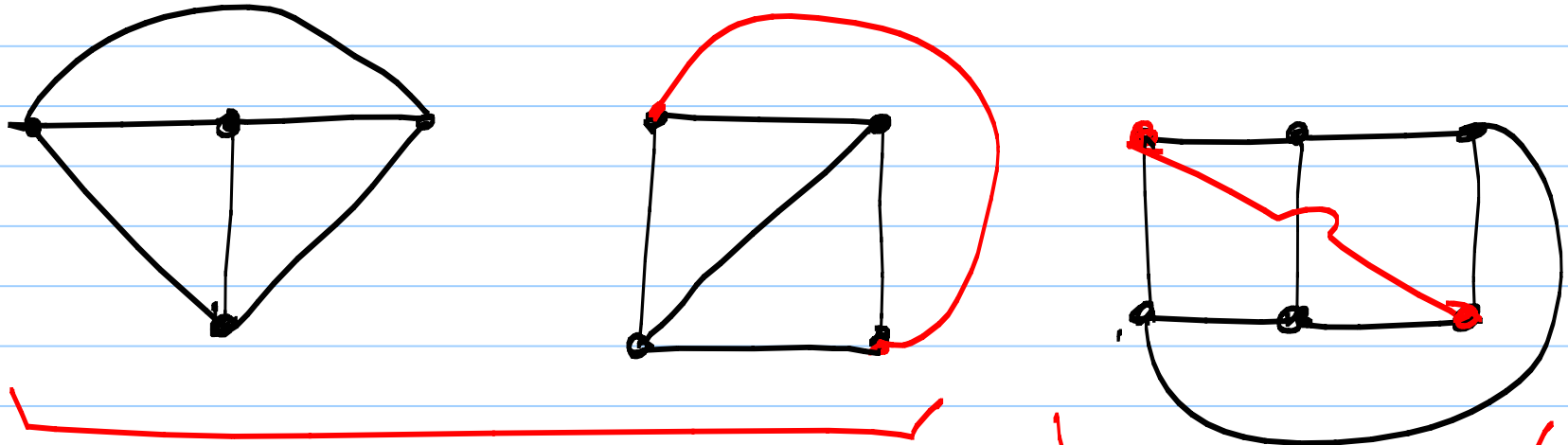
EC1010: Lecture 11

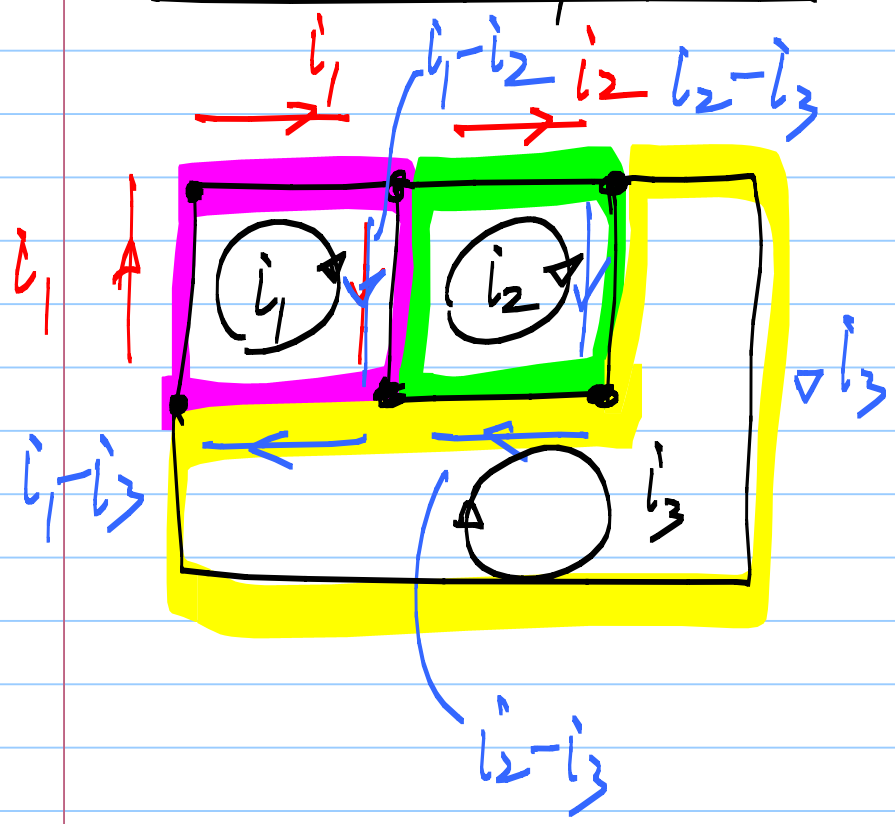
Mesh analysis (KVL based analysis for planar circuits)

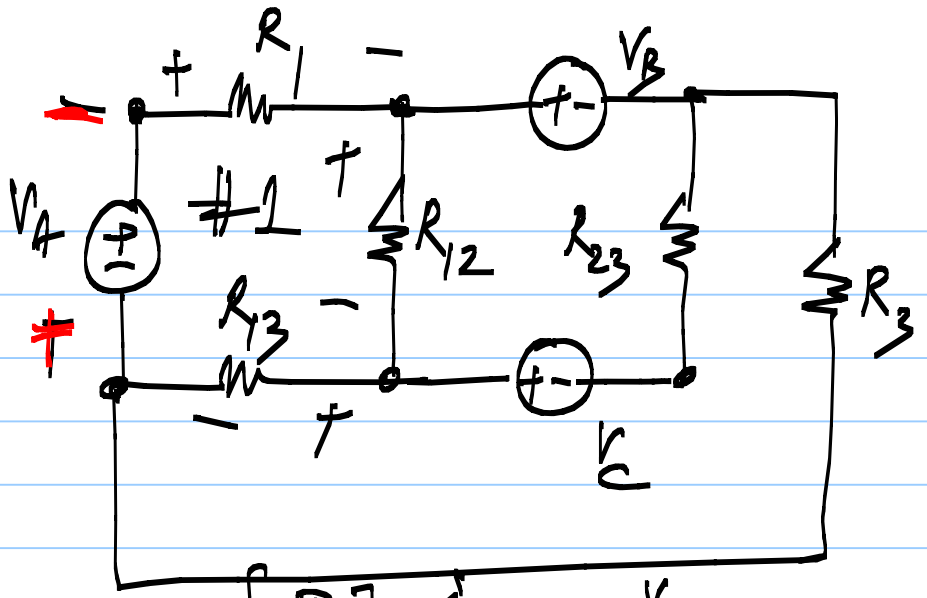


Planar

X

Planar graphs / circuits





$$[R]\,\underline{i} = \underline{V}$$

$$\begin{bmatrix} R_1+R_2+R_3 & -R_{12} & -R_{13} \\ -R_{12} & R_{12}+R_{23} & -R_{23} \\ -R_{13} & -R_{23} & R_{13}+R_{23}+R_3 \end{bmatrix} \begin{bmatrix} i_1 \\ i_2 \\ i_3 \end{bmatrix} = \begin{bmatrix} V_A \\ V_C - V_B \\ -V_C \end{bmatrix}$$

Super mesh.

Mesh #1:

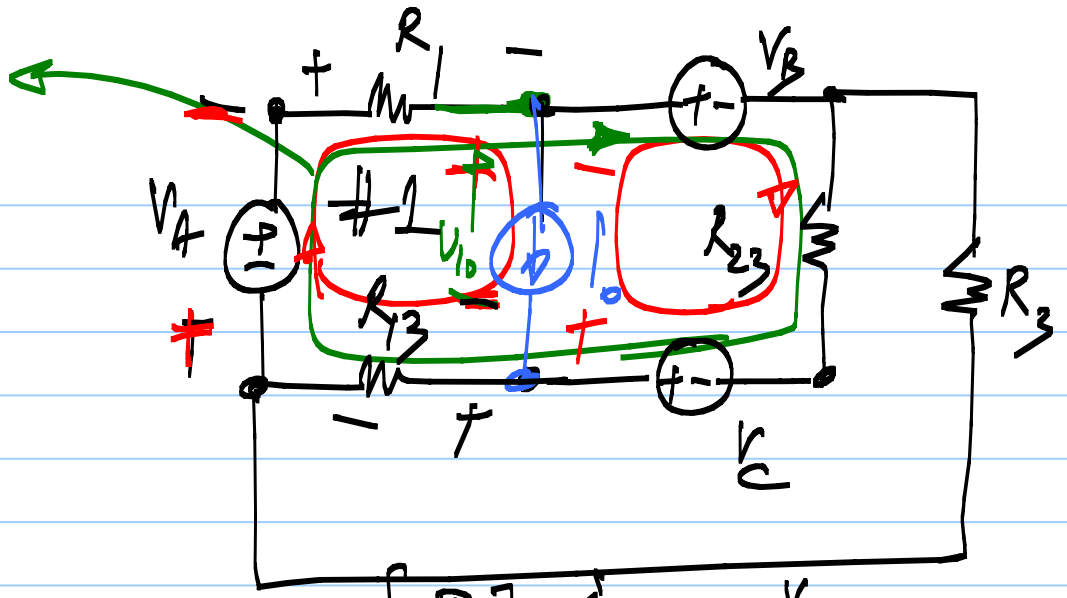
$$v_{R_1} + v_{R_3} + v_{R_{23}} = v_A$$

$$v_{R_{23}} - v_{R_3} = V_C - V_B$$

$$v_{R_1} + v_{R_3} + v_{R_{23}} = V_A + V_C - V_B$$

$$i_1 R_1 + (i_1 - i_3) R_3 + (i_2 - i_3) R_{23}$$

$$i_1 - i_2 = I_0$$



$$[R]\,\underline{i} = \underline{V}$$

$$\begin{bmatrix} R_1+R_2+R_3 & -R_2 & -R_3 \\ -R_2 & R_2+R_{23} & -R_{23} \\ -R_3 & -R_{23} & R_{13}+R_{23}+R_3 \end{bmatrix} \begin{bmatrix} i_1 \\ i_2 \\ i_3 \end{bmatrix} = \begin{bmatrix} V_A \\ V_C - V_B \\ -V_C \end{bmatrix}$$

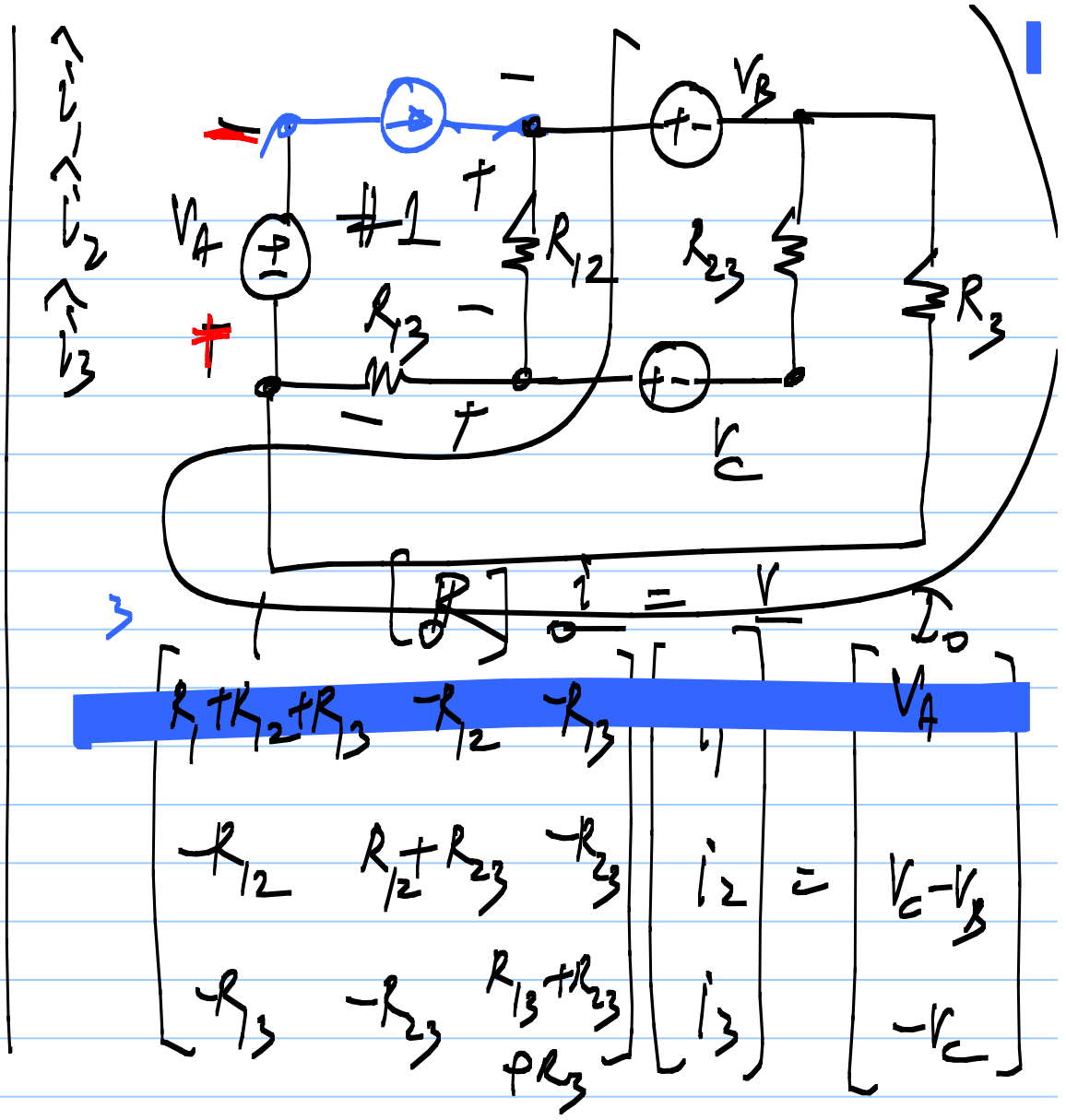
* CCVS

* CCCS

* VCVS

* VCVS

mesh #

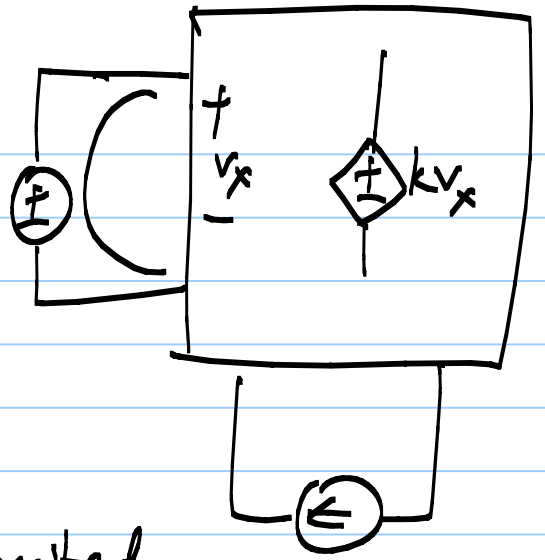


$$\underline{i} = [R]^{-1} \begin{bmatrix} V_A \\ V_C - V_B \\ -V_C \end{bmatrix} \qquad [G]\,\underline{v} = \underline{I}$$

$$= \underline{[R^{-1}]} \left[\begin{bmatrix} V_A \\ 0 \\ 0 \end{bmatrix} + \begin{bmatrix} 0 \\ V_C \\ -V_C \end{bmatrix} + \begin{bmatrix} 0 \\ -V_B \\ 0 \end{bmatrix} \right] \qquad \begin{bmatrix} V_A \\ +V_C \\ -V_C \end{bmatrix} + \begin{bmatrix} 0 \\ -V_B \\ 0 \end{bmatrix}$$

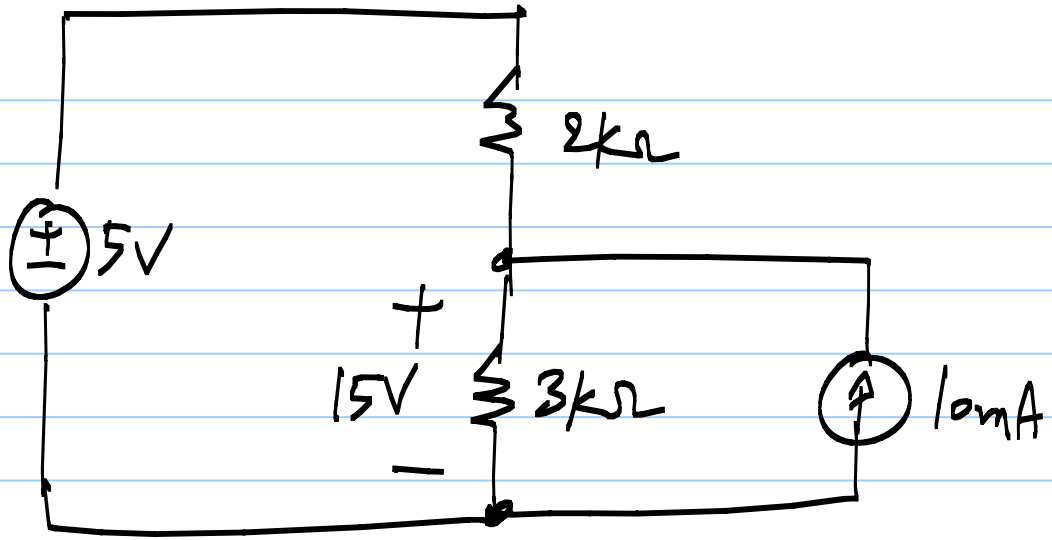
MNA: V, I, R, dependent sources. (lin.)

$$[G]\,\underline{v} = \underline{I}$$

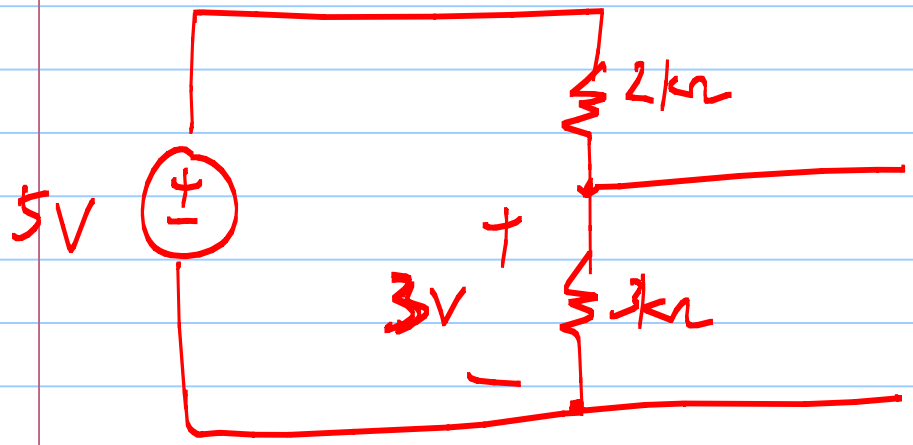


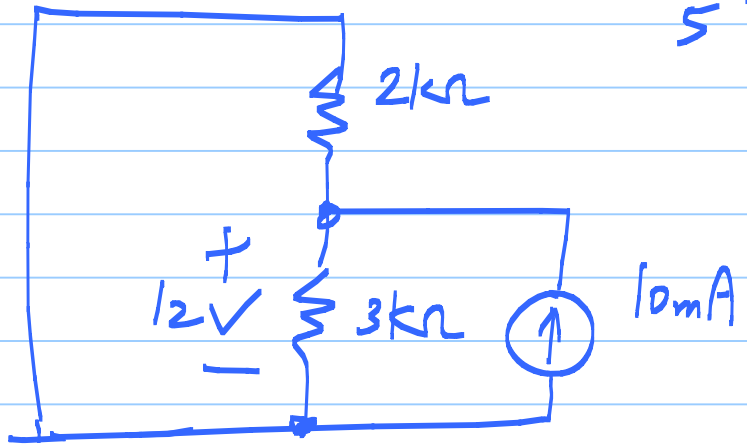
Superposition: Solution to a circuit excited by multiple independent sources equals the sum of solutions to the circuit with each ind. source acting by itself (and all other sources set to Zero)

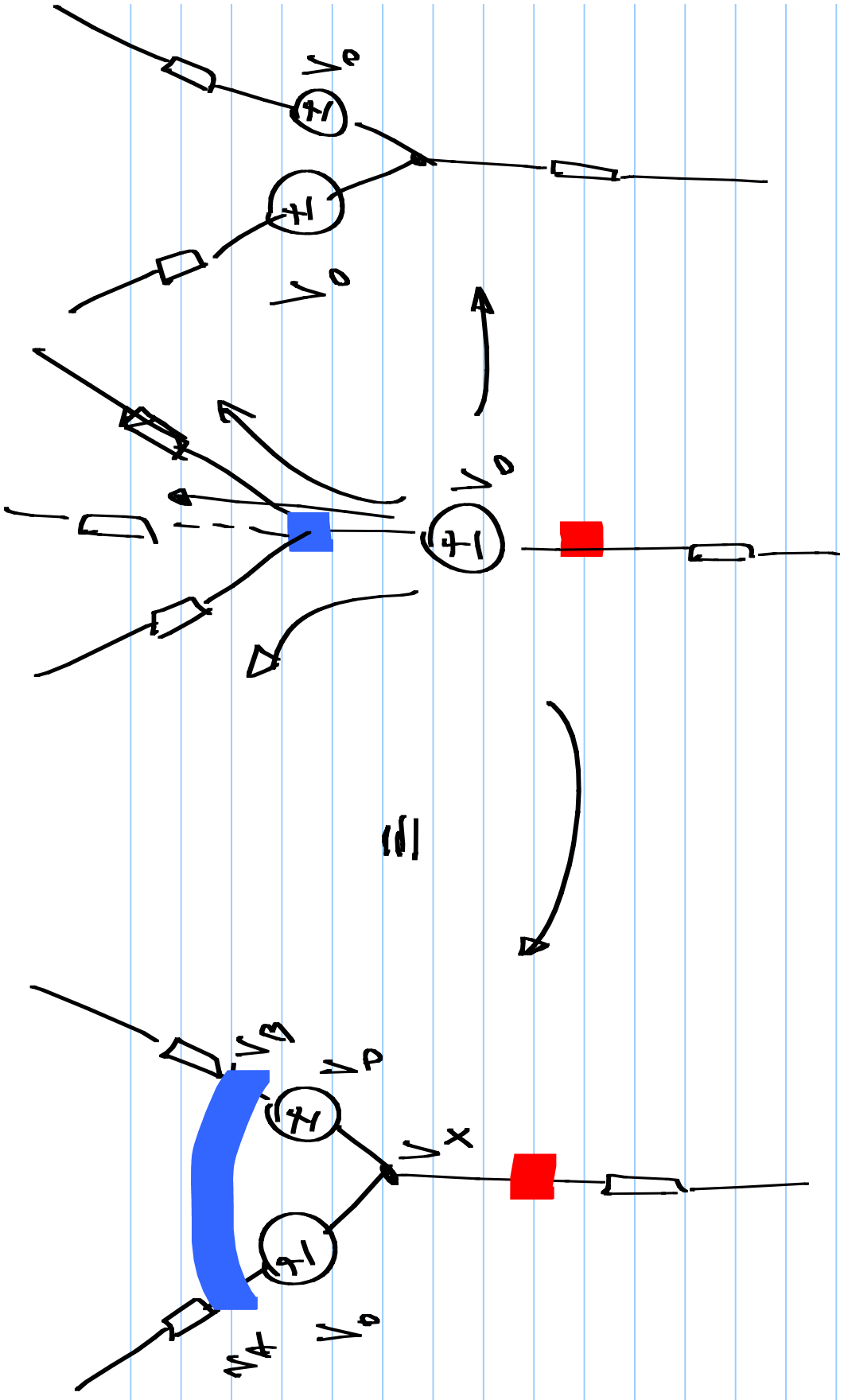
Vsource: short
Isource: open

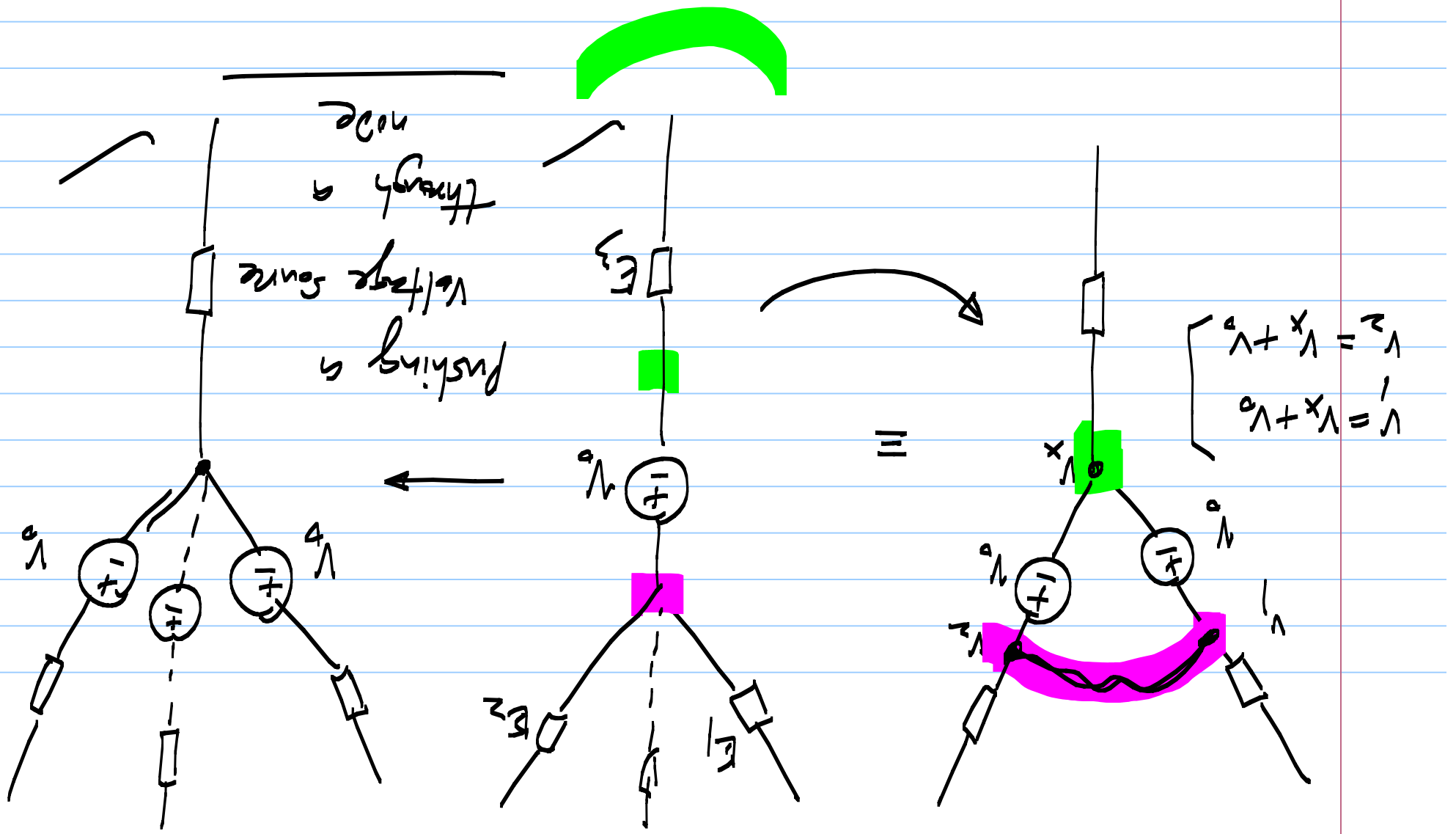


$$\frac{2k\Omega \cdot 3k\Omega}{2k\Omega + 3k\Omega} = \frac{6}{5}k\Omega$$






V_0
+1
-1
V_0
V_0
+1
V_B
V_P
-1
V_X
N_A
V_0


node
through a
pushing a
voltage source
$\mathcal{E}_3$
V_a
V_b
V_c
$\mathcal{E}_2$
$\mathcal{E}_1$
$\equiv$
V_x
V_a
V_b
V_c
V_1
V_2
$V_2 = V_x + V_a$
$V_1 = V_x + V_a$