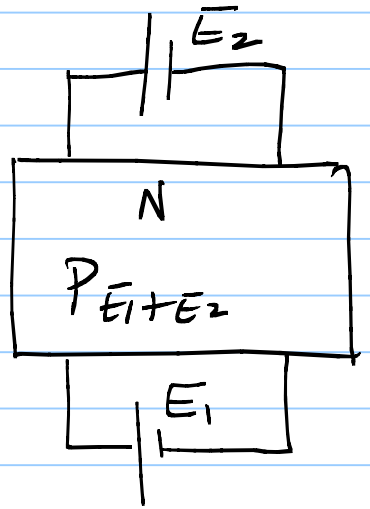
Electric & Magnetic Circuits

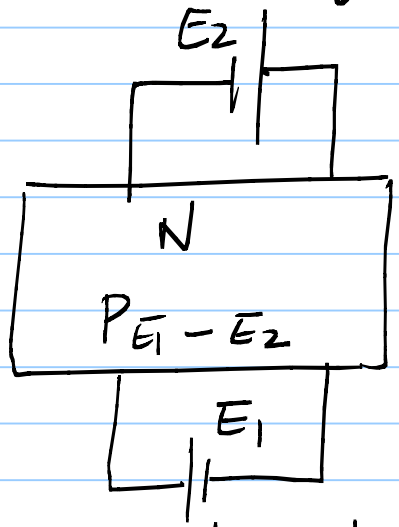
Note Title 03-02-2012

Problem Set 2

1) 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 voltage sources E_1 & E_2 as shown in Fig 1(a) & (b) respectively.

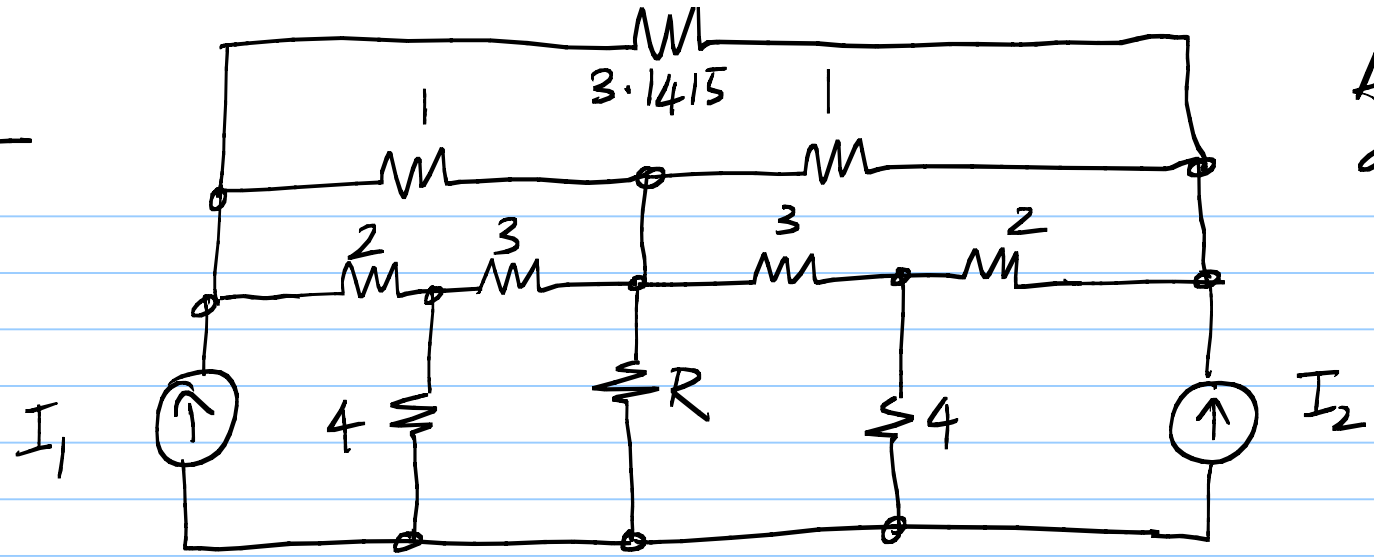
(a)





Determine $(P_{E_1} + P_{E_2})$ in terms of $P_{E_1+E_2}$ & $P_{E_1-E_2}$, where P_{E_1} & P_{E_2} are powers dissipated in N while acting alone.

Problem 2



All resistors are in ohms.

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

(b) Repeat the above exercise for $I_1 = -1A$ & $I_2 = 1A$

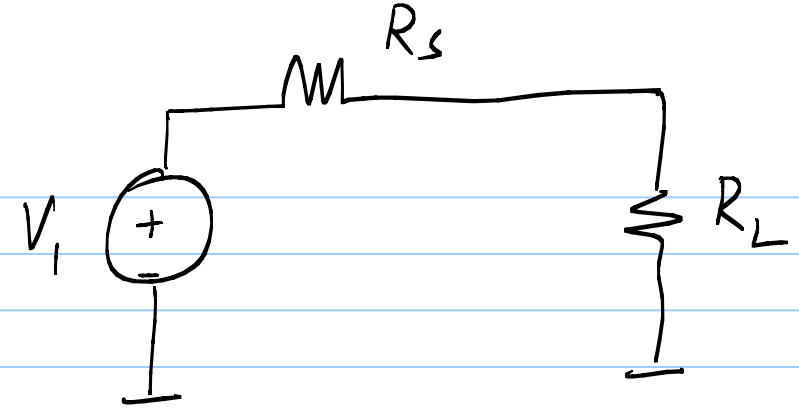
(c) Repeat (a) for $I_1 = 1A$ & $I_2 = 4A$

Problem 3 :- A network N composed of resistors only has two pairs of terminals brought out. When a voltage source of 20V is connected across the first pair of terminals, resistances of 2Ω & 6Ω connected across the other pair of terminals draw 4A & 2A respectively.

(a) A current source and a variable resistance are now connected in parallel across the second pair of terminals and the resistance is varied till the power consumed by it is maximum, this maximum being 18W. What is the magnitude of current in the current source?

(b) The voltage source is replaced by an ameter and a voltage source of 30V is connected at the second pair of terminals. What is the current read by the ammeter?

Problem 4



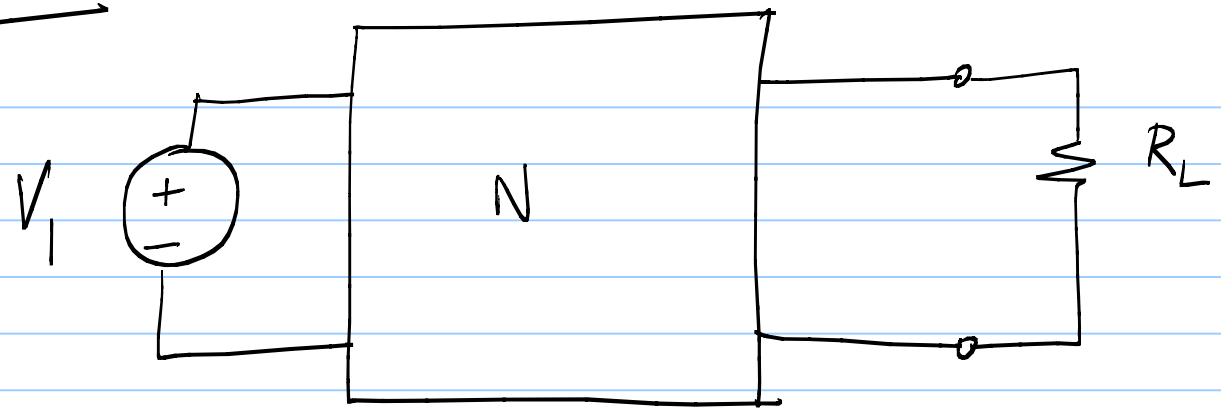
Show that the power dissipated in R_L (denoted by P_L) can be expressed as

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

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

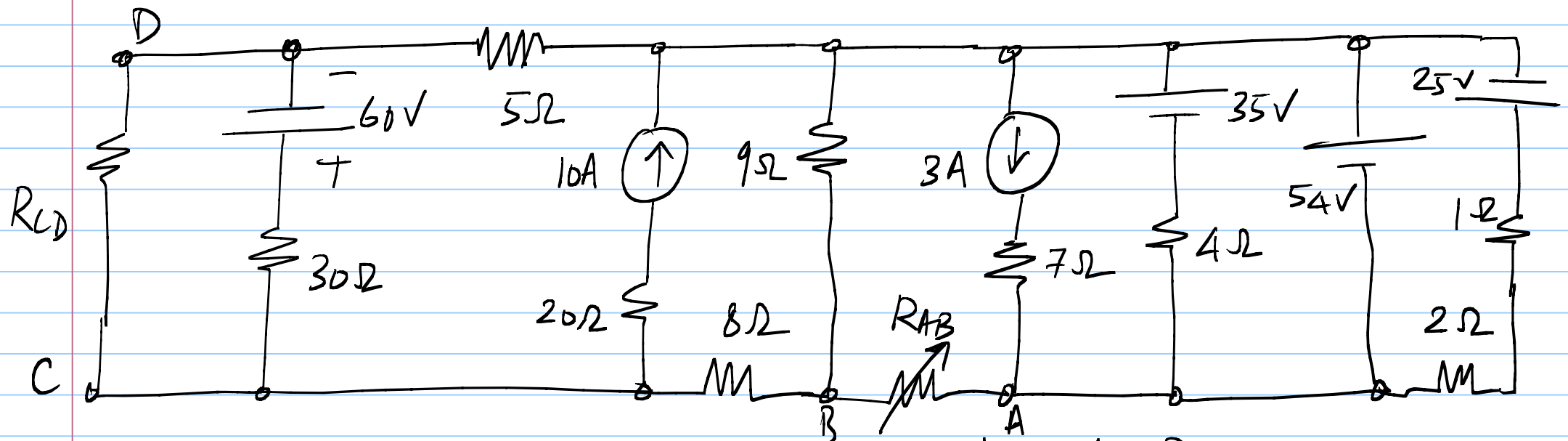
Determine P_{max}. Γ_L is called the reflection coefficient of the load R_L. For what Γ_L is maximum power dissipated in R_L?

Problem 5:



N is a network with resistors only. It is observed that the power dissipated in R_L is equal to 8W when R_L is either 25Ω or 100Ω. Determine the power dissipated in R_L when $R_L = 75\Omega$.

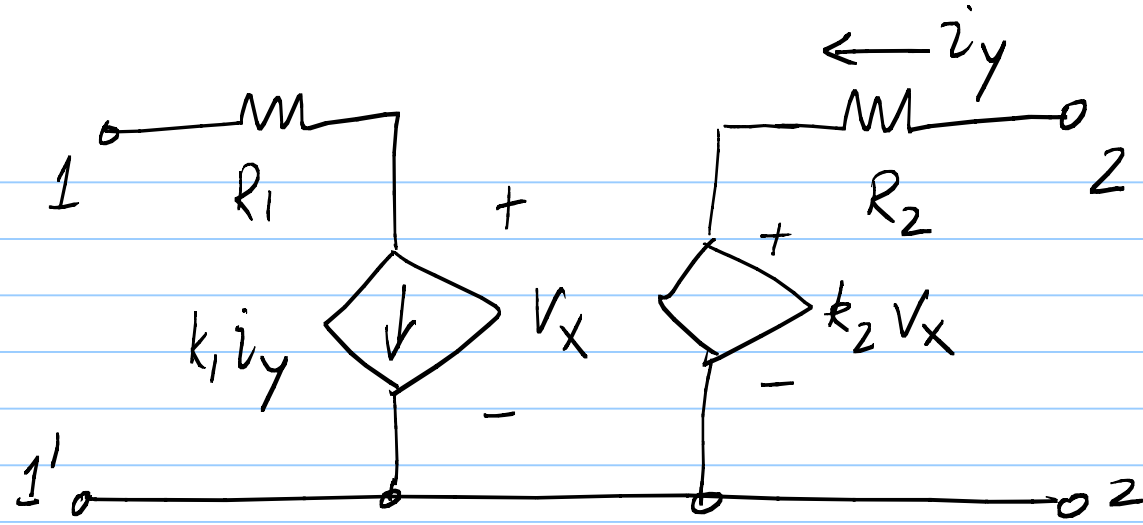
Problem 6



In the network shown above, it is observed that R_{AB} consumes maximum power when it is equal to R_{CD}.

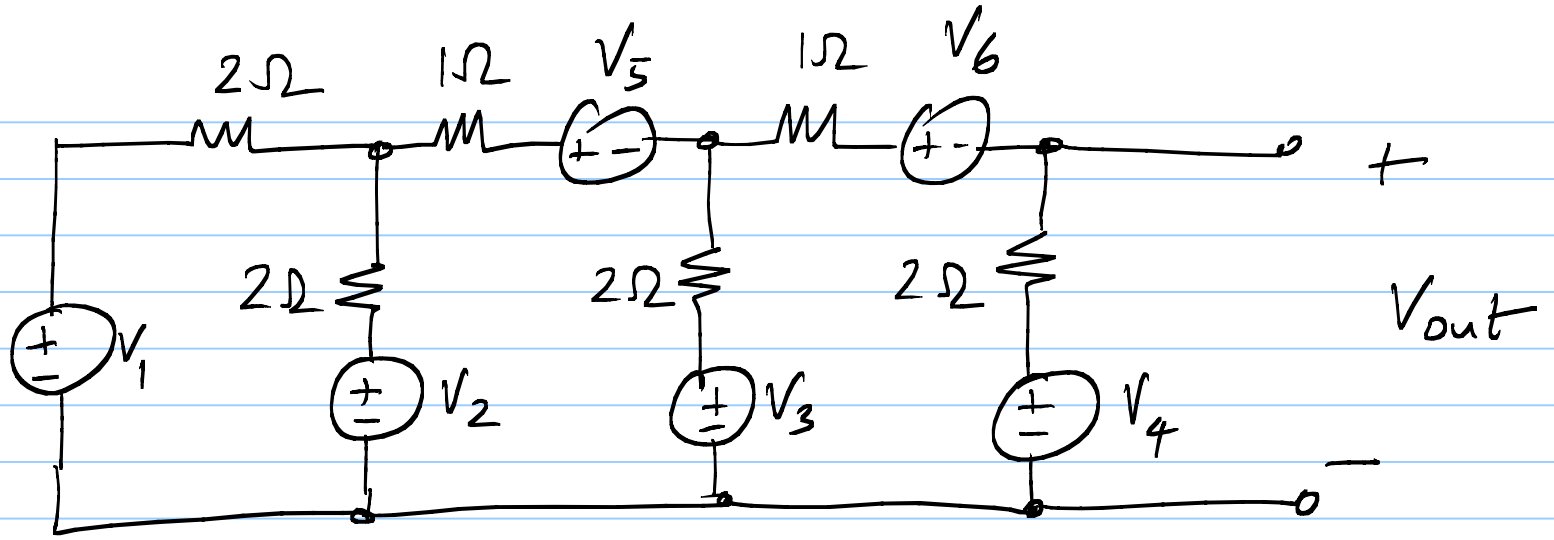
Calculate R_{CD} & the maximum power input to R_{AB}.

Problem 7



The two port shown above should be reciprocal. Determine the condition that should exist among the constants k_1, k_2 and R_1, R_2.

Problem 8

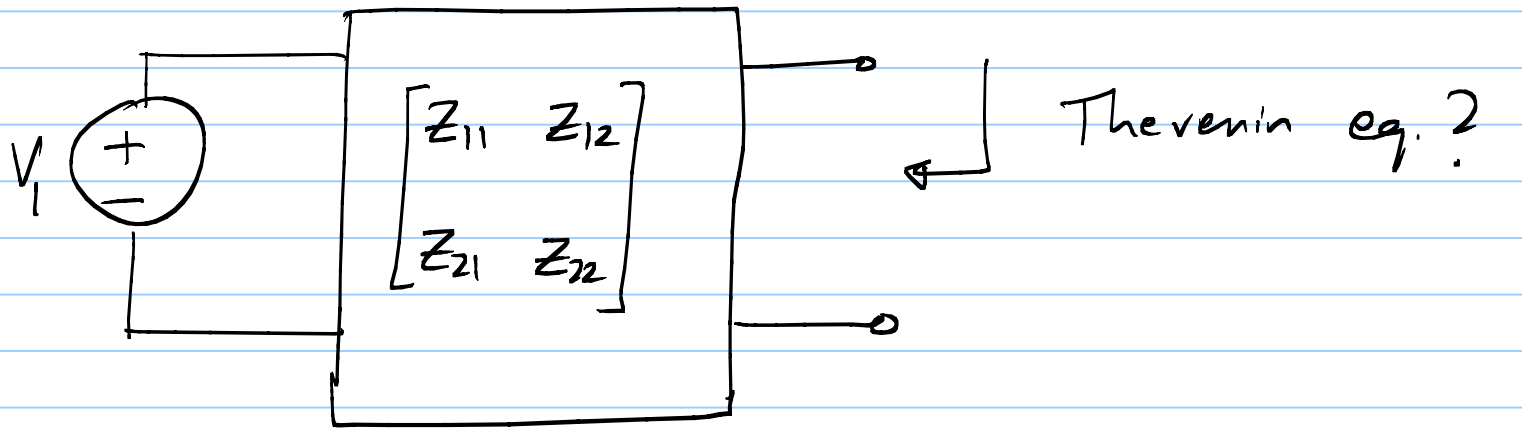


In the circuit above, determine

$$\frac{V_{out}}{V_1}, \frac{V_{out}}{V_2}, \ldots, \frac{V_{out}}{V_6}$$

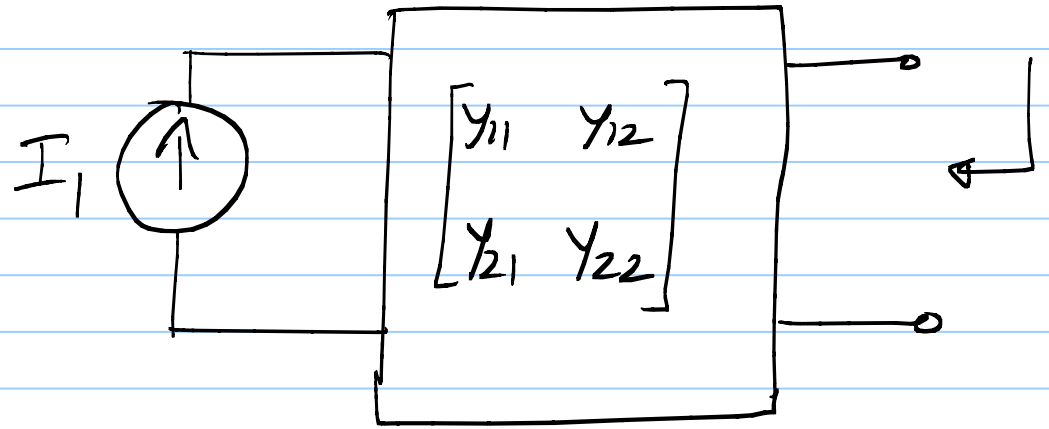
Problem 9

Determine the Thevenin equivalent of the following



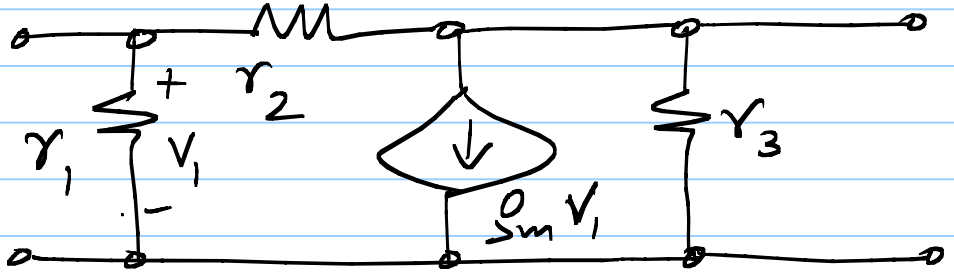
Problem 10

Determine the Norton equivalent of the following

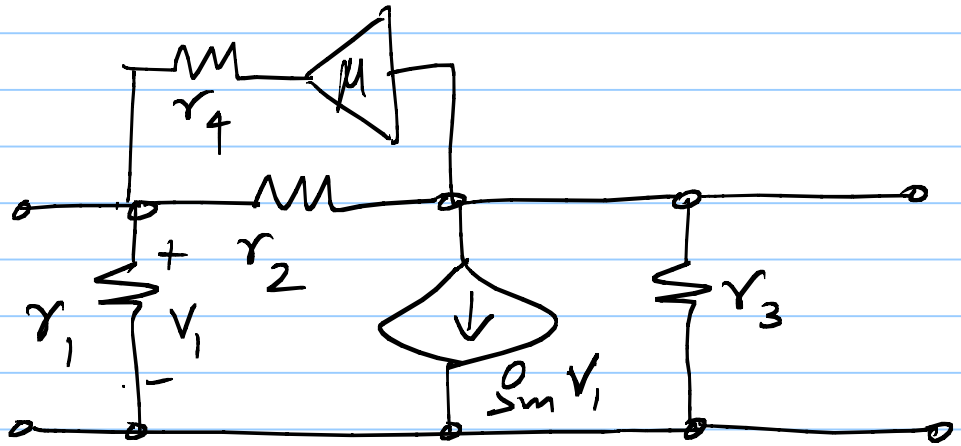


Norton eq. ?

Problem 11: Determine the y-parameters of



r_1, r_2 & r_3 are resistors.

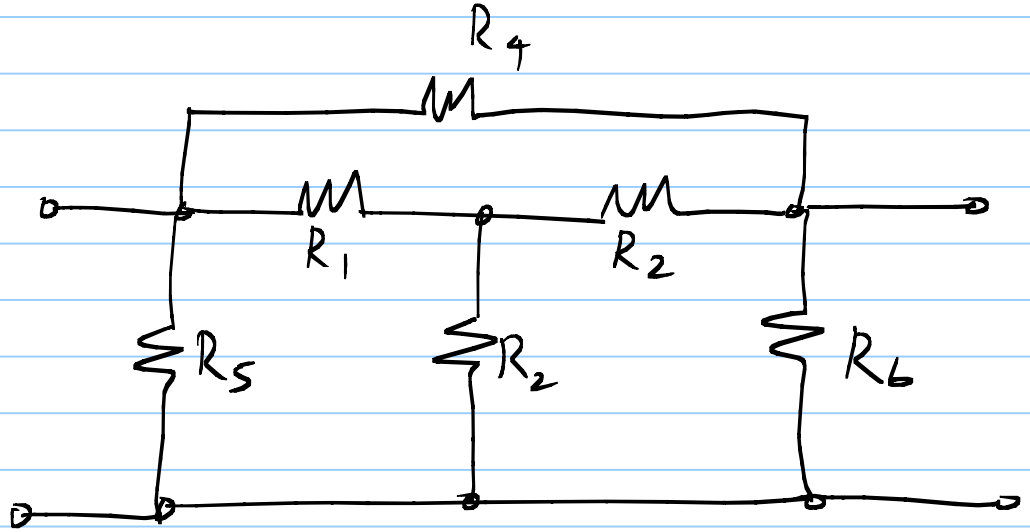


Determine μ so that

$y_{12} = 0$

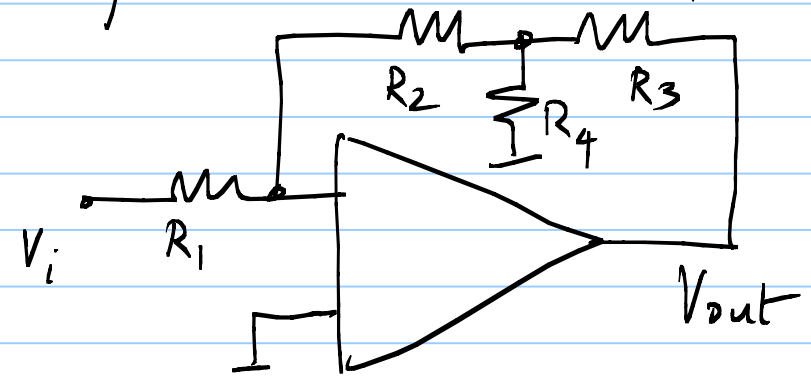
Problem 12

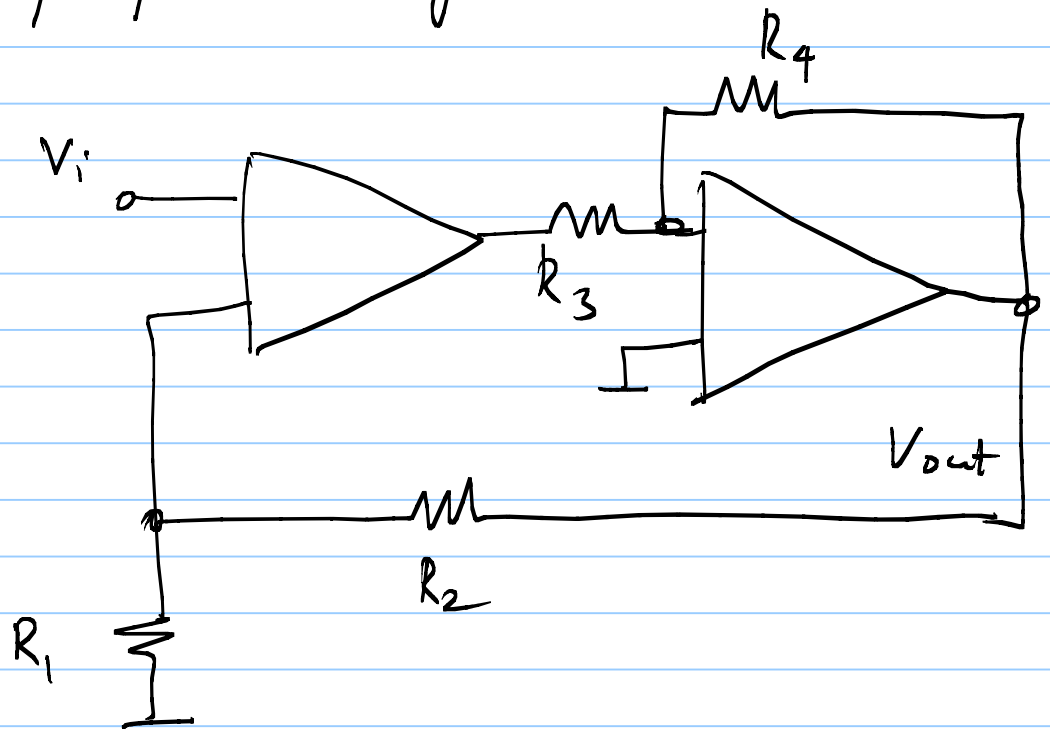
Determine the y-parameters of the following

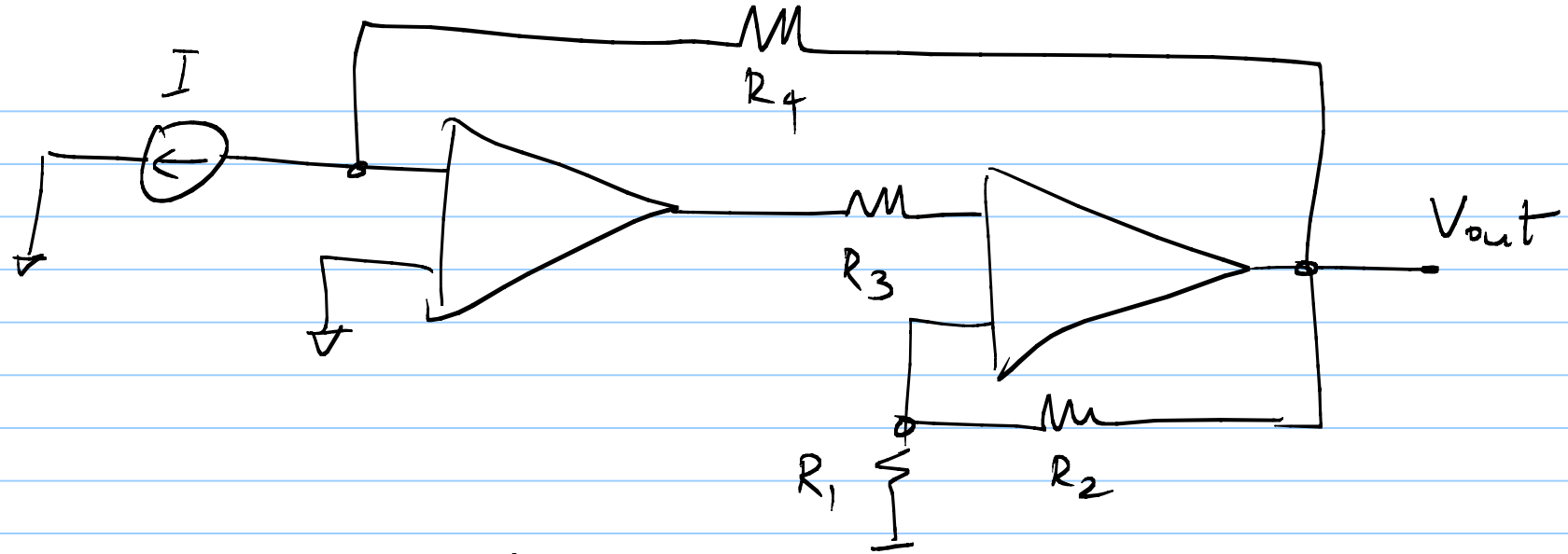


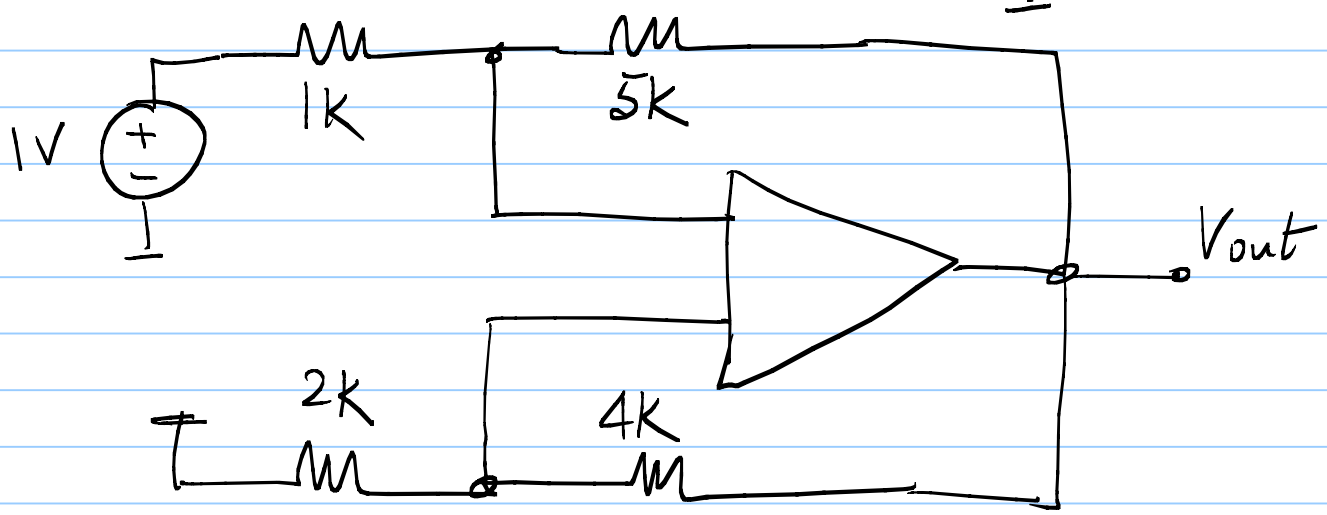
Problem 13

Determine the signs on the opamps for negative feedback operation. Find V_{out}/V_i






I
R4
R3
Vout
R1
R2


1V
1K
5K
Vout
2K
4K

Problem 14

Write the Modified Nodal Analysis (MNA) equations for the following network.