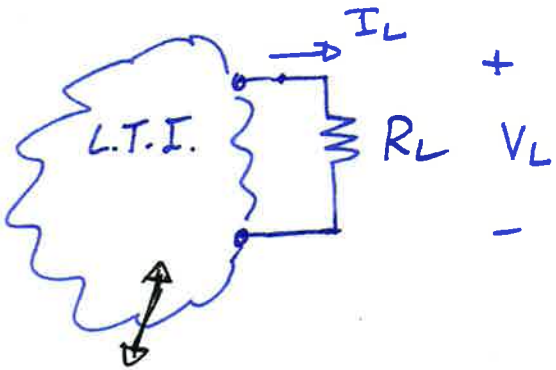
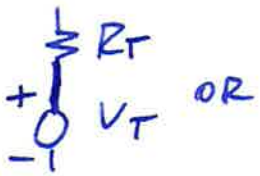
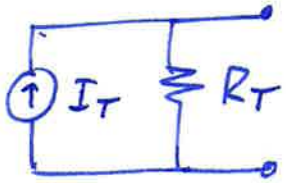
THEVENIN AND NORTON TRANSFORMATIONS

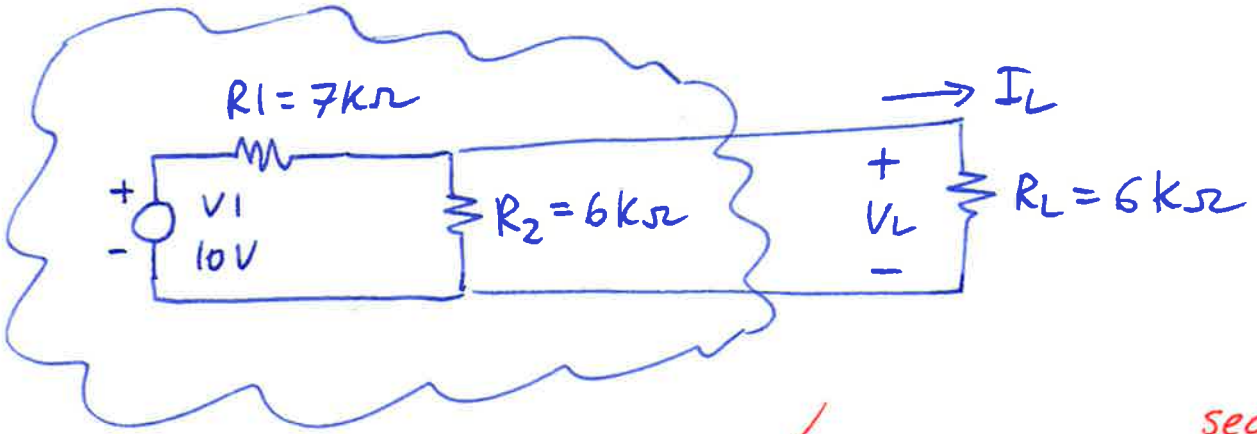




OR

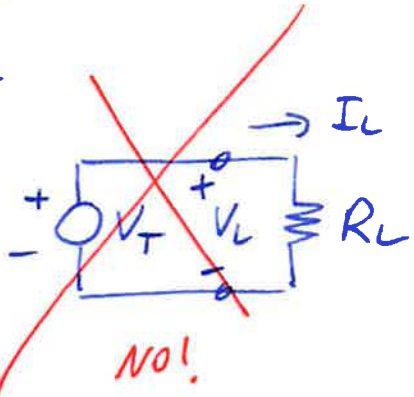


Example



How we model the stuff inside the "bubble" does not matter, as long a the voltage and the current on the load are correct ! However, we want a model that is general enough that once is built, it works for any RL we attach to it!

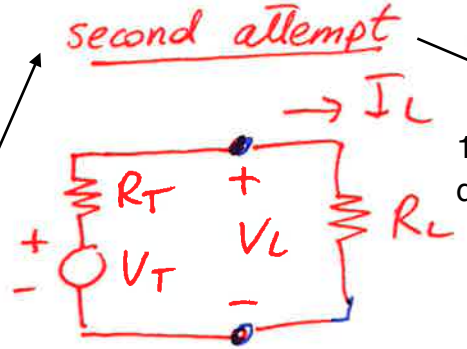
First attempt



Let's try to set the voltage across the load by applying an ideal voltage source.
The value of VT we need is exactly VL

Then if I change RL I also need to change VT so I would have to change the model based on RL

second attempt



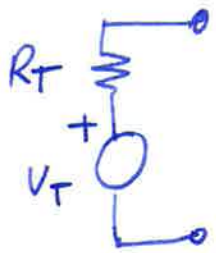
1. I need a voltage VT different from VL

2. But then I need to add some resistance that when "traversed" by IL drops just the right amount of voltage to get VL on the load

1.

2 cases (extremes)

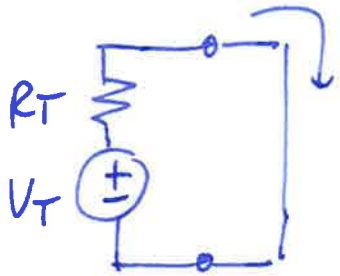
- $R_L = \infty$



$V_{open} = V_T$

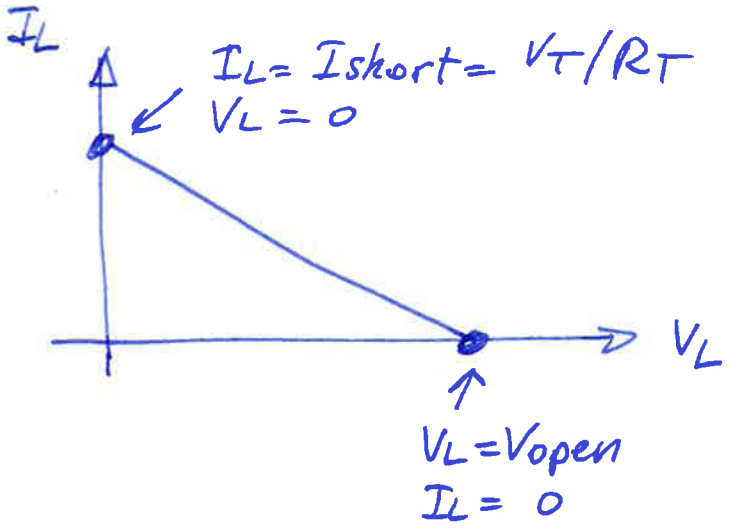
$I_L = 0$

- $R_L = 0$



$I_{short} = \frac{V_T}{R_T}$ → $R_T = V_{OPEN} / I_{SHORT}$

$V_L = 0$



straight line between two points:

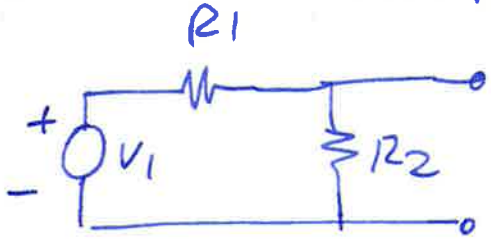
$$I_L - \frac{V_T}{R_T} = -\frac{1}{R_T} \cdot V_L$$

$$\updownarrow$$

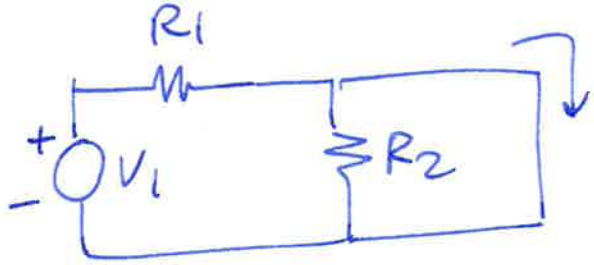
$$I_L = -\frac{1}{R_T} V_L + \frac{V_T}{R_T}$$

$(y = m \cdot x + n)$

back to the example:



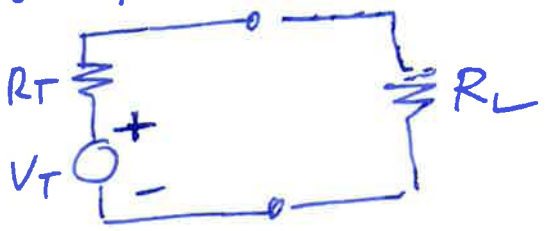
$V_T = V_{open} = \frac{V_1}{R_1 + R_2} \cdot R_2 = 4.62\,V$



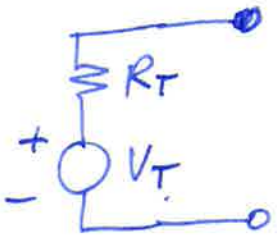
$I_{short} = \frac{V_T}{R_T} = \frac{V_1}{R_1} = \frac{10V}{7k\Omega} \approx 1.43\,mA$

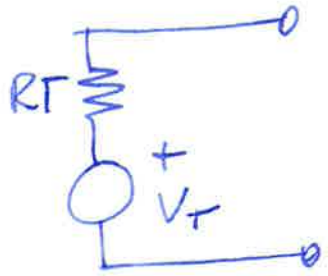
$R_T = \frac{V_T}{I_{short}} = \frac{4.62V}{1.43\,mA} \approx 3.23\,k\Omega$

Thevenin/Norton Transf. rules

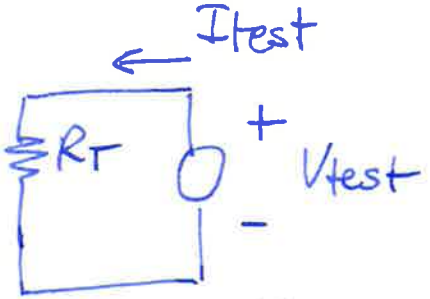


→ remove R_L to find out V_T

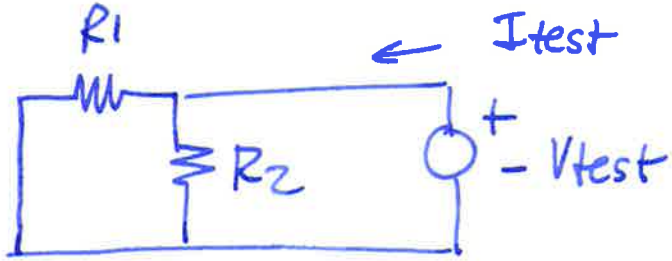




→ remove V_T and apply test voltage



$\frac{V_{test}}{I_{test}} = R_T$



replace indep. voltage source
$V=0 \rightarrow$ short

replace indep. current source
$I=0 \rightarrow$ open

$$\frac{V_{test}}{I_{test}} = R_T = R_1 \| R_2 =$$

$$= 7k\Omega \| 6k\Omega \approx 3.23k\Omega$$

same as using a multimeter in a lab.
(shutdown the supply of the board)