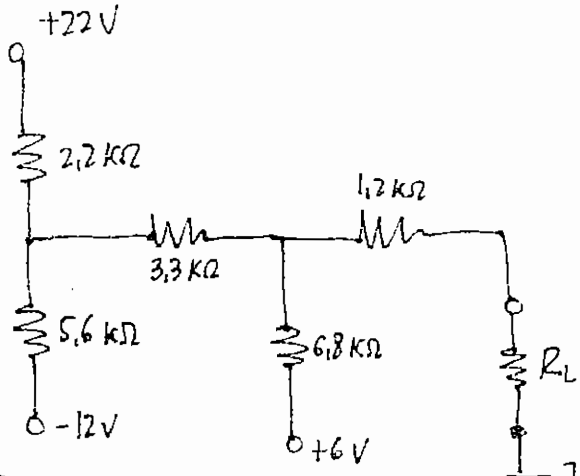
HW # 13

9-17



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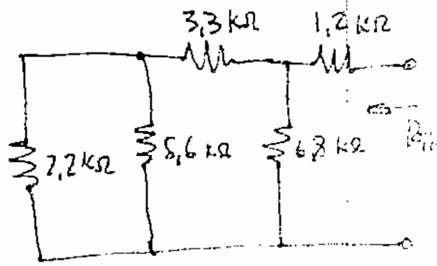


$$R_{TH} = \left[\left[(2{,}2\ k\Omega \parallel 5{,}6\ k\Omega) + 3{,}3\ k\Omega\right] \parallel (6{,}8\ k\Omega)\right] + 1{,}2\ k\Omega =$$

$$= \left[\left[\ 1{,}58 + 3{,}3\ \right] \parallel 6{,}8\right] + 1{,}2\ k\Omega = \left[4{,}88 \parallel 6{,}8\right] + 1{,}2 = 2{,}84 + 1{,}2 = 4{,}04\ k\Omega$$

$$\boxed{R_{TH} = 4{,}04\ k\Omega}$$

E_{TH} -> Source Conversions

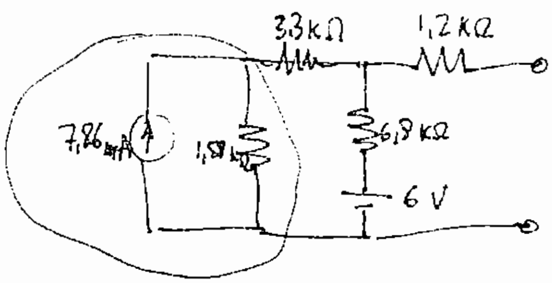
$I_1 = \dfrac{22\ V}{2{,}2\ k\Omega} = 10\ mA \qquad R = 2{,}2\ k\Omega$

$I_2 = \dfrac{12\ V}{5{,}6\ k\Omega} = 2{,}14\ mA \qquad R = 5{,}6\ k\Omega$

Combinin parallel current sources

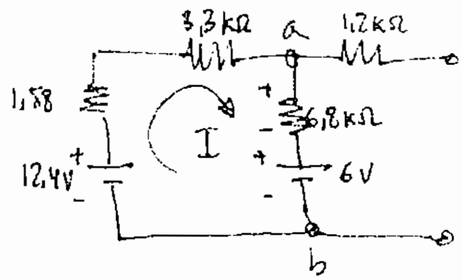
$I_T = I_1 - I_2 = 10\ mA - 2{,}14\ mA = 7{,}86\ mA$

$2{,}2\ k\Omega \parallel 5{,}6\ k\Omega = 1{,}58\ k\Omega$



Source Conversion

=>



$$I = \frac{E_T}{R_T} = \frac{12{,}4\ V - 6\ V}{1{,}58 + 3{,}3 + 6{,}8} = 550\ \mu A$$

$$V_{6,8} = I \cdot R = 550\ \mu A \cdot 6{,}8\ k\Omega = 3{,}74\ V$$

$$E_{TH} = V_{ab} = V_{6,8} + E_6 = 3{,}74\ V + 6\ V = \boxed{9{,}74\ V = E_{TH}}$$

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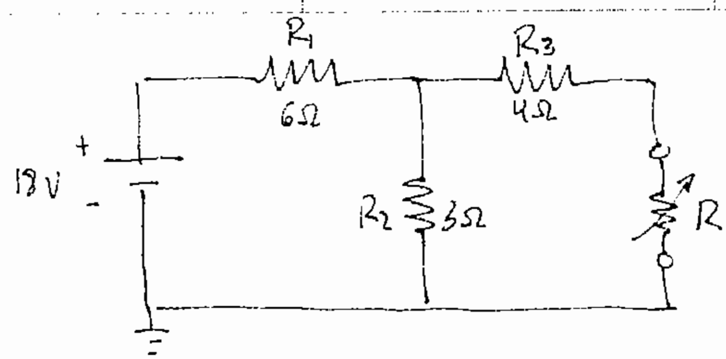

Max Power Transfer Condition $R = R_{TH}$

$R_{TH} = R_3 + (R_1 \| R_2) = 6\Omega$ so $\boxed{R = 6\Omega}$

$P_{max} = \dfrac{E_{TH}^2}{4R_{TH}} = \dfrac{6V^2}{4 \cdot 6} = \boxed{1.5\,W = P_{max}}$

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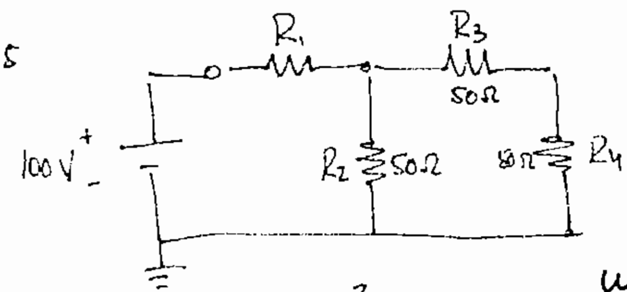
$R = R_{TH} = 2.18\,\Omega$ from problem 11

$E_{TH} = 9.81\,V$ $\quad P_{max} = \dfrac{E_{TH}^2}{4R_{TH}} = \dfrac{(9.81\,v)^2}{4 \cdot 2.18} = \boxed{11.06\,W = P_{max}}$

9-35



R_1 ?

$E_{TH} = 100\left(\dfrac{R_2}{R_1 + R_2}\right)$

R_1 must be ≥ 0

E_{TH} is max when $R_1 = 0$.

What about R_{TH}?

$P_{max} = \dfrac{E_{TH}^2}{4R_{TH}}$

$R_{TH} = 50 + \underbrace{\left(\dfrac{1}{R_1} + \dfrac{1}{50}\right)^{-1}}$

As $R_1 \to 0$ $\quad R_{1\|2} \to 0 \Rightarrow R_{TH} \to$ Minimum

If $R_1 = 0 \Rightarrow E_{TH}$ is a maximum and R_{TH} is a minimum $\Rightarrow$

$\boxed{R_1 = 0\,\Omega}$ $\quad P_{MAX} = \dfrac{E_{TH}^2}{4R_{TH}}$ is Max when $R_1 = 0\Omega$.

This solution works for this problem but would likely fail for another problem. See Next Page for How to solve it every time.

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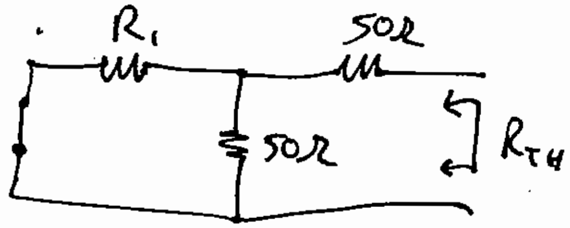
CONCEPT

Max Power to R_Y occurs when $R_Y = R_{TH}$ $\Rightarrow$ find R_{TH} external to R_Y and set it equal to 50Ω to determine R_1.

SOLUTION



$$50\Omega = R_{TH} = 50\Omega + \left(\frac{1}{R_1} + \frac{1}{50}\right)^{-1}$$

$$0 = \left(\frac{1}{R_1} + \frac{1}{50}\right)^{-1}$$

Multiply by 1

$$\left(\frac{R_1}{R_1}\right)(0) = \left(\frac{1}{\frac{1}{R_1} + \frac{1}{50}}\right)\frac{R_1}{R_1} \qquad 1 = \frac{R_1}{R_1}$$

Multiply Both sides By $\left(1 + \frac{R_1}{50}\right)$

$$\left(1 + \frac{R_1}{50}\right)0 = \frac{R_1}{\cancel{\left(1 + \frac{R_1}{50}\right)}}\cancel{\left(1 + \frac{R_1}{50}\right)}$$

$$\boxed{0 = R_1}$$