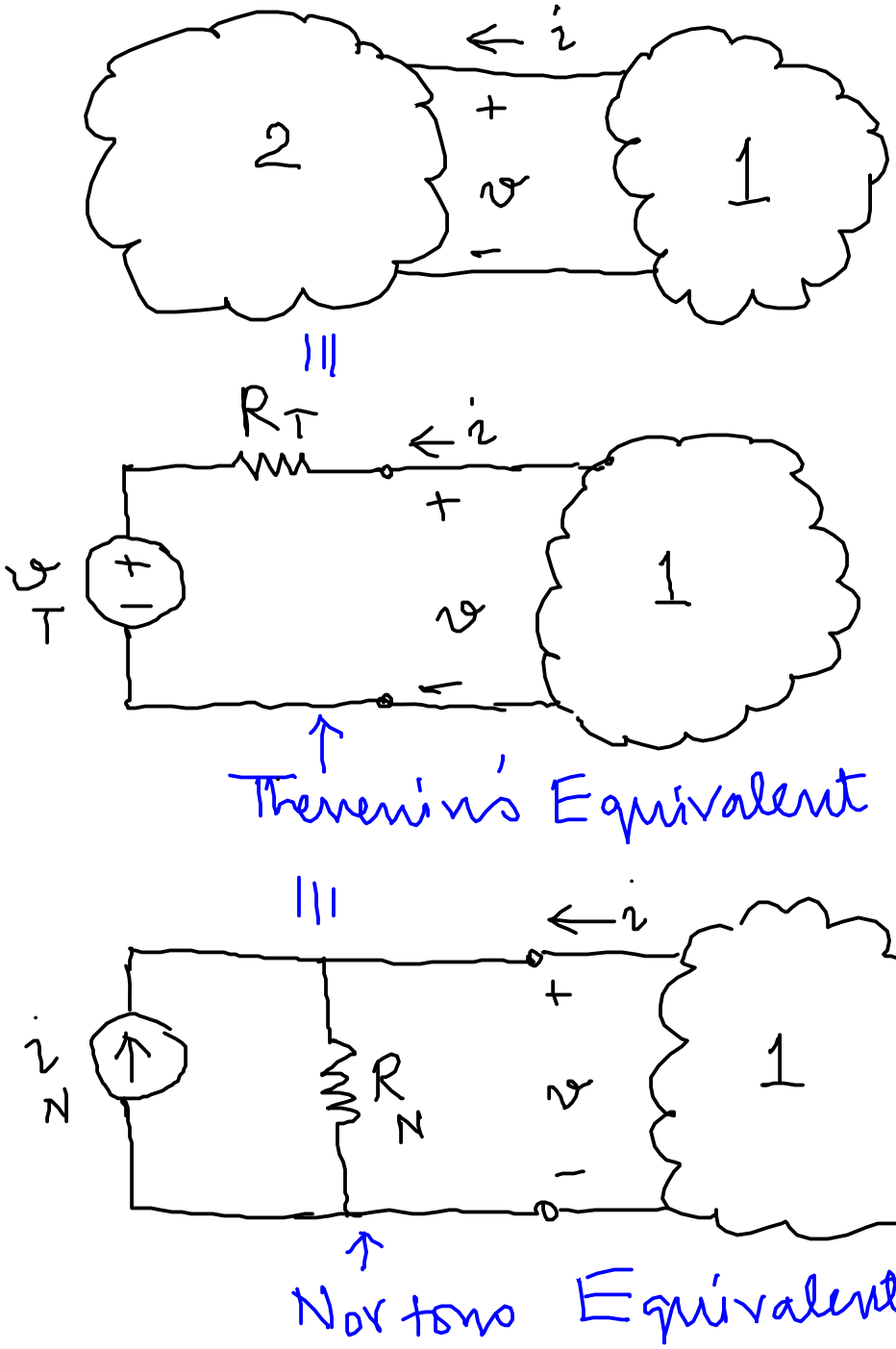
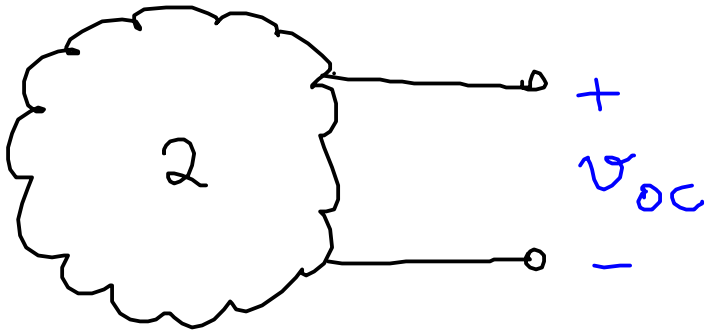
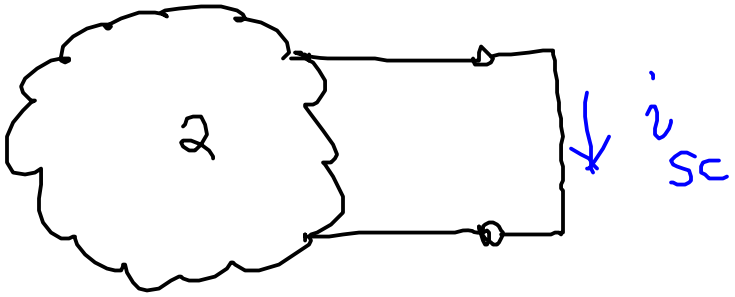
Equivalent Circuits



Determining v_T, i_N, R_T, R_N

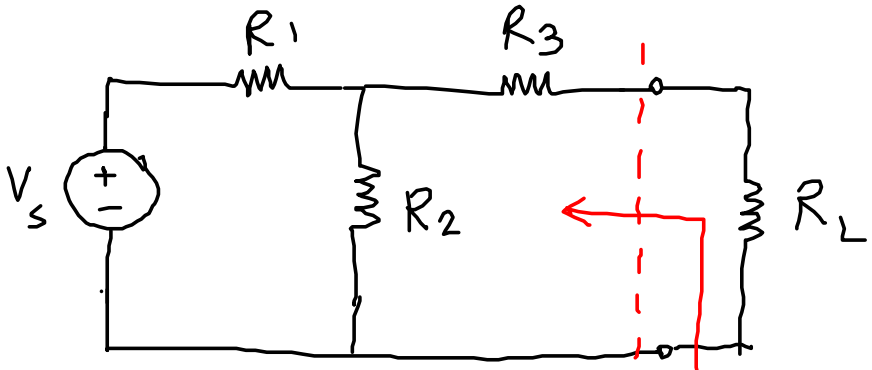




$$v_T = v_{oc}$$

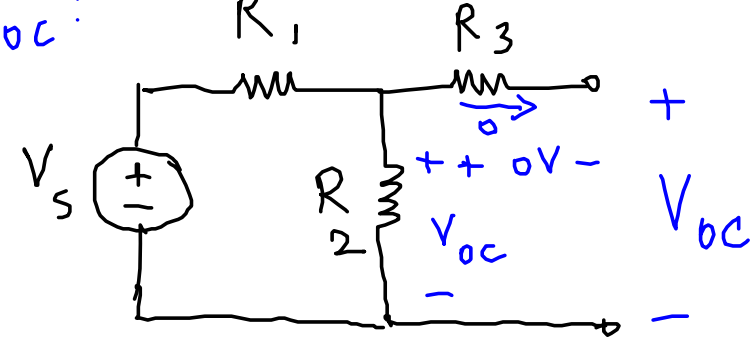
$$i_N = i_{sc}$$

$$R_T = R_N = \frac{v_{oc}}{i_{sc}}$$



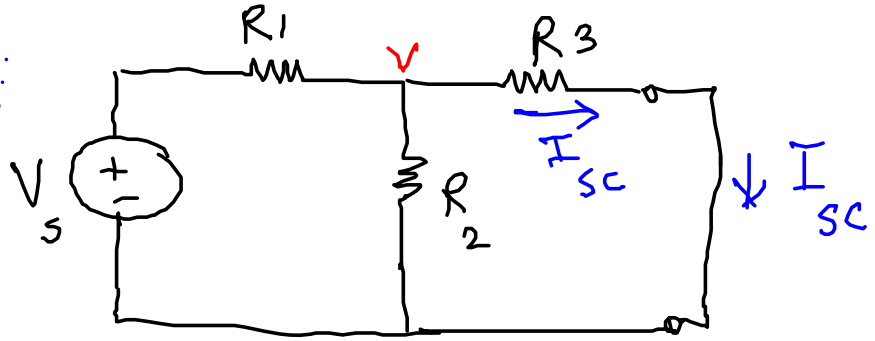
T & N equivalent

V_{OC}:



$$V_{OC} = \frac{R_2}{R_1 + R_2} V_S$$

I_{SC}:

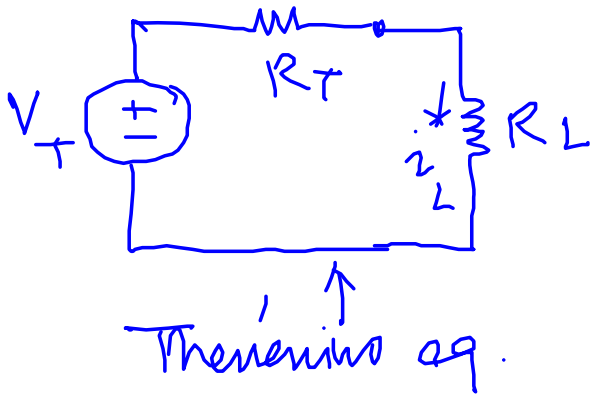


$$\frac{V_S - V}{R_1} + \frac{0 - V}{R_2} + \frac{0 - V}{R_3} = 0$$

find V

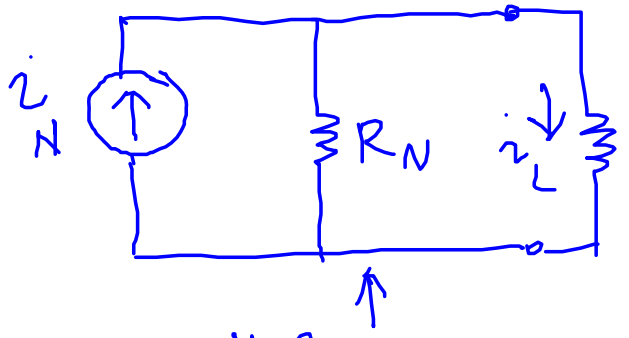
$$I_{SC} = \frac{V - 0}{R_3}$$

$V_T = v_{OC}$, $I_N = i_{SC}$, $R_N = R_T = \frac{v_{OC}}{i_{SC}}$



$$i_L = \frac{V_T}{R_T + R_L}$$

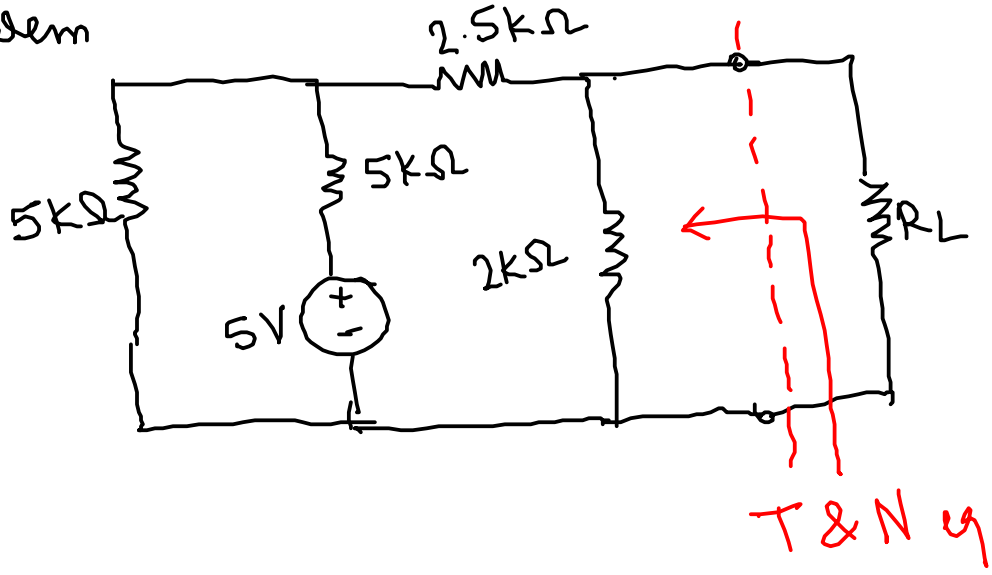
Thevenin eq.



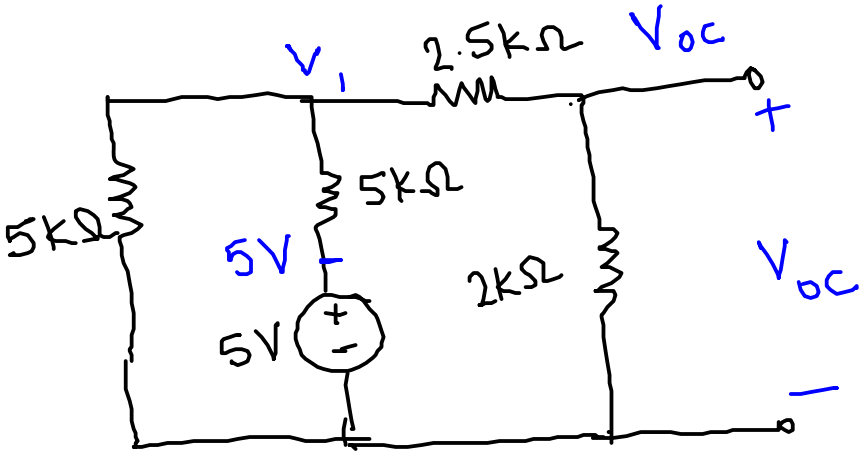
$$i_L = \frac{\frac{1}{R_L}}{\frac{1}{R_N} + \frac{1}{R_L}} i_N$$

Norton eq.

Problem



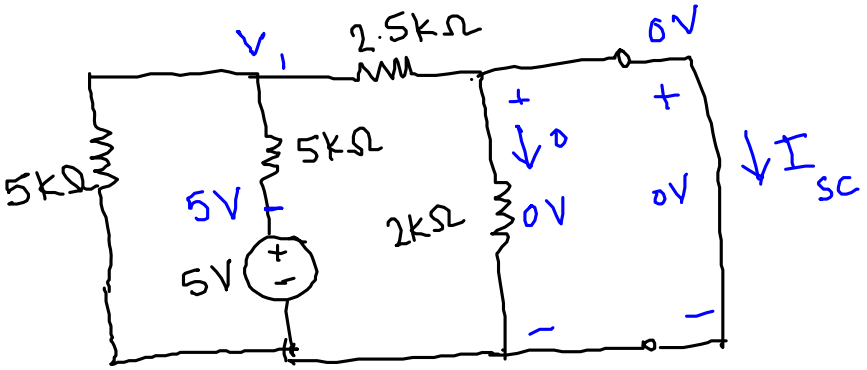
T & N eq.



$$\frac{0 - V_1}{5k\Omega} + \frac{5V - V_1}{5k\Omega} + \frac{V_{oc} - V_1}{2.5k\Omega} = 0$$

$$\frac{V_1 - V_{oc}}{2.5k\Omega} + \frac{0 - V_{oc}}{2k\Omega} = 0$$

find V_1 & V_{oc}

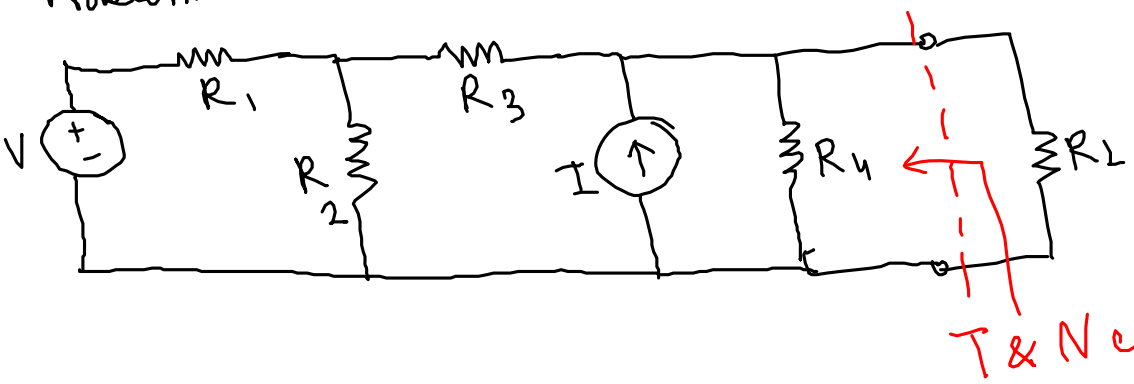


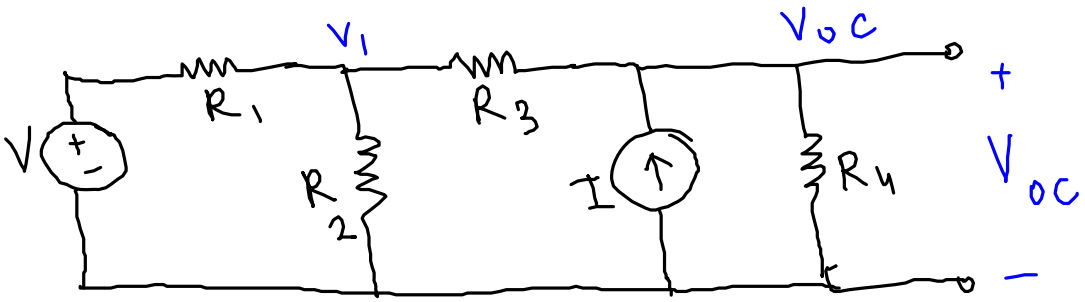
$$I_{sc} = \frac{V_1 - 0}{2.5k\Omega}$$

$$\frac{0 - V_1}{5K} + \frac{5 - V_1}{5K} + \frac{0 - V_1}{2.5K} = 0 \qquad \text{find } V_1$$

$$I_{sc} = \frac{V_1}{2.5k\Omega}$$

Problem

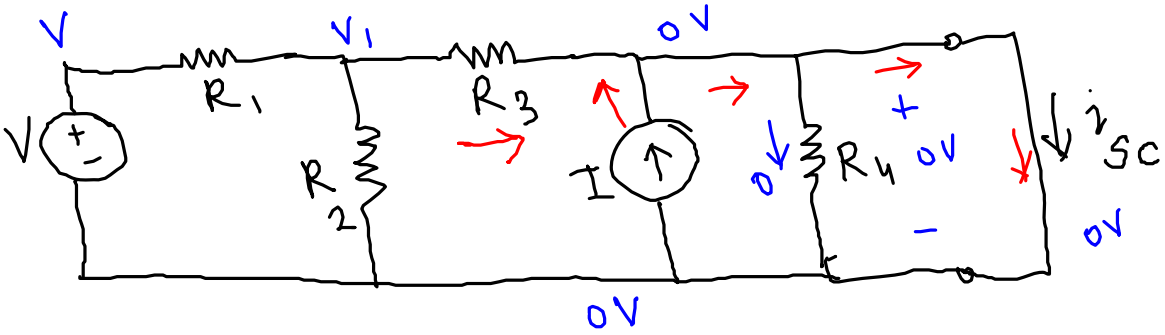




$$\frac{V - V_1}{R_1} + \frac{0 - V_1}{R_2} + \frac{V_{oc} - V_1}{R_3} = 0$$

$$\frac{V_1 - V_{oc}}{R_3} + I + \frac{0 - V_{oc}}{R_4} = 0$$

find V_1 & V_{oc}



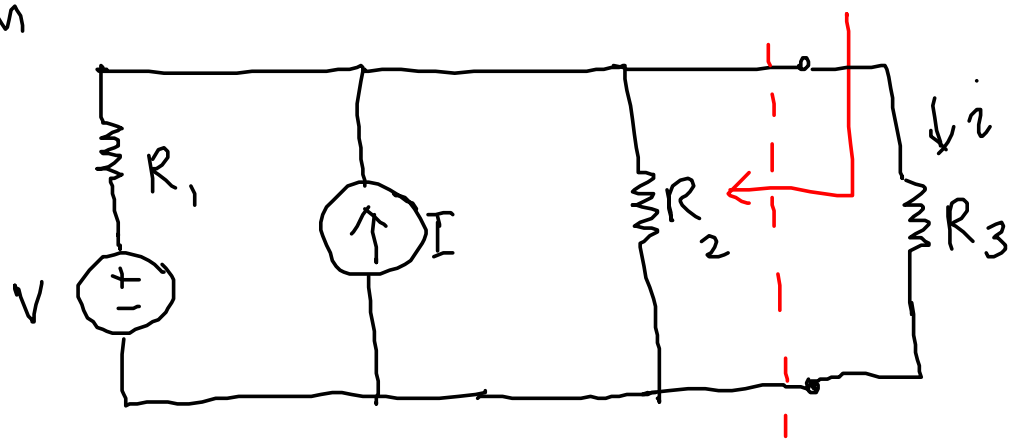
$$\frac{V - V_1}{R_1} + \frac{0 - V_1}{R_3} + \frac{0 - V_1}{R_2} = 0$$

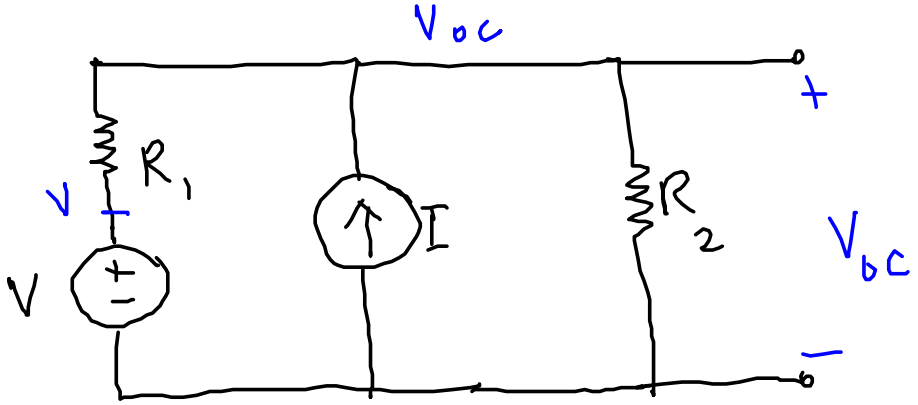
find V_1

$$i_{sc} = \frac{V_1 - 0V}{R_3} + I$$

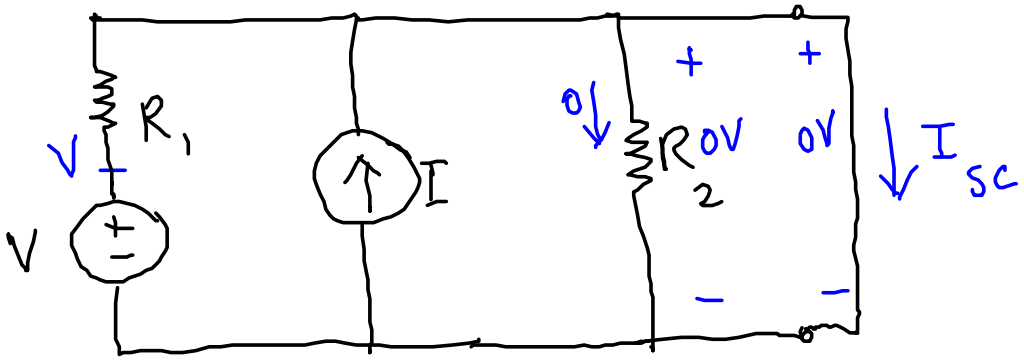
Problem

T & N eq.





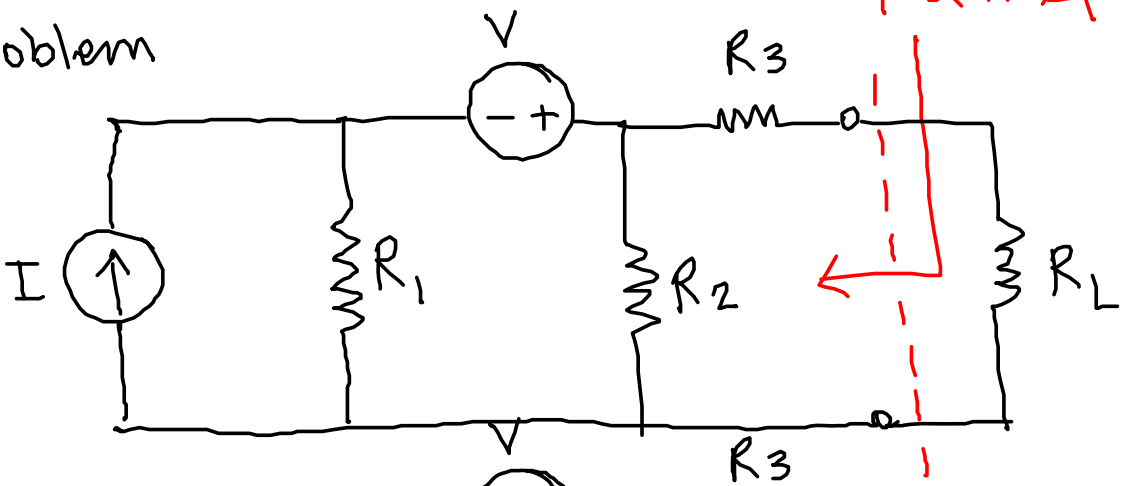
$$\frac{V - V_{oc}}{R_1} + I + \frac{0 - V_{oc}}{R_2} = 0 \qquad \text{find } V_{oc}$$

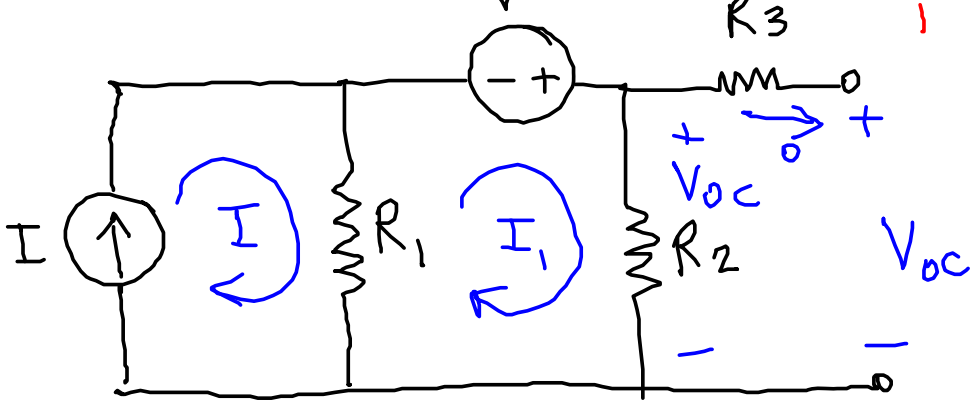


$$I_{sc} = \frac{V - 0}{R_1} + I$$

Problem

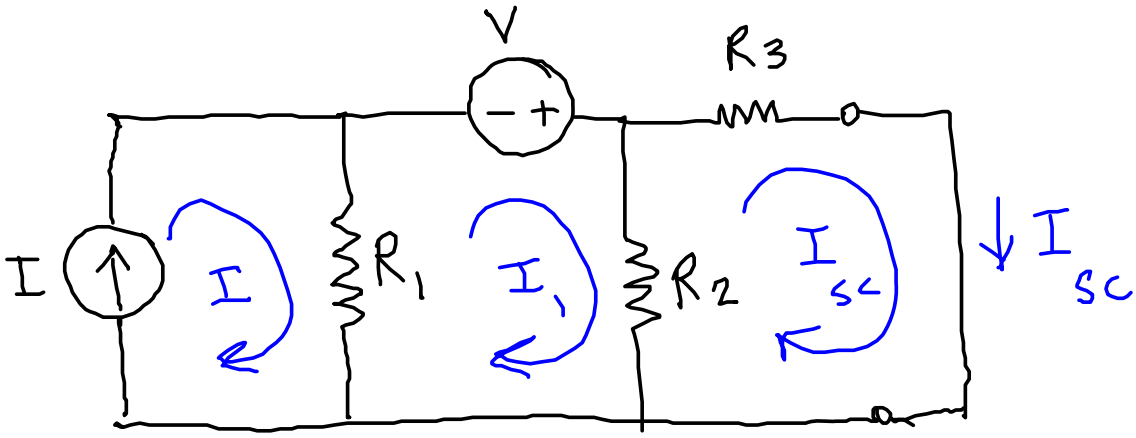
T & N eq.





$$R_1(I_1 - I) - V + R_2 I_1 = 0 \qquad \text{find } I_1$$

$$V_{oc} = R_2 I_1$$

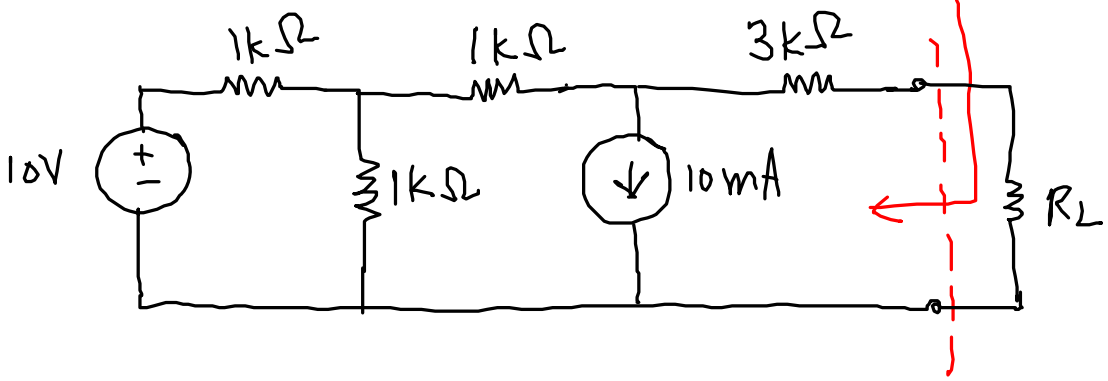


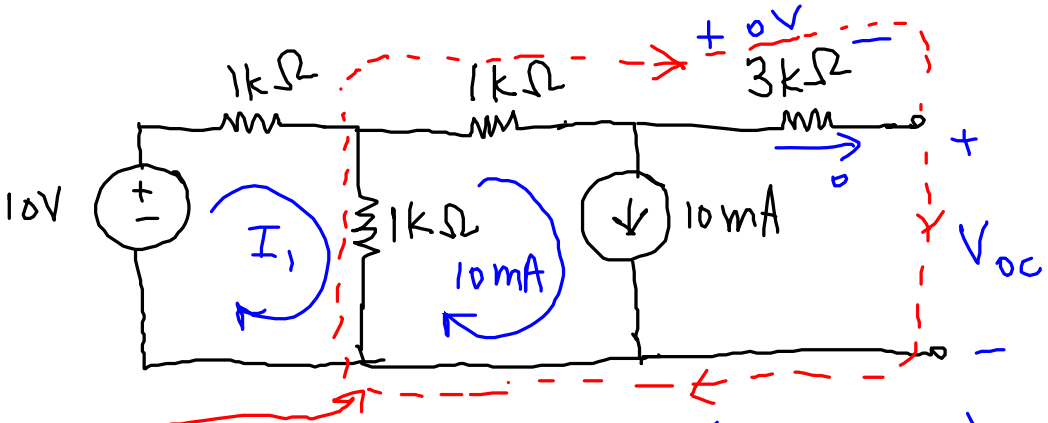
$$R_1(I_1 - I) - V + R_2(I_1 - I_{sc}) = 0$$

$$R_3 I_{sc} + R_2(I_{sc} - I_1) = 0 \qquad \text{find } I_{sc}$$

Problem

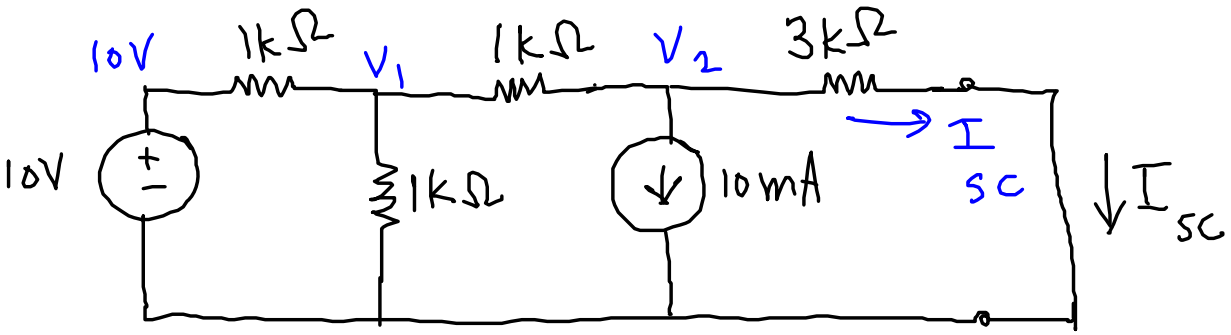
T & N eq.





$-10V + 1K\Omega I_1 + 1K\Omega(I_1 - 10mA) = 0$ find I_1

$V_{oc} + 1K\Omega(10mA - I_1) + 1K\Omega(10mA) = 0$ find V_{oc}



$$\frac{10V - V_1}{1k\Omega} + \frac{0 - V_1}{1k\Omega} + \frac{V_2 - V_1}{1k\Omega} = 0$$

$$\frac{V_1 - V_2}{1k\Omega} - 10mA + \frac{0 - V_2}{3k\Omega} = 0 \quad \text{find } V_1 \text{ \& } V_2$$

$$I_{sc} = \frac{V_2 - 0}{3k\Omega}$$