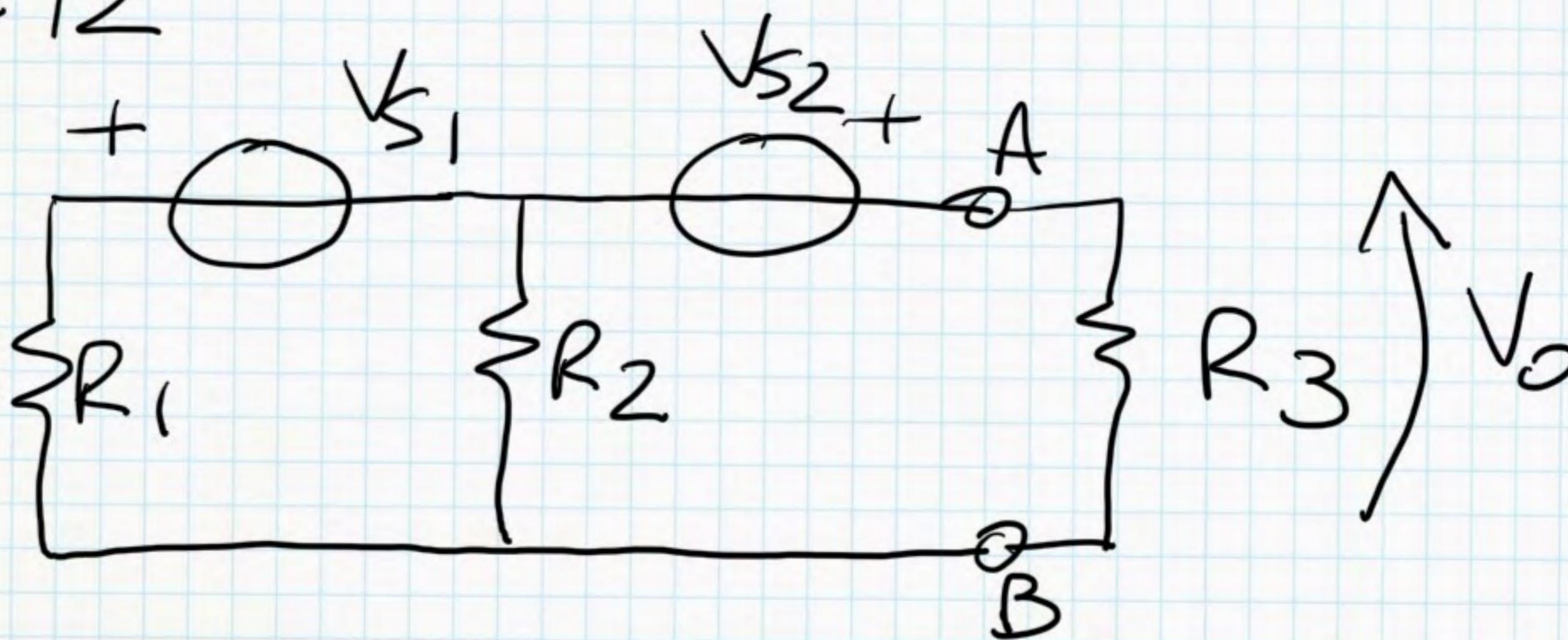


ESE 12



$$V_{S1} = 6 \text{ V}$$

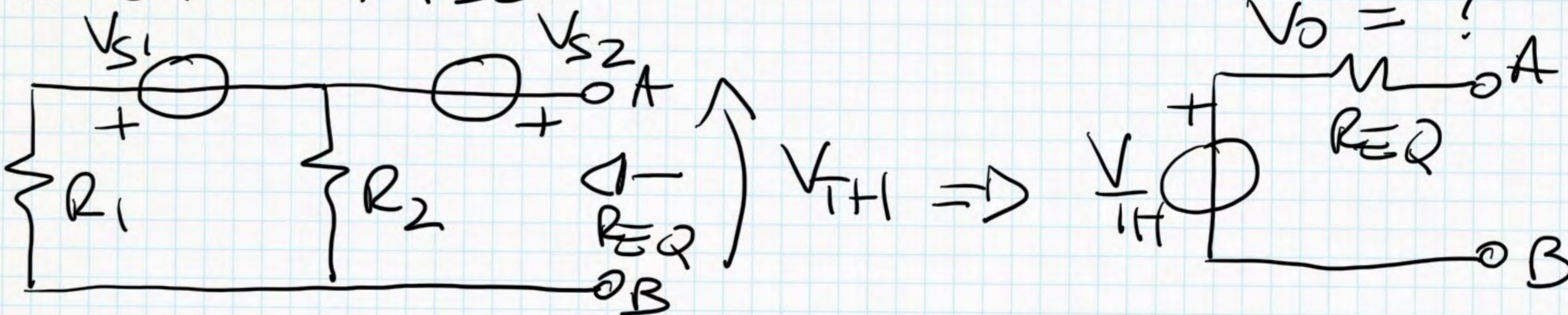
$$V_{S2} = 12 \text{ V}$$

$$R_1 = 2 \Omega$$

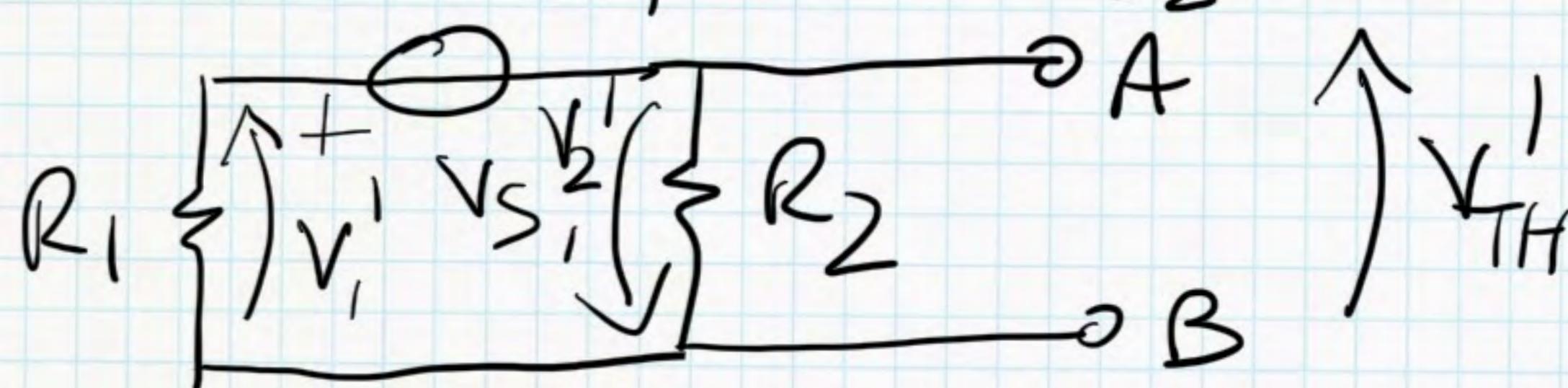
$$R_2 = 5 \Omega$$

$$R_3 = 2 \Omega$$

$$V_o = ?$$



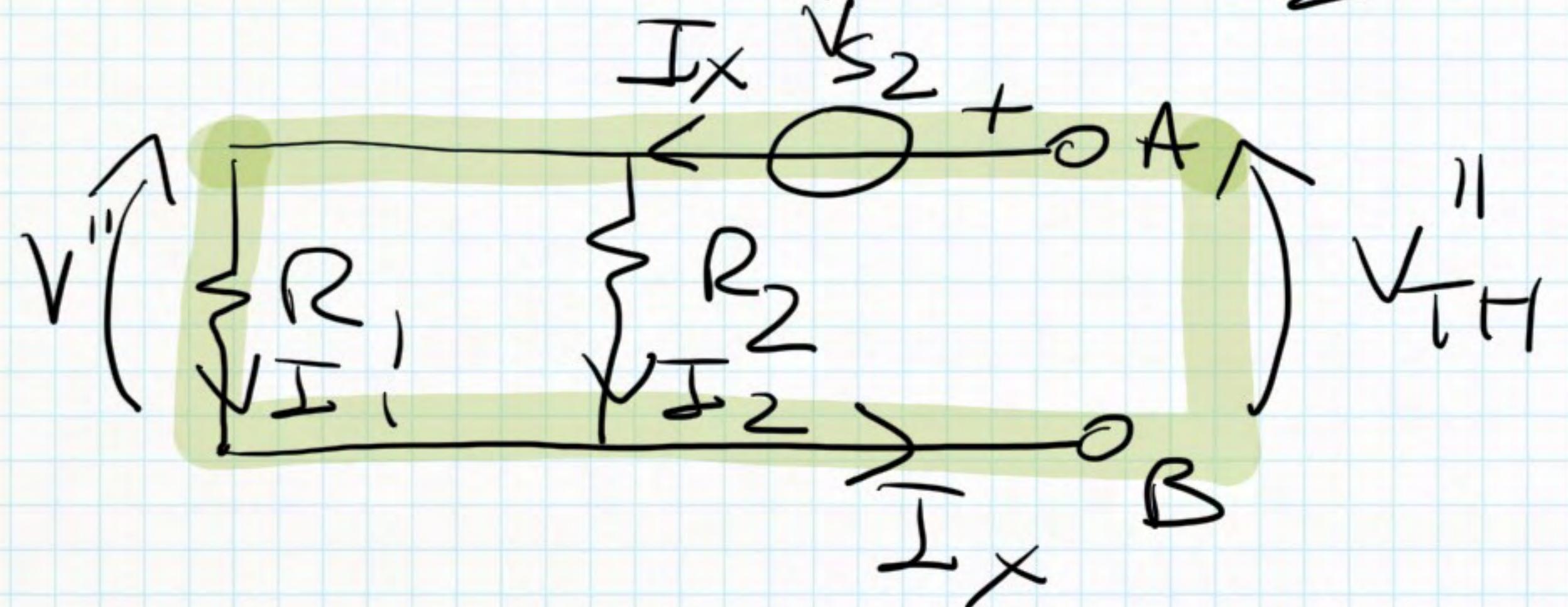
CASO 1 V_{S1} ON V_{S2} OFF



$$V_2' = V_{S1} \frac{R_2}{R_1 + R_2} = 5 \text{ V}$$

$$V_{TH}' = -V_2' = -5 \text{ V}$$

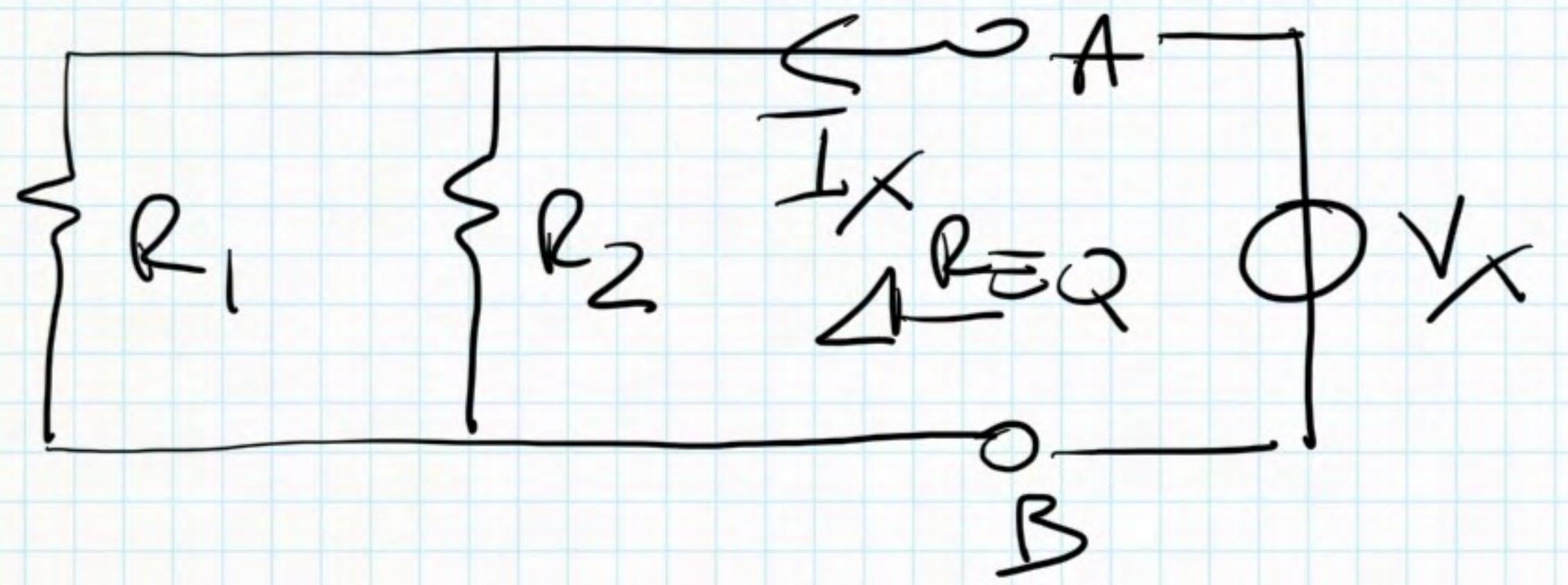
CASO 2 V_{S_1} OFF V_{S_2} ON



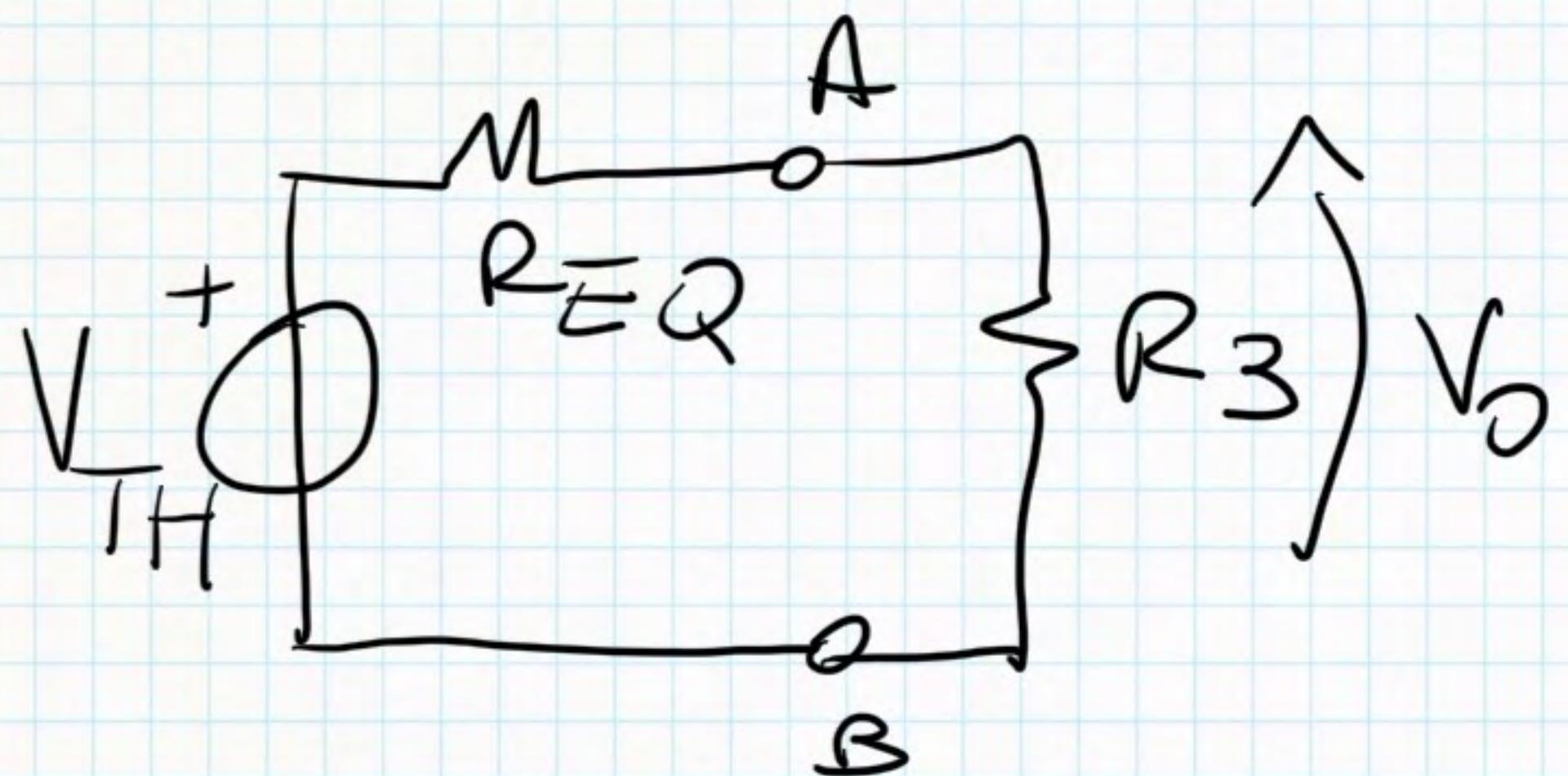
$$I_x = 0A \Rightarrow I_1 = I_2 = 0A \Rightarrow V'' = 0V$$

$$V''_{TH} = V_{S_2} + V'' = V_{S_2} = 12V$$

$$V_{TH} = V'_1 + V''_{TH} = 8V$$

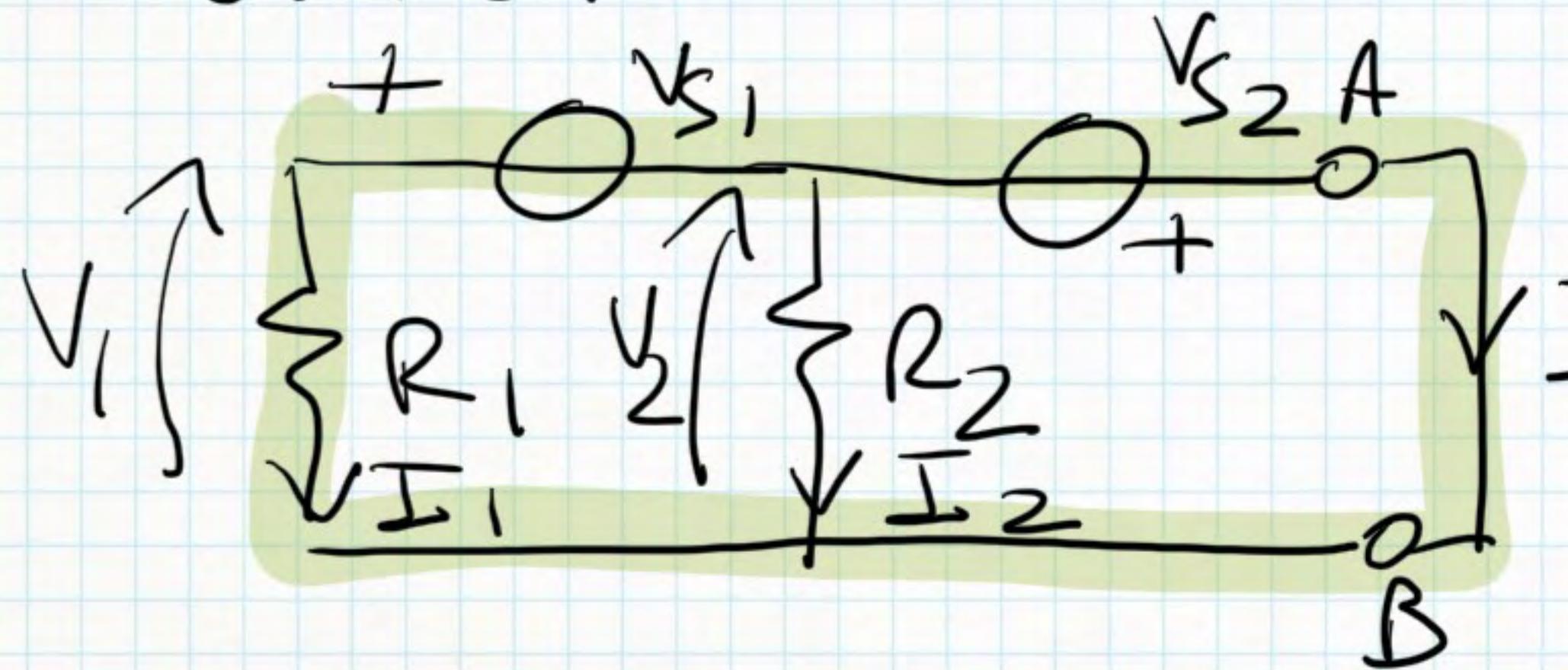


$$R_{EQ} = \frac{V_x}{I_x} = \frac{I_x (R_1 // R_2)}{I_x} = R_1 // R_2 = \frac{R_1 R_2}{R_1 + R_2} = \frac{4}{3} \Omega$$



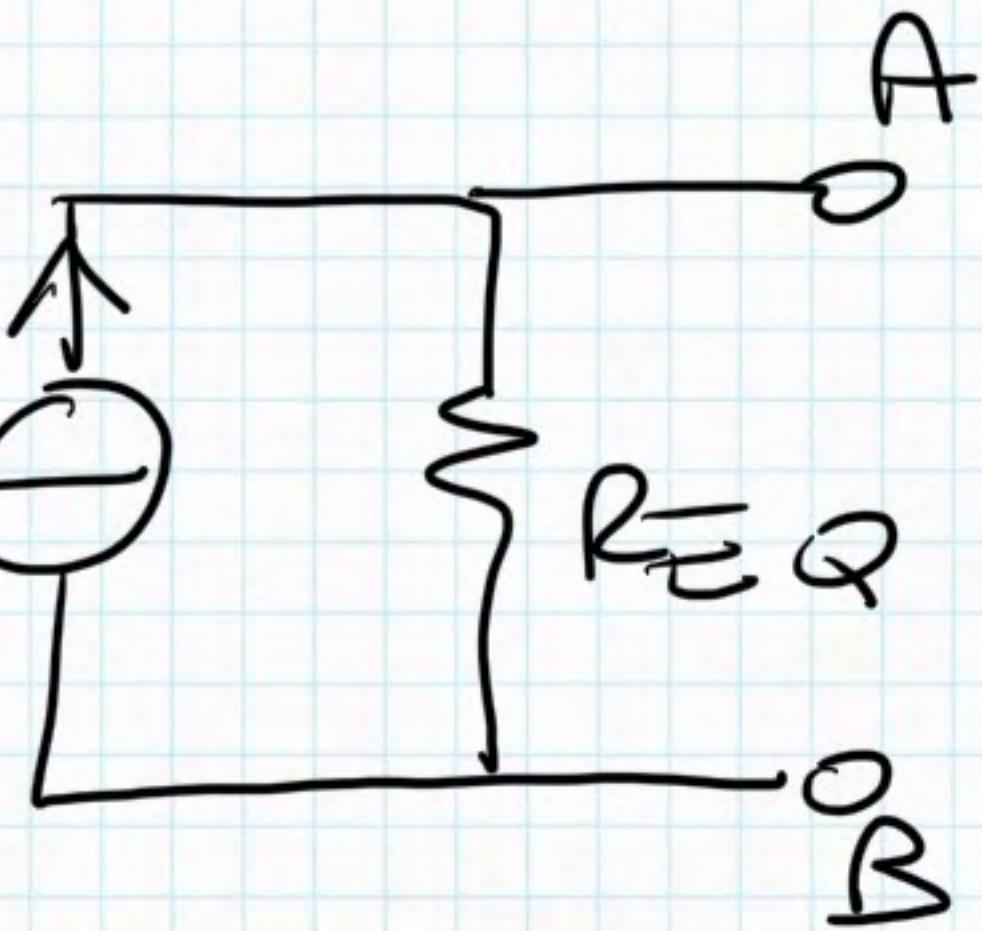
$$V_b = V_{TH} \frac{R_3}{R_{EQ} + R_3} = \frac{25}{5} V$$

NORTON



I_N

$$I_N \Rightarrow I_N$$



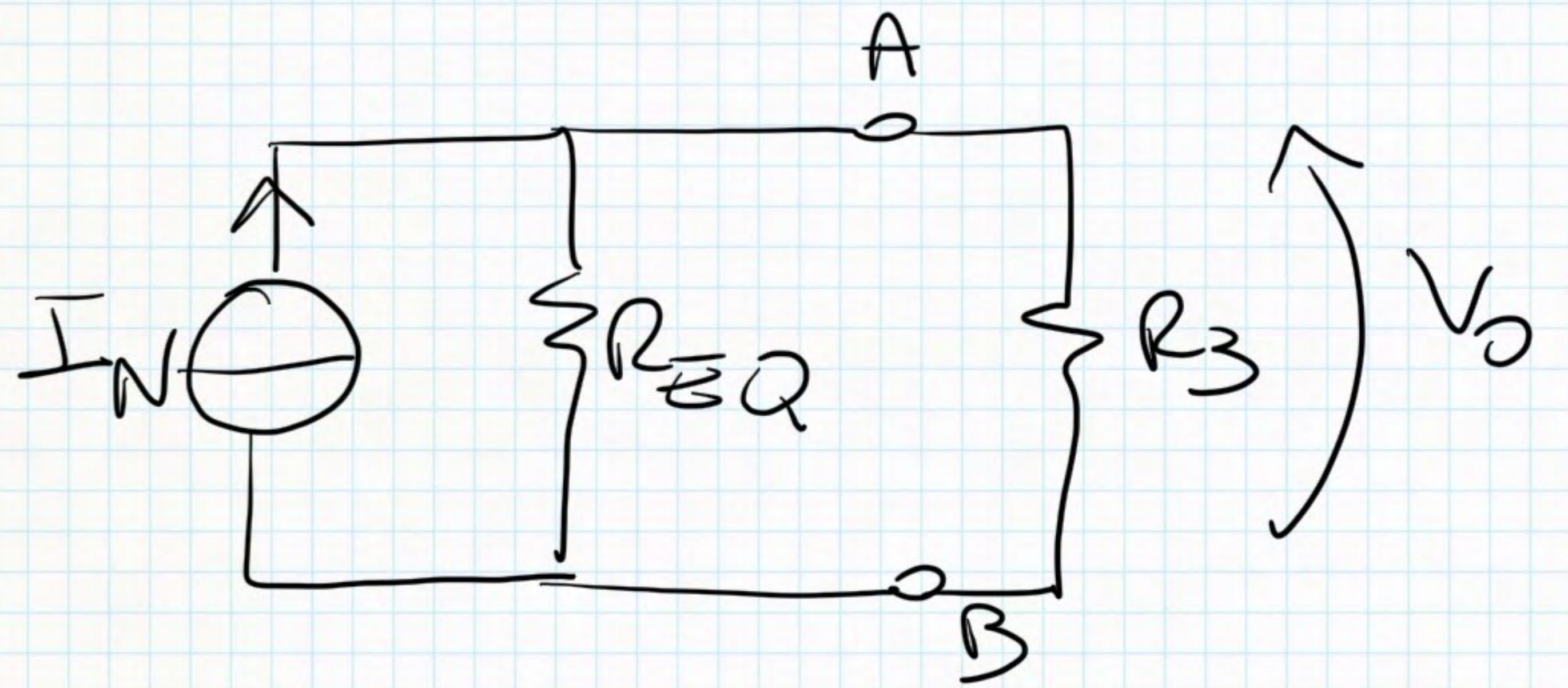
$$I_1 + I_2 + I_N = 0 \Rightarrow I_N = -I_1 - I_2$$

$$I_2 = \frac{V_2}{R_2}$$

$$V_2 = -V_{S2} \Rightarrow I_2 = -\frac{V_{S2}}{R_2} = -3A$$

$$V_{S1} = V_{S2} + V_1 \Rightarrow V_1 = V_{S1} - V_{S2} \Rightarrow I_1 = \frac{V_1}{R_1} = \frac{V_1 - V_{S2}}{R_1} = -3A$$

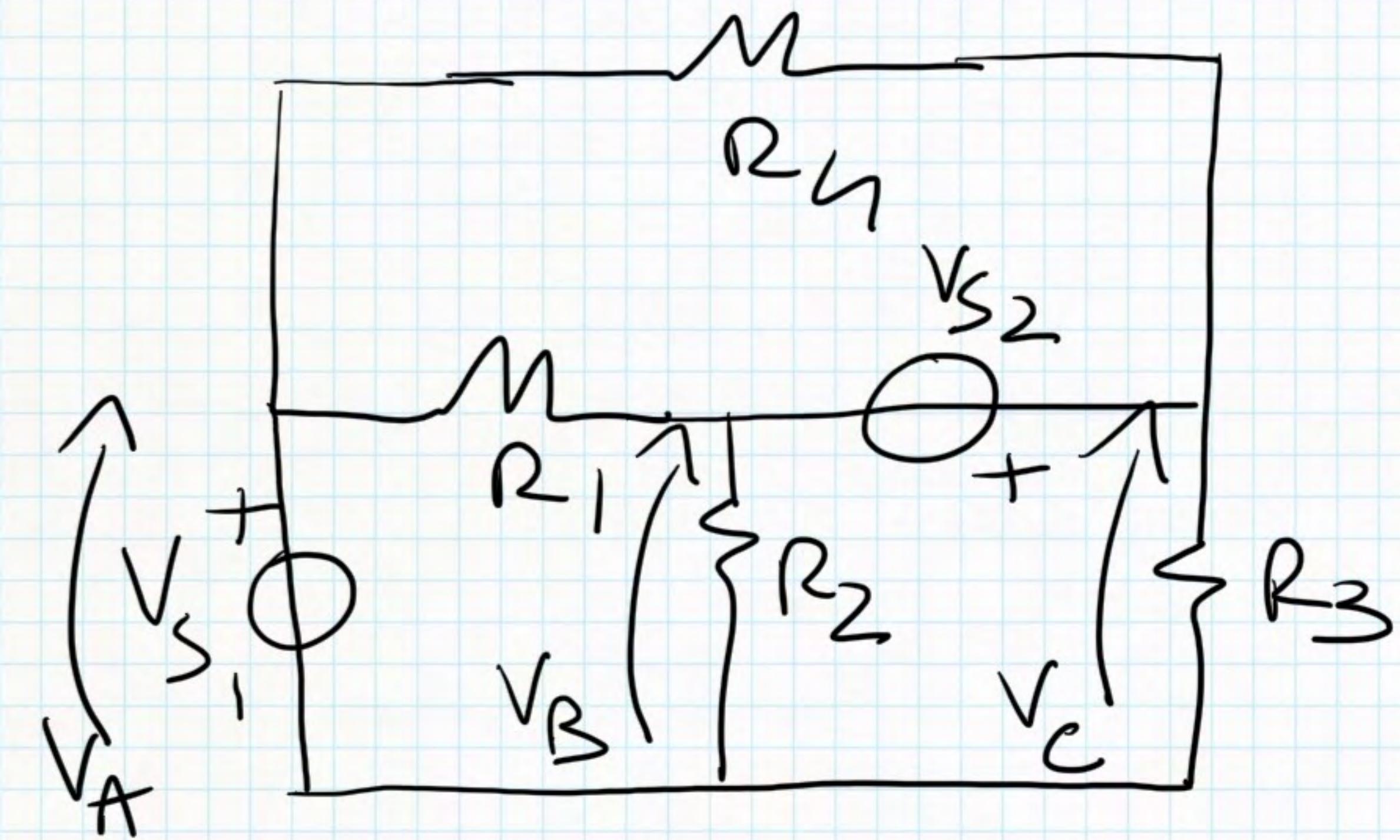
$$I_N = -I_1 - I_2 = 6 \text{ A}$$



$$R_{EQ} // R_3 = \frac{4}{5} \Omega$$

$$V_0 = I_N (R_{EQ} // R_3) = \frac{24}{5} \text{ V}$$

ESE 13



$$V_{S_1} = 12 \text{ V}$$

$$V_{S_2} = 10 \text{ V}$$

$$R_1 = 2 \Omega$$

$$R_2 = 12 \Omega$$

$$R_3 = R_L = 8 \Omega$$

$$V_A = ?$$

$$V_B = ?$$

$$V_C = ?$$

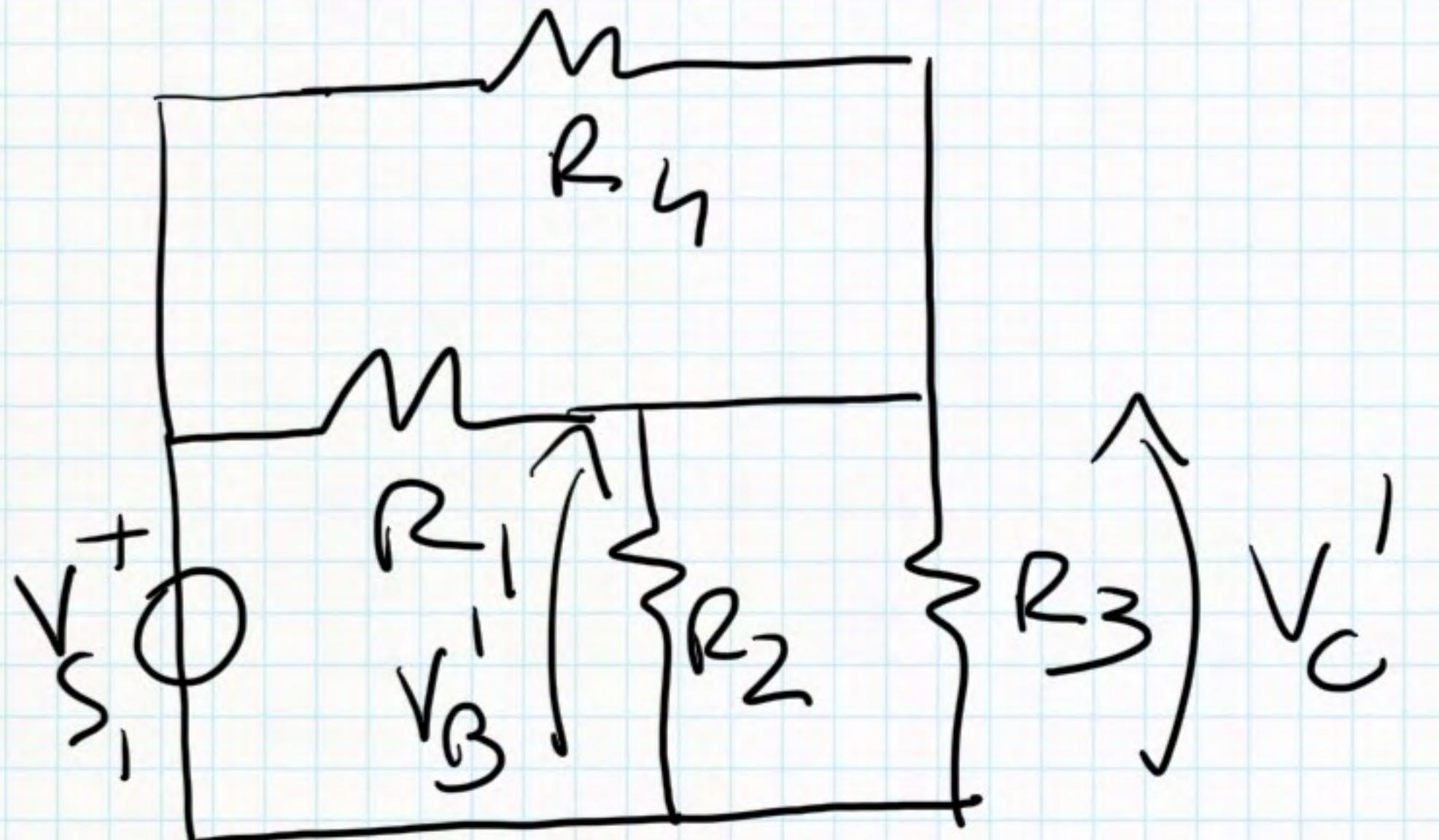
$$V_A = V_{S_1} = 12 \text{ V}$$

V_B e V_C con PSE

CASO I

V_{S_1} ON

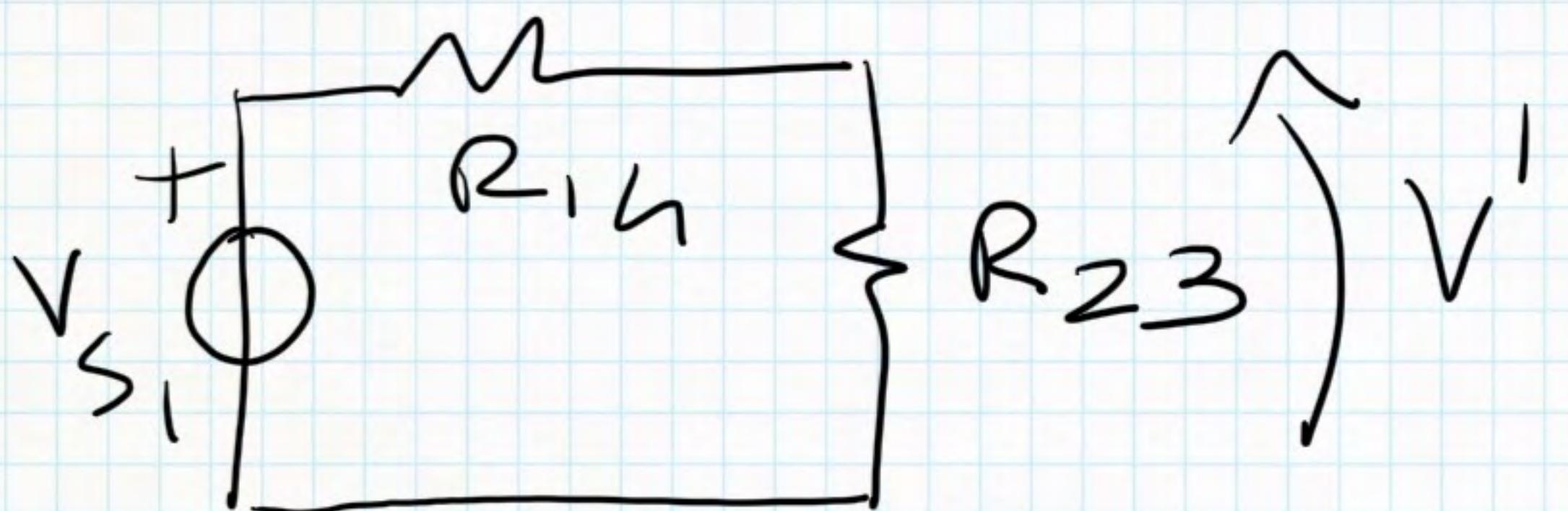
V_{S_2} OFF



$$V_B' = V_C' = V'$$

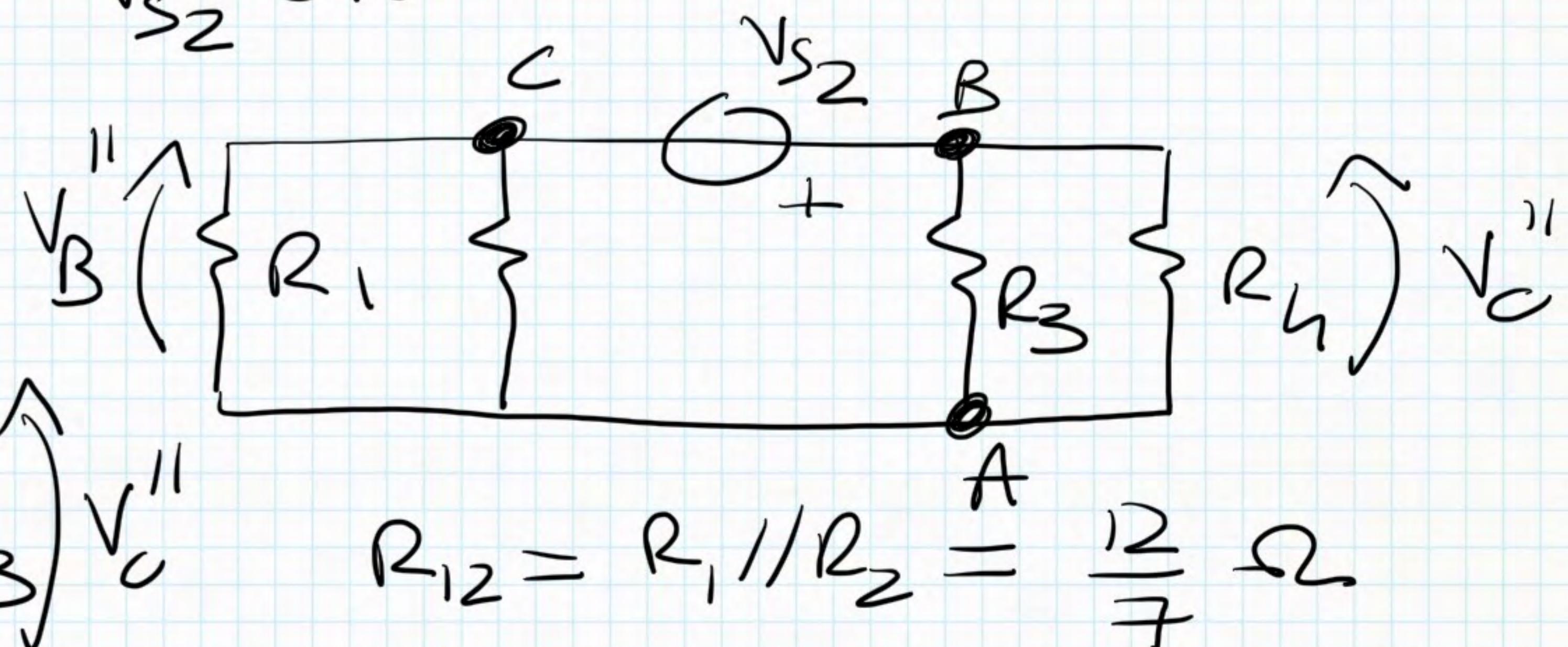
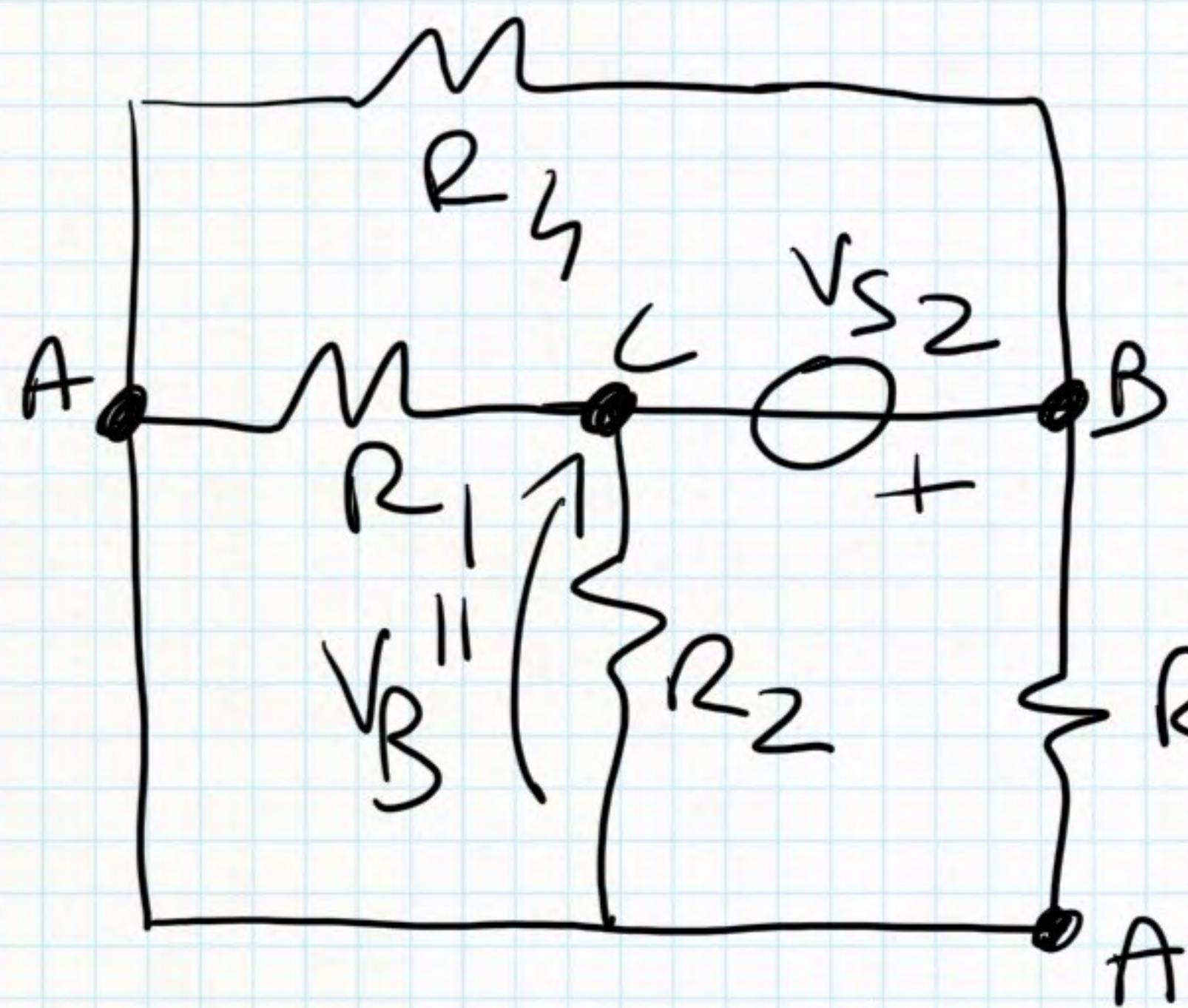
$$R_{1L} = R_1 // R_L = \frac{R_1 R_L}{R_1 + R_L} = \frac{3}{5} \Omega$$

$$R_{23} = R_2 // R_3 = \frac{2}{5} \Omega$$

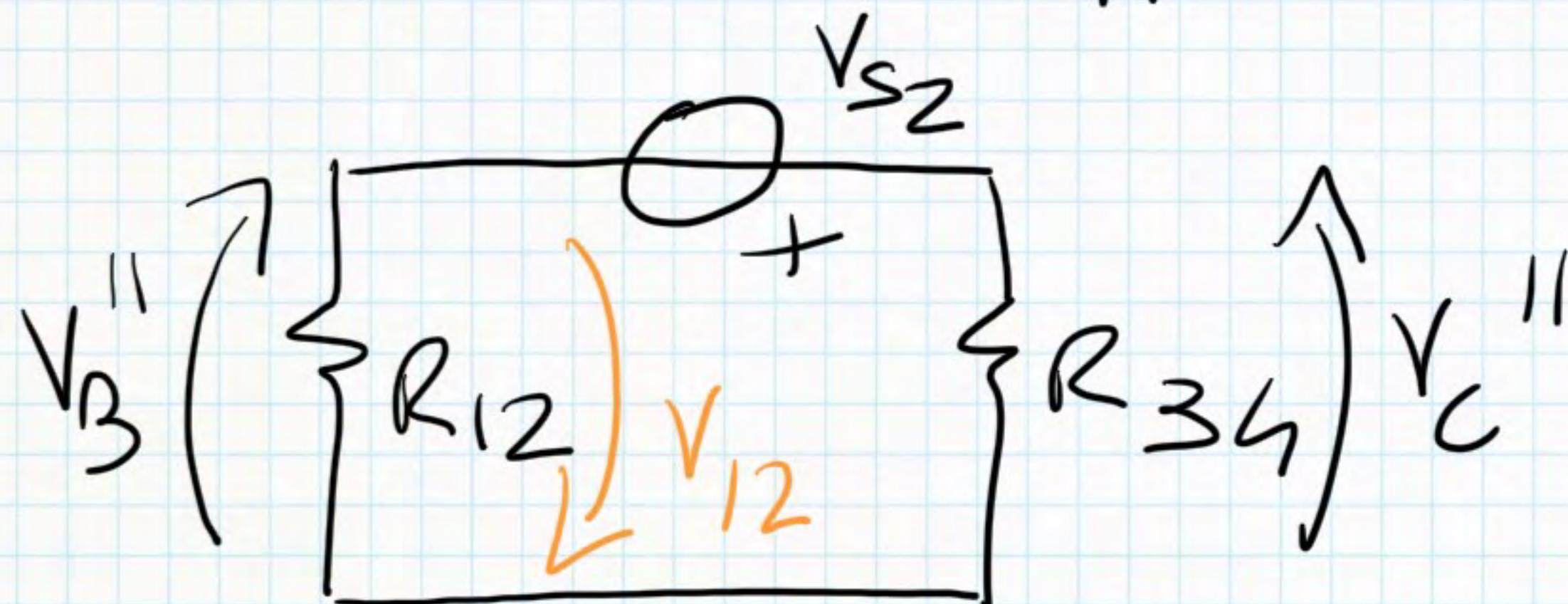


$$V' = V_{S_1} \frac{R_{23}}{R_{1L} + R_{23}} = 9V$$

CASO 2 V_{S1} OFF V_{S2} ON



$$R_{3L} = R_3 // R_L = 4 \Omega$$



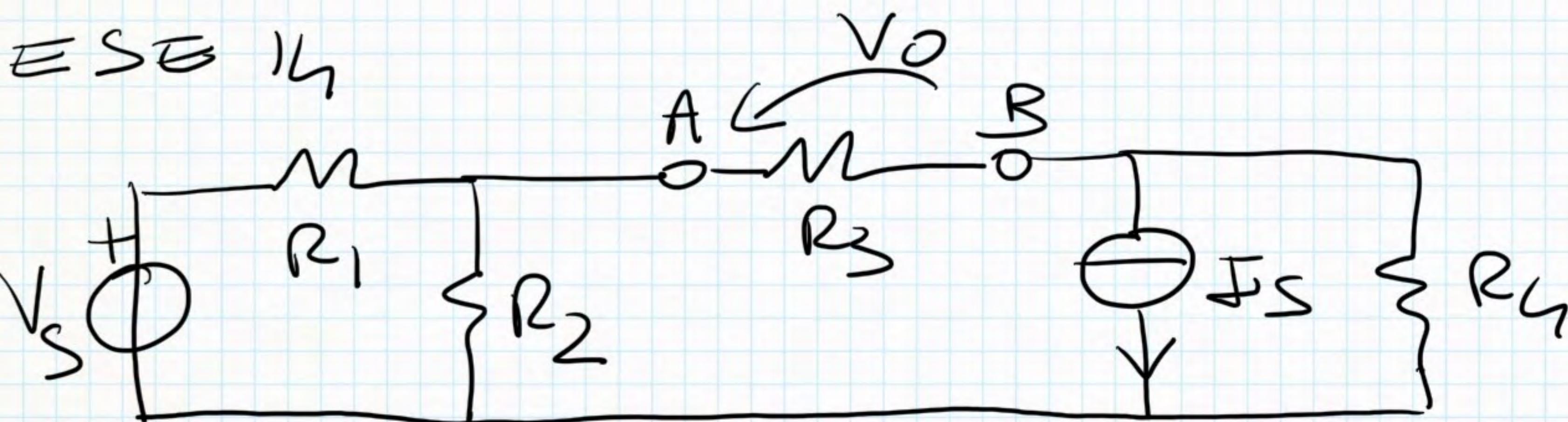
$$V_C'' = V_{S2} \frac{R_{3L}}{R_{12} + R_{3L}} = 7V$$

$$V_{12} = V_{S2} \frac{R_{12}}{R_{12} + R_{34}} = 3V$$

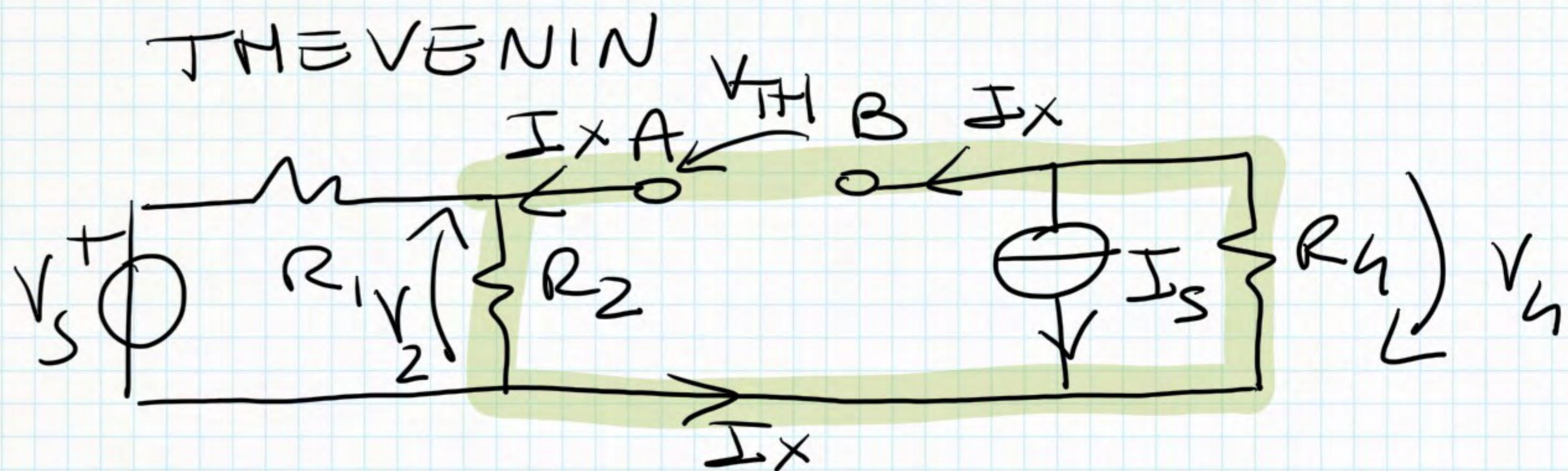
$$V_B'' = -V_{12} = -3V$$

$$V_B = V_B' + V_B'' = V' + V_B'' = 6V$$

$$V_C = V_C' + V_B'' = V' + V_C'' = 16V$$



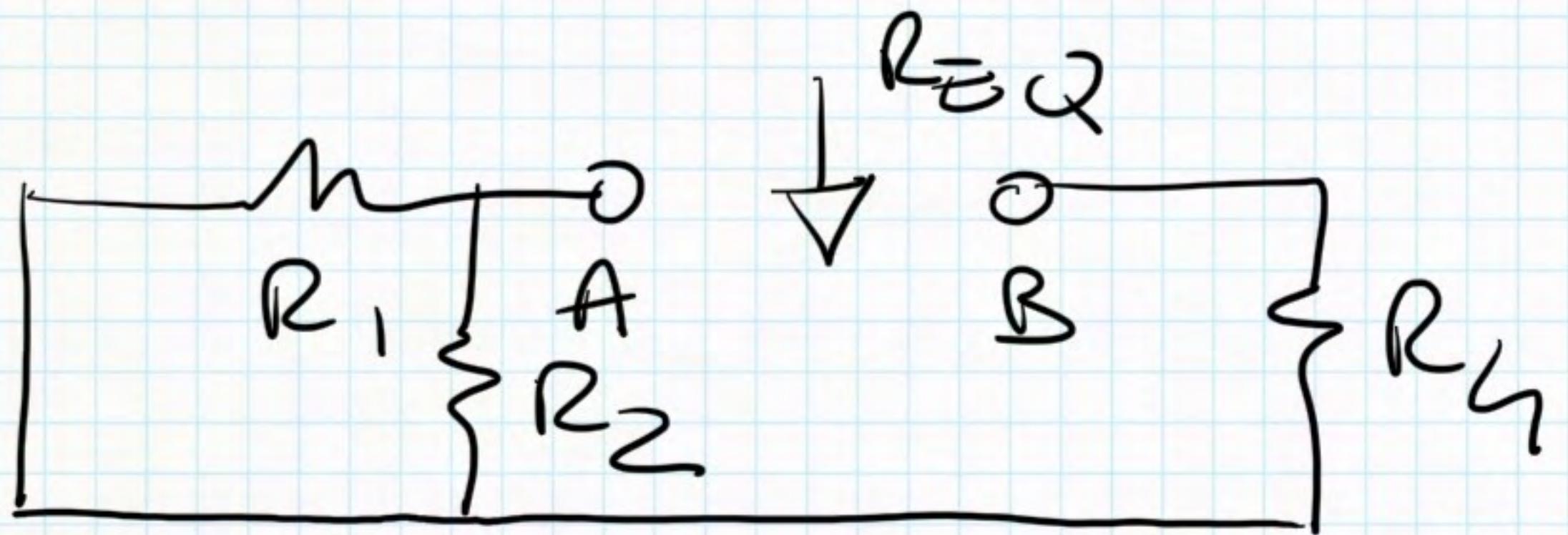
$$\begin{aligned}
 V_s &= 12V \\
 R_1 &= 3\Omega \\
 R_2 &= 6\Omega \\
 R_3 &= 8\Omega \\
 R_4 &= 2\Omega \\
 I_s &= 2A \\
 V_o &= ?
 \end{aligned}$$



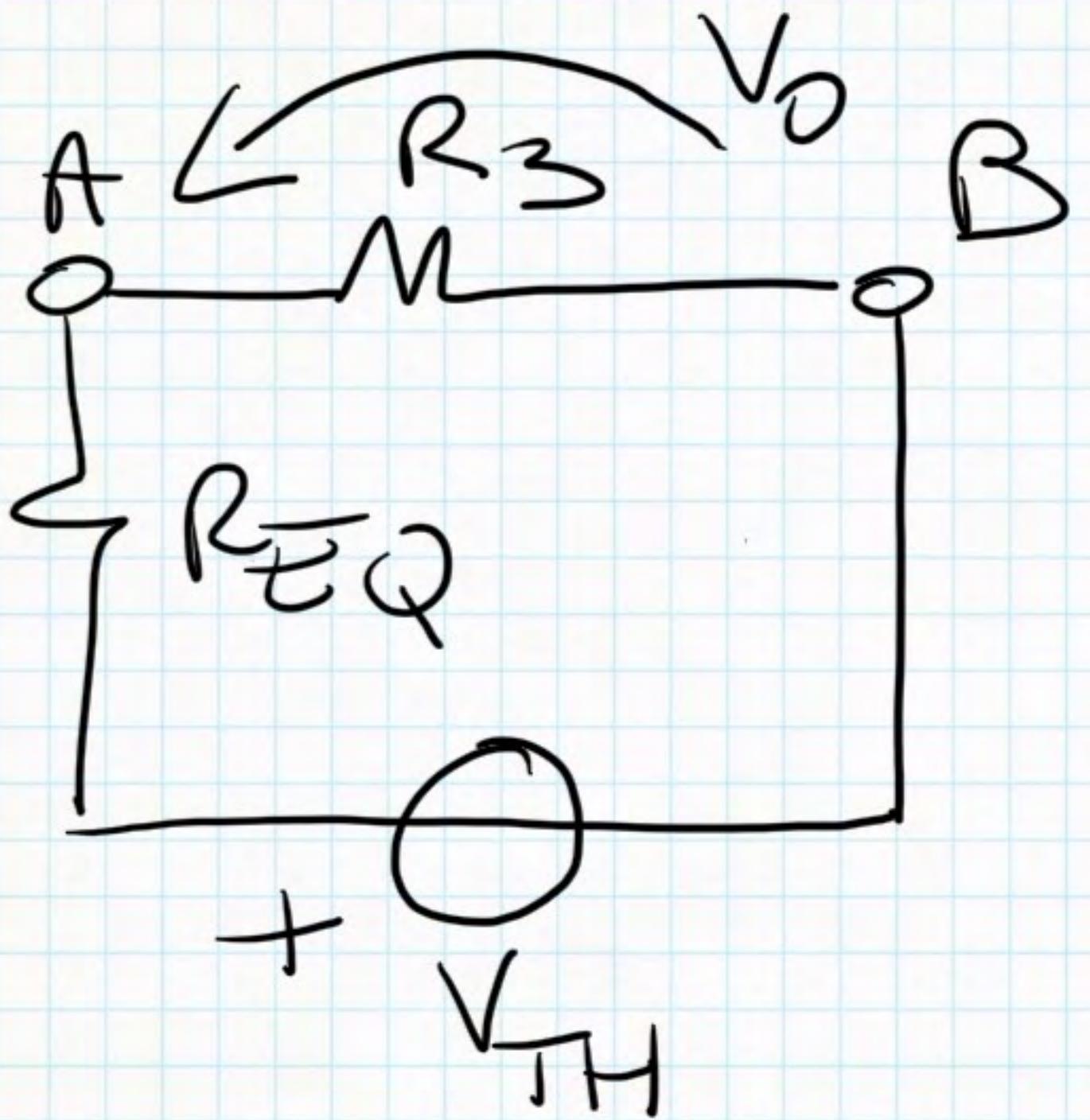
$$I_x = 0A \Rightarrow I_h = I_s \Rightarrow V_h = I_s R_h = 4V$$

$$V_2 = V_s \frac{R_2}{R_1 + R_2} = 8V$$

$$V_{TH} = V_h + V_2 = 12V$$

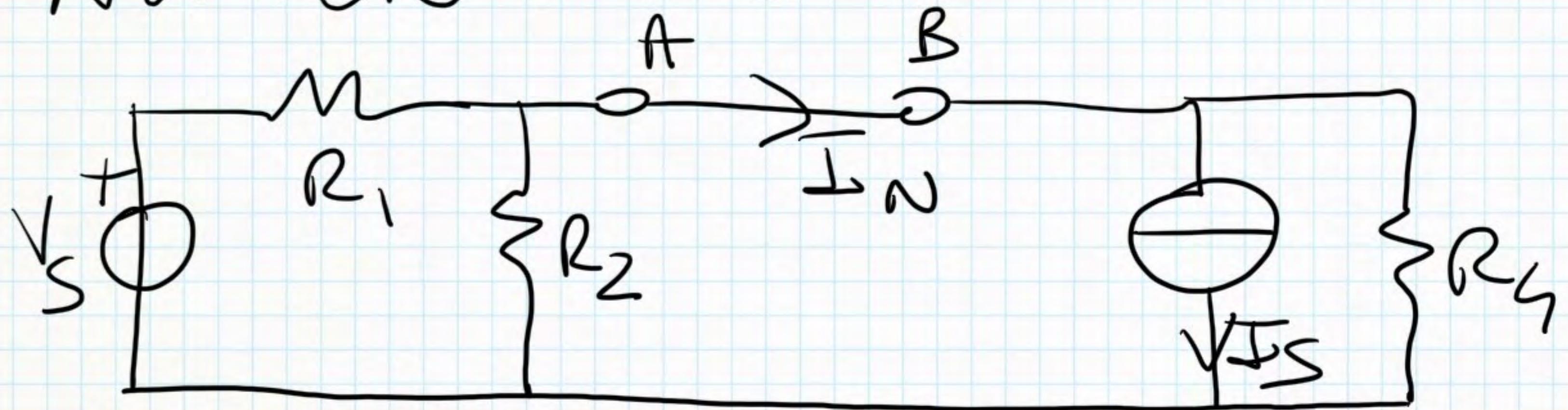


$$R_{EQ} = R_L + R_1 // R_2 = R_L + \frac{R_1 R_2}{R_1 + R_2} = 4 \Omega$$



$$V_o = V_{TH} \frac{R_3}{R_{EQ} + R_3} = 8V$$

NORTON + PSE

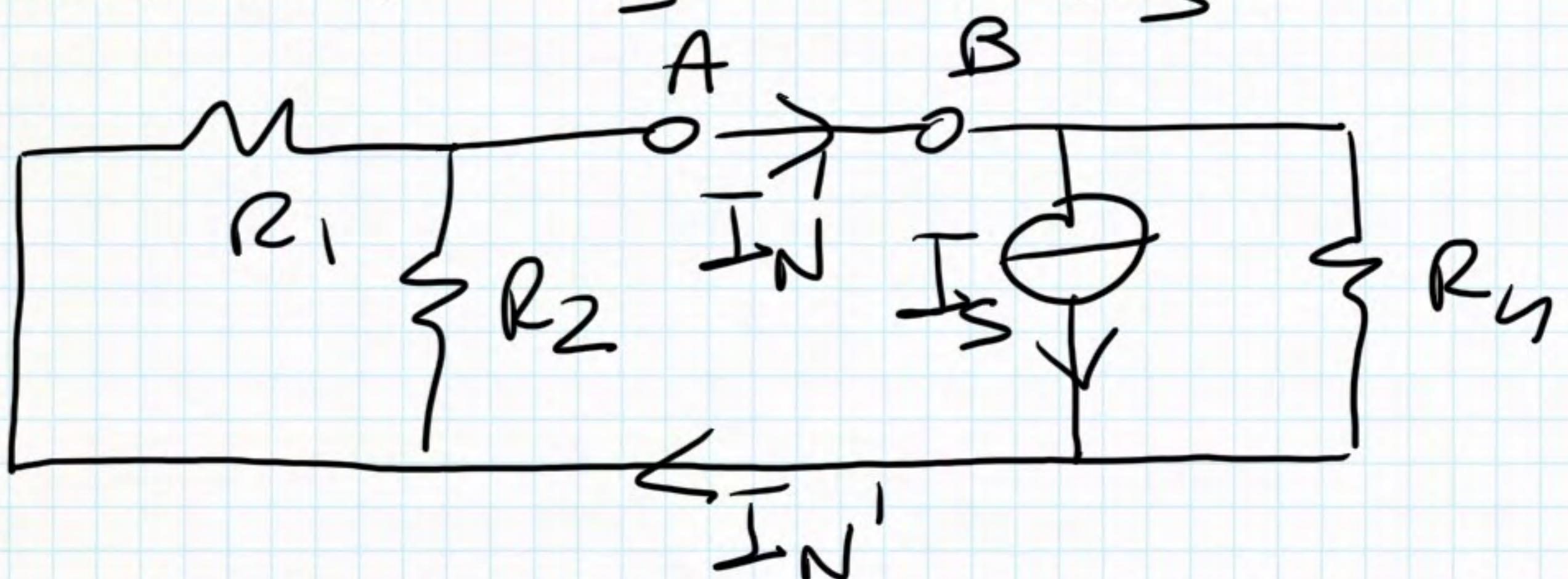


$$I_N' = I_S \frac{G_{12}}{G_4 + G_{12}}$$

$$G_{12} = \frac{1}{R_{12}} = \frac{1}{2} S$$

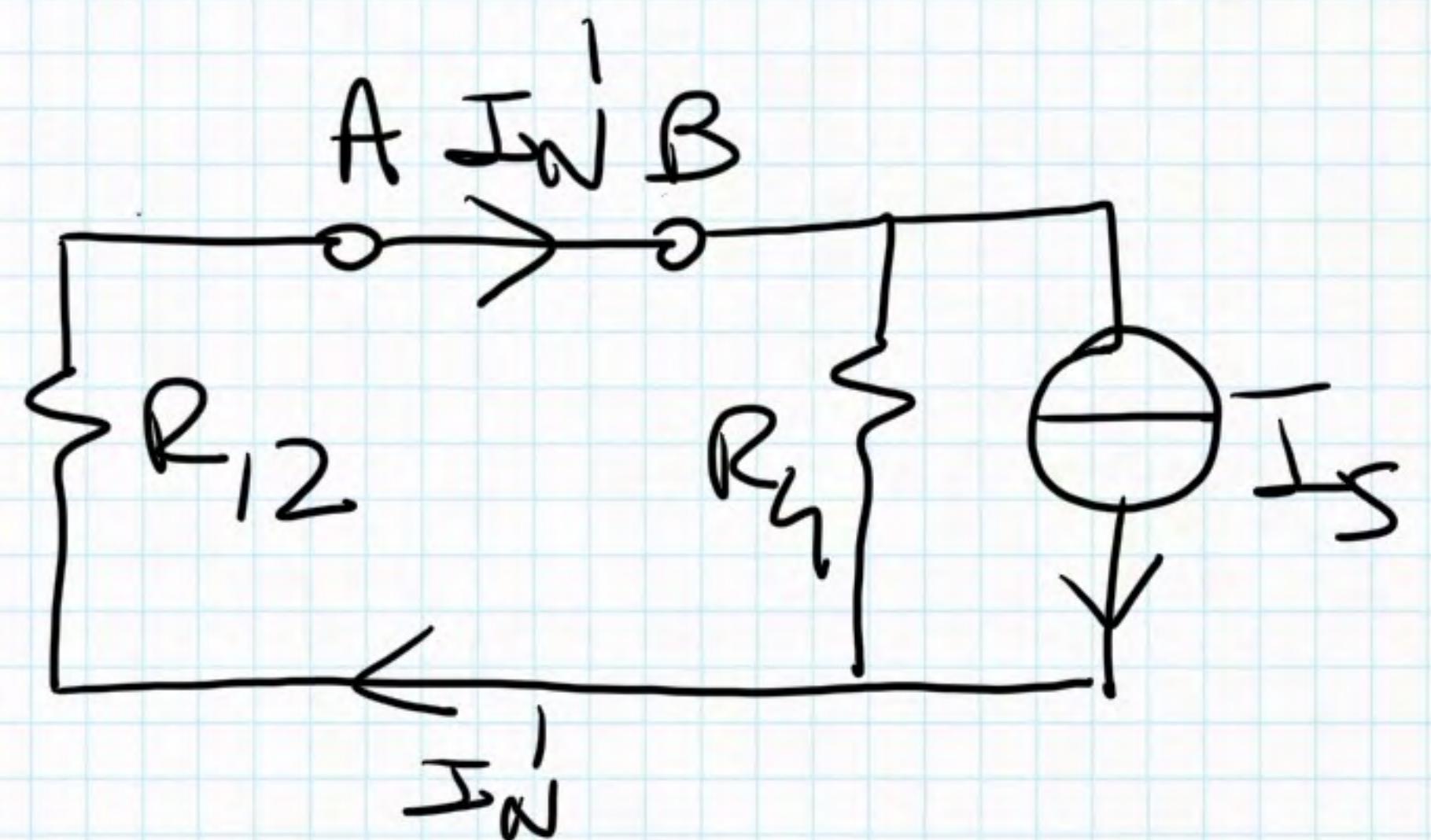
$$G_4 = \frac{1}{R_L} = \frac{1}{2} S$$

CASO 1 V_s OFF I_S ON

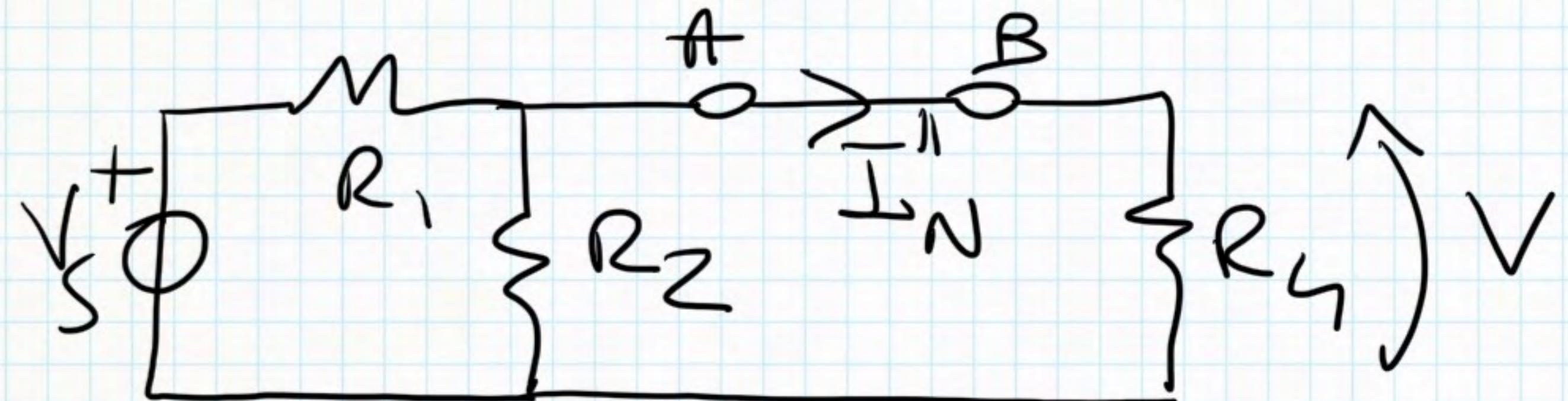


$$R_{12} = R_1 // R_2 = 2 \Omega$$

$$I_N' = I_S \frac{R_L}{R_L + R_{12}} = 1 A^*$$



CASO 2 V_S ON I_S OFF

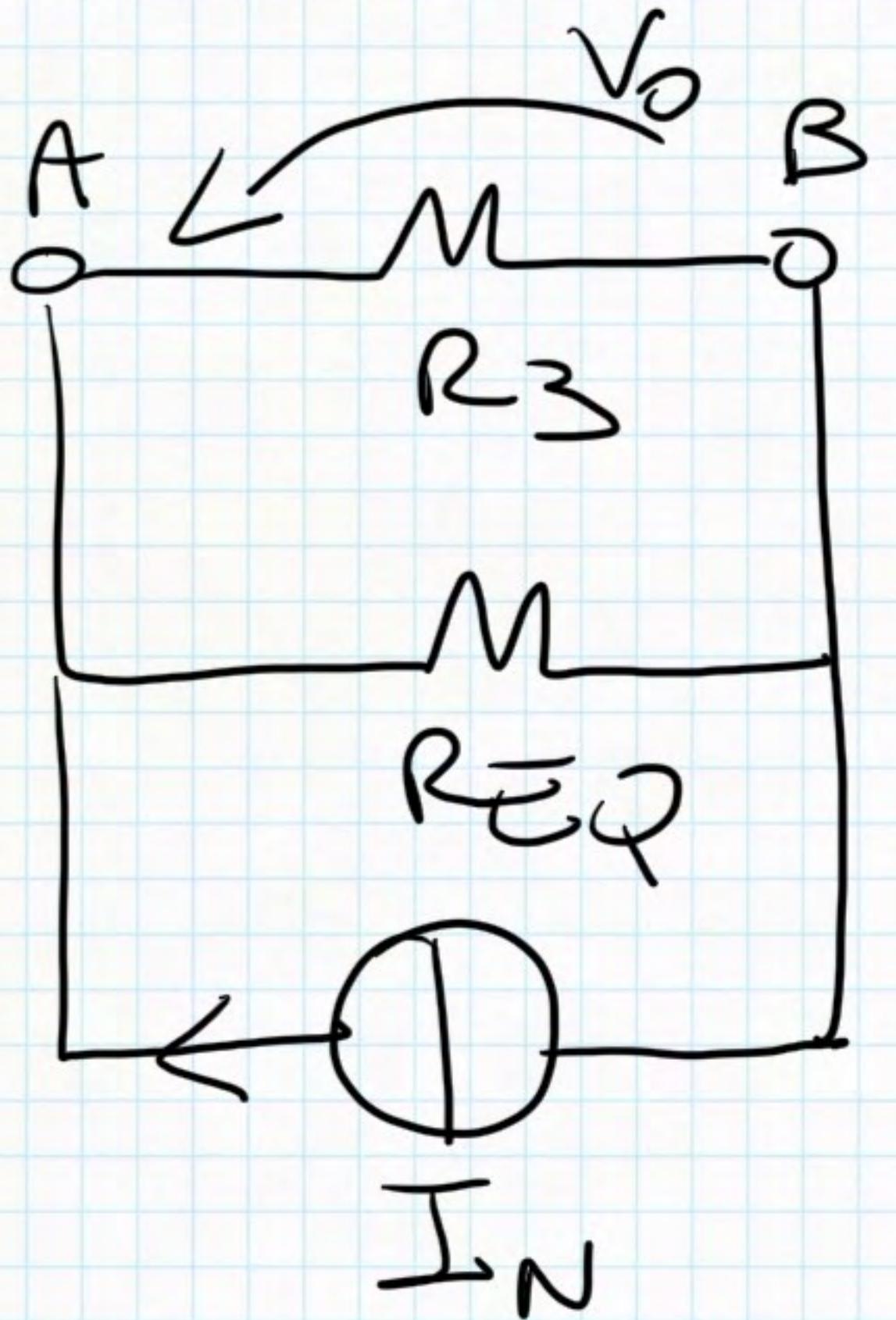


$$R_2 // R_H = \frac{3}{2} \Omega$$

$$V = V_S \cdot \frac{R_2 // R_H}{R_1 + R_2 // R_H} = 4 V$$

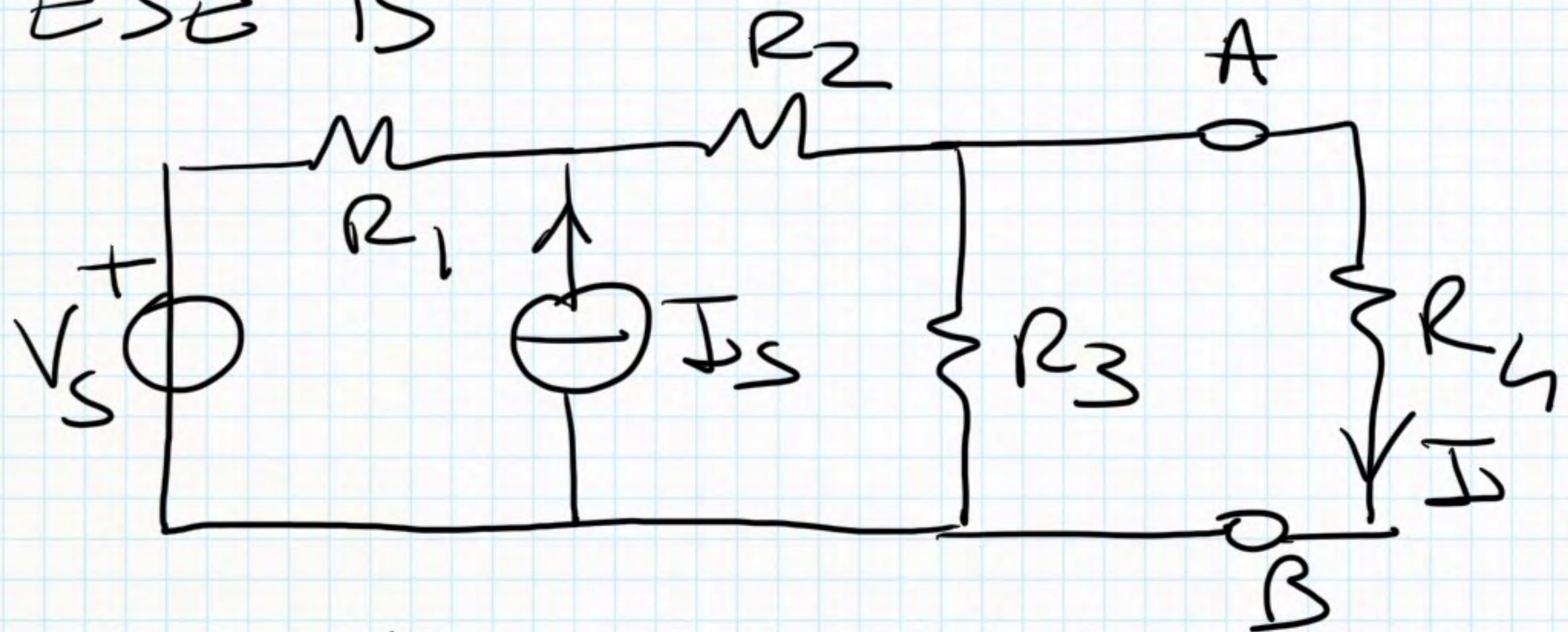
$$I_N'' = \frac{V}{R_H} = 2 A$$

$$I_N = I_N' + I_N'' = 3 \text{ A}$$



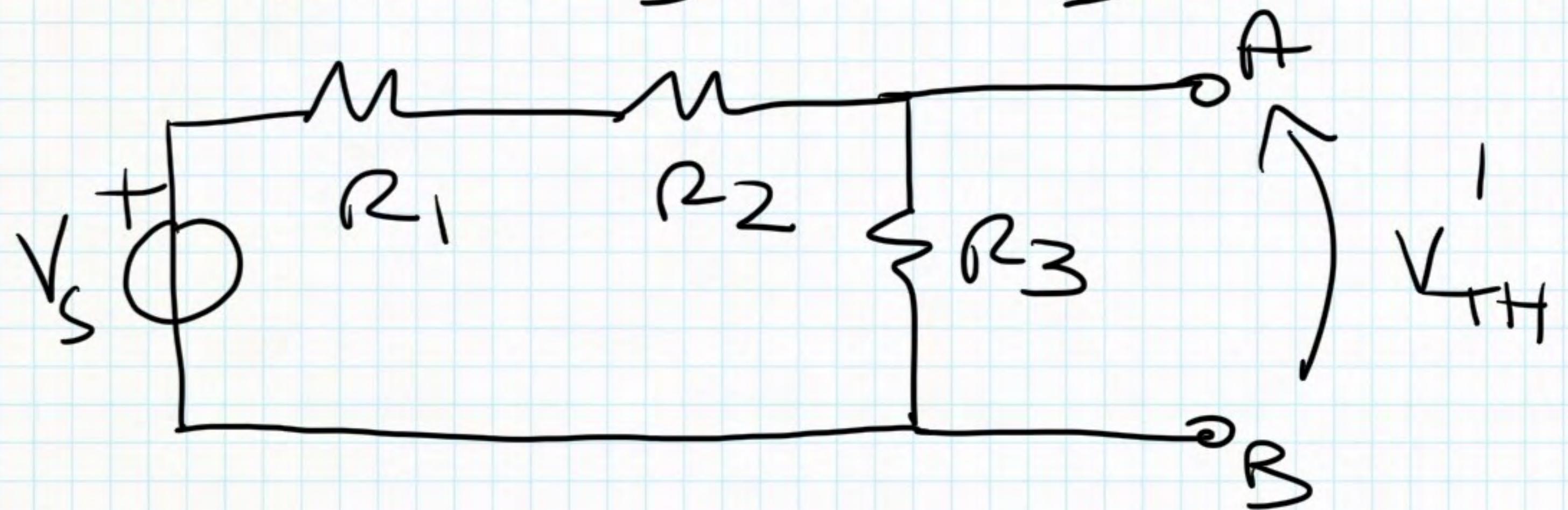
$$V_o = I_N (R_{EQ} // R_3) = 8V$$

ESE IS



THEVENIN + PSE

CASO 1 V_s ON I_s OFF



$$V_s = 12V$$

$$I_s = 2A$$

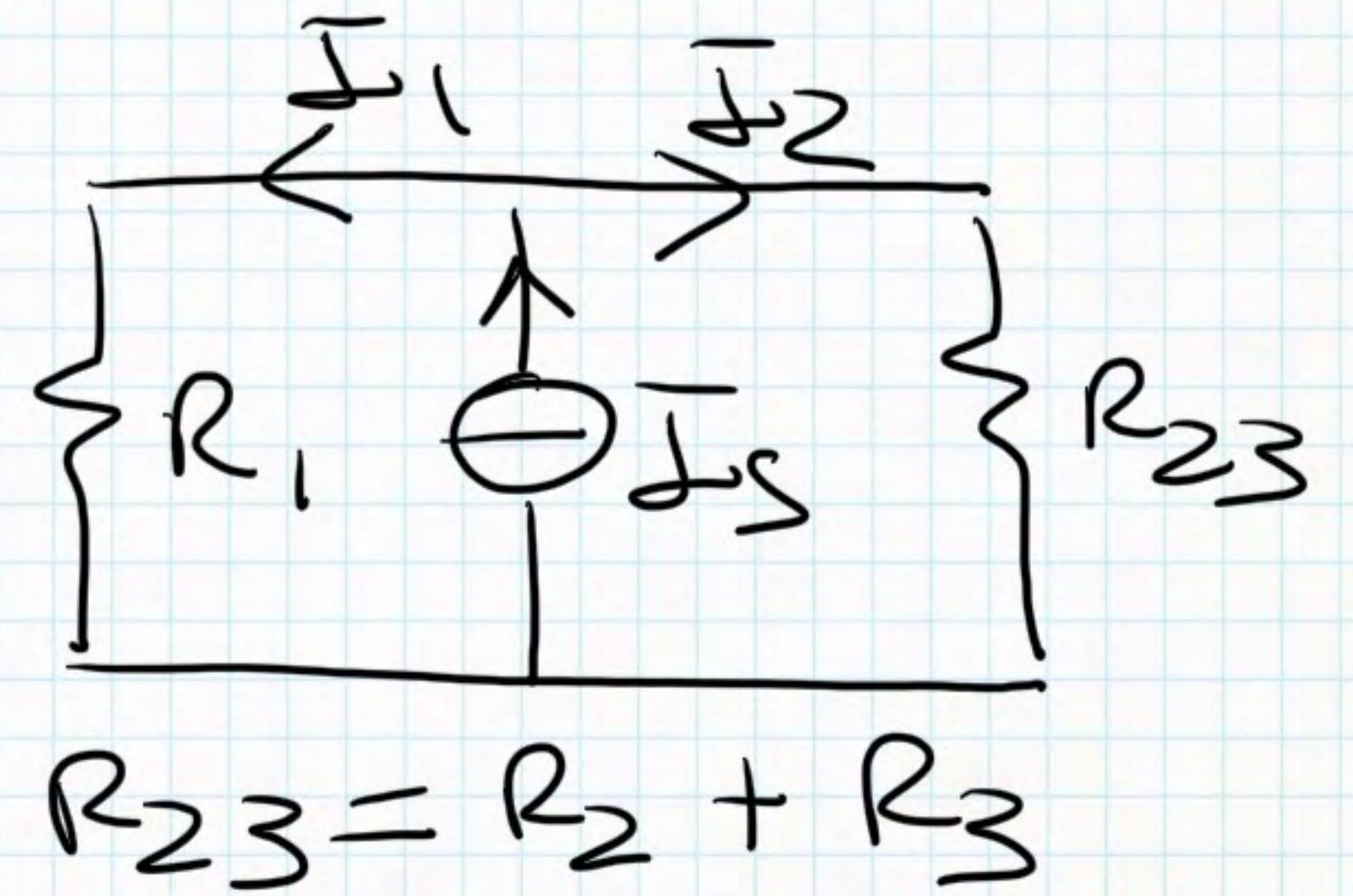
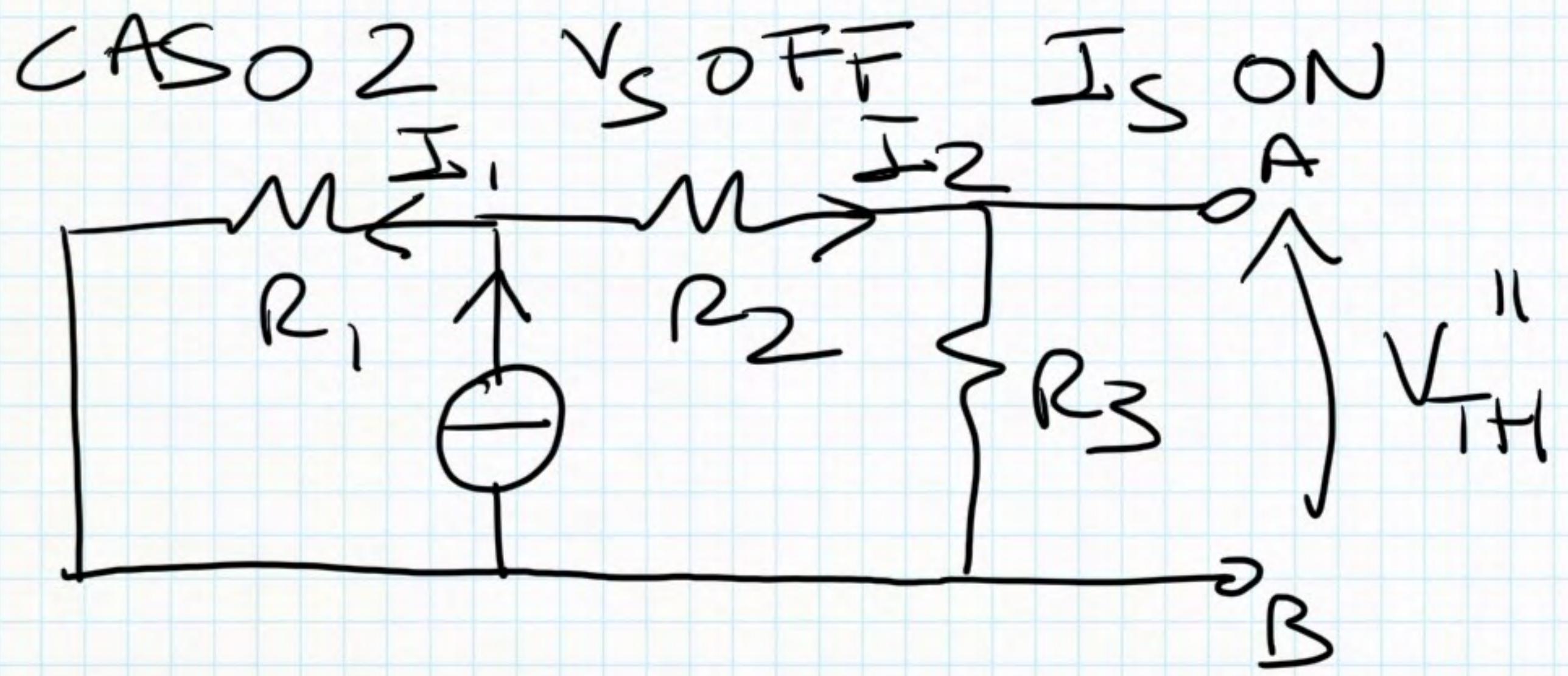
$$R_1 = R_2 = 6\Omega$$

$$R_3 = 4\Omega$$

$$R_4 = 1\Omega$$

$$I = ?$$

$$V_{TH} = V_s \frac{R_3}{R_1 + R_2 + R_3} = 3V$$



$$R_{23} = R_2 + R_3$$

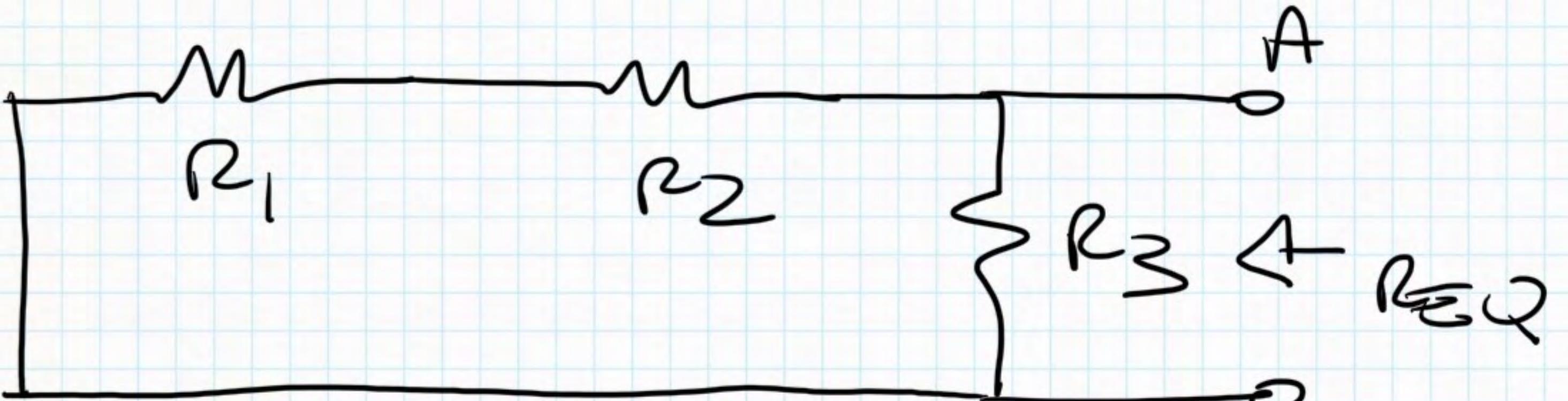
$$I_2 = I_S \frac{R_1}{R_1 + R_{23}} = \frac{3}{4} A = I_S \frac{G_{23}}{G_1 + G_{23}}$$

$$V_{TH}'' = I_2 R_3 = 3V$$

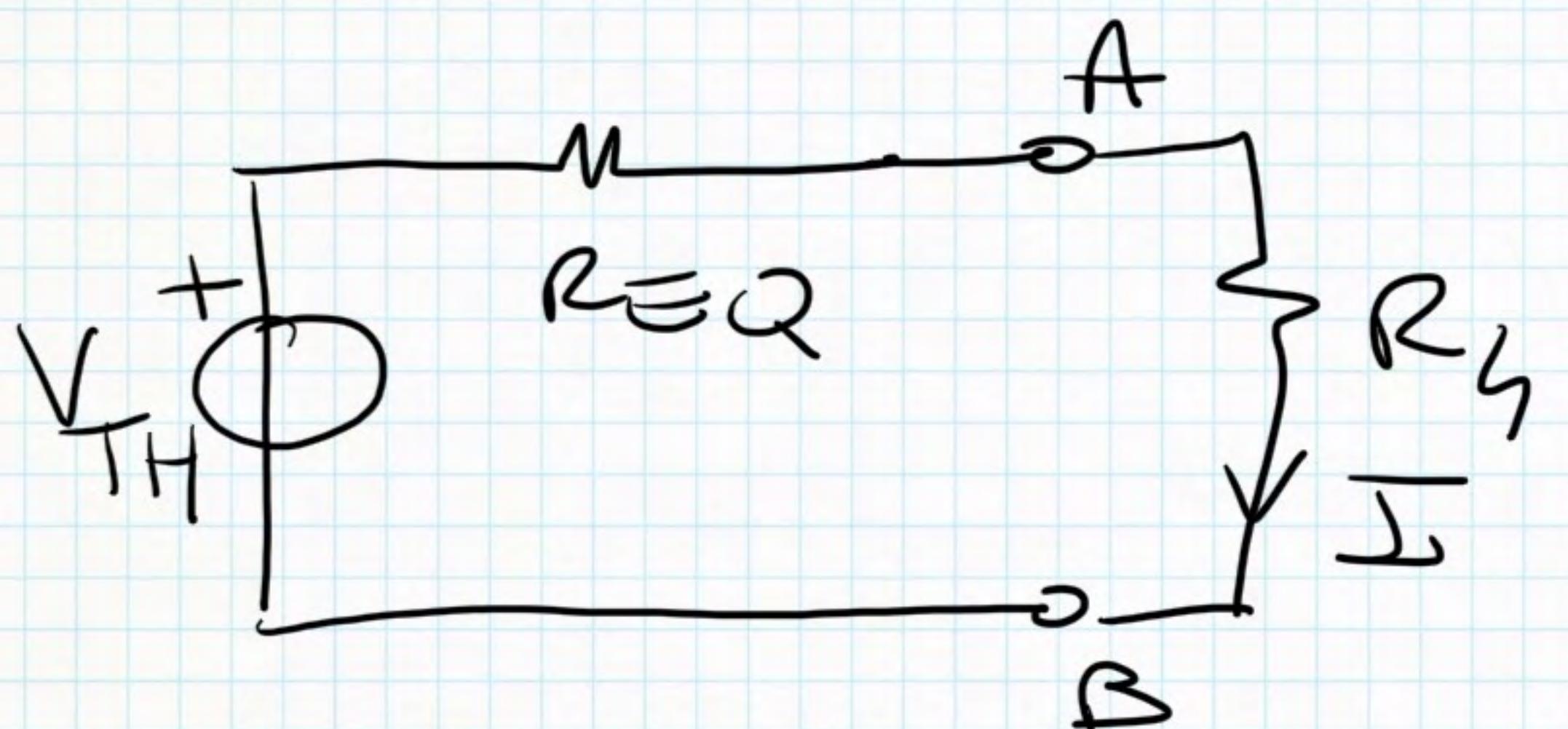
$$G_{23} = \frac{1}{R_{23}} = \frac{1}{10} S$$

$$V_{TH} = V_{TH}^1 + V_{TH}'' = 6V$$

$$G_1 = \frac{1}{R_1} = \frac{1}{6} S$$

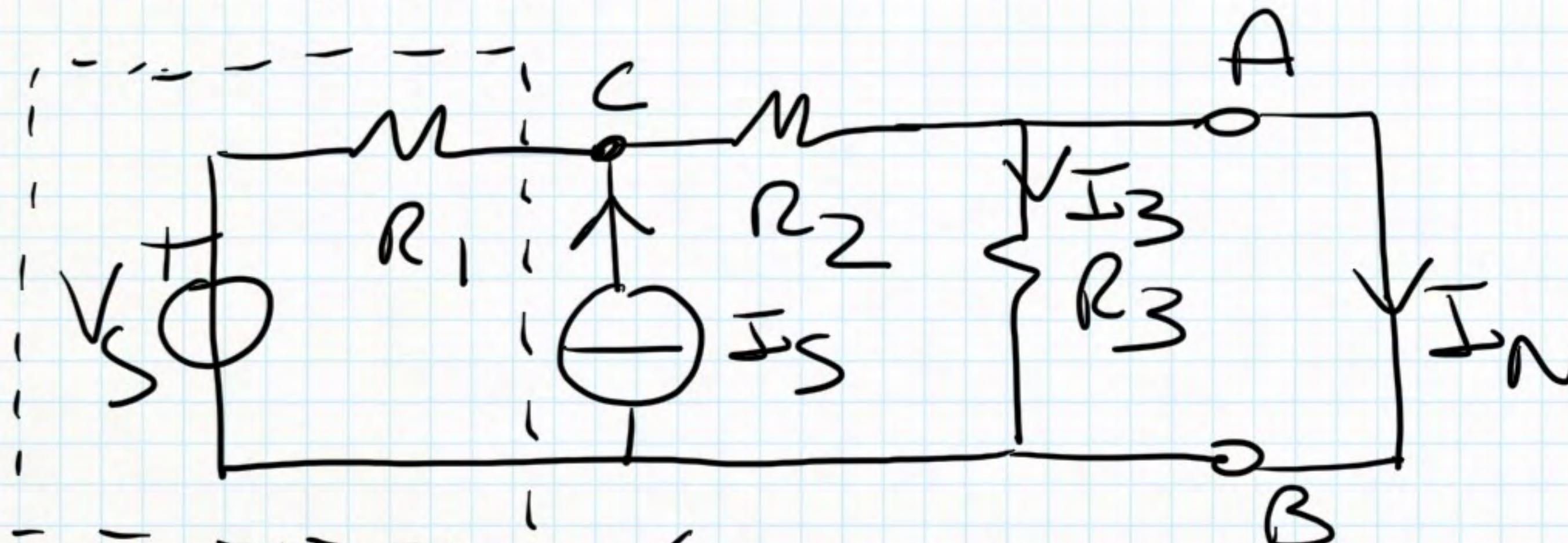


$$R_{EQ} = R_3 \parallel (R_1 + R_2) = \frac{R_3 (R_1 + R_2)}{R_3 + R_1 + R_2} = 3\Omega$$

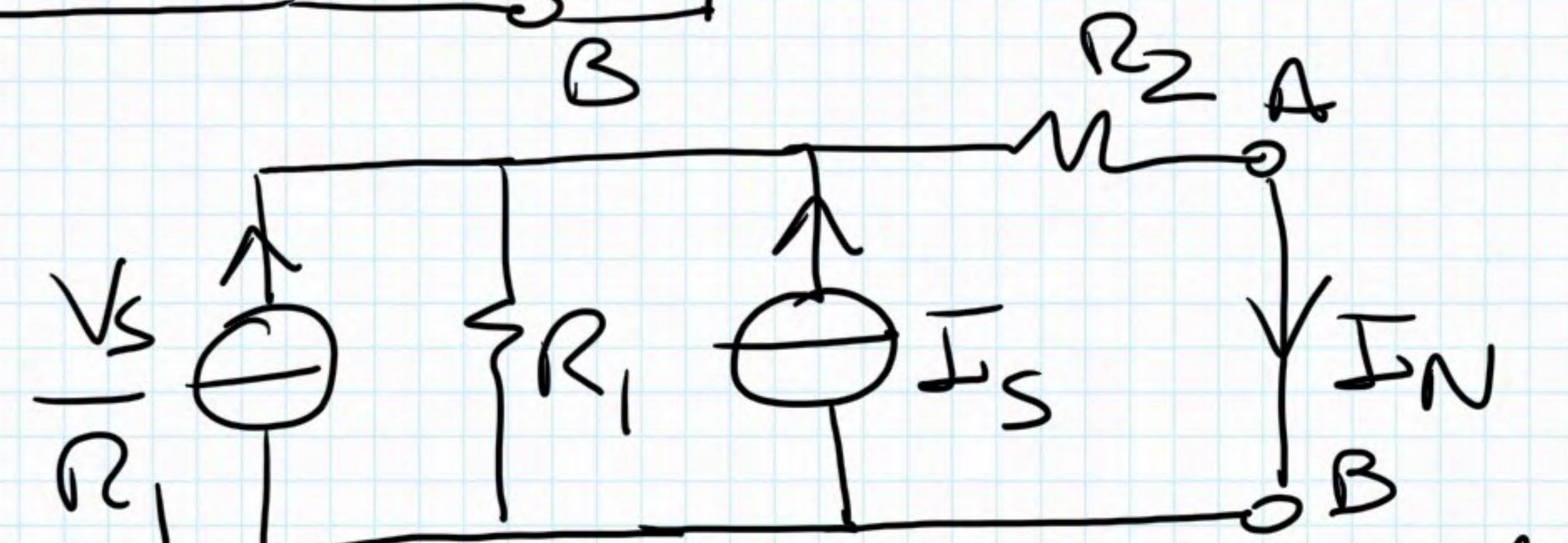
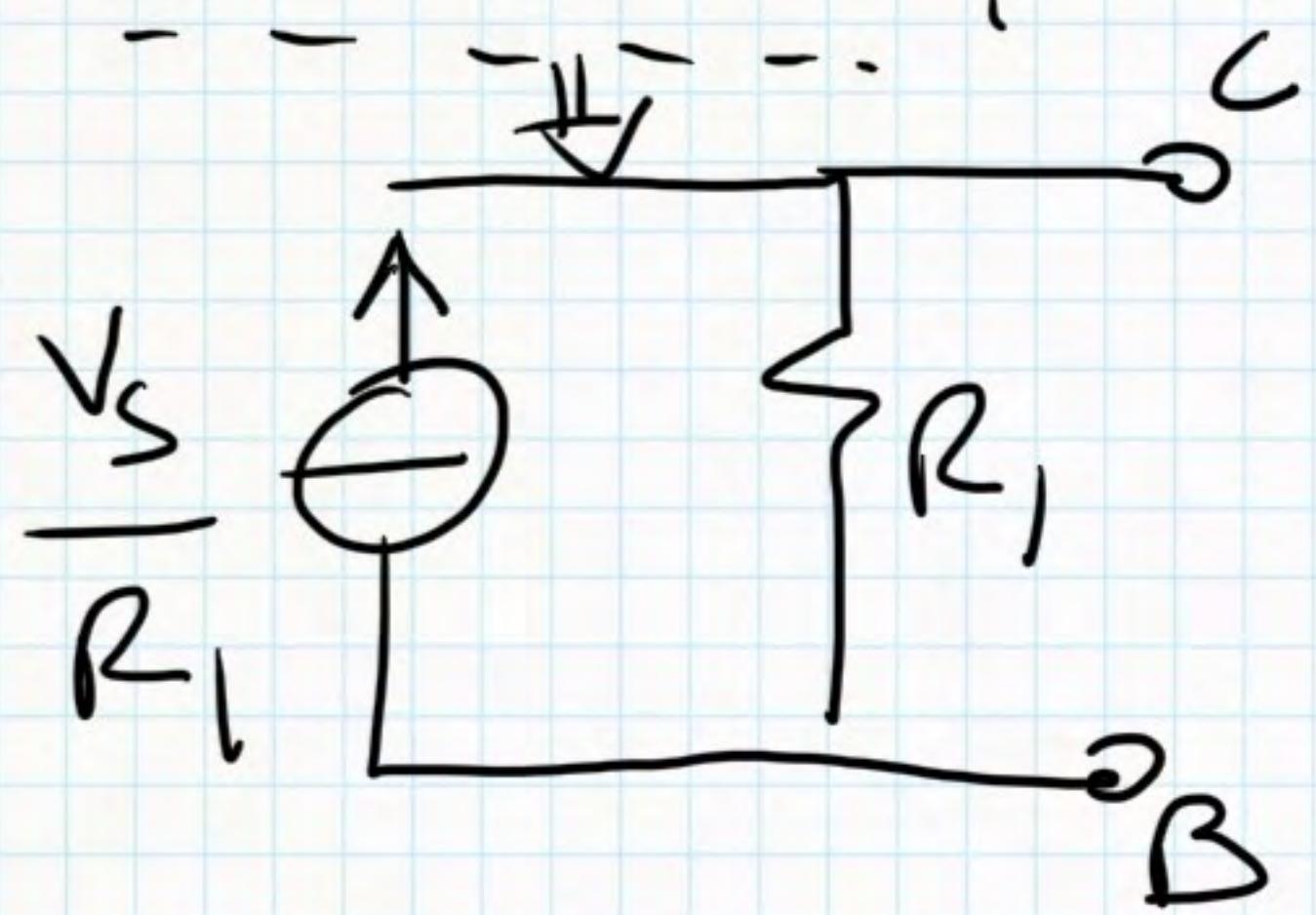


$$I = \frac{V_{TH}}{R_{EQ} + R_L} = \frac{3}{2} A$$

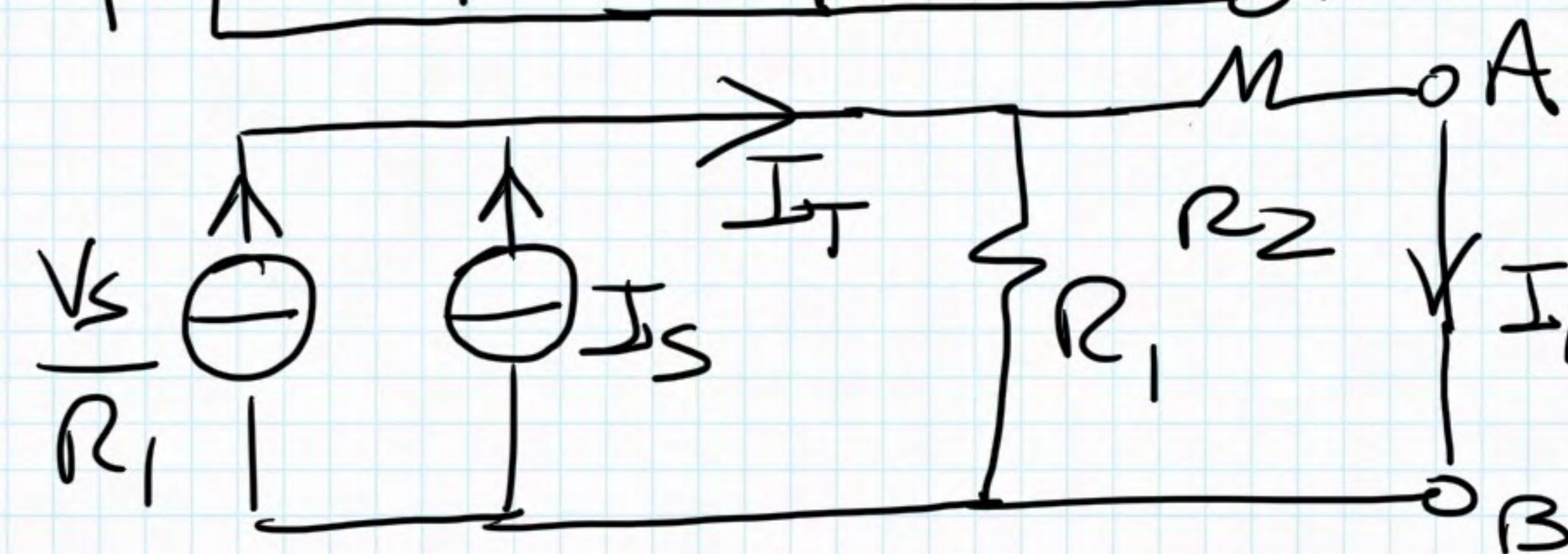
NORTON



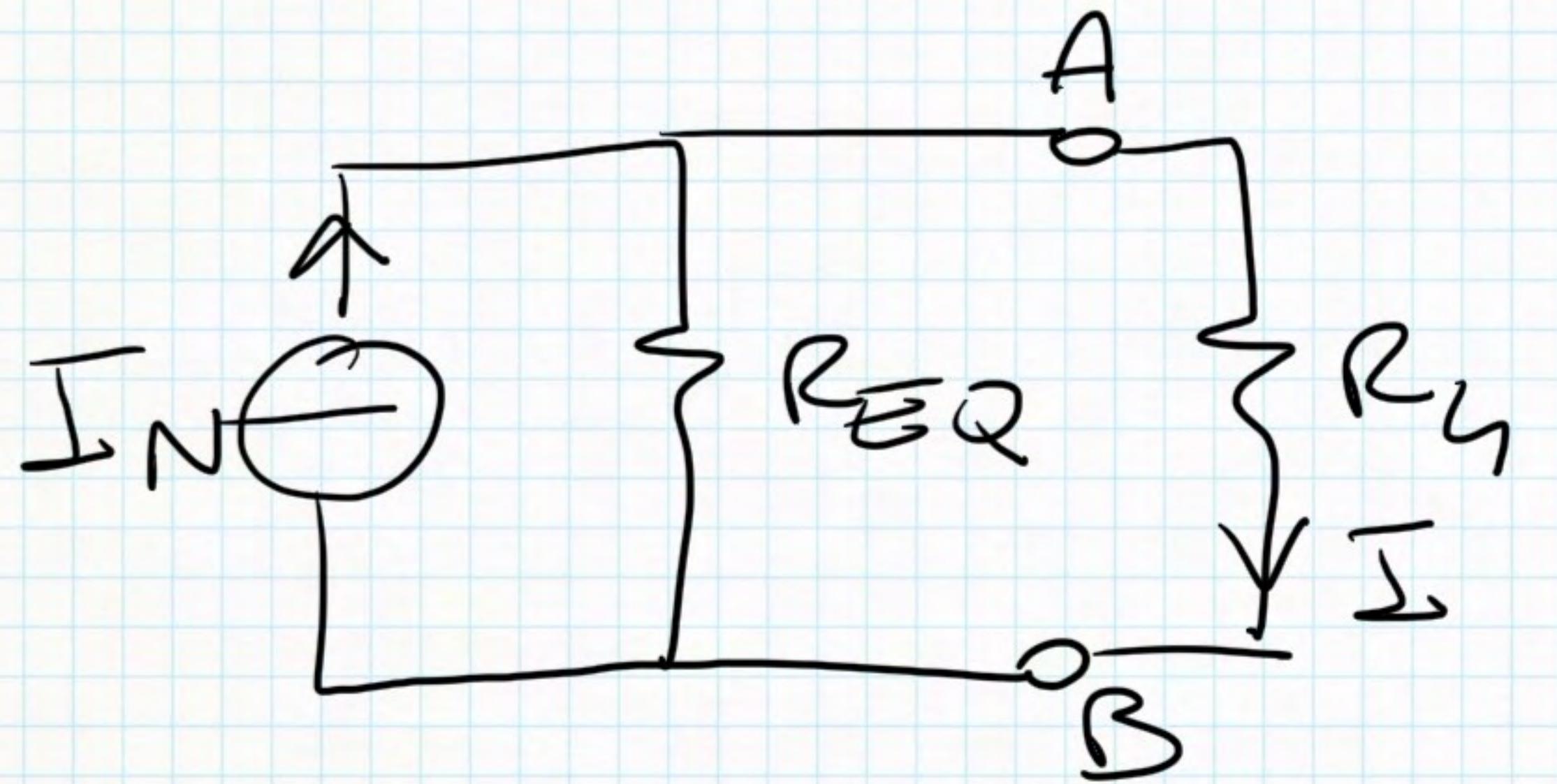
$$I_3 = 0A!$$



$$I_T = \frac{V}{R_1} + I_S$$

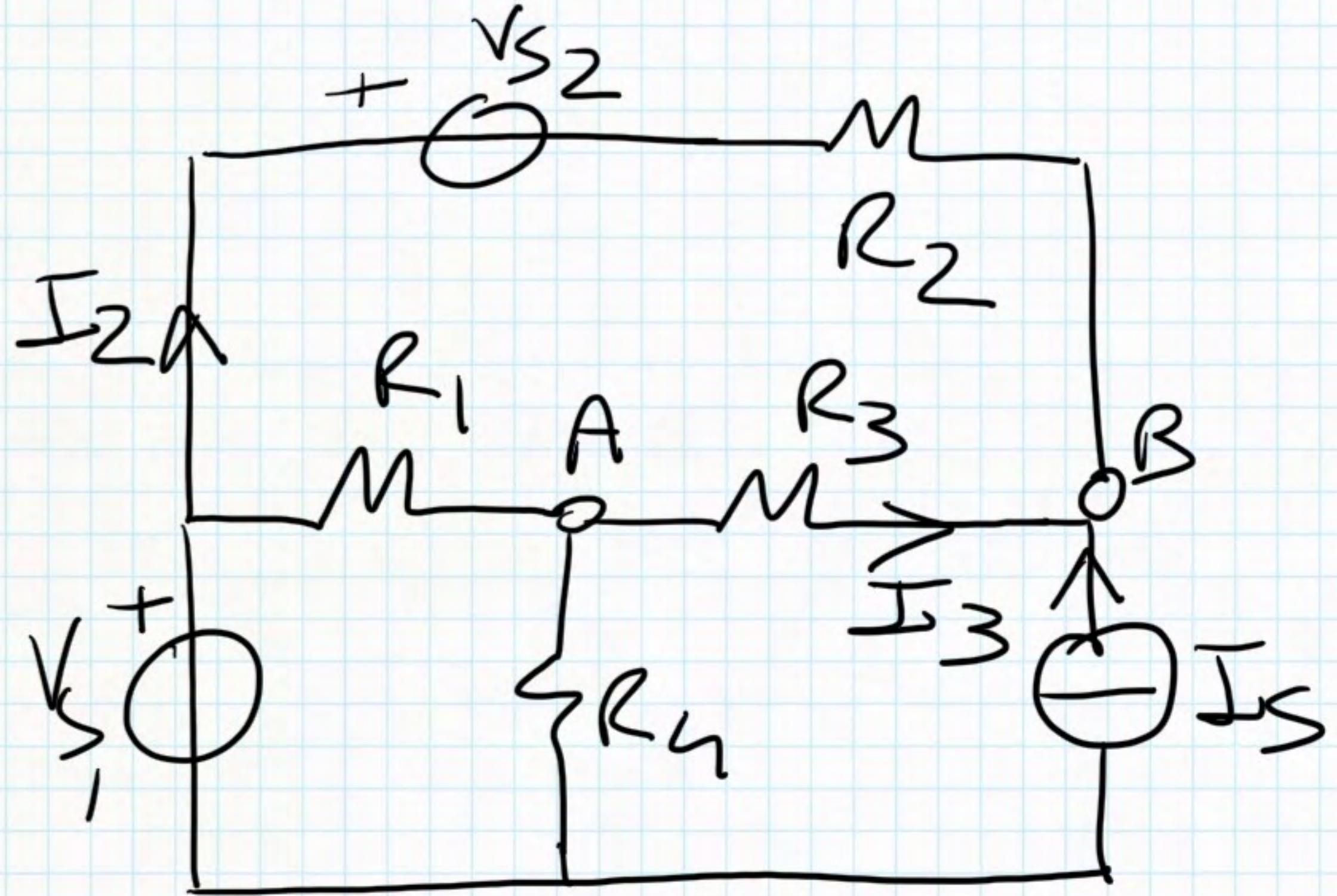


$$I_N = I_T \frac{R_1}{R_1 + R_2} = 2A$$



$$I = I_N \frac{R_{EQ}}{R_{EQ} + R_L} = \frac{3}{2} \text{ A}$$

ESE 16



NORTON + PSE

$$V_{S1} = 6 \text{ V}$$

$$V_{S2} = 10 \text{ V}$$

$$I_S = 2 \text{ A}$$

$$R_1 = 6 \Omega$$

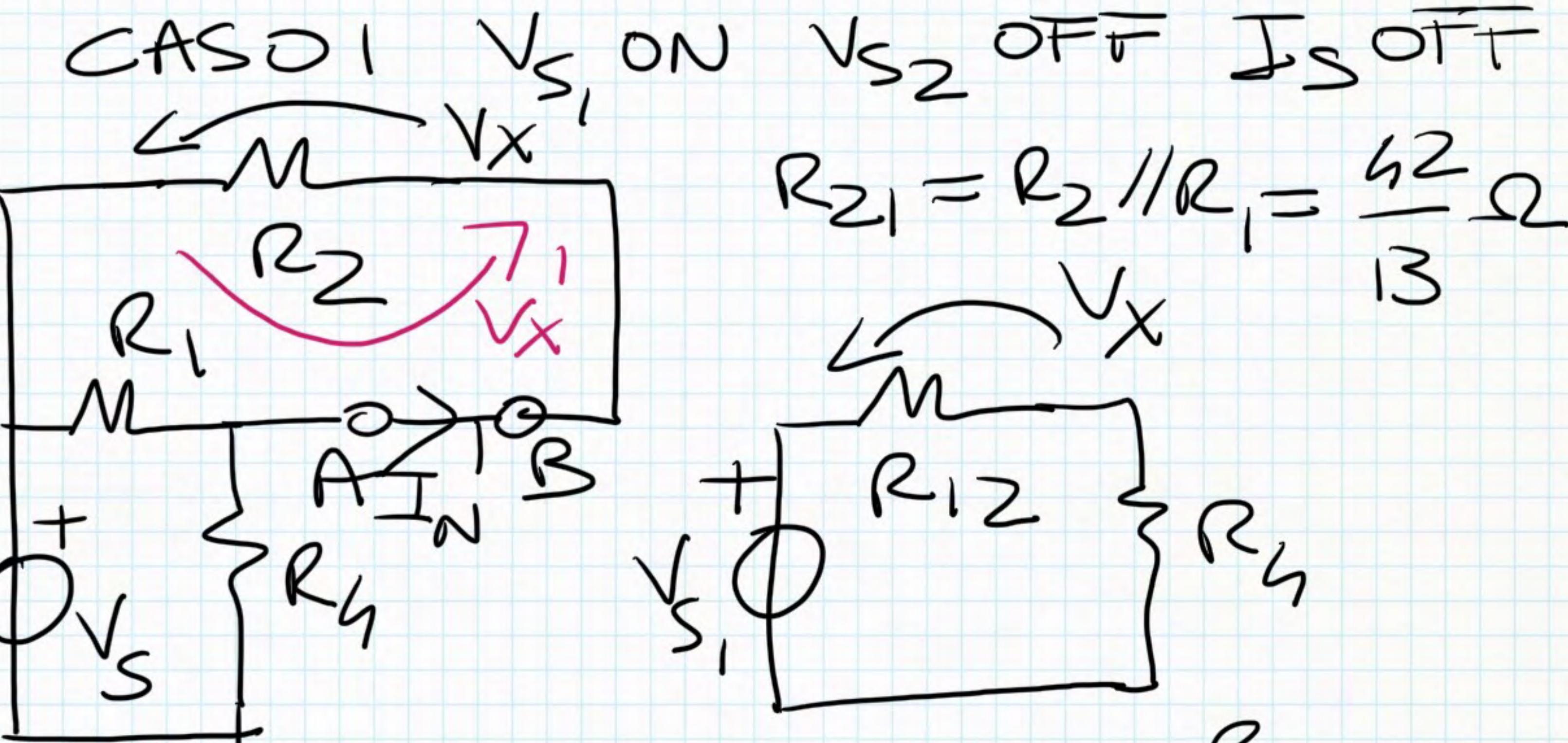
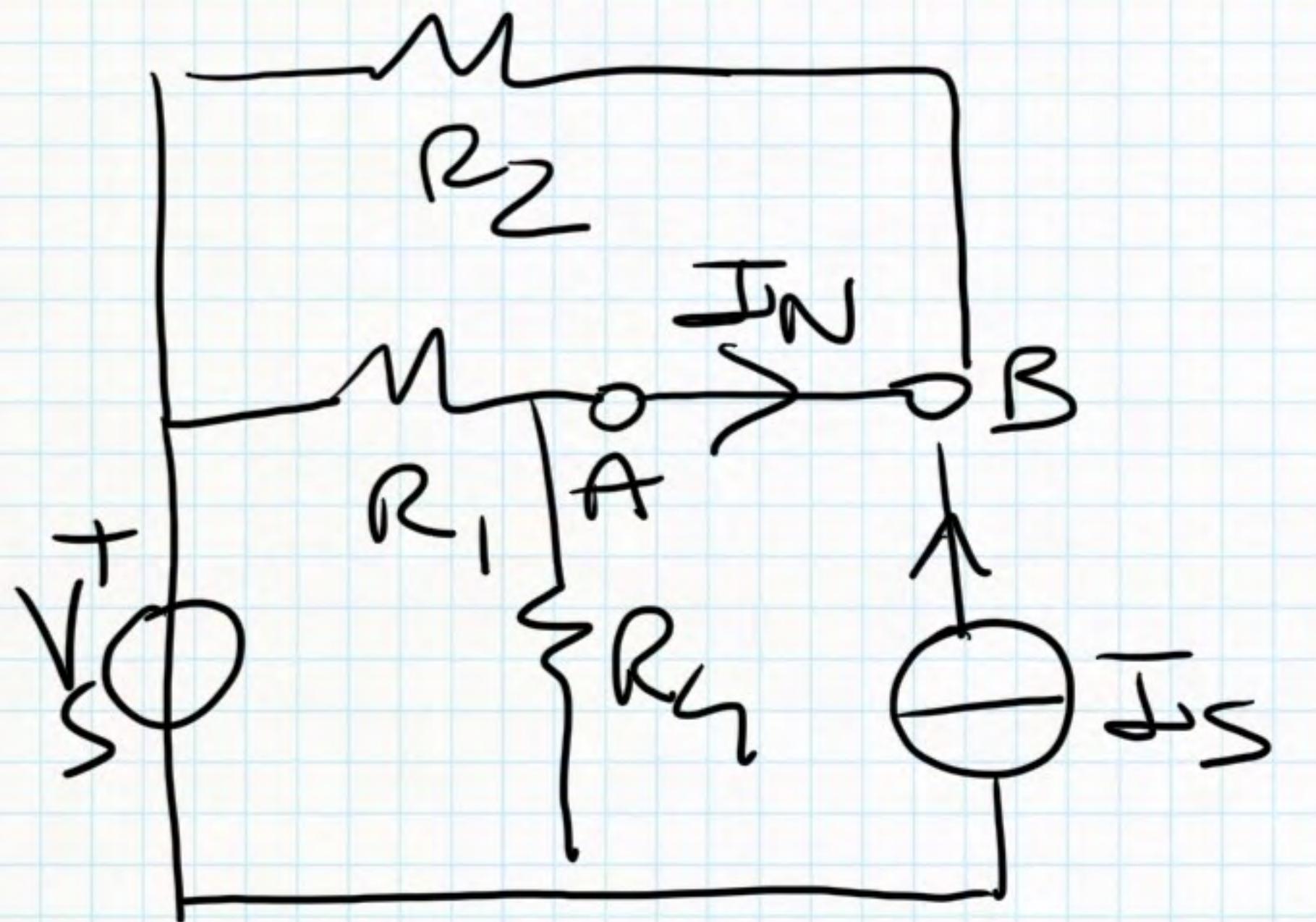
$$R_2 = 7 \Omega$$

$$R_3 = 5 \Omega$$

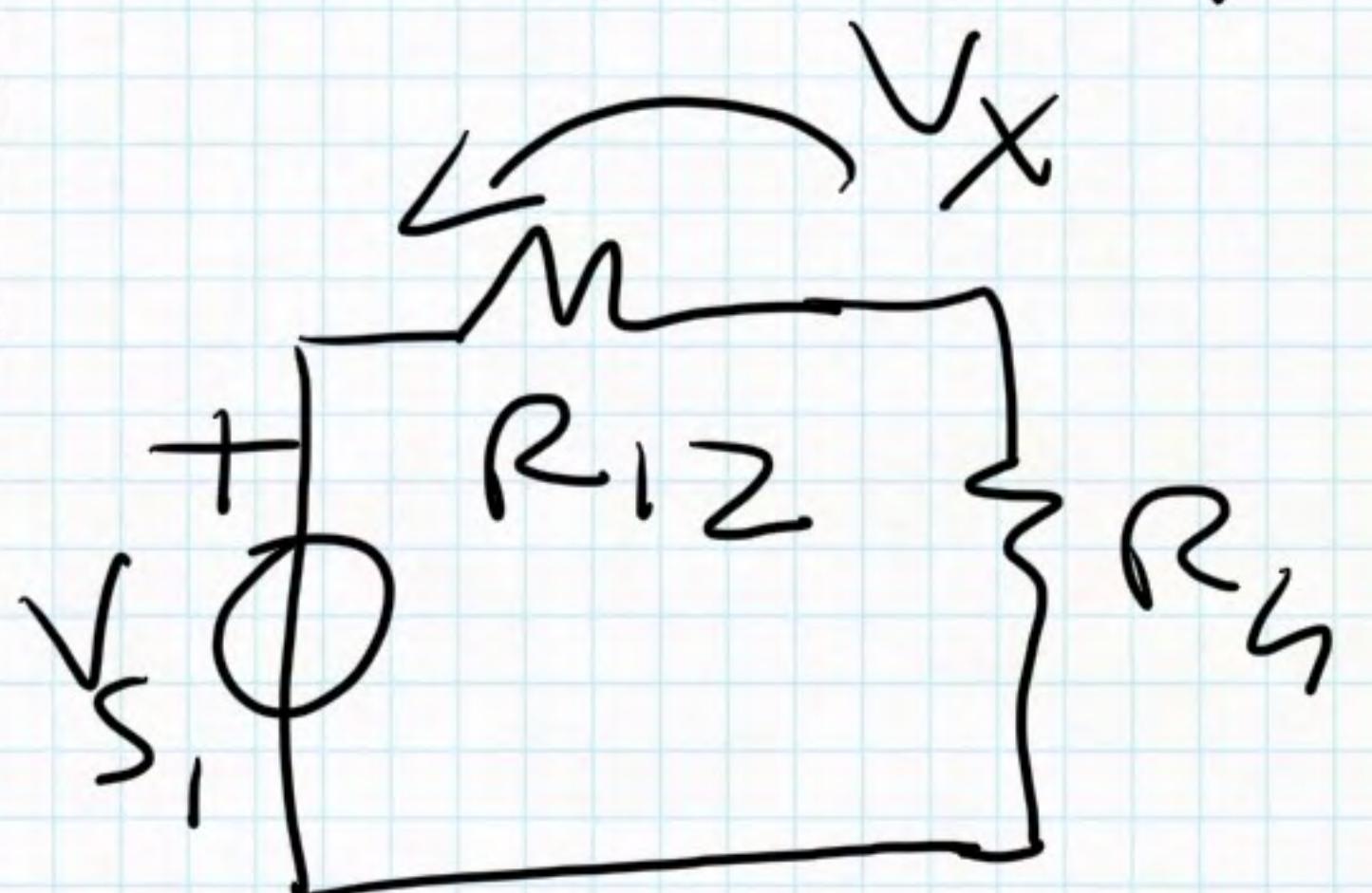
$$R_4 = 3 \Omega$$

$$I_3 = ? \quad P_{R3} = ?$$

$$I_2 = ? \quad P_{VS2} = ?$$



$$R_{21} = R_2 // R_1 = \frac{42}{13} \Omega$$



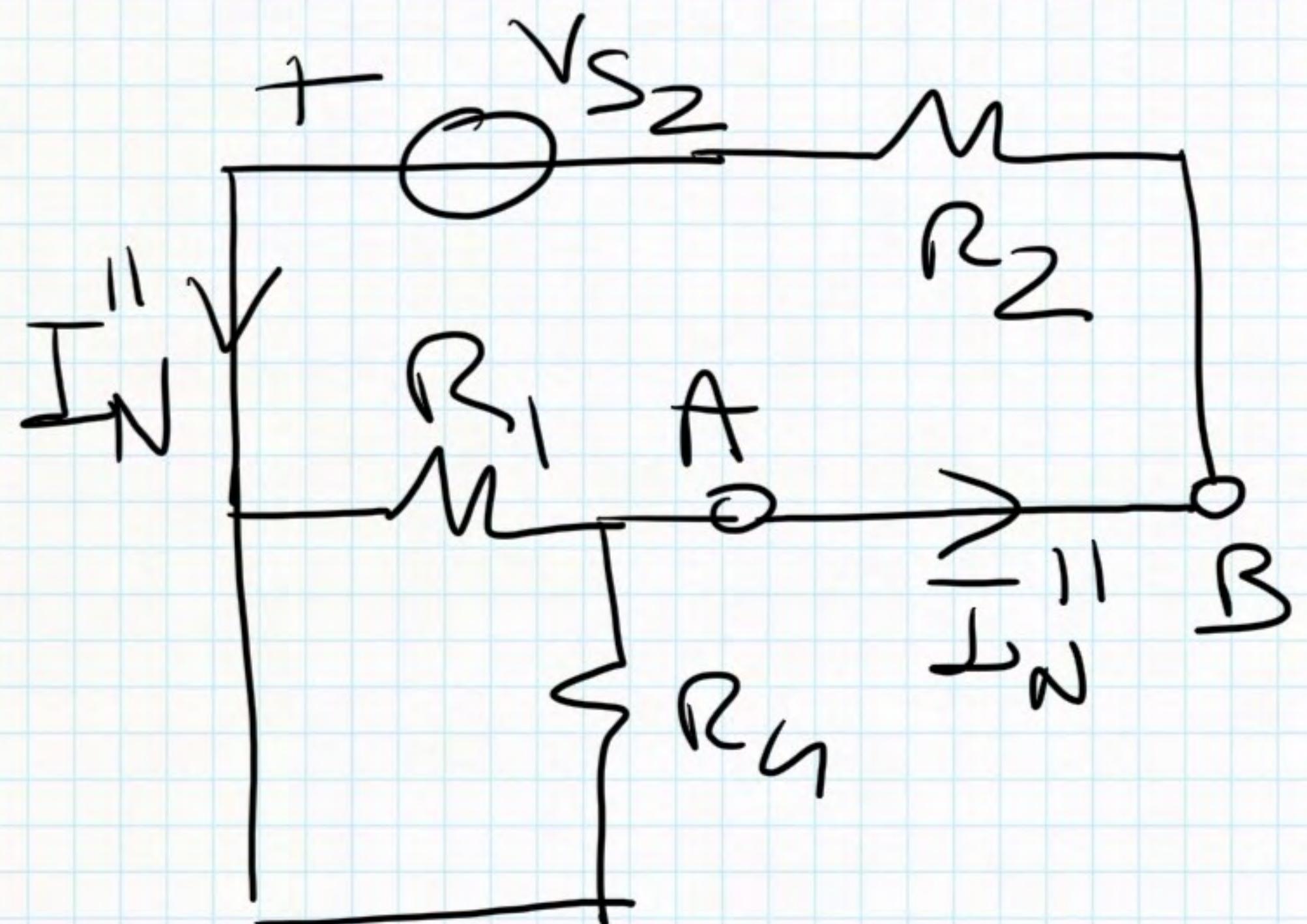
$$V_x = V_{S1} \frac{R_{21}}{R_{21} + R_L} =$$

$$= \frac{28}{13} V$$

$$I_N = \frac{V_x}{R_2} = - \frac{V_x}{42} = - \frac{4}{9} A$$

CASO 2 V_{S1} OFF

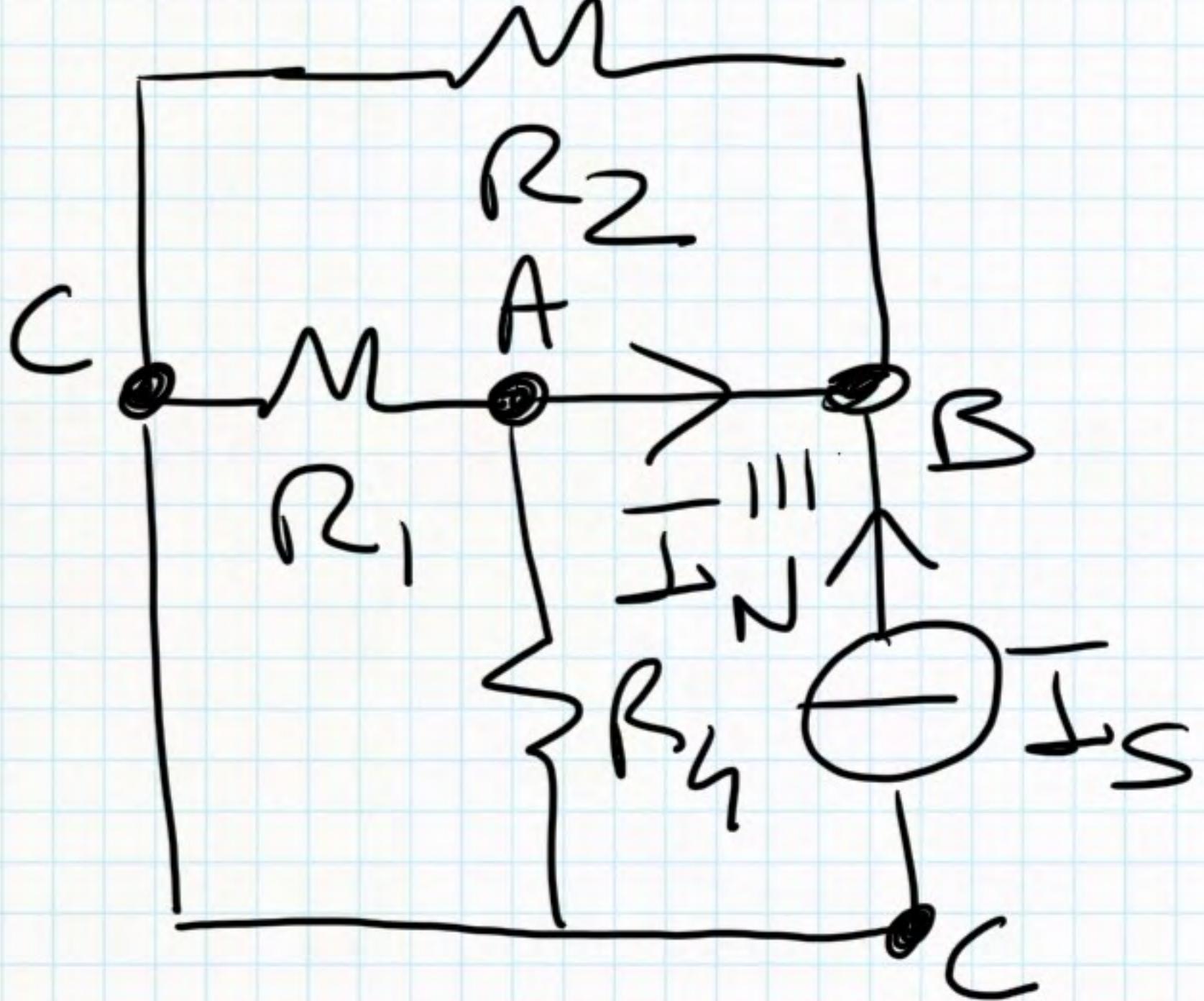
V_{S2} ON I_S OFF



$$R_1 // R_H = 2 \Omega$$

$$I_N'' = \frac{V_{S2}}{R_2 + R_1 // R_H} = \frac{10}{3} \text{ A}$$

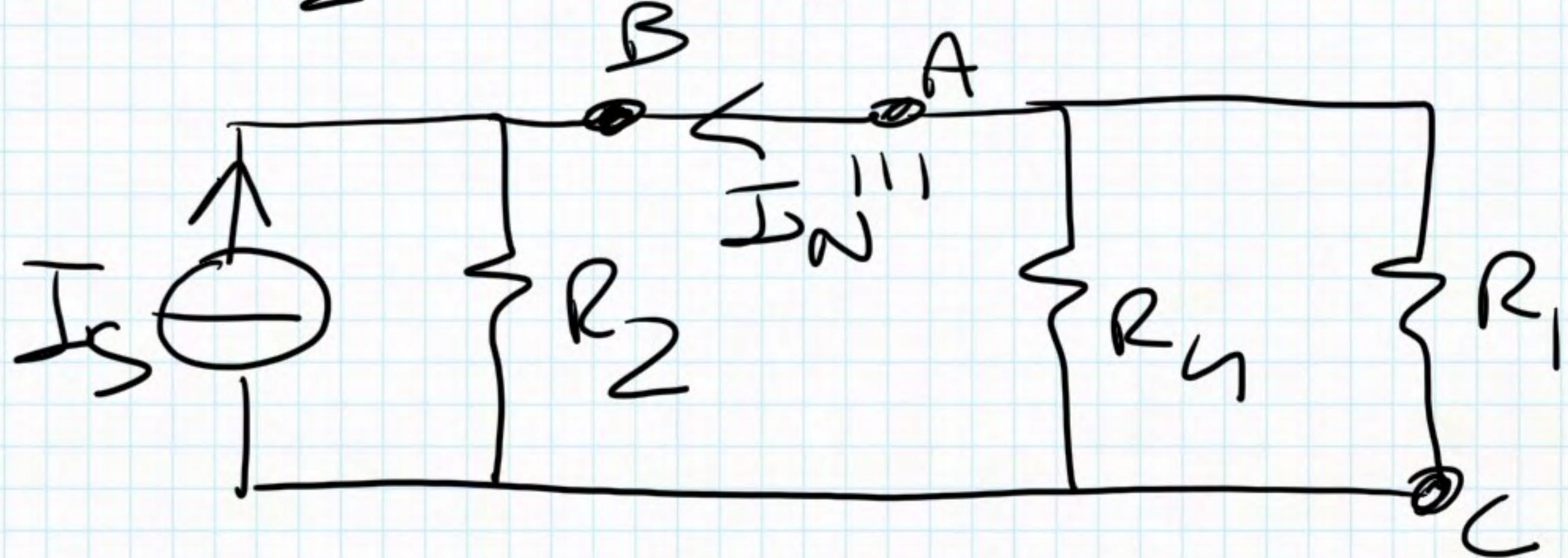
CASO 3



V_{S1} OFF

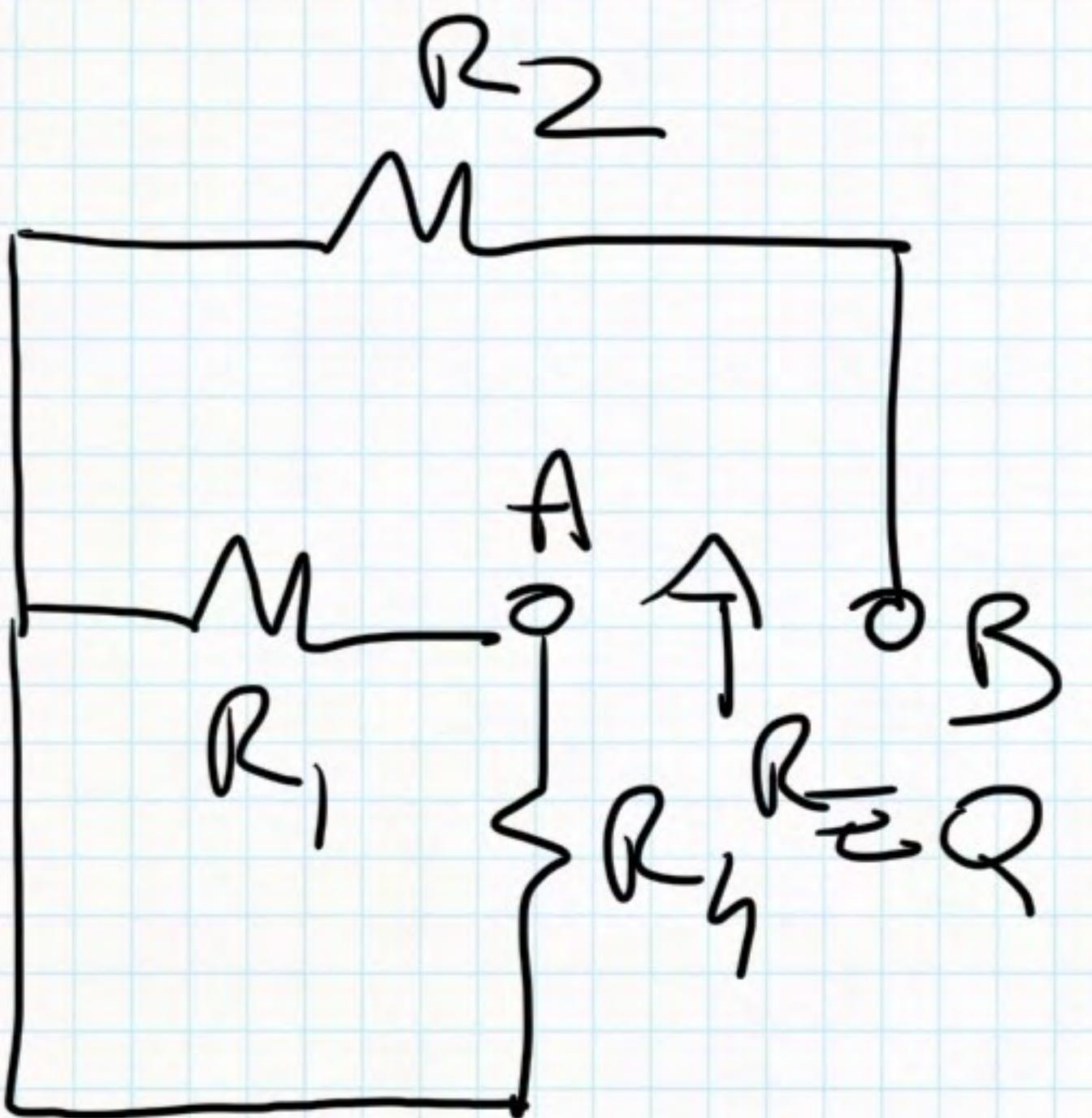
V_{S2} OFF

I_S ON

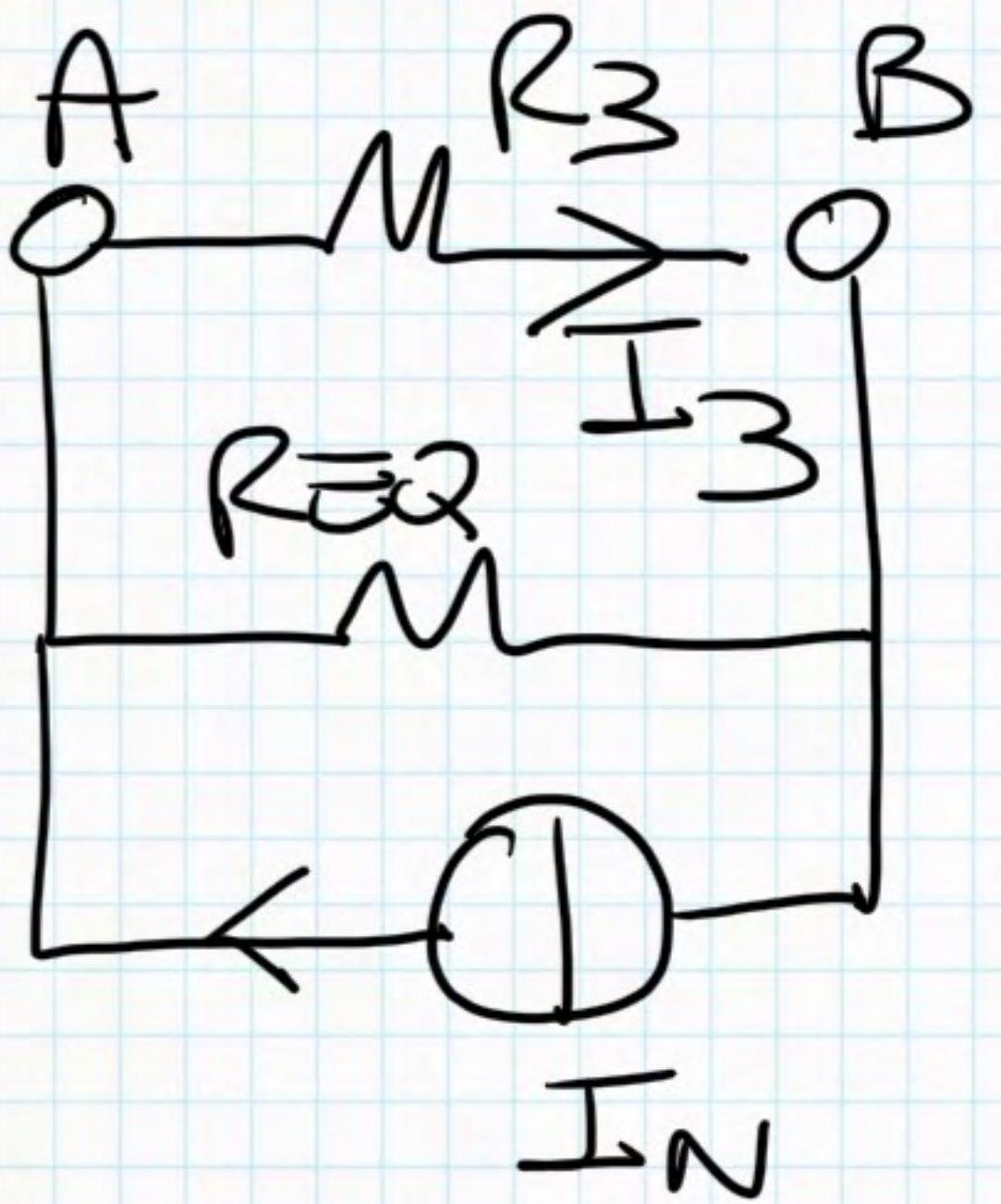


$$I_N''' = -I_S \frac{R_2}{R_2 + R_1 // R_N} = -\frac{14}{3} A$$

$$I_N = I_N' + I_N'' + I_N''' = -\frac{8}{3} A$$



$$R_{EQ} = R_2 + R_1 // R_3 = 9\Omega$$



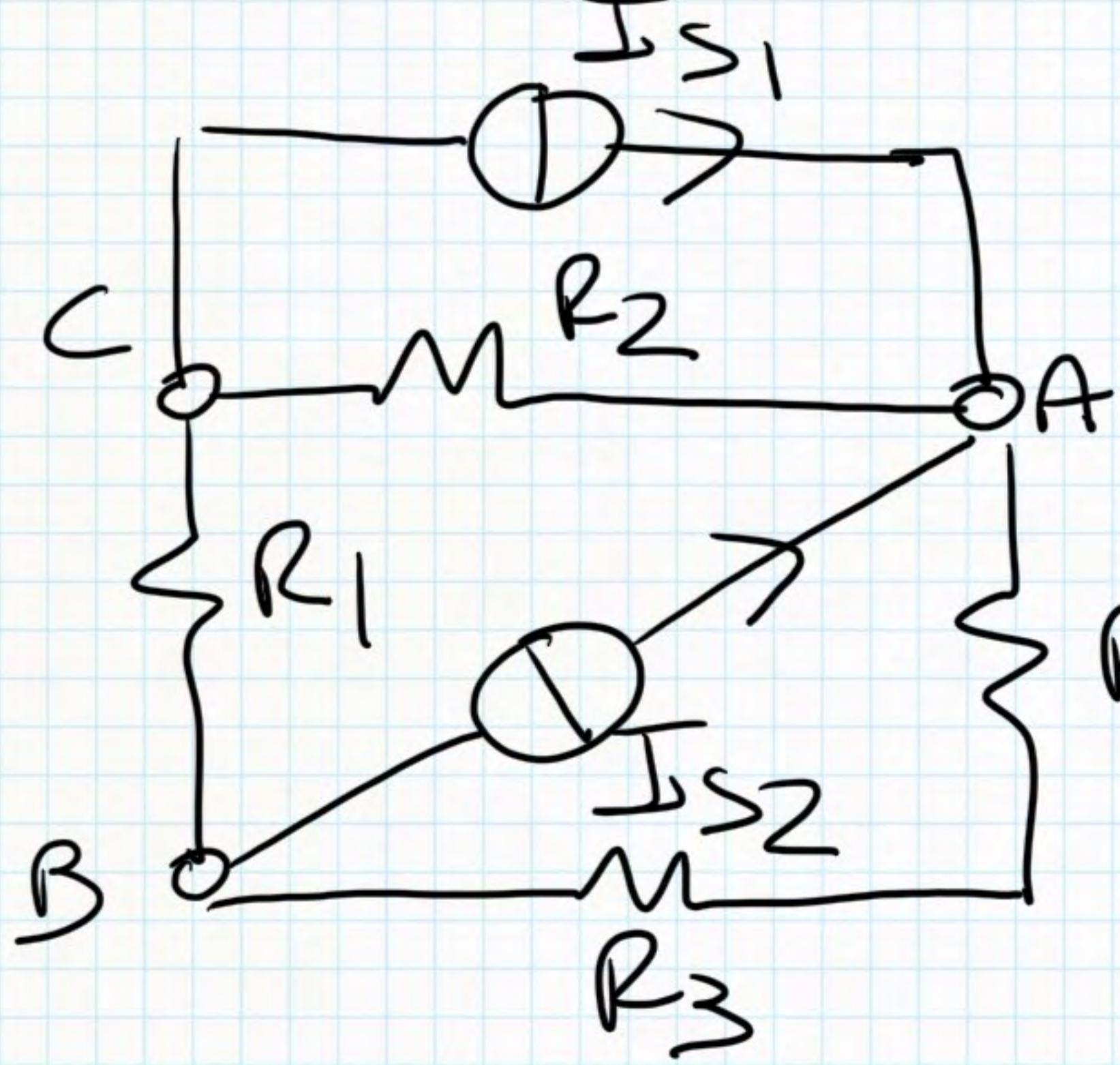
$$I_3 = I_N \frac{R_{EQ}}{R_3 + R_{EQ}} = -\frac{1}{7} A$$

$$\text{LKC B: } I_2 + I_3 + I_s = 0 \Rightarrow I_2 = -I_s - I_3 = -\frac{10}{7} A$$

$$P_{R_3} = R_3 I_3^2 = \frac{80}{49} W$$

$$P_{V_{S2}} = V_2 I_2 = -\frac{100}{7} W \text{ (POTENZA EROGATA)}$$

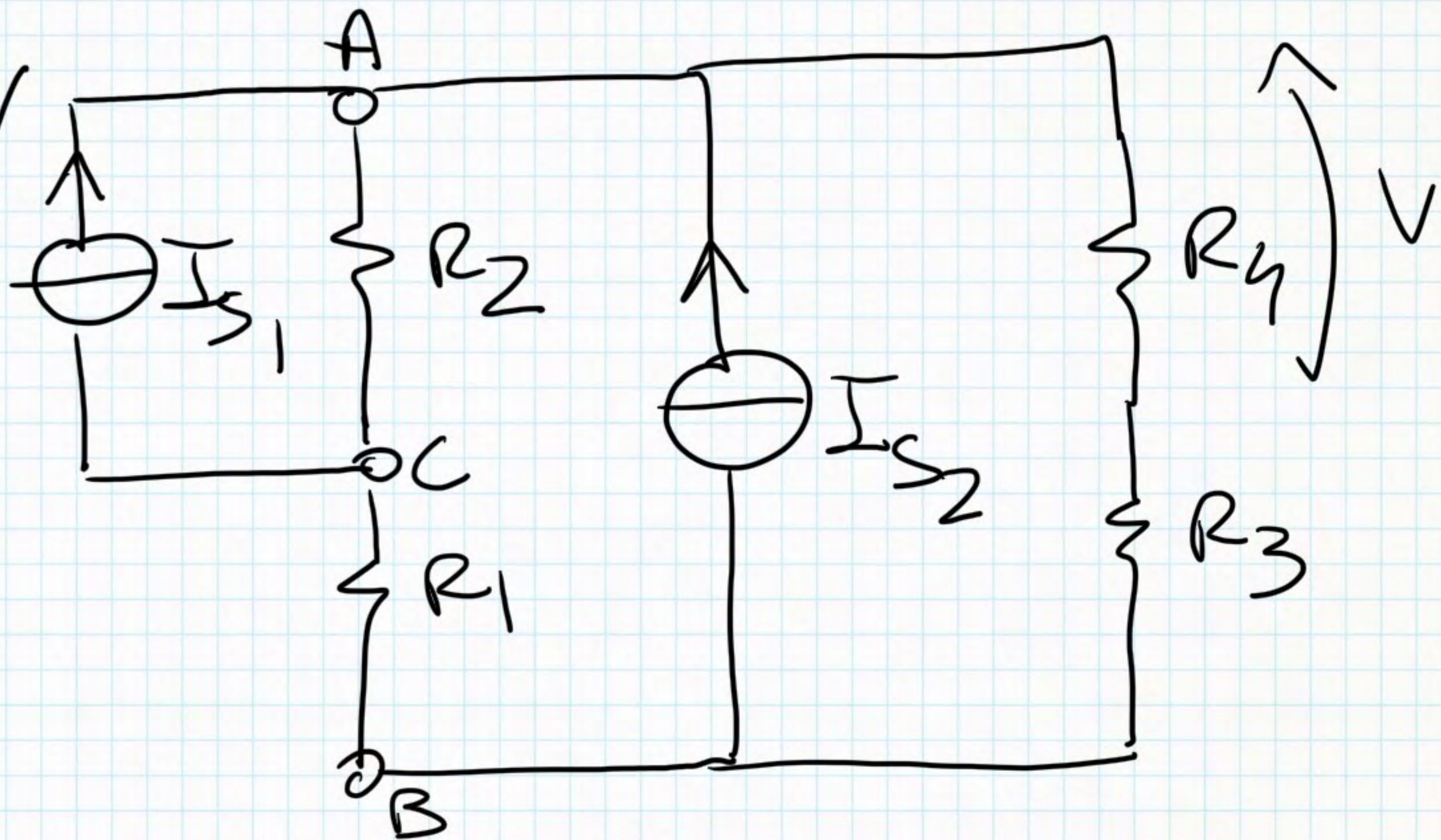
$E \leq 17$



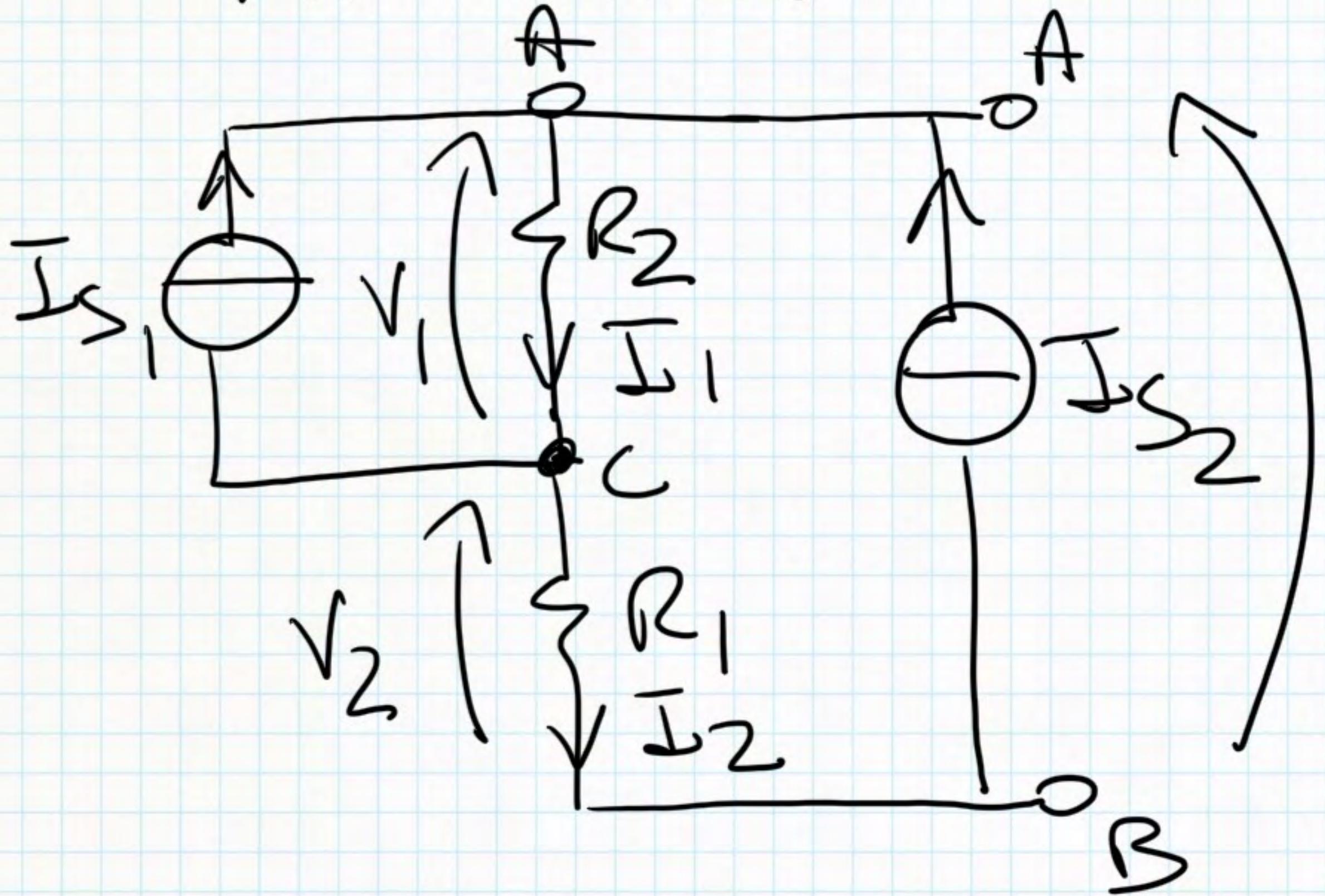
$$I_{S1} = I_{S2} = 3A$$

$$R_1 = R_2 = R_3 = R_4 = 4\Omega$$

$$V = ?$$



THE VENIN



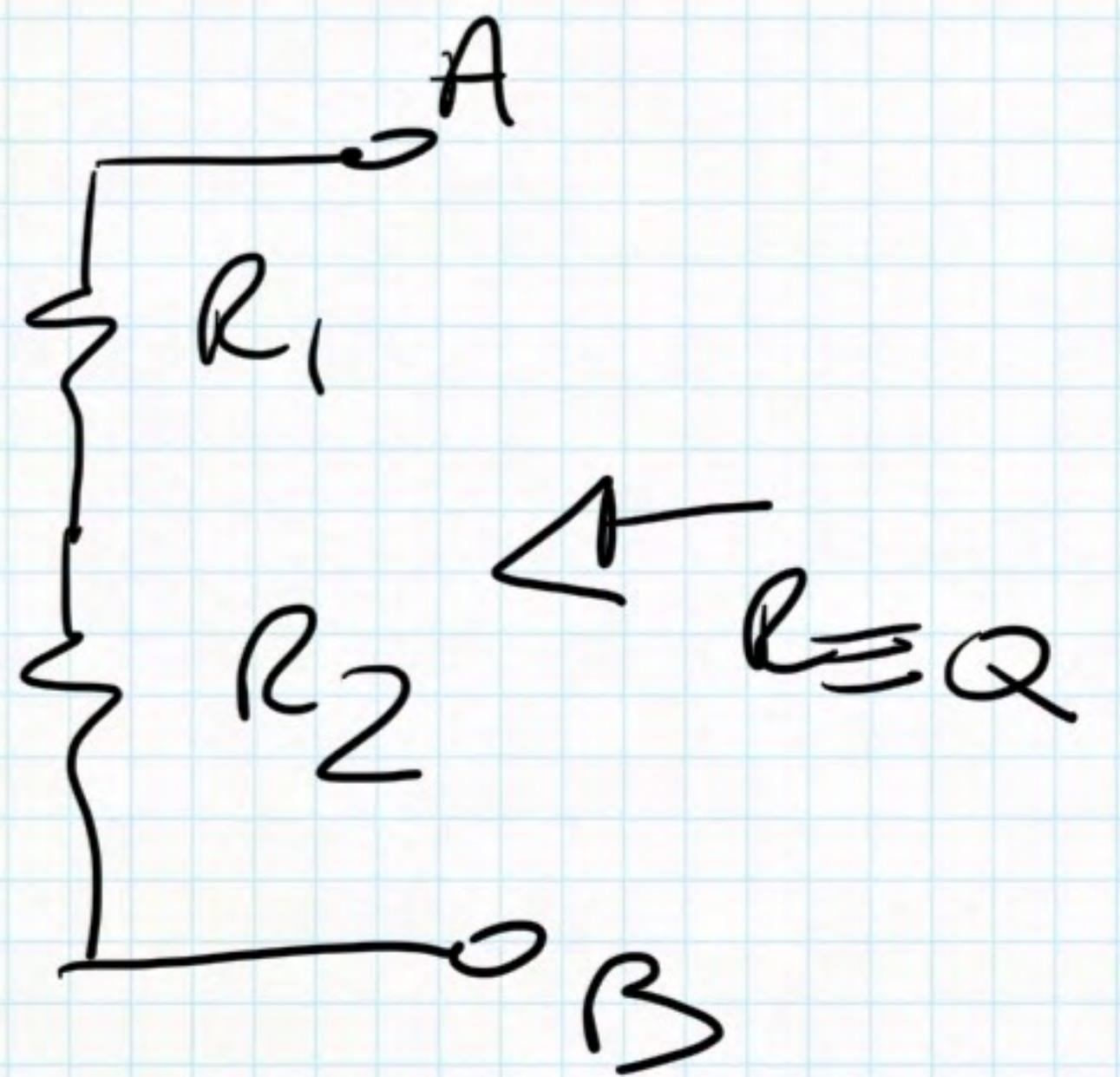
$$\text{LKCA: } I_{S_2} + I_{S_1} = I_1 = 6A$$

$$\begin{aligned}\text{LKC C: } I_1 &= I_2 + I_{S_1} \Rightarrow \\ V_{TH} &\Rightarrow I_2 = I_1 - I_{S_1} = 3A\end{aligned}$$

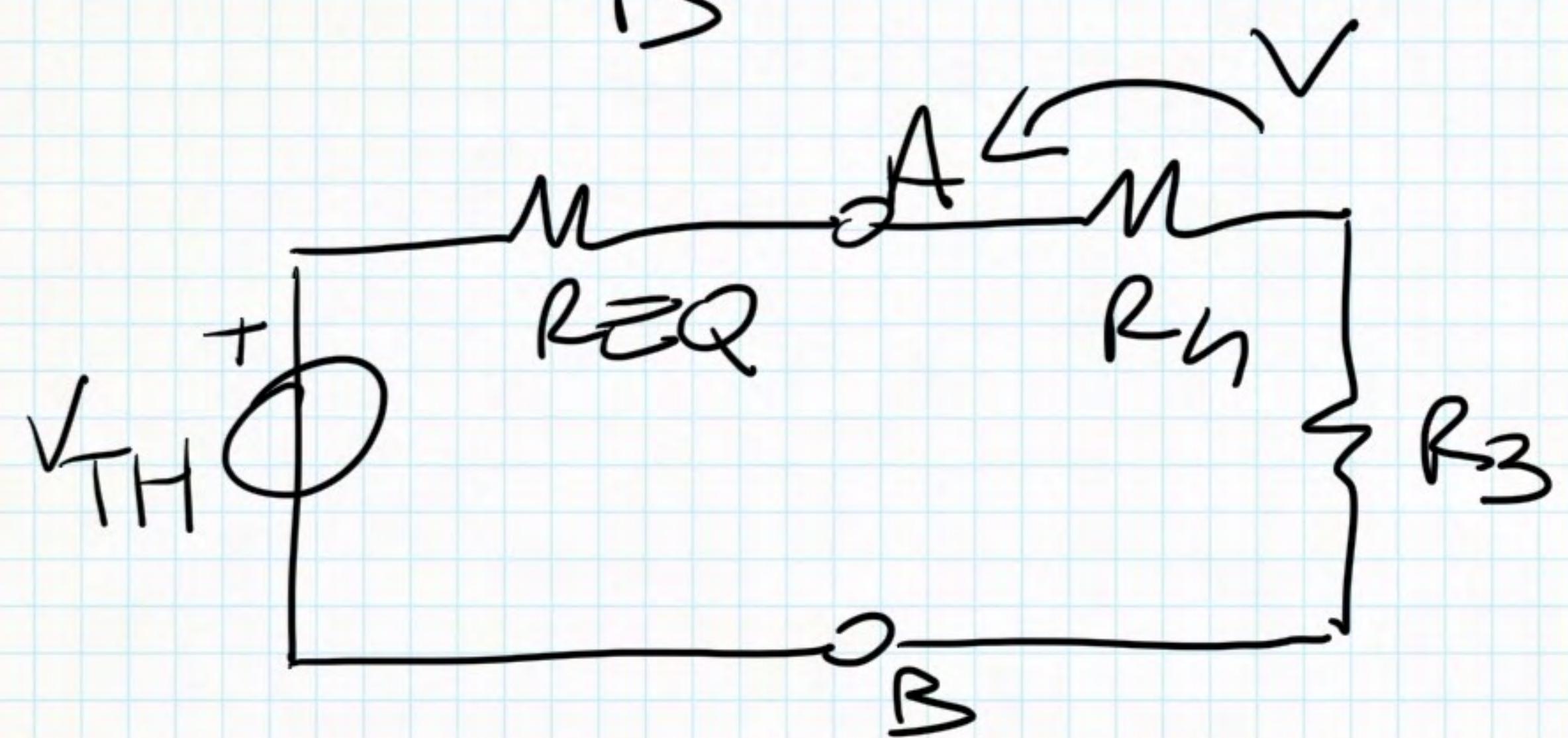
$$V_1 = I_1 R_2 = 2 \times 12 = 24V$$

$$V_2 = I_2 R_1 = 12V$$

$$V_{TH} = 36V$$



$$R_{EQ} = R_1 + R_2 = 8\Omega$$



$$V = V_{TH} \frac{R_H}{R_{EQ} + R_H + R_B} = 9V$$