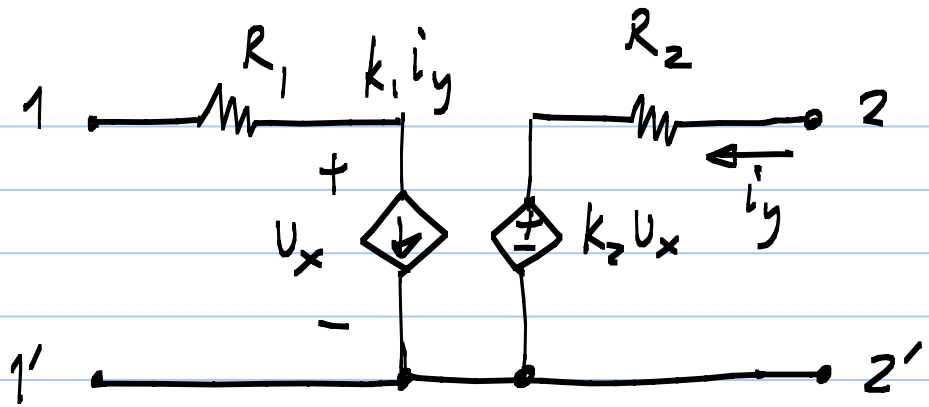
EE1001 Electrical and Magnetic Circuits
Problem set #4 (Due on 17th February 2015)

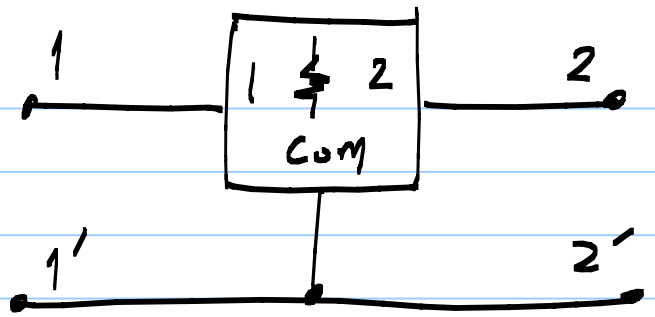
HKD: Hayt, Kemmerly, and Durbin
Engineering circuit analysis, 8th Edition (Indian)
McGraw Hill 2013

1.



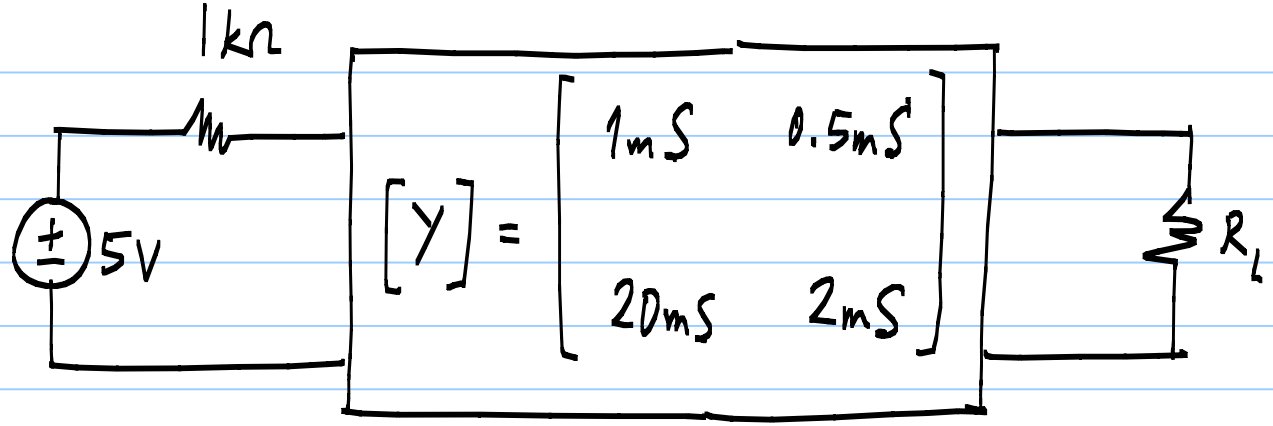
Determine the constraints between $\{R_1, R_2, k_1, k_2\}$ for the network above to be reciprocal.

2.



The two port shown is a three terminal two port network. (i.e one of the terminals is common to both ports). If the network is purely resistive, determine the constraint on y_{21} or z_{21} 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.

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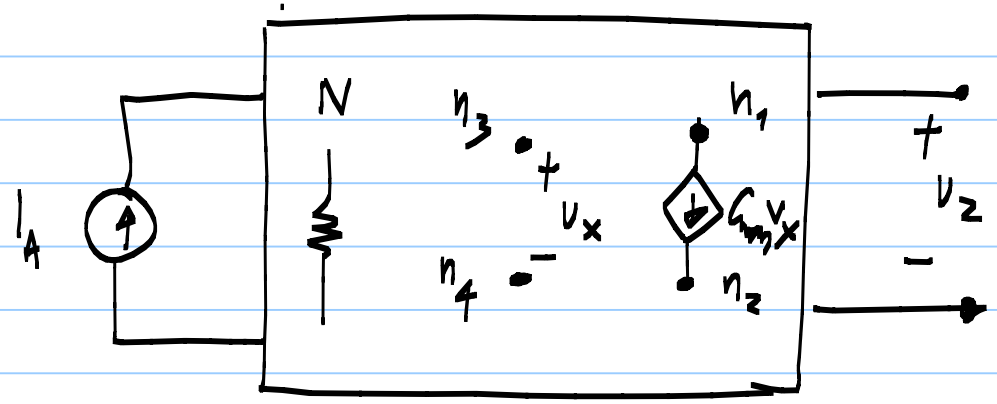
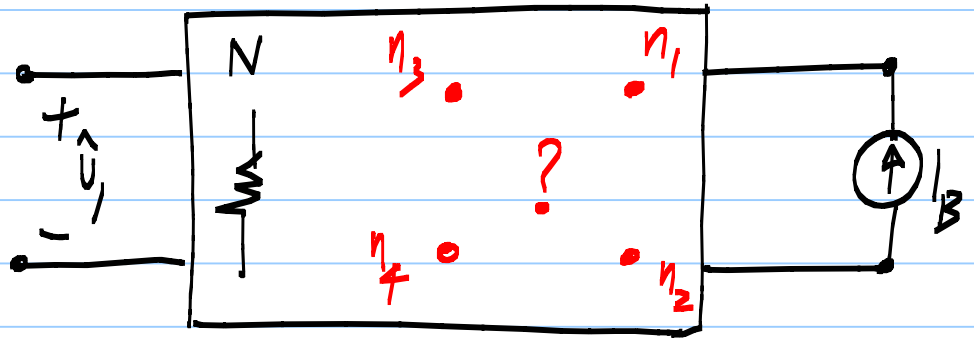
Case #1



Case #2



The network N has only resistors and a single controlled source. Connected to nodes η_1-η_4

We know that such networks are in general not reciprocal.

Can you replace only the controlled source by another element

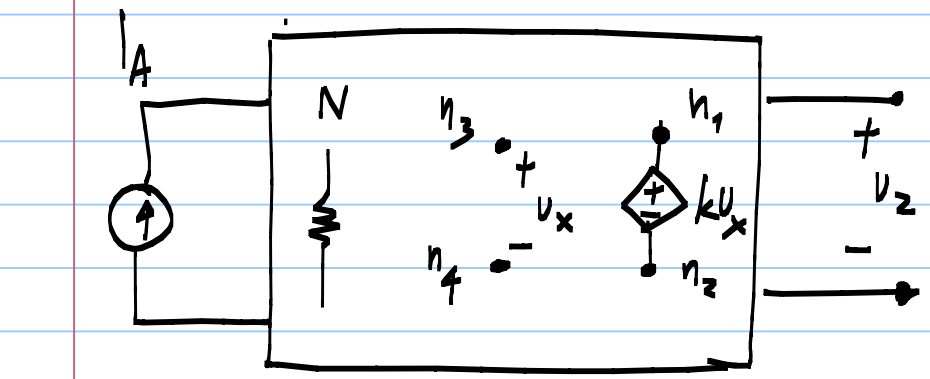
(i.e) a new element connected to $n_1 - n_4$ such that

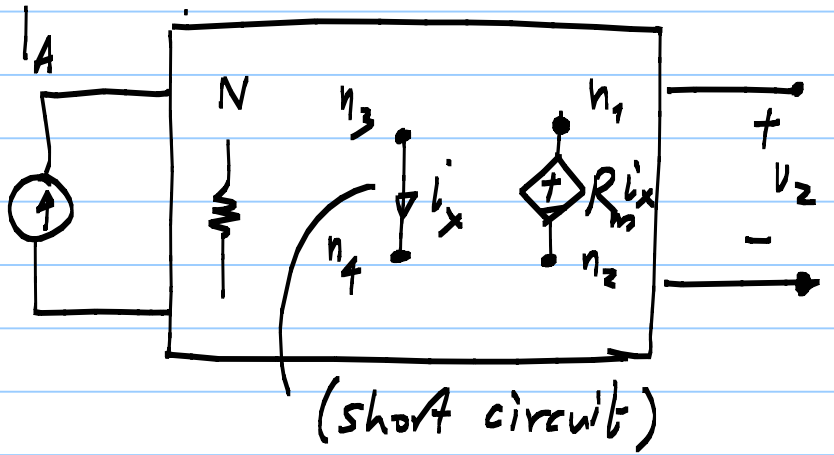
$$\frac{\hat{V}_1}{I_B} = \frac{V_2}{I_4}$$

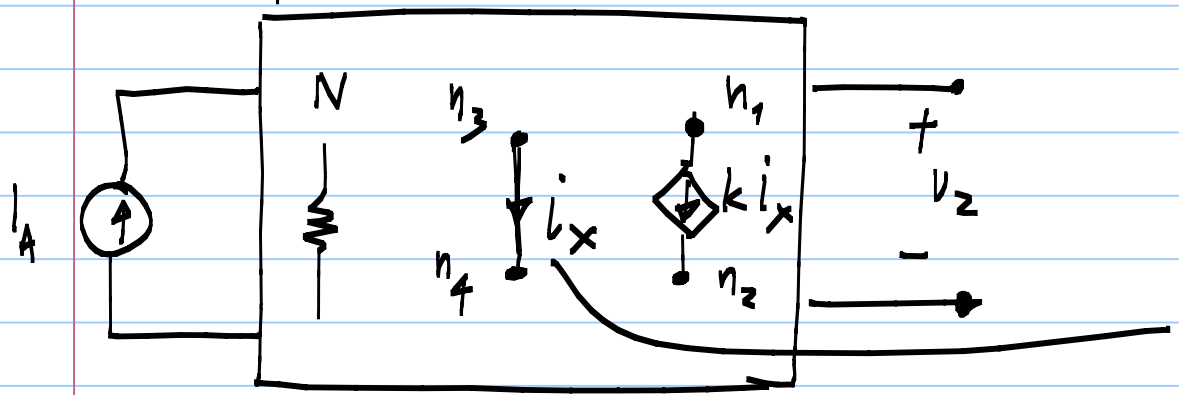
(case #2) (case #1)

(Hint: Follow the steps of 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:







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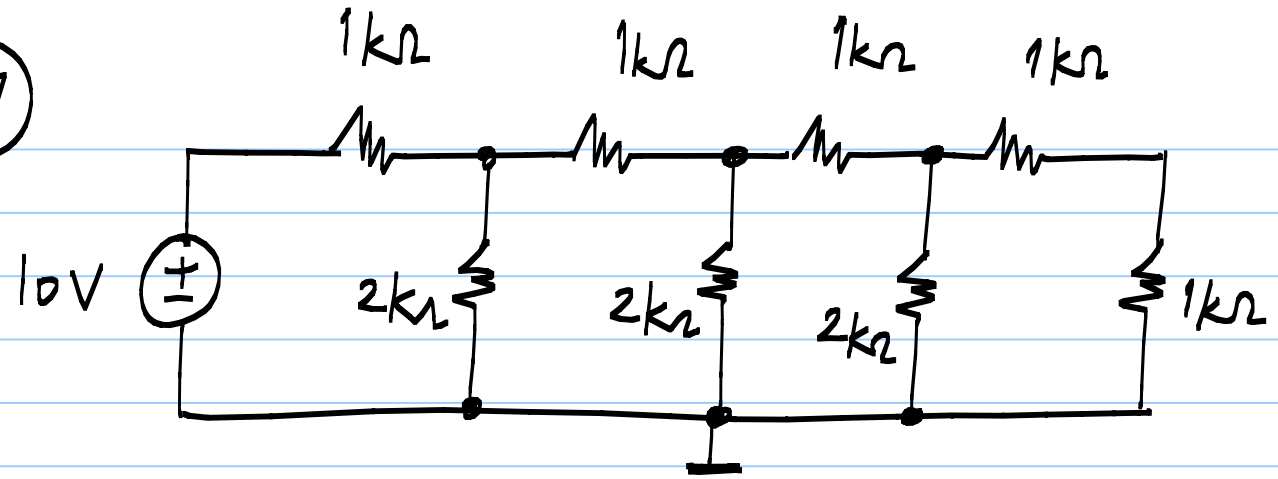
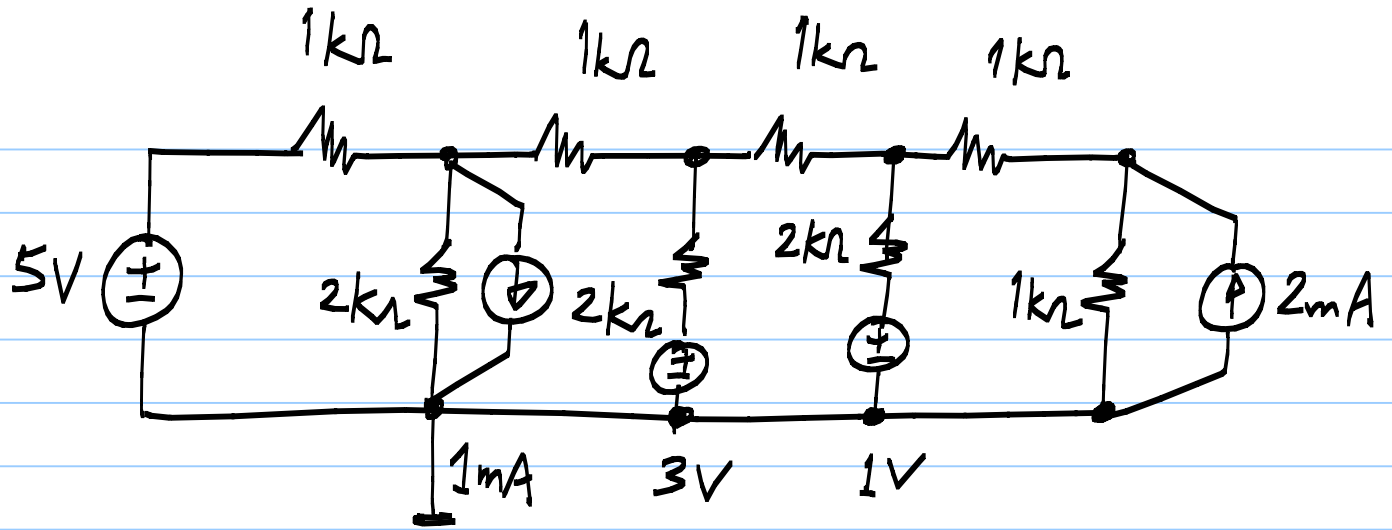


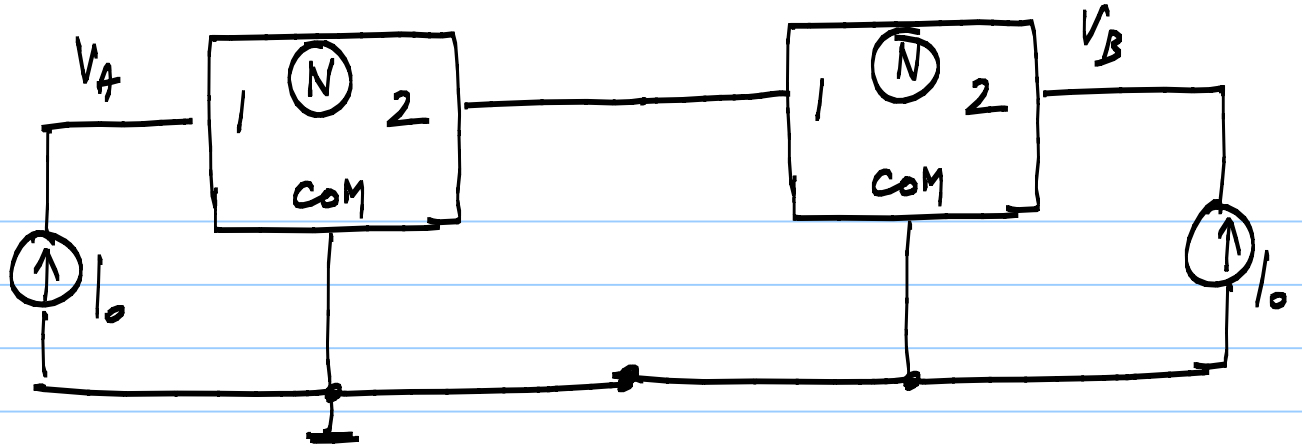
Determine all resistor currents and voltages.

(8)



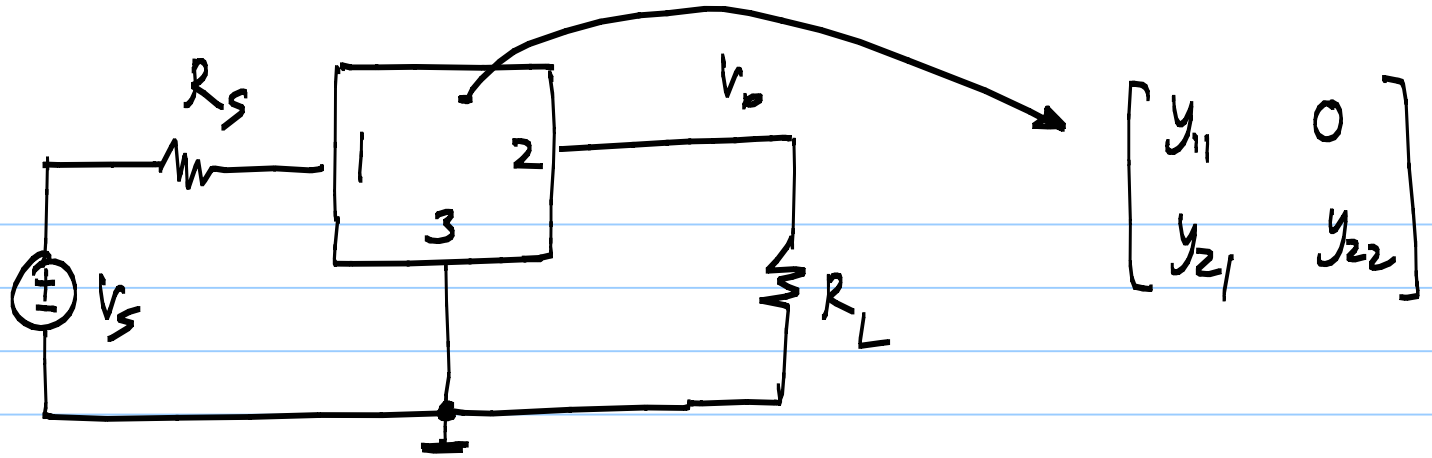
Determine the power delivered by the 5V source.

(9)



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

(10)



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

$$\left| V_o/V_s \right|$$