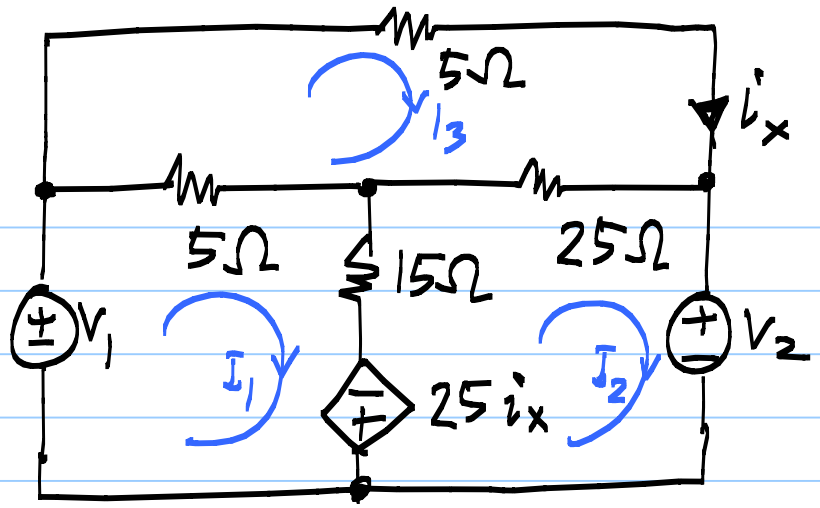
EC1010: Electrical and Magnetic circuits.

Note Title 1/28/2013

Problem set #3 (Due on 14th Feb. 2014)

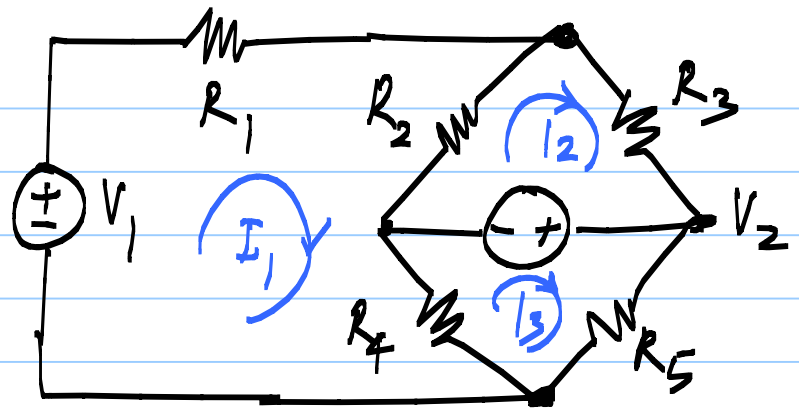
HKD: Hayt, Kemmerly, and Durbin
Engineering circuit analysis, 8th Edition (Indian)
McGraw Hill 2013

1



* Set up the mesh analysis eqn. $[R]\underline{I} = \underline{V}$
* Solve for $\underline{I}$
* Determine the power dissipated in the 25Ω resistor
* Determine the power dissipated/supplied by all the sources

(2)

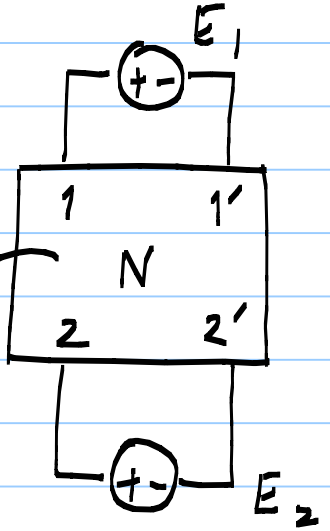


The mesh equations for the above circuit are as given below. Determine all component values:

$$\begin{bmatrix} 112\Omega & -90\Omega & -10\Omega \\ -90\Omega & 100\Omega & 0 \\ -10\Omega & 0 & 100\Omega \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \\ I_3 \end{bmatrix} = \begin{bmatrix} -12\,V \\ 5\,V \\ -5\,V \end{bmatrix}$$

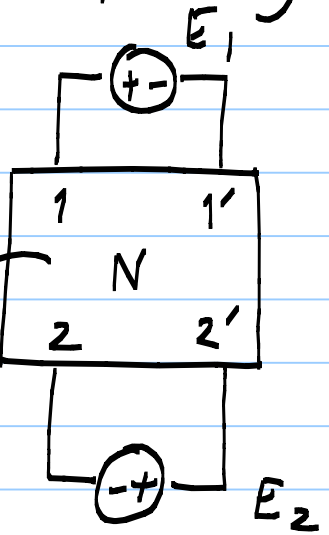
(3) Let $P_{E_1+E_2}$ and $P_{E_1-E_2}$ be the powers dissipated in a network N consisting of linear time invariant resistances excited by two voltages E_1 and E_2 in the polarities shown in (a) & (b) respectively.

(a)



Power dissipated $= P_{E_1+E_2}$

(b)

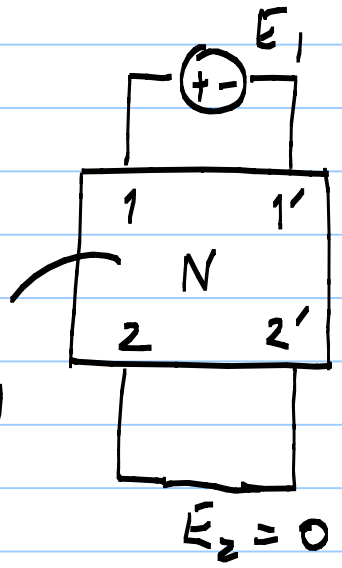


Power dissipated $= P_{E_1-E_2}$

Cont'd

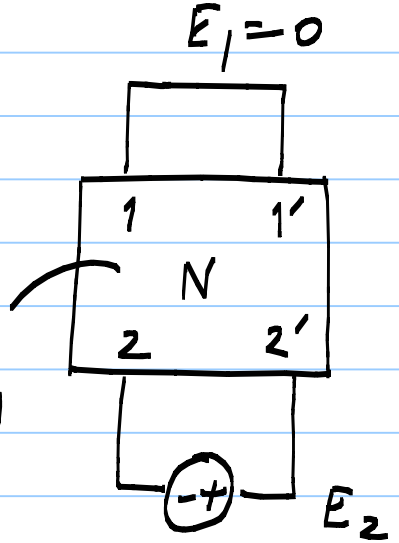
Determine $P_{E_1} + P_{E_2}$ where P_{E_1} and P_{E_2} are the powers dissipated in N when E_1 and E_2 are acting alone as shown in (c) and (d) respectively.

(c)



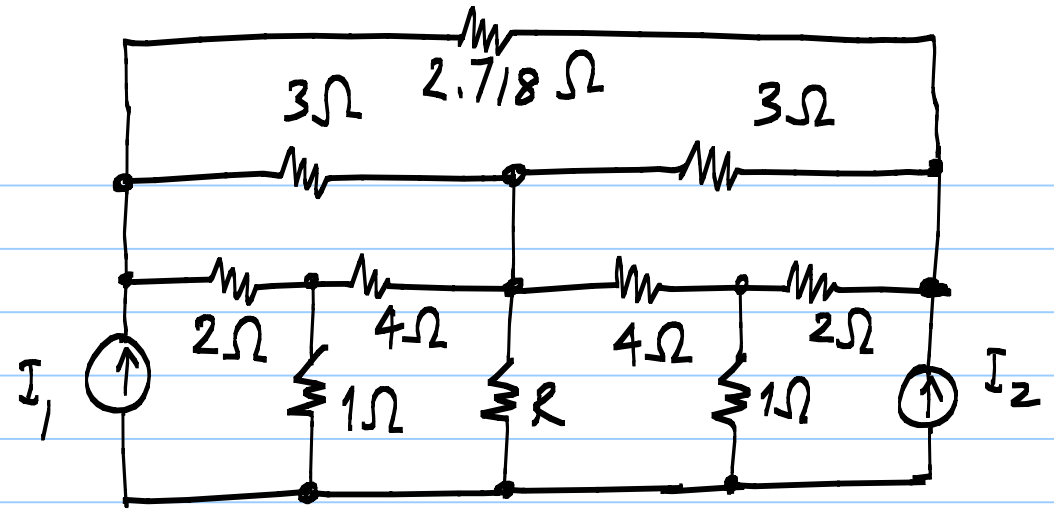
Power dissipated = P_{E_1}

(d)



Power dissipated = P_{E_2}

④



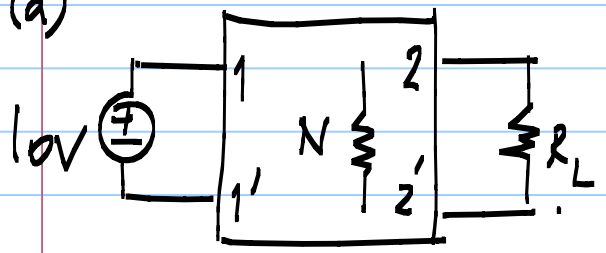
(a) For $I_1 = I_2 = 1A$, determine R so that it dissipates the maximum power. What is the value of the max. power?

(b) Repeat the above for $I_1 = 2A$ and $I_2 = -2A$

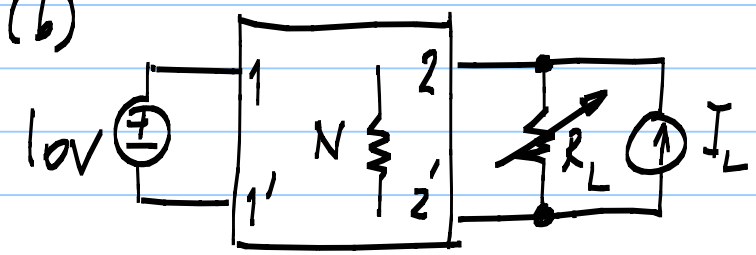
(c) Repeat the above for $I_1 = 1A$ and $I_2 = 4A$

(5) N consists only of resistors and two pairs of terminals 1-1' and 2-2' are brought out (a). When 10 V is connected to 1-1' and $R_L = 2\Omega$ is connected to 2-2', the latter draws 2A. When $R_L = 6\Omega$, it draws 1A.

(a)

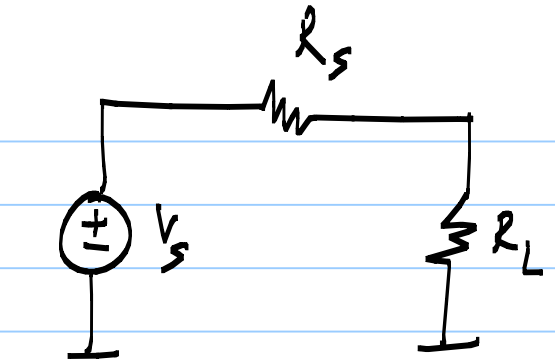


(b)



When I_L & a variable R_L are connected to 2-2' and R_L varied, the maximum power dissipated in R_L is 4.5W. Find I_L. (5)

(6)



(R_s is fixed)

Show that the power P_L, dissipated in R_L can be expressed as

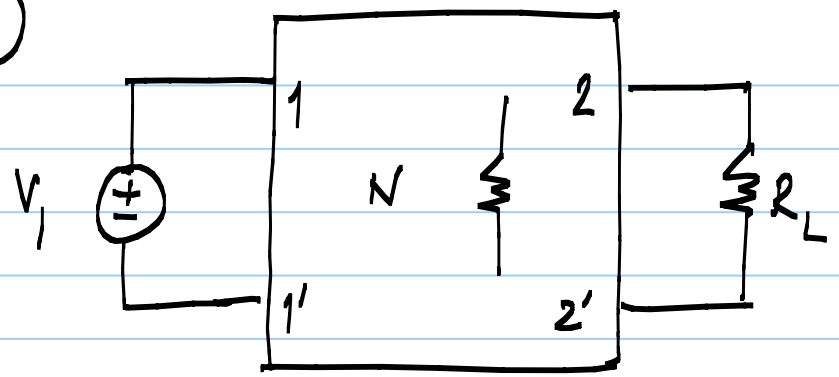
$$P_L = P_{max}\left(1 - |\Gamma_L|\right)^2$$ where

$$\Gamma_L = \frac{R_L - R_s}{R_L + R_s}$$ and P_{max} is independent of R_L.

Determine P_{max}.

Γ_L is called "reflection coefficient" of the load R_L. What is Γ_L for (a) maximum power dissipated in R_L, (b) min. power dissipated in R_L

(7)



N consists only of resistors. The power in R_L equals 8W when R_L is either 50Ω or 200Ω. Determine the power dissipated in R_L when $R_L = 150\Omega$.