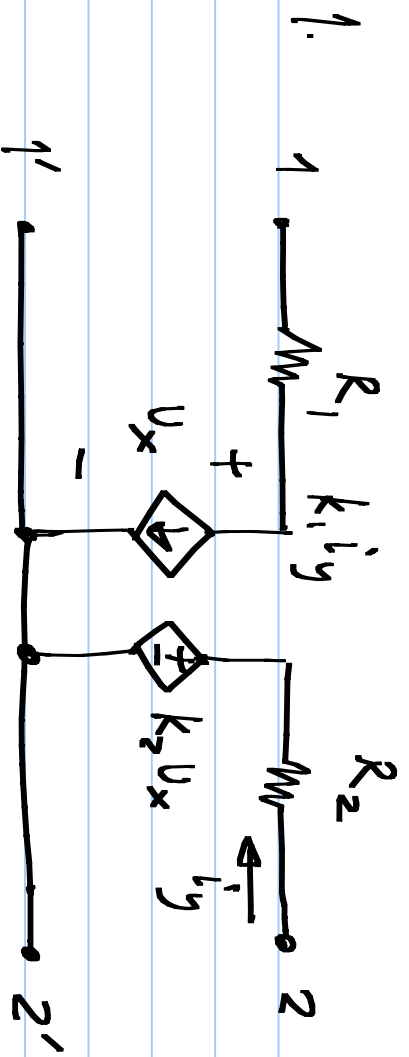


EECE 1010: Electrical and Magnetic Circuits.

Problem set #4 (Due on 21<sup>st</sup> Feb. 2014)

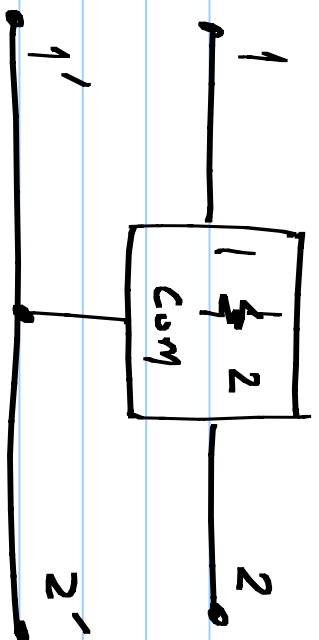
HKD: Hayt, Kemmerly, and Durbin

Engineering circuit analysis, 8<sup>th</sup> Edition (Indian)  
McGraw Hill 2013



Determine the constraints between  $\{R_1, R_2, k_1, k_2\}$  for the network above to be reciprocal.

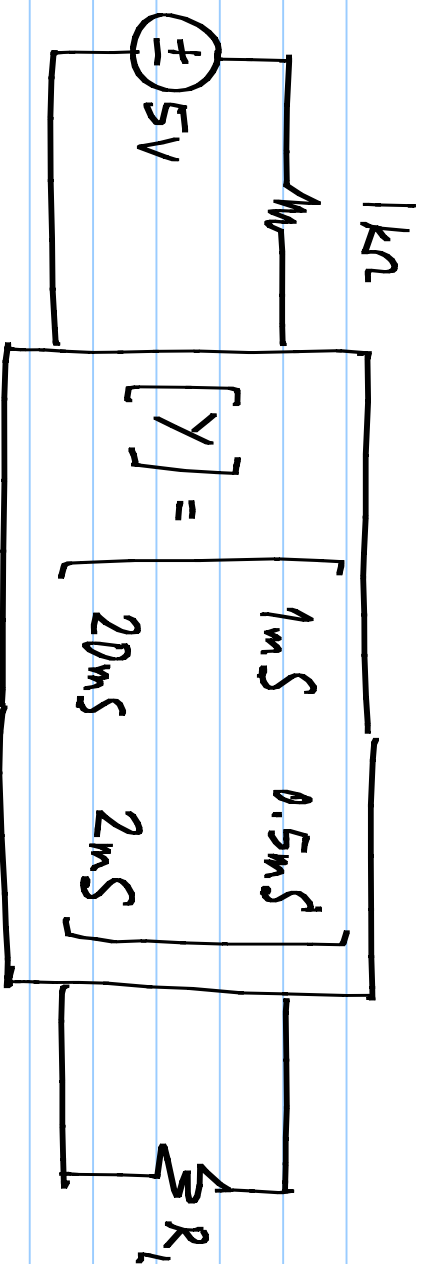
2.



The two port shown is a three terminal two port network. (ie one of the

terminals is common to both ports). If the network is purely resistive, determine the constraint on  $Y_2$  or  $Z_2$  of the network.

3.

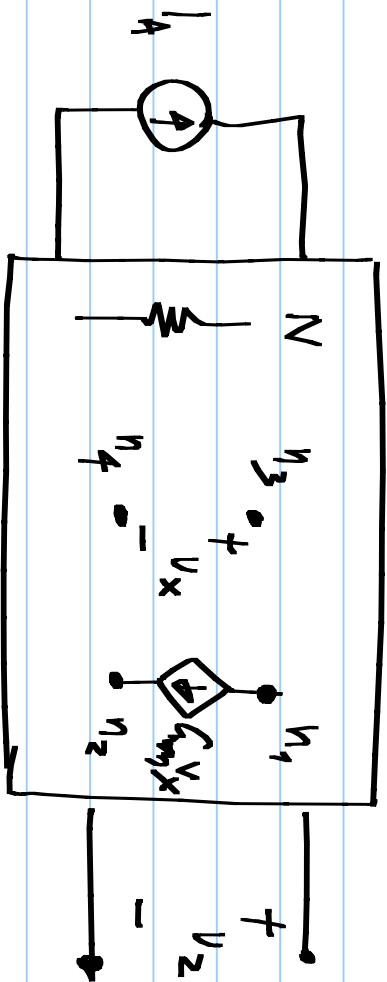


Determine  $R_L$  such that it dissipates maximum power. Also determine the maximum power.

4. We know that two port networks with only resistors are reciprocal, and those including controlled sources are not necessarily so. What about networks containing resistors and capacitors or inductors? Follow the steps used to determine reciprocity of resistive networks and draw your conclusions.

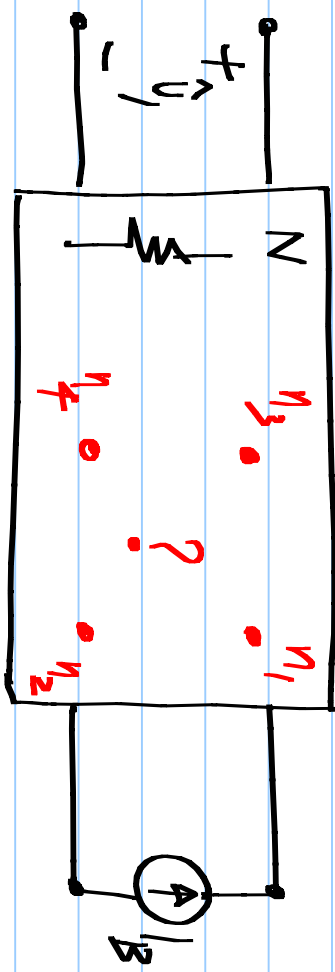
5

Case #1



The network  $N$  has only resistors and a single controlled source. connected to nodes  $n_1, n_2$

Case #2



We know that such networks are in general not reciprocal.

Can you replace only the controlled source by another element

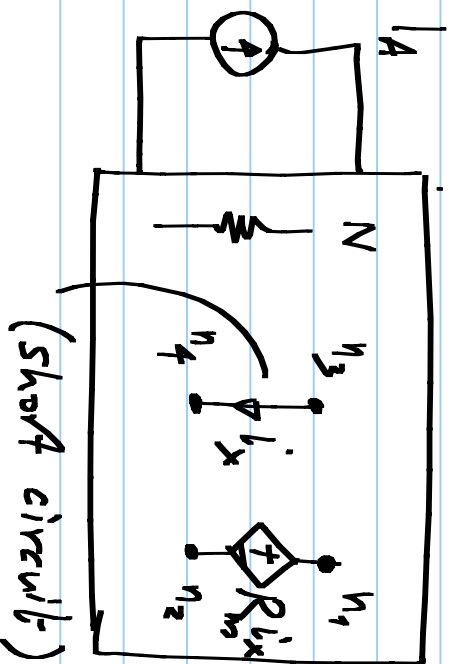
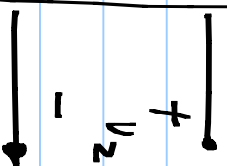
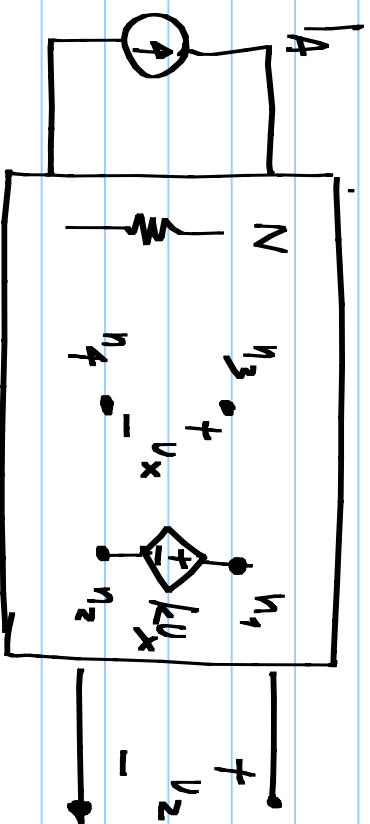
(i.e) a new element connected to  $n_1 - n_2$  such that

$$\frac{V_1}{I_B} = \frac{V_2}{I_A}$$

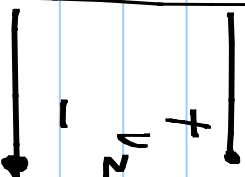
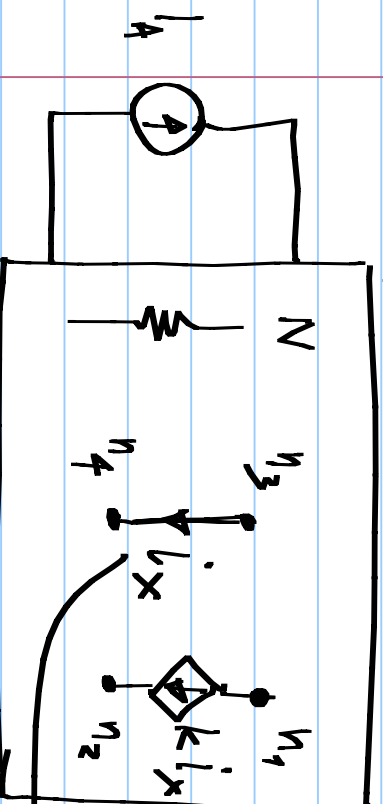
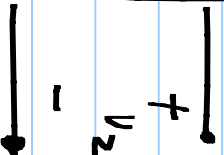
(Case #2) (Case #1)

(Hint: Follow the steps of the proof of reciprocity theorem while keeping track of the controlled source branches separately).

6. If you are able to do the previous problem, repeat it for other controlled sources as shown below:



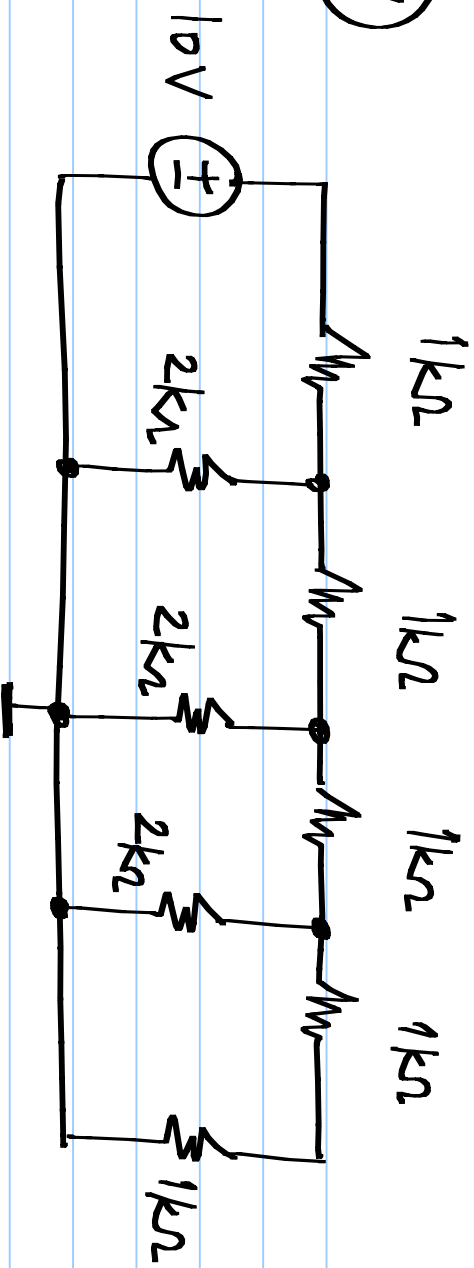
(short circuit)



(short circuit)

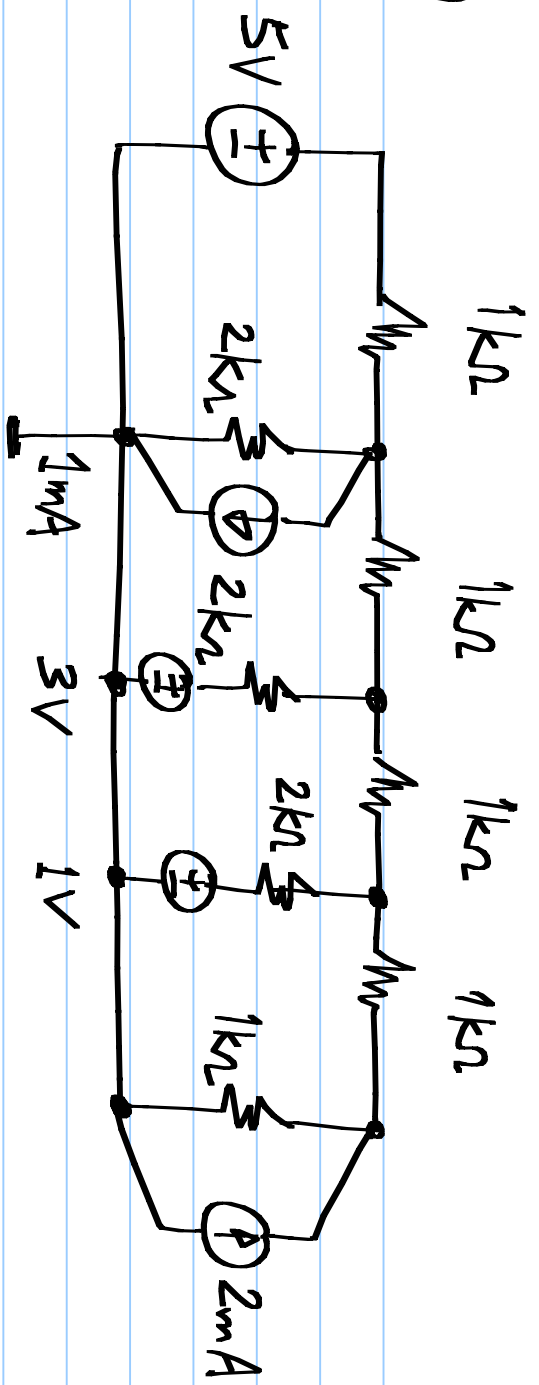


7

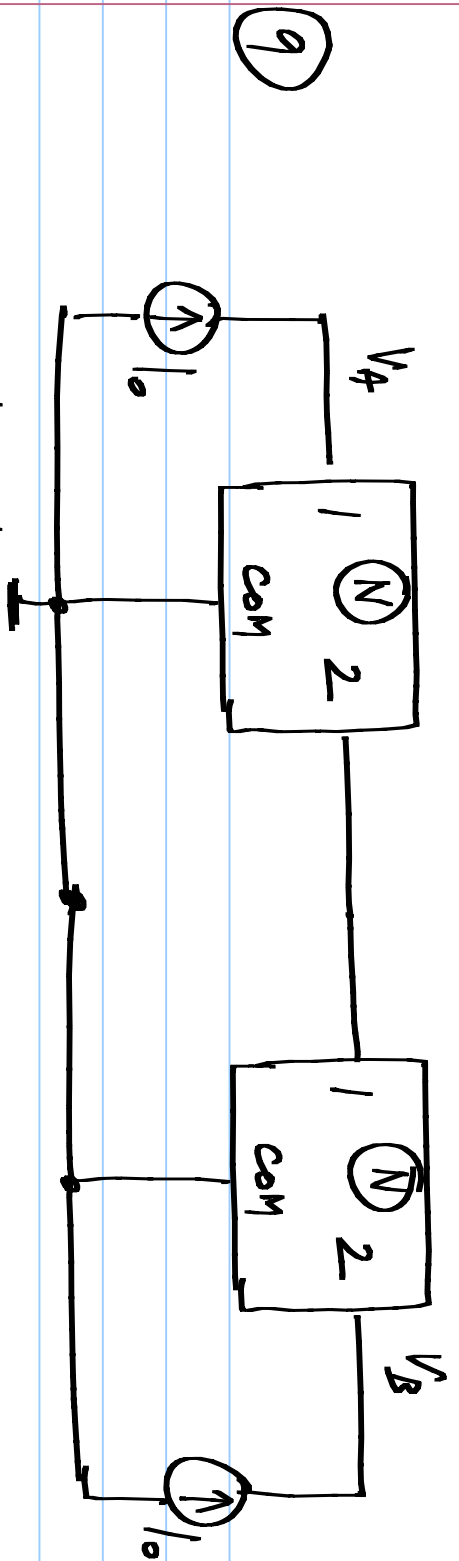


Determine all resistor currents and voltages.

8

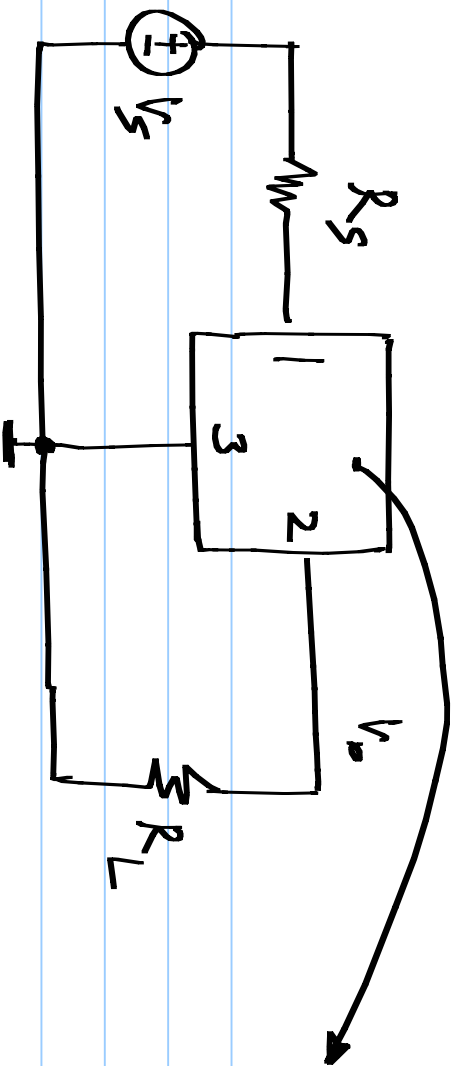


Determine the power delivered by the 5V source.



The circuit above is made using two identical resistive 3 terminal two port networks  $N$  driven by identical current sources  $I_0$ . Determine  $V_A$  and  $V_B$  in terms of  $I_0$  and z. parameters of  $N$ .

(1b)



$$\begin{bmatrix} y_{11} & 0 \\ y_{21} & y_{22} \end{bmatrix}$$

Determine  $V_o/V_s$ . Assuming all positive  $y$  parameters, determine the constraints on them to maximize

$$\left| \frac{V_o}{V_s} \right|$$