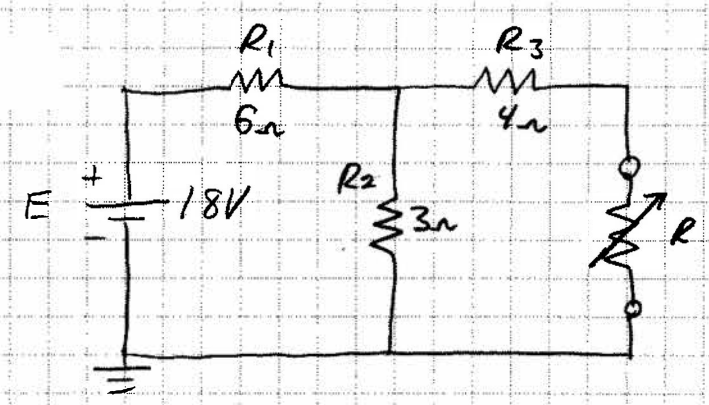
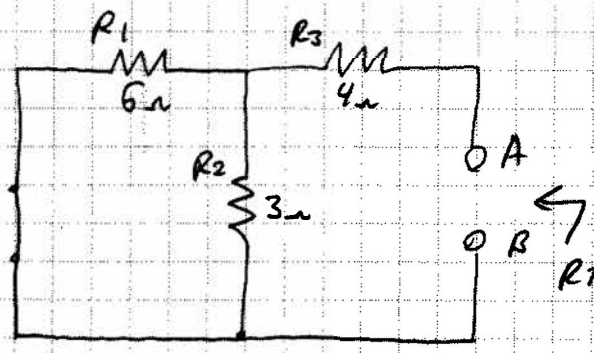
P9.9



(a) FIND THE THEVENIN EQUIVALENT CIRCUIT EXTERNAL TO "R."

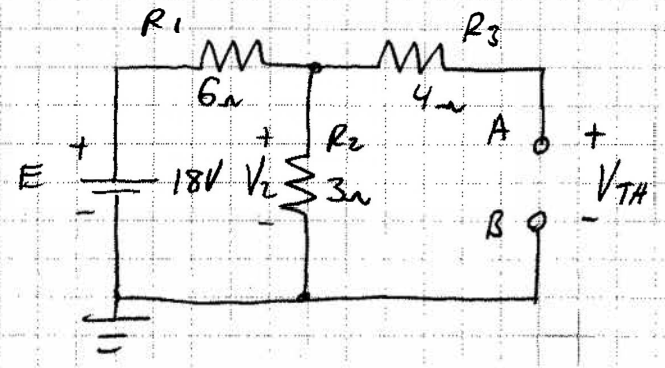
RTH - DEACTIVATE (RELAX) SOURCES
- O/C ^ & LABEL "A" & "B"
THE COMPONENT/SYS OF INTEREST



$R_{TH} = R_{AB} = R_1 // R_2 + R_3$

$= \boxed{6\Omega}$

VTH - FIND V_{AB} (O/C) WITH THE SOURCES IN-CIRCUIT

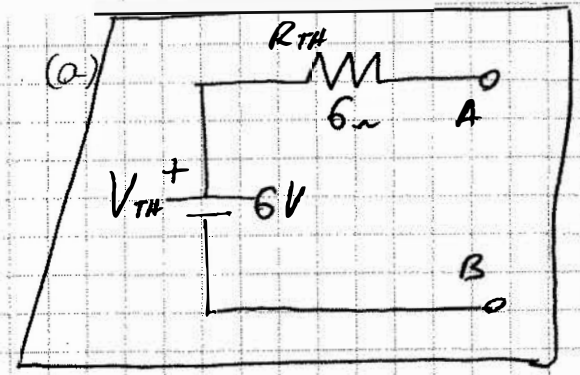


$V_2 = E\left(\frac{R_2}{R_1+R_2}\right) = \underline{6V}$

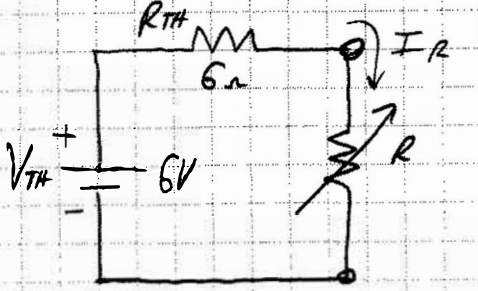
$V_{TH} = V_2 = \boxed{6V}$

* NO CURRENT THROUGH R_3

P9.9 Continued



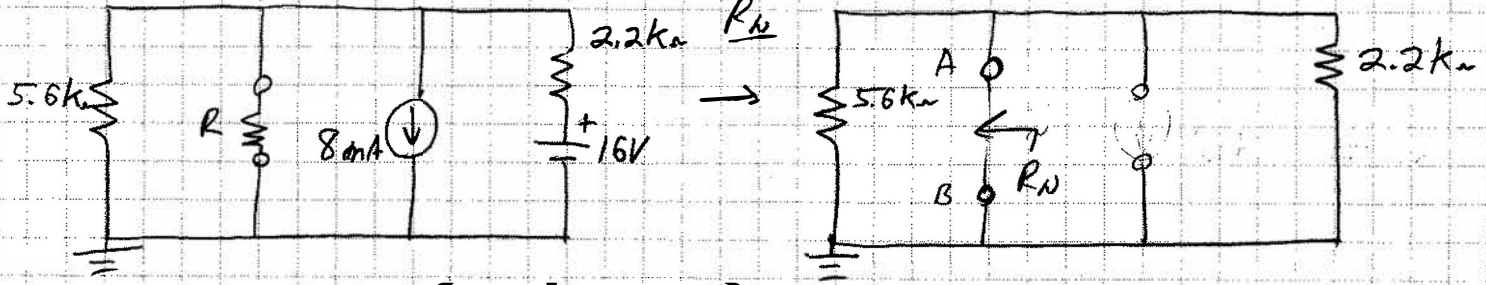
(b) Find I_R for R = 2Ω, 30Ω, 100Ω



$$I_R = \frac{V_{TH}}{R_{TH} + R} = \frac{6V}{6\Omega + R}$$

R	I_R
2Ω	750.0 mA
30Ω	166.7 mA
100Ω	56.60 mA

P9.13 FIND THE NORTON EQUIVALENT EXTERNAL TO "R"

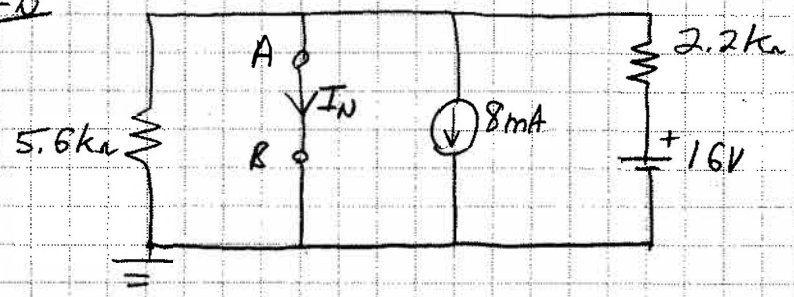


(redrawn)

$$R_N = 5.6k\Omega \,//\, 2.2k\Omega$$

$$\boxed{R_N = 1.580k\Omega}$$

I_N



I_N (DUE TO THE 8 mA SOURCE): I_N'

$I_N' = -8\ mA$ (SOURCE IS S/C)

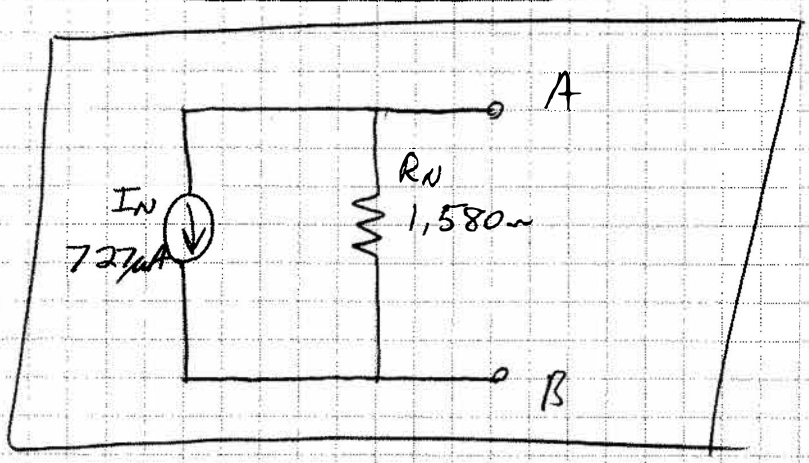
I_N (DUE TO 16V SOURCE): I_N''

$$I_N'' = \frac{16V}{2200\Omega} = 7.273\ mA$$

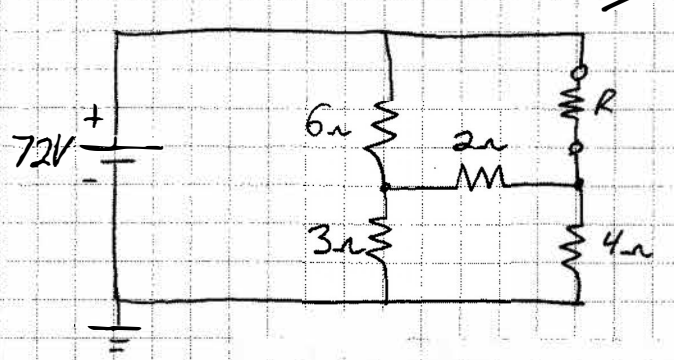
$\therefore$ $I_N = -8\ mA + 7.273\ mA$

$$\boxed{I_N = -727.3\ \mu A}$$

NORTON EQUIVALENT

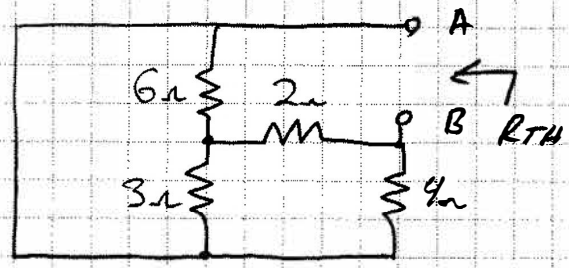


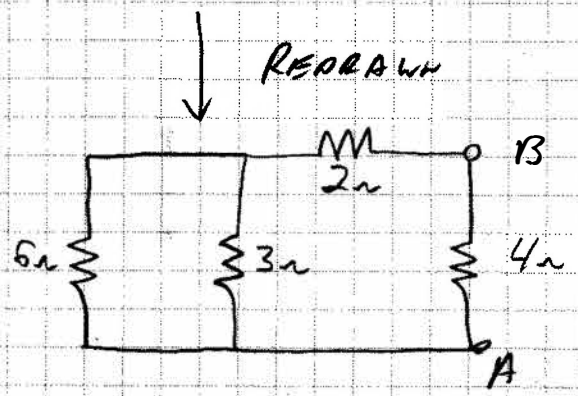
P9.14: Find the Thevenin equivalent external to "R"



(Using a 72V source instead of a 2A source as specified)

R_{TH}





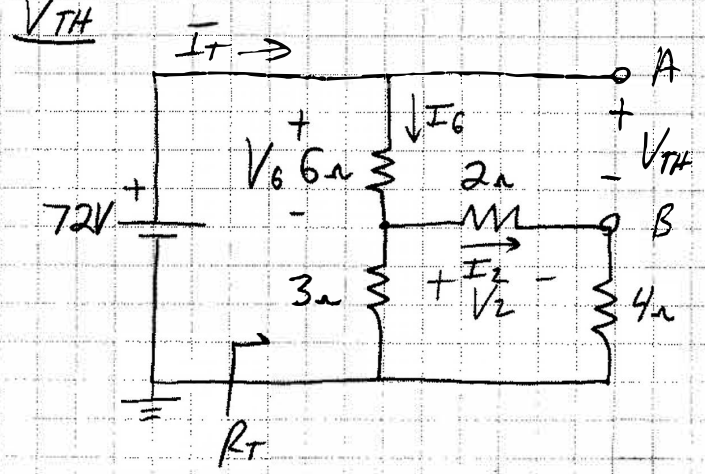
$R_{TH} = R_{AB}$

$= [(6\Omega \,//\, 3\Omega) + 2\Omega] \,//\, 4\Omega$

$= (2\Omega + 2\Omega) \,//\, 4\Omega$

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

V_{TH}



$R_T = (4\Omega + 2\Omega) \,//\, 3\Omega + 6\Omega$

$R_T = 2\Omega + 6\Omega = \underline{8\Omega}$

$I_T = \dfrac{72V}{R_T} = \underline{9A}$

$I_6 = I_T = \underline{9A}$

$\therefore V_6 = (6\Omega)(9A) = \underline{54V}$

$I_2 = I_6\left(\dfrac{2\Omega}{6\Omega}\right) = \underline{3A}$

$\therefore V_2 = (I_2)(2\Omega) = \underline{6V}$

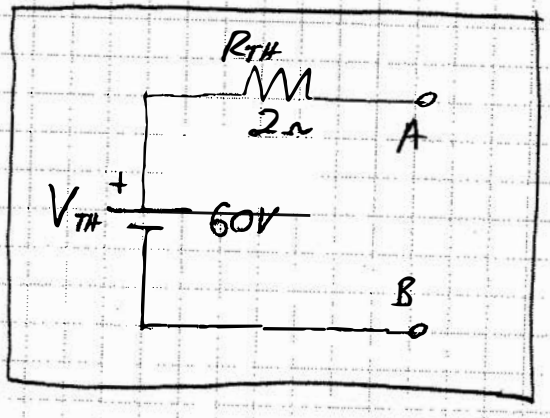
P9.14 (CONTINUED)

KVL: $V_6 - V_{TH} + V_2 = 0$

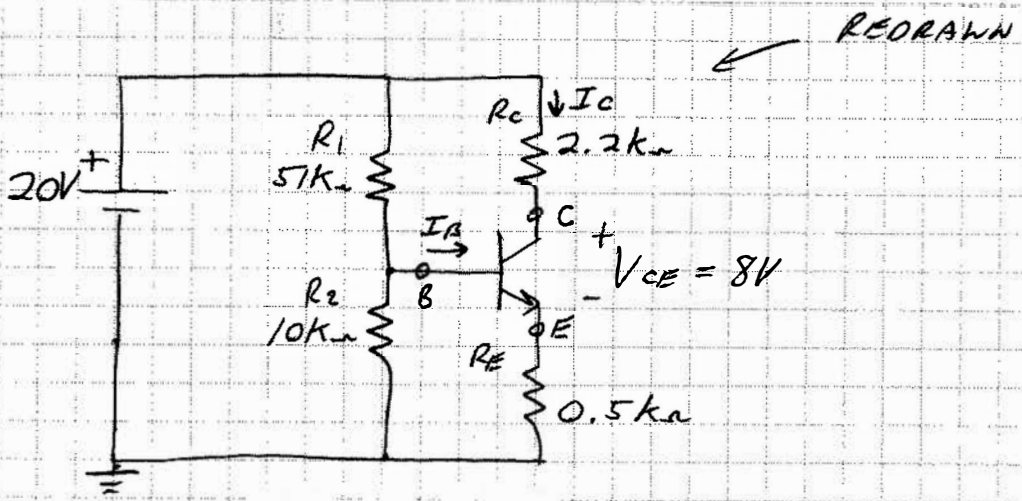
$$V_{TH} = V_6 + V_2 = 54V + 6V$$

$$\boxed{V_{TH} = 60V}$$

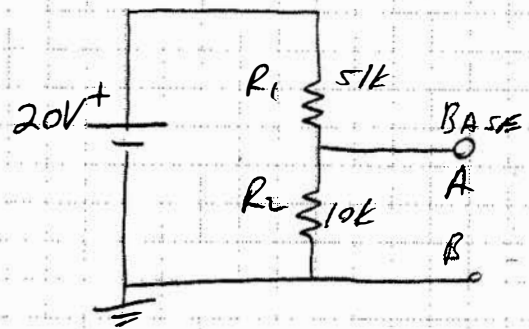
THEVENIN EQUIVALENT



P9.19

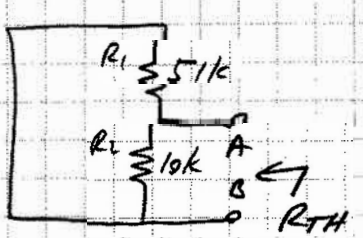


(a) FIND THE THEVENIN EQUIVALENT FOR THE CIRCUIT TO THE LEFT OF THE BASE TERMINAL



P9.19 (CONTINUED)

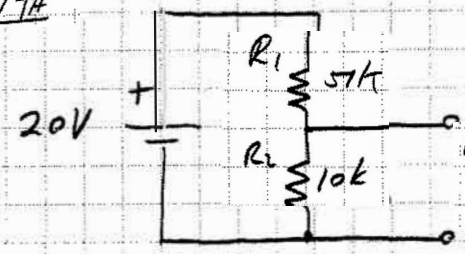
R_{TH}



$$R_{TH} = R_1 // R_2$$

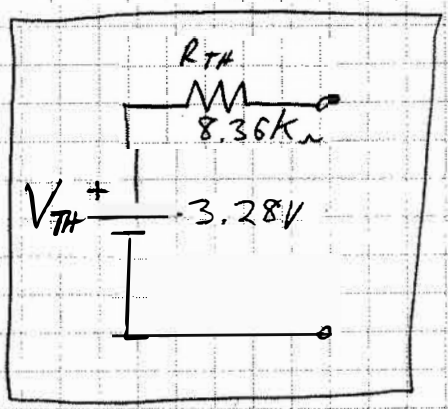
$$\boxed{R_{TH} = 8.361 k\Omega}$$

V_{TH}

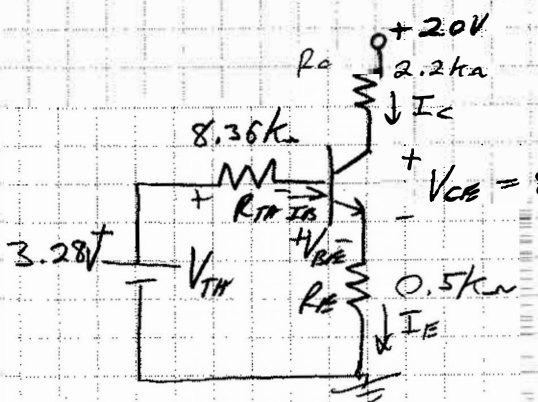


$$V_{TH} = 20V\left(\frac{R_2}{R_1+R_2}\right) = \boxed{3.279V}$$

THEVENIN EQUIVALENT



(b) USING $I_C = I_E$ & $V_{CE} = 8V$, FIND $|I_E|$



KVL: $20 - I_C R_C - V_{CE} - I_E R_E = 0$

BUT $I_C = I_E$

$\therefore\ 20 = I_C R_C + V_{CE} + I_C R_E$

$20 = I_C(R_C + R_E) + V_{CE}$

OR $I_C = \dfrac{(20-8)V}{2.7 k\Omega}$

$$\boxed{I_C = I_E = 4.44 mA}$$

P9.19 (CONTINUED)

(c) FIND I_B IF $V_{BE} = 0.7V$

KVL: $3.28V - I_B(8.36k\Omega) - V_{BE} - I_E R_E = 0$

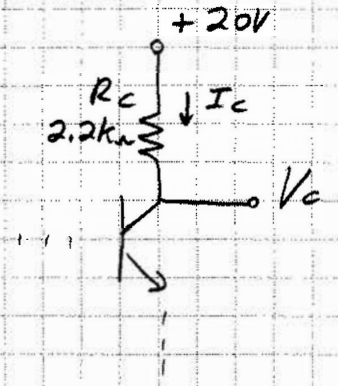
$V_{BE} = 0.7V$ (GIVEN)

$I_E = 4.44mA$ (PART b)

$3.28V - 0.7V - (4.44mA)(500\Omega) = I_B(8.36k\Omega)$

$$I_B = \frac{360mV}{8.36k\Omega} = \boxed{43.1\mu A}$$

(d) FIND V_C



KVL: $+20 - I_C R_C - V_C = 0$

$V_C = 20 - I_C R_C$

$I_C = I_E = 4.44mA$

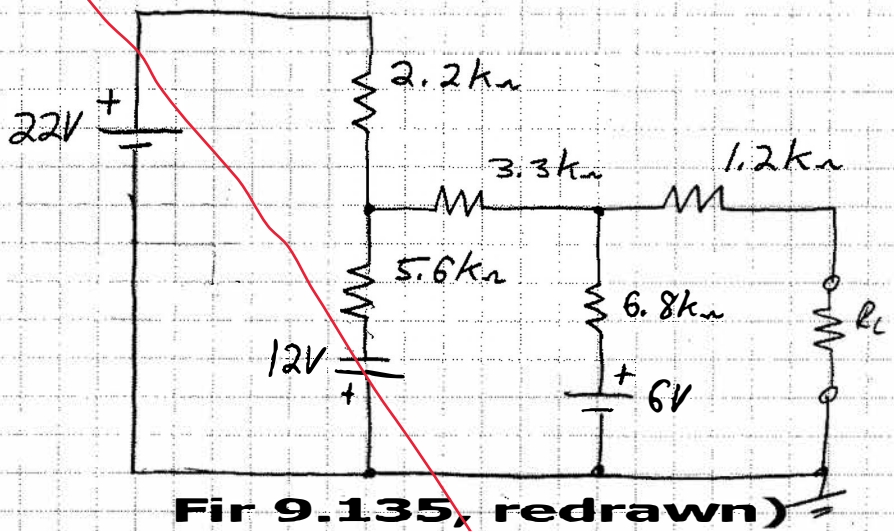
$R_C = 2.2k\Omega$

$\therefore V_C = 20V - (4.44mA)(2200\Omega)$

$$\boxed{V_C = 10.2V}$$

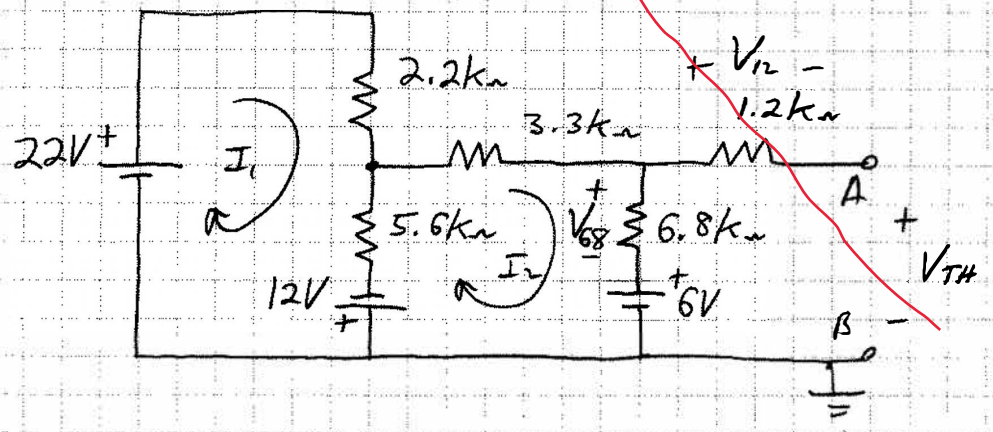
P9.34 FIND THE VALUE OF R_L FOR MAX POWER TRANSFER TO R_L & DETERMINE P_{MAX}

REDRAWN



Fir 9.135, redrawn)

- FIND V_{TH} & R_{TH}



P9.34 (CONTINUED)

1: $22 - 2.2k I_1 - 5.6k I_1 + 5.6k I_2 + 12 = 0$

$-7.8k I_1 + 5.6k I_2 = -34$ (1)

2: $-12 - 5.6k I_2 + 5.6k I_1 - 3.3k I_2 - 6.8k I_2 - 6 = 0$

$5.6k I_1 - 15.7k I_2 = 18$ (2)

SOLVING YIELDS: $I_1 = 4.753\,mA$

$I_2 = 548.9\,\mu A$

V_{TH}:

KVL: $6 + V_{68} - V_{12} - V_{TH} = 0$

$V_{68} = (I_2)(6800\Omega)$

$= (548.9\mu A)(6800\Omega) = \underline{3.733V}$

$V_{12} = 0V$, DUE TO O/C AT A+B

$\therefore V_{TH} = 6 + 3.733V = \underline{9.73V}$

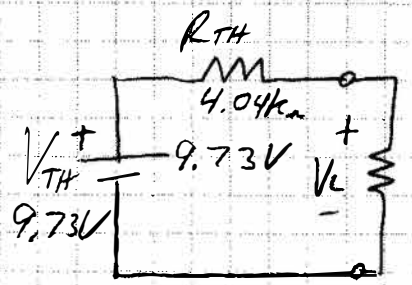
R_{TH}: REPLACE VOLTAGE SOURCES W/ S/C

$R_{TH} = (2.2k\Omega // 5.6k\Omega + 3.3k\Omega) // 6.8k\Omega + 1.2k\Omega$

$4.880k\Omega // 6.8k\Omega + 1.2k\Omega$

$\underline{R_{TH} = 4.041k\Omega}$

$\therefore \boxed{R_{L\,MAX\,PWR} = R_{TH} = 4.04k\Omega}$

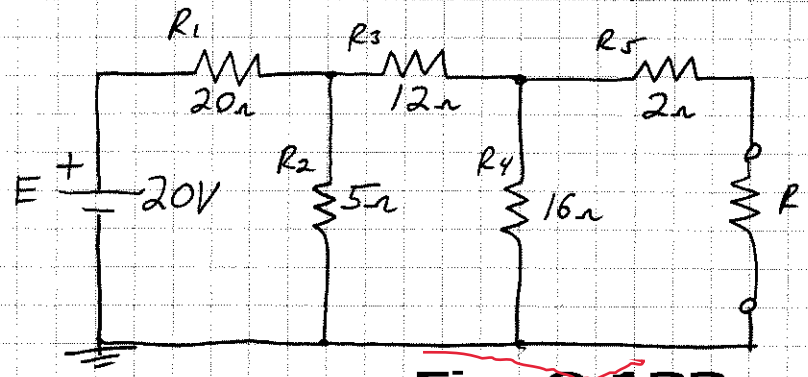


$R_L = R_{TH}$
$4.04k\Omega$

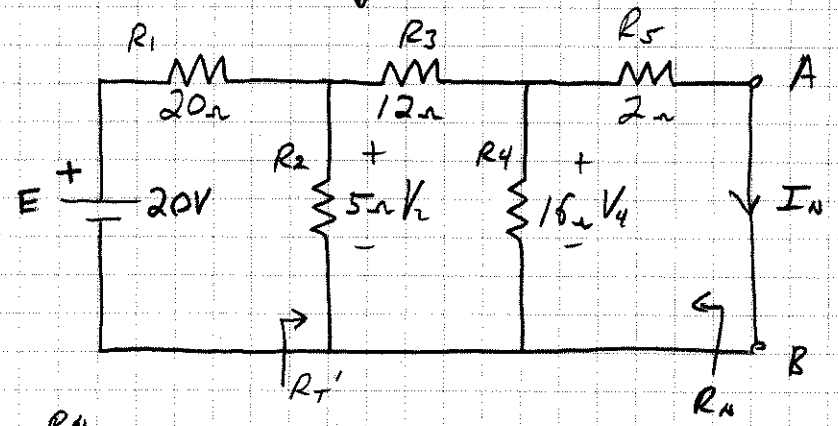
$V_L = \frac{V_{TH}}{2} = \underline{4.87V}$

$\therefore \boxed{P_{R_L} = \frac{V_L^2}{R_L} = 5.86\,mW}$

IA 9.2 FIND THE NORTON EQUIVALENT CIRCUIT EXTERNAL TO "R."



~~Fig. 9.133~~ Fig 9.140

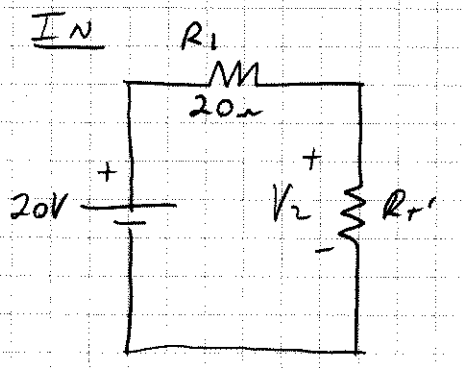


RN

$$R_N = (R_1 // R_2 + R_3) // R_4 + R_5$$
$$= (4\Omega + 12\Omega) // 16\Omega + 2\Omega$$
$$= 8\Omega + 2\Omega$$

$$\boxed{R_N = 10\Omega}$$

IN



$$R_T' = [(R_4 // R_5) + R_3] // R_2$$
$$= [(16\Omega // 2\Omega) + 12\Omega] // 5\Omega$$
$$= 13.778\Omega // 5\Omega = \underline{3.669\Omega}$$

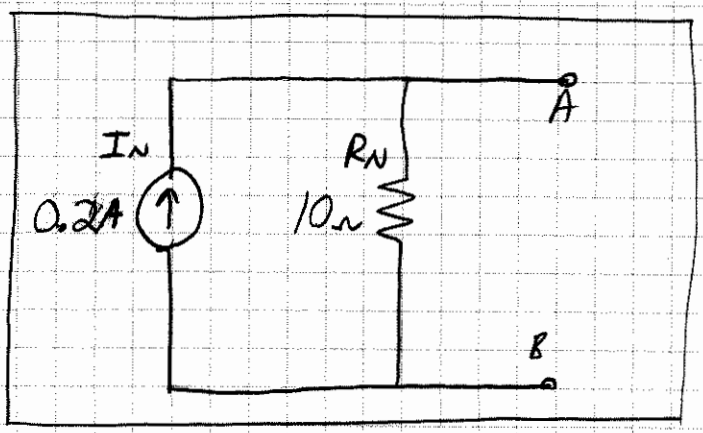
$$V_2 = 20V\left(\frac{3.669\Omega}{20\Omega + 3.669\Omega}\right) = \underline{3.10V}$$

$$V_4 = 3.1V\left(\frac{16\Omega // 2\Omega}{16\Omega // 2\Omega + 12\Omega}\right) = \underline{400.0\,mV}$$

IA 9.2 (CONTINUED)

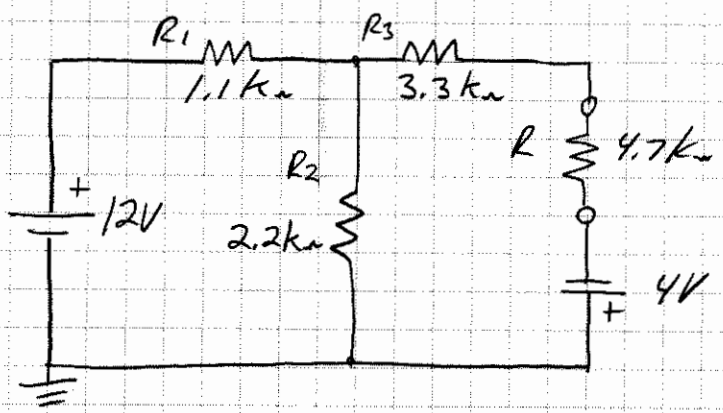
$$I_N = \frac{V_4}{R_5} = \frac{40.0\,\text{k}\Omega\text{V}}{2\,\Omega} = \boxed{200\,\text{mA}}$$

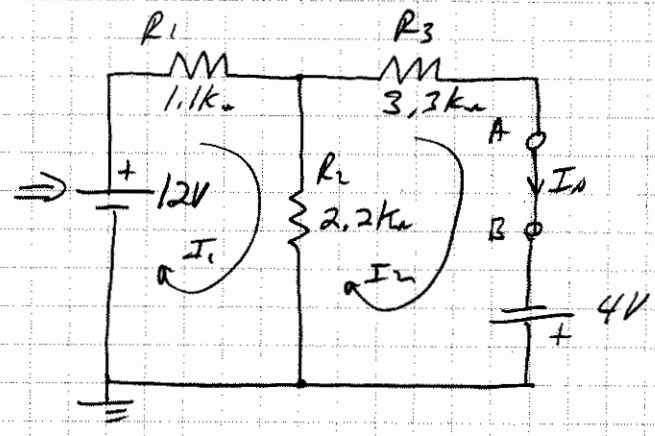
NORTON EQUIVALENT



9.141 (with R = 4.7K as stated)

FIG 9.134 REDRAWN





$$R_N = R_1 // R_2 + R_3 = 733.3\,\Omega + 3.3\,\text{k}\Omega$$

$$\boxed{R_N = 4.033\,\text{k}\Omega}$$

I_N

1: $12 - 1.1\text{k}I_1 - 2.2\text{k}I_1 + 2.2\text{k}I_2 = 0 \rightarrow -3.3\text{k}I_1 + 2.2\text{k}I_2 = -12$ (1)

2: $-2.2\text{k}I_2 + 2.2\text{k}I_1 - 3.3\text{k}I_2 + 4 = 0 \rightarrow 2.2\text{k}I_1 - 5.5\text{k}I_2 = -4$ (2)

SOLVING YIELDS: $I_1 = 5.62\,\text{mA}$

$I_2 = 2.98\,\text{mA}$

$\therefore \boxed{I_N = I_2 = 2.98\,\text{mA}}$

IA 9.2 (CONTINUED)

NORTON EQUIVALENT