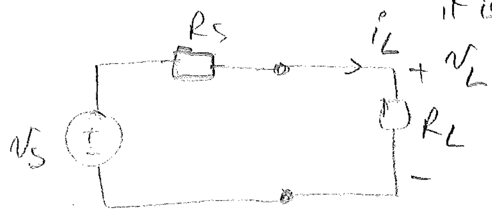
▸ Continue w/ last page from last time!

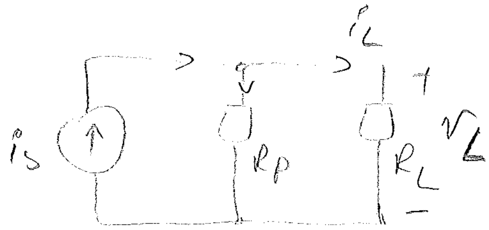
Source transformations

> ideal voltage and current sources do not really exist in practice!

ideal — more realistic or practical model — ideal — more realistic or practical model.

$R_S \triangleq$ internal/output resistance and it is undesired!





(1) $\boxed{v_L = v_S - R_S \cdot i_L}$

R_S: we would like it as small as possible such that $v_L \to v_S$!

(2) $\boxed{i_L = i_S - \frac{v_L}{R_P}}$

R_P: we would like it as large as possible such that $i_L \to i_S$!

> Open-circuit voltage: $R_L = \infty$

$\Rightarrow i_L = \frac{v_L}{R_L} = 0 \Rightarrow \boxed{v_{L_{oc}} = v_S}$

> Short-circuit current: $R_L = 0$

$\Rightarrow v_L = 0 \Rightarrow \boxed{i_{L_{sc}} = \frac{v_S}{R_S}}$

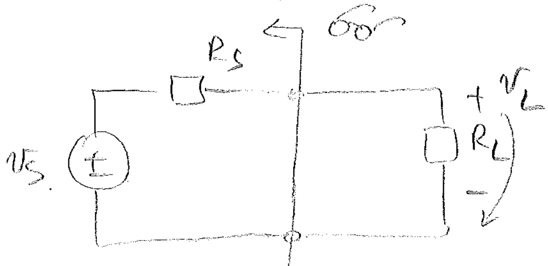
> Open-circuit voltage: $R_L = \infty$

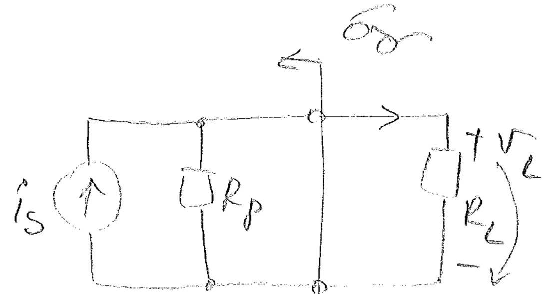
$\boxed{v_{L_{oc}} = R_p \cdot i_S}$

> Short-circuit current: $R_L = 0$

$\boxed{i_{L_{sc}} = i_S}$

Equivalent practical sources





$$v_L = \frac{R_L}{R_S + R_L} v_S$$

$$v_L = R_L \cdot \frac{R_P}{R_P + R_L} i_S$$

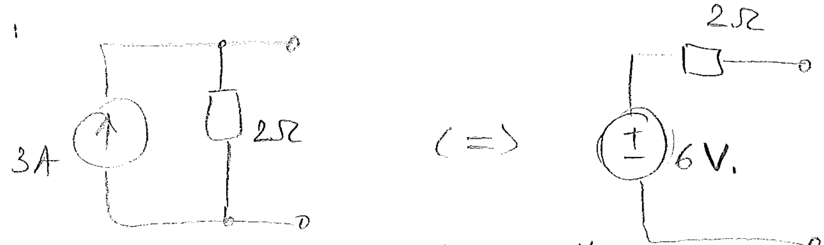
Note: could have said that i_L should be the same and get the same conclusion:

The two practical sources are electrically equivalent (from the p.o.v. of load R_L) if: (i_L and v_R are the same in both cases!!!)

curr → voltage: $\begin{cases} v_S = R_P \cdot i_S \\ R_S = R_P \end{cases}$!

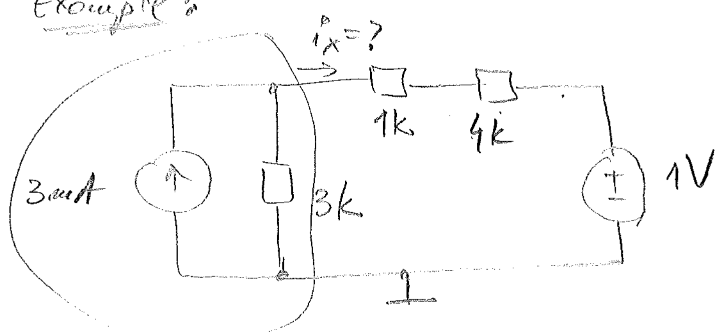
voltage → current: $\begin{cases} i_S = \frac{v_S}{R_P} \\ R_S = R_P \end{cases}$

Example:



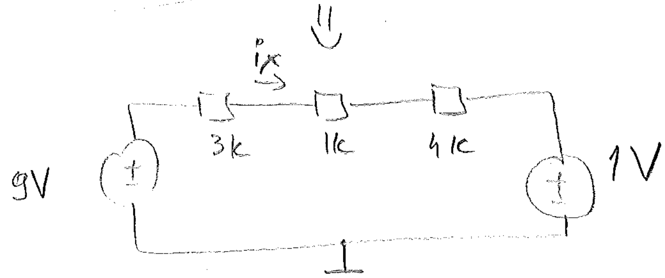
current → voltage

Example:



Use source transformations and simplifications!

⇓



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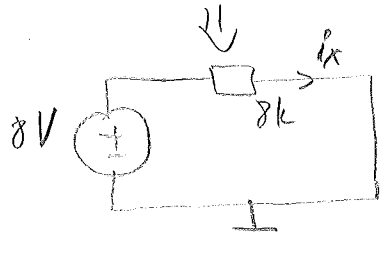
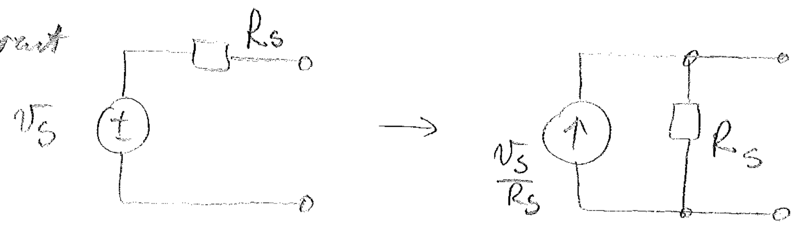


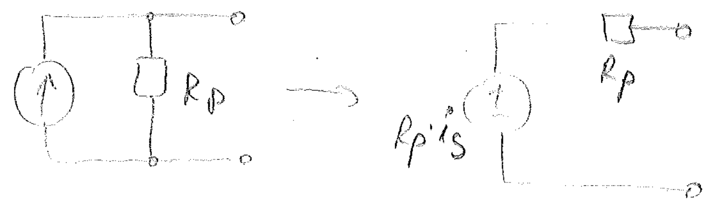
$$i_x = \frac{8\,V}{8k} = 1\,mA$$

Conclusion: The source transformation technique exploits the equivalence between a voltage source in series with a resistance AND a current source in parallel with a resistance!

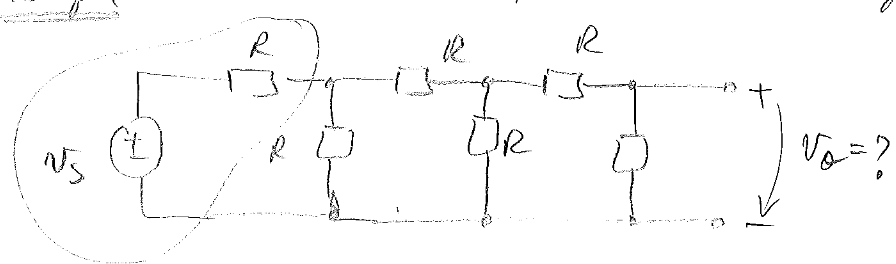
voltage -> current

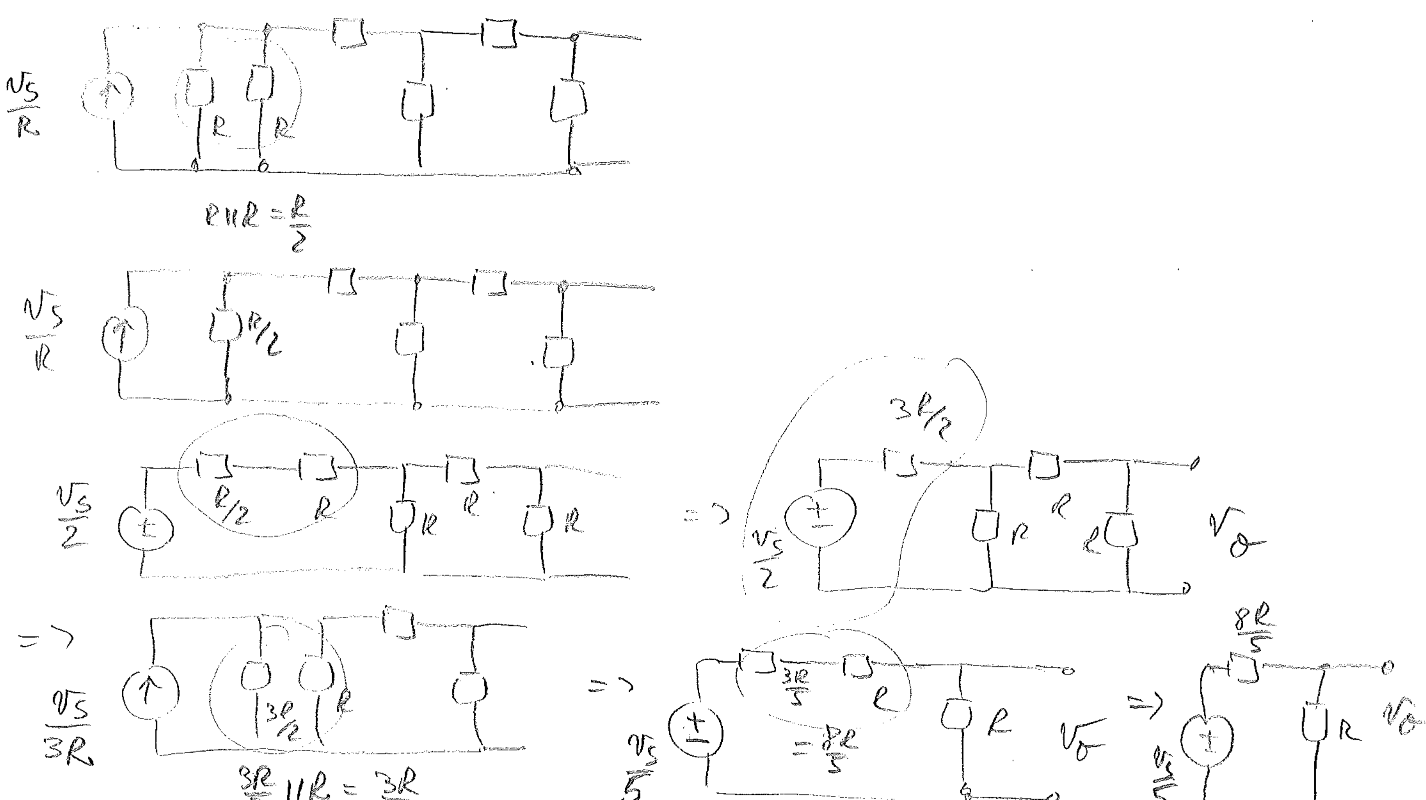


current -> voltage.



Example: Use source transf. to derive an expression for $v_o = v_o(v_S)$!





$$v_o = \frac{R}{R + \frac{8R}{5}} \cdot \frac{v_S}{5} = \frac{1}{13} v_S$$

(!) $\boxed{v_o = \frac{1}{13} v_S}$