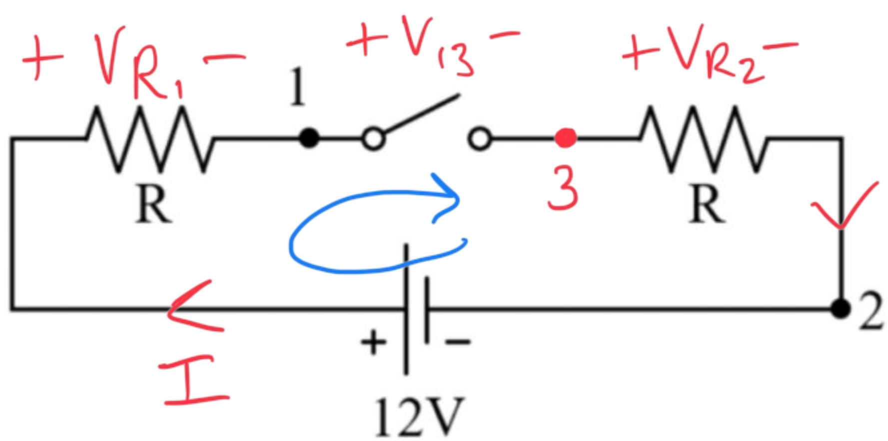
MAE 3780/3783: Mechatronics
January 29, 2024

Logistics Updates

- This week in lab – **Lab 1**
  - Tinkercad prelab 15 minutes before lab session
  - Written prelab printed or shown on device at beginning of lab section
- HW 2 (resistors) released on asap – Due **Friday, February 9, 11 pm**
- Fill out when2meet with availability/OH preferences



What is the voltage difference between points 1 and 2?

- ○ 0V
- ○ 6V
- ● 12V

$$V_{32} = \boxed{V_{R_2} = 0}$$

$$V_{12} = V_{13} + \cancel{V_{32}}^{\,0}$$

$$V_{12} = V_{13} = 12\,V$$

From KVL:

$$-12 + V_{R_1} + V_{13} + V_{R_2} = 0$$

From KCL:

$$I = 0$$

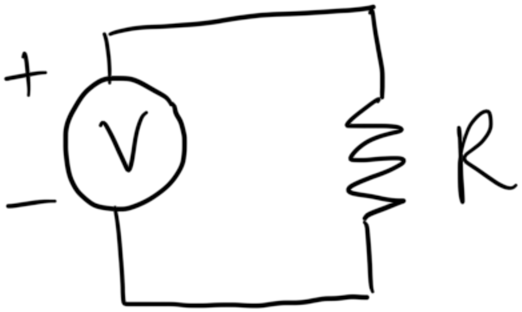
From Ohm's Law:

$$V_{R_1} = R \cdot I = 0$$

$$\boxed{V_{R_2} = R \cdot I = 0}$$

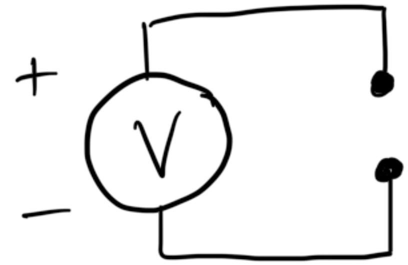
$$-12 + 0 + V_{13} + 0 = 0$$

$$V_{13} = 12\,V$$



$R \to \infty$

$I = \frac{V}{R} = 0$

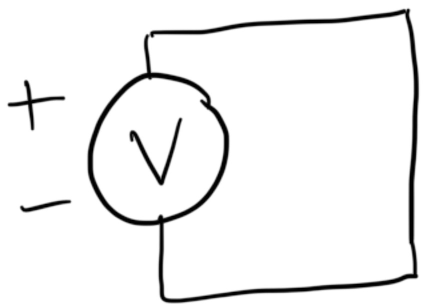


open circuit

there is no complete path for current to flow

$R \to 0$

$I = \frac{V}{R} \to \infty$



short circuit

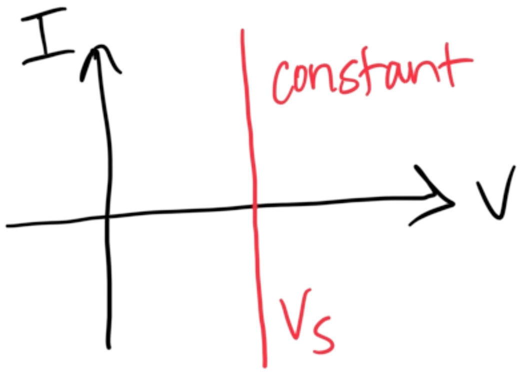
* can result in dangerously high currents / melting things

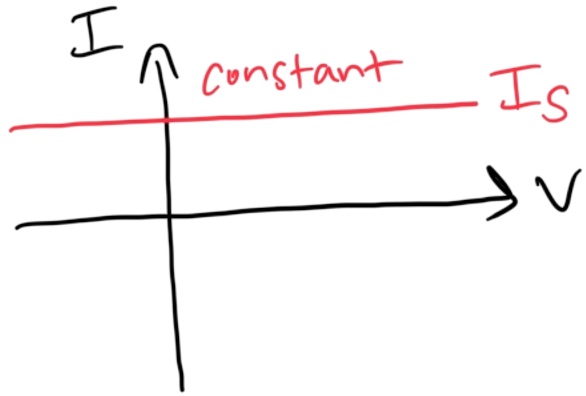
Practical Sources

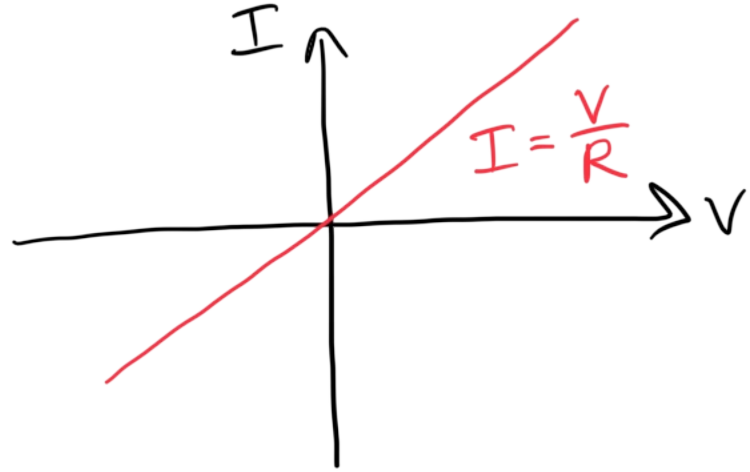
ideal voltage source

$\Rightarrow V = \text{const}$ regardless of I

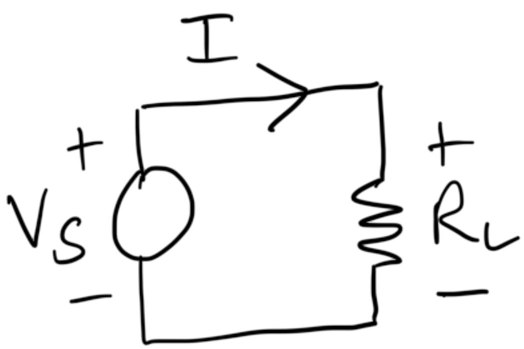
ideal current source







Ideally:

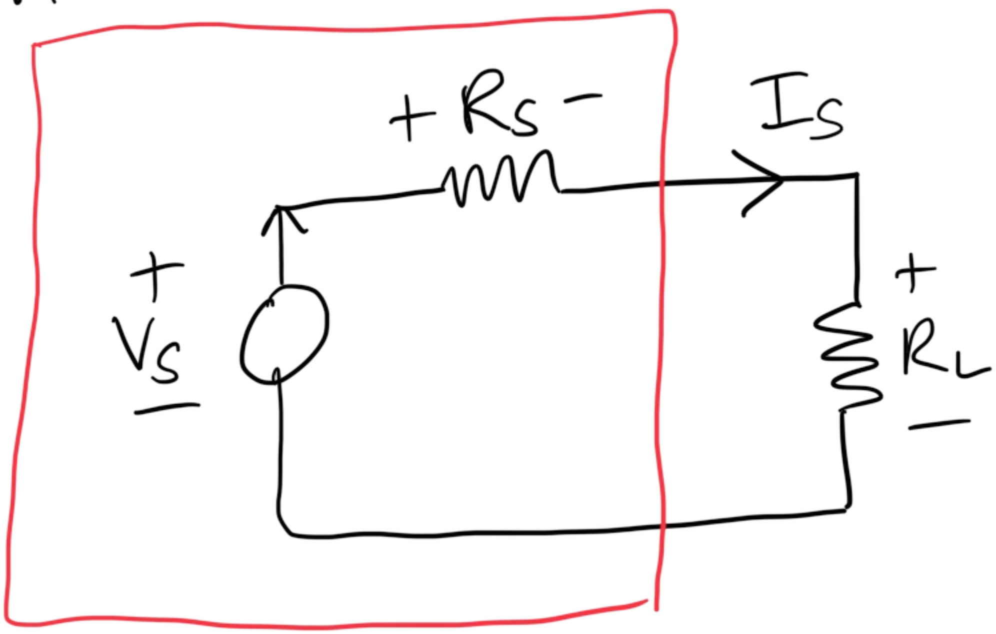


$V = R \cdot I$

as $R_L \to 0$, $I \to \infty$

practically, I is bounded

modeled as:



voltage source

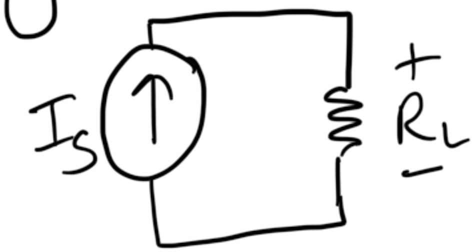
if $R_L = 0$,
max current
$$I_{Smax} = \frac{V_S}{R_S}$$

effect on R_L:

$$V_{R_L} = I_S \cdot R_L = \frac{V_S}{R_S + R_L} \cdot R_L = V_S \frac{R_L}{R_S + R_L}$$

want R_S to be small

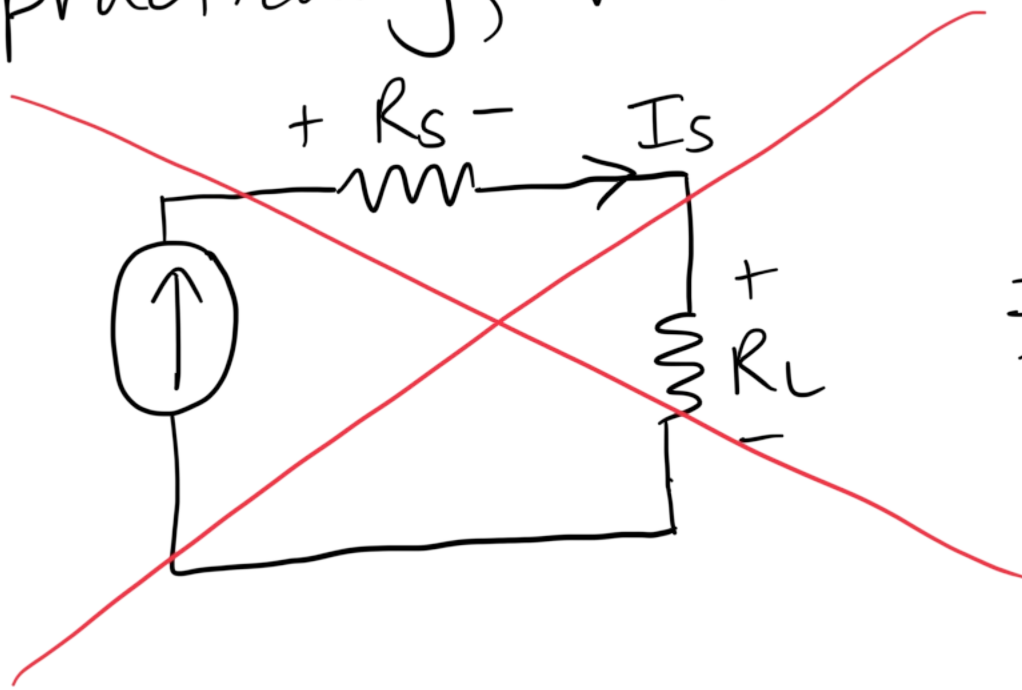
similarly for current sources,

ideally: 

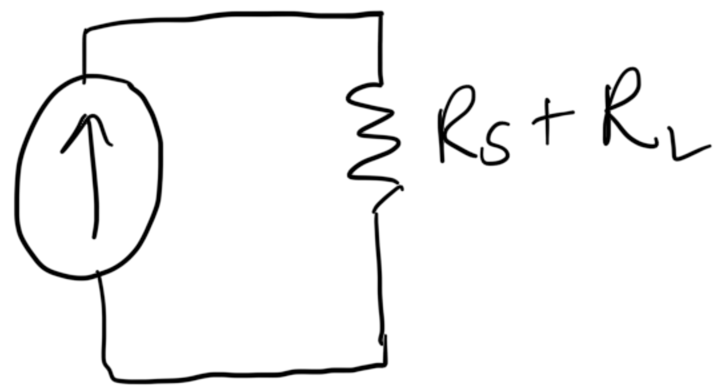
$$I = \frac{V}{R}$$

as $R \to \infty$, $V \to \infty$

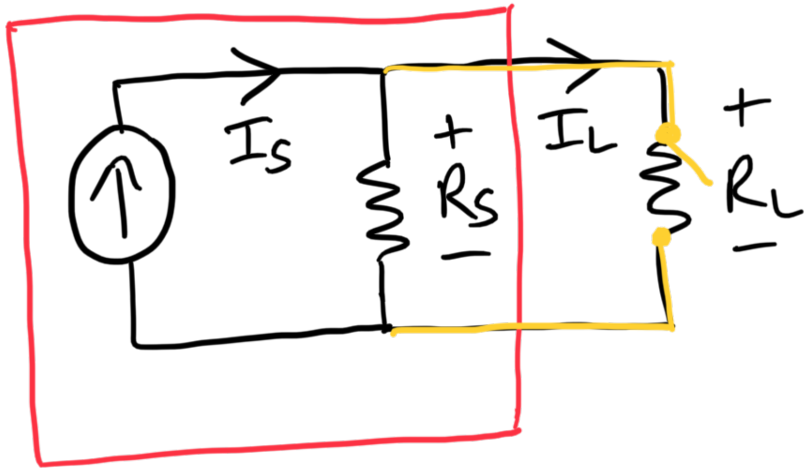
practically, V is bounded (R_S)



$\equiv$



$$I_S = \frac{V}{R_S + R_L}$$



current source

$$V_{L\max} = I_s R_s$$

as $R_L \to \infty$, open circuit

effect on R_L:

$$I_L = I_s - \frac{V_L}{R_s}$$

want R_s to be large