800\text{ Wh} + 400\text{ Wh} + 4800\text{ Wh} + 225\text{ Wh} + 240\text{ Wh} + 175\text{ Wh}}{1000} = 18.64\text{ kWh}$$

$(18.64\text{ kWh})(12¢/\text{kWh}) = \$2.24$

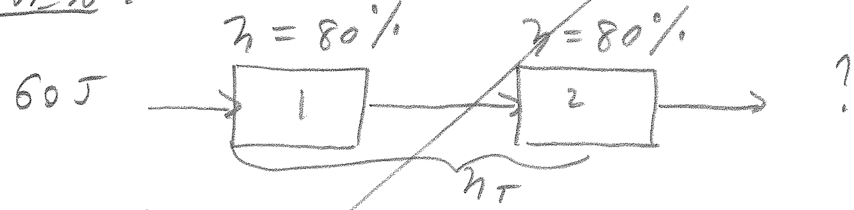
(4-50) GIVEN: $P_{IN} = 410\,W$, $P_{OUT} = 0.5\,hp$ } MOTOR

FIND: η %

$$(0.5\,hp)\left(\frac{746\,W}{hp}\right) = \underline{373\,W}$$

$$\eta = \frac{P_o}{P_i} = \frac{373\,W}{410\,W} = 0.9097 \text{ or } 91.0\%$$

(4-58) GIVEN:

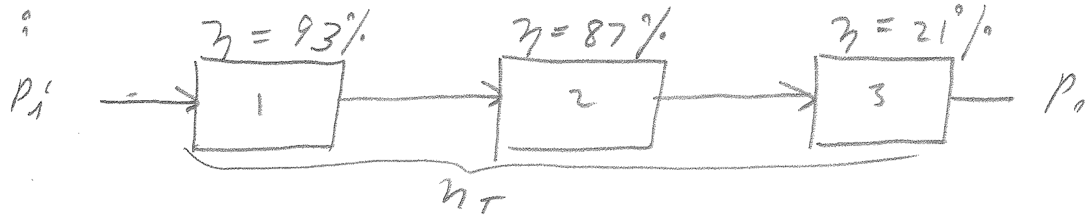


FIND: W_o

$$W_o = (W_i)(\eta_T), \quad \eta_T = (\eta_1)(\eta_2) = \underline{0.64}$$

$$\therefore W_o = (60\,J)(0.64) = \boxed{38.4\,J}$$

(4-60) GIVEN:



(a) FIND: η_T

$$\eta_T = (\eta_1)(\eta_2)(\eta_3) = 0.1699 \text{ or } \boxed{17.0\%}$$

(b) FIND: IF SYSTEM 3 WERE REPLACED SO $\eta_3 = 90\%$, FIND THE % INCREASE IN η_T

$$\eta_T' = (0.93)(0.87)(0.80) = 0.647 \text{ or } \underline{64.7\%}$$

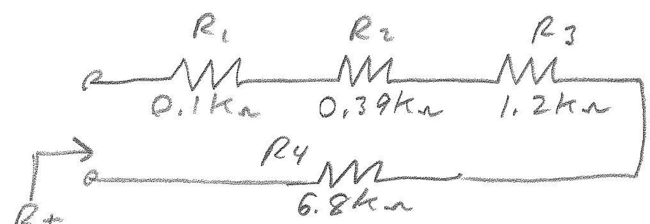
(4-60) (b) CONTINUED

$$\% \text{ INCREASE} = \frac{\text{NEW } \# - \text{OLD } \#}{\text{OLD } \#} \times 100\%$$

$$= \frac{0.6473 - 0.1701}{0.1701} \times 100\%$$

$$= \boxed{280.6\%}$$

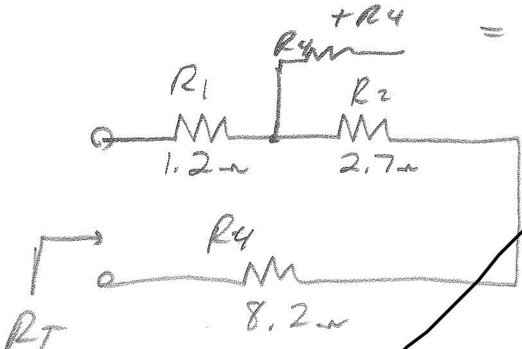
(5-2) FIND R_T FOR EACH CIRCUIT. ONLY STANDARD R VALUES WERE USED.



(a)

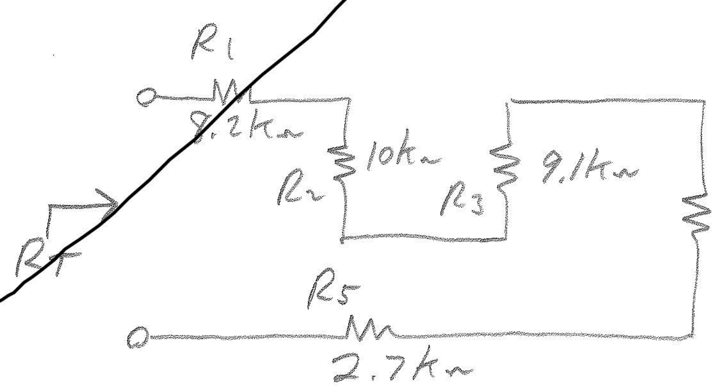
$R_T = R_1 + R_2 + R_3 + R_4 = (100 + 390 + 1200 + 6800)$

$= \boxed{8,490\Omega}$



(b)

$R_T = R_1 + R_2 + R_4 = \boxed{12.1\Omega}$



(c)

Chapter 5

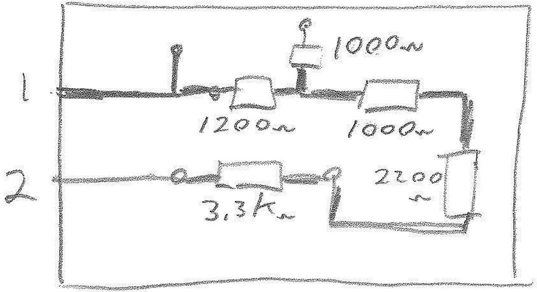
3. a. $R_T = 0.1\ \text{k}\Omega + 0.39\ \text{k}\Omega + 1.2\ \text{k}\Omega + 6.8\ \text{k}\Omega = 8.49\ \text{k}\Omega$

   b. $R_T = 1.2\ \Omega + 2.7\ \Omega + 8.2\ \Omega = 12.1\ \Omega$

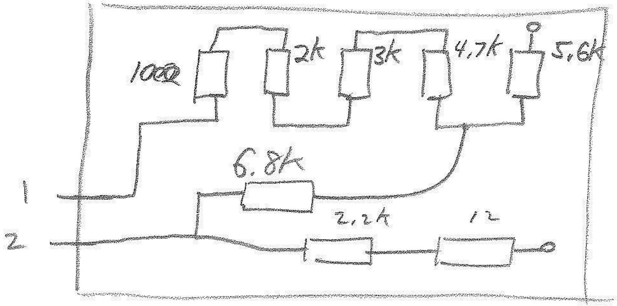
   c. $R_T = 1.2\ \Omega + 2.2\ \Omega + 3.3\ \Omega + 4.7\ \Omega = 11.4\ \Omega$

~~(5-3)~~ FIND $R_{T1,2}$

5-5



(a)



(b)

$R_{1,2} = 1200 + 1000 + 2200 + 3300$

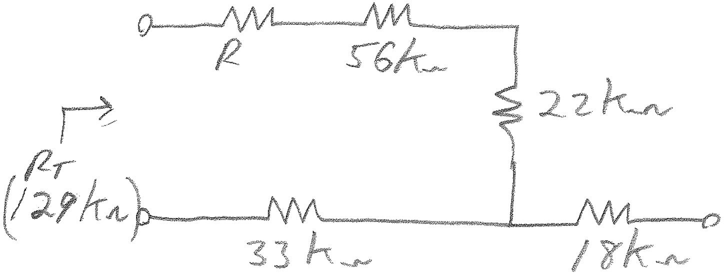
$= \boxed{7,700\ \Omega}$

$R_{1,2} = 1000 + 2k + 3k + 4.7k +$

$17.5k\Omega$

$= \boxed{17,500\ \Omega}$

~~5-6)~~ 5-8

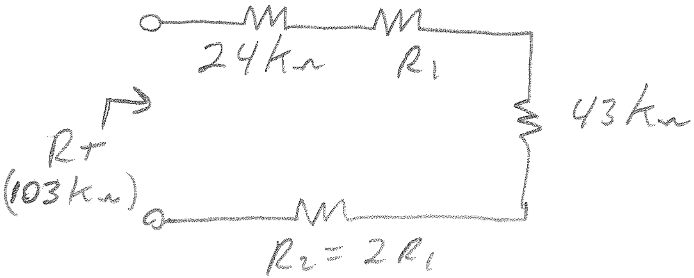


(a)

$$R_T = R + 56k + 22k + 33k$$

$$R_T = 129k$$

$$\therefore \boxed{R = 18k\Omega}$$



(d)

$$R_T = 24k + R_1 + 43k + 2R_1$$

$$R_T = 103k$$

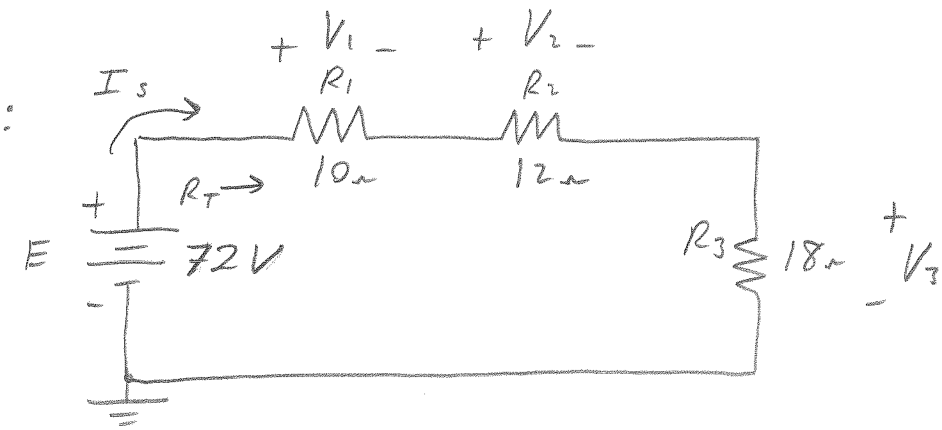
$$\therefore 103k = 24k + 43k + 3R_1$$

$$R_1 = \frac{103k - 24k - 43k}{3}$$

$$\boxed{\begin{aligned} R_1 &= 12k\Omega \\ R_2 &= 2R_1 = 24k\Omega \end{aligned}}$$

5-10

~~(5-8)~~ GIVEN:



FIND:

a) R_T

$$R_T = R_1 + R_2 + R_3 = \boxed{40\Omega}$$

b) I_s

$$I_s = \frac{E}{R_T} = \frac{72V}{40\Omega} = \boxed{1.8A}$$

c) V_1, V_2, V_3

$$V_1 = (I_s)(R_1) = (1.8A)(10\Omega) = \boxed{18V}$$

$$V_2 = (I_s)(R_2) = (1.8A)(12\Omega) = \boxed{21.6V}$$

$$V_3 = (I_s)(R_3) = (1.8A)(18\Omega) = \boxed{32.4V}$$

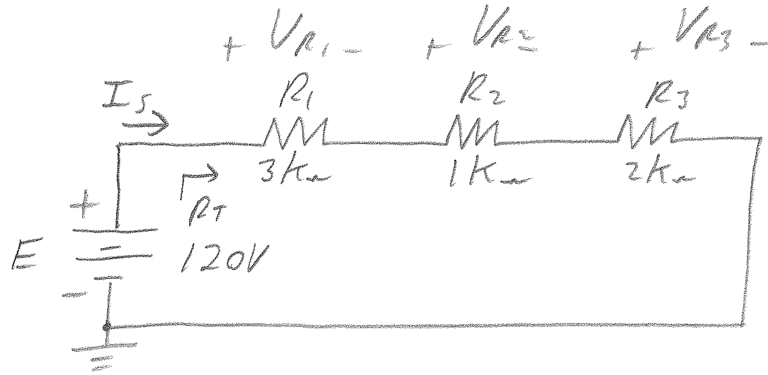
d) $P_{source} = (E)(I_s) = (72V)(1.8A) = \boxed{129.6W}$

e) $P_{R_3} = (I_s)^2 R_3$

$$= (1.8A)^2(18\Omega) = \boxed{58.3W}$$

5-16

~~(5-13)~~ GIVEN:



FIND a) R_T, I_S, V_{R1}, V_{R2}, V_{R3}

$$R_T = R_1 + R_2 + R_3 = \boxed{6k\Omega}$$

$$I_S = E/R_T = 120V/6k\Omega = \boxed{20\,mA}$$

$$V_{R1} = (I_S)(R_1) = \boxed{60V}$$

$$V_{R2} = (I_S)(R_2) = \boxed{20V}$$

$$V_{R3} = (I_S)(R_3) = \boxed{40V}$$

b) P_{R1}, P_{R2}, P_{R3}

$$P_{R1} = (I_S)^2 R_1 = \boxed{1.2W}$$

$$P_{R2} = (I_S)^2 R_2 = \boxed{400\,mW}$$

$$P_{R3} = (I_S)^2 R_3 = \boxed{800\,mW}$$

c) $P_{R1} + P_{R2} + P_{R3}$

$$\boxed{P_T = 2.4W}$$

THE SAME

d) $P_{DELIVERED}$

$$P_{DELIVERED} = (E)(I_S) = \boxed{2.4W}$$

e) COMPARE $P_{T\_RESISTORS}$ To $P_{DELIVERED}$

THE TOTAL POWER DELIVERED TO THE RESISTORS IS EQUAL TO THE TOTAL POWER DELIVERED BY THE SOURCE

~~(5-13)~~ CONTINUED

(f) WHICH R RECEIVED THE MOST POWER?
WHY?

$\boxed{R_1}$

$P = I^2 R$
& R_1 WAS LARGER THAN
R_2 OR R_3

(g) WHAT HAPPENED TO P_{R_T}?

DISSIPATED - FORM OF HEAT

(h) FIND PMIN-RATING FOR EACH R IF
THE CHOICES ARE $\frac{1}{2}$W, 1W, 2W, 5W

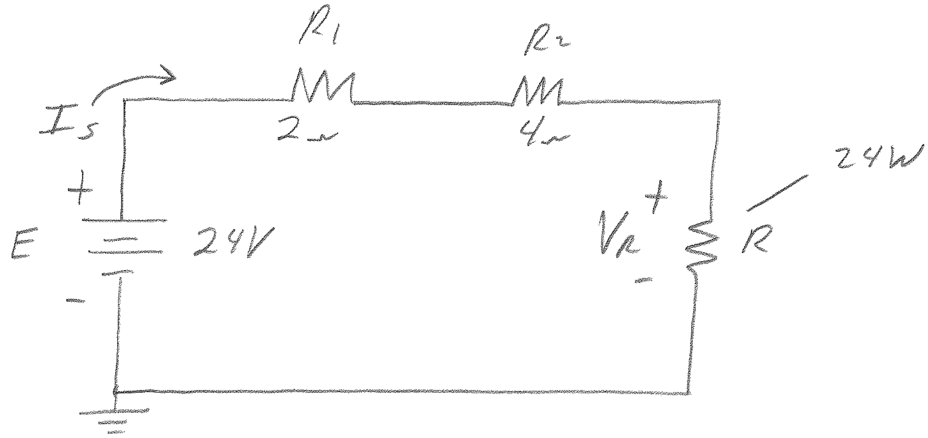
$R_1 \rightarrow 2W$

$R_2 \rightarrow 1/2 W$

$R_3 \rightarrow 1W$

5-20

~~(5-17)~~ GIVEN:



FIND: R

$$R_T = R_1 + R_2 + R = 6\Omega + R$$

$$I_S = \frac{E}{R_T} = \frac{24V}{R + 6\Omega} \qquad (1)$$

$$P_R = (I_S)^2 R \longrightarrow 24W = (I_S)^2 R \qquad (2)$$

SOLVE (2) FOR R: $R = \frac{24W}{(I_S)^2}$

INTO (1): $$I_S = \frac{24V}{\frac{24W}{(I_S)^2} + 6\Omega} \qquad (3)$$

$\times \frac{I_S^2}{I_S^2}$: $I_S = \frac{24V\,(I_S^2)}{24W + 6\Omega\,(I_S^2)}$

CROSS MULT: $24 I_S + 6 I_S^3 = 24 I_S^2$

OR

$$6 I_S^3 - 24 I_S^2 + 24 I_S = 0$$

$I_S = 0A$ ← TRIVIAL SOLUTION

$2A$ ← $\underline{I_S = 2A}$

$2A$

SOLVE (2) FOR R: $R = \frac{P_R}{I_S^2} = \frac{24W}{(2A)^2} = \boxed{6\Omega}$