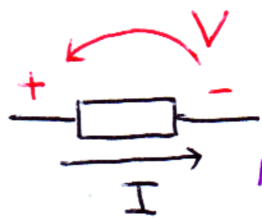
P3360 / AEP 3630

Lecture 2

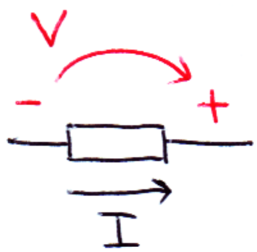
Power



instantaneous power $P = IV$

dissipative $P > 0$

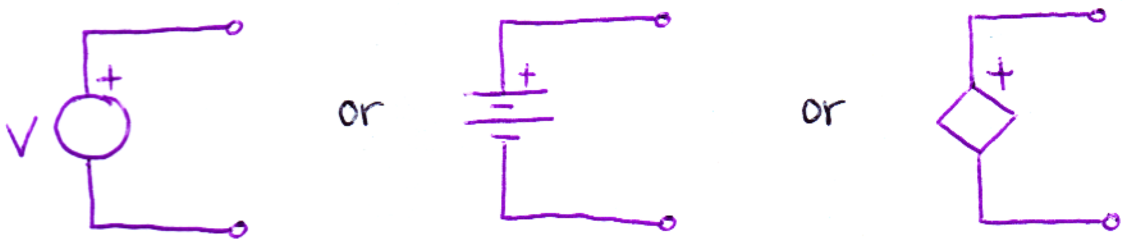
resistors are always dissipative



supplies energy $P < 0$

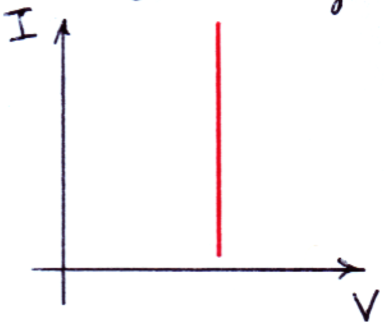
Need elements that supply energy!

② Voltage source



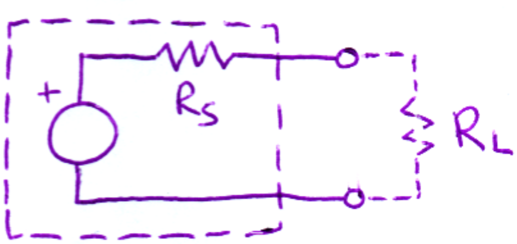
controlled voltage source

ideal voltage source holds const voltage no matter what



slope $= \infty = \frac{1}{R}$ ⇒ slope resistance of ideal volt. source is 0

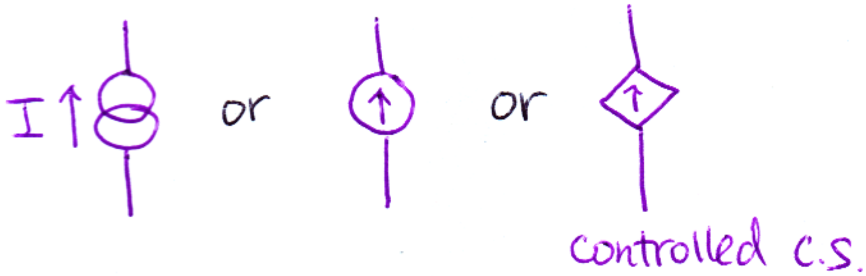
Practical volt. source



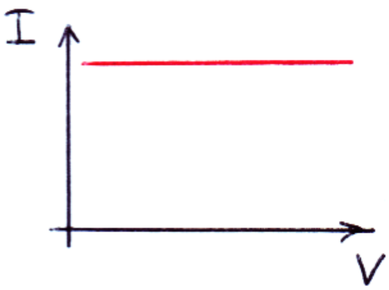
voltage may not be const

if $R_S \ll R_L$ ⇒ close to ideal volt source

③ Current source

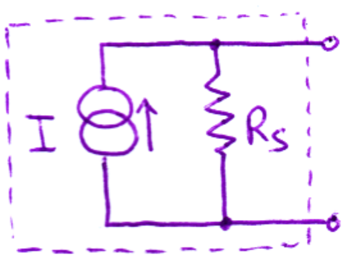


<u>Ideal current source</u> supplies const current no matter what



slope = 0, $R_s = \infty$ no slope conductance

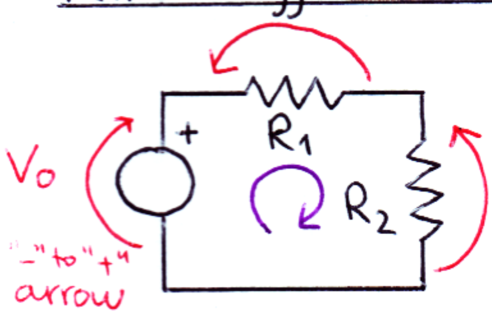
<u>Practical current source</u>



if $R_s \gg R_L \Rightarrow$ close to an ideal current source

Circuit analysis

<u>Kirchhoff's voltage law (KVL)</u>



$$\sum V_k = 0$$

around any loop

otherwise ∞ accel.

<u>Kirchhoff's current law (KCL)</u>

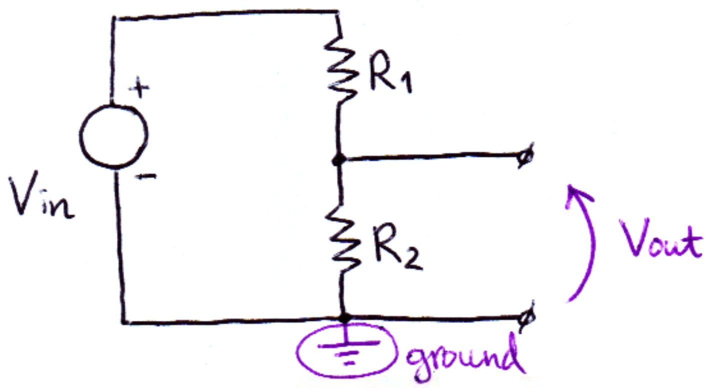
$$\sum I_k = 0$$

for any node

conservation of charge

KVL & KCL are <u>completely</u> general (linear & nonlinear dc & ac, etc.)

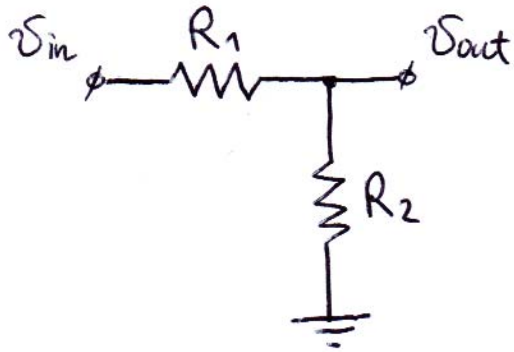
Voltage divider



$$V_{out} = V_{in} \frac{R_2}{R_1 + R_2}$$ (memorize)

$$V_{out} < V_{in}$$

A word on notations



we understand
- ideal volt. source connected between v_{in} & ground
- open circuit ($R_L \to \infty$) between v_{out} & ground

Circuit simplifying techniques

Superposition

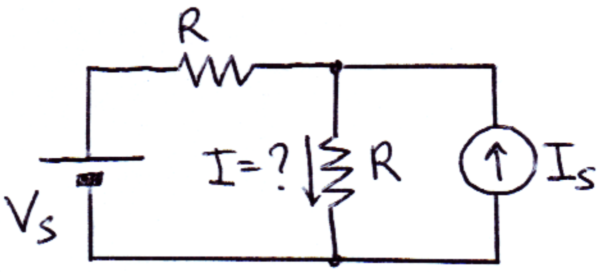
Given a <u>linear</u> circuit containing several i_s, v_s, the total i, v at a given point is algebraic sum from <u>each individual</u> source.

step 1. For <u>each</u> $(i_s)_k$ or $(v_s)_k$: replace <u>all other</u> v_s with shorts and i_s with open circuit

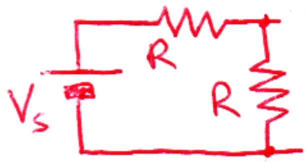
step 2. compute i_k and v_k

step 3. sum $v = \sum_k v_k$ and $i = \sum_k i_k$

Ex. Find I ?

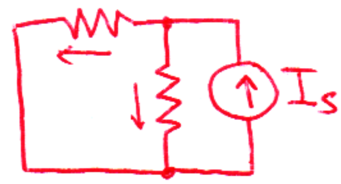


① open I_s



$$I_1 = \frac{V_s}{2R}$$

② short V_s

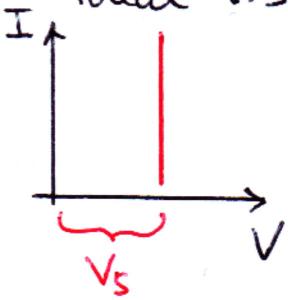


$$I_2 = \frac{I_s}{2}$$

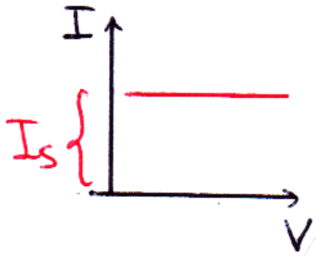
③ sum $I = \dfrac{V_s}{2R} + \dfrac{I_s}{2}$

Thevenin equivalent

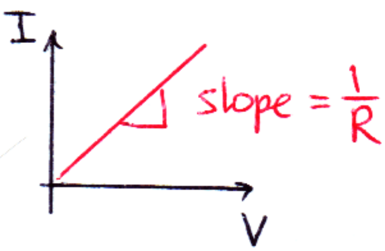
ideal v.s.

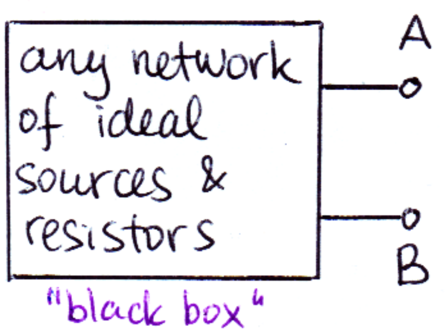


ideal c.s.



some R





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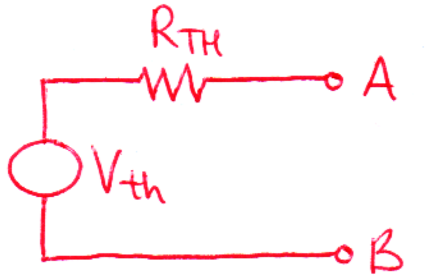

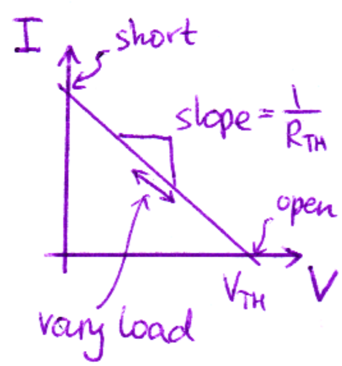

any combination of <u>linear</u> circuit elements with two output terminals may be replaced with <u>ideal volt. source</u> and <u>series resistance</u>

$$V_{TH} = V_{o.c.} \qquad R_{TH} = \frac{V_{o.c.}}{I_{s.c.}}$$