Circuit Review

Last updated 3/7/23

Circuit Review

- Kirchkoff's Laws
  - Current Law: $\sum currents_{entering\ a\ node} = 0$
  - Voltage Law: $\sum voltages_{around\ a\ loop} = 0$

- Resistance
  - $V = IR$
  - Series Resistors: $R_{series} = \sum_{n=1}^{m} R_n$
  - Parallel Resistors: $1/R_{parallel} = \sum_{n=1}^{m} 1/R_n$

Circuit Review

- Capacitance
  - $Q \; = \; CV$
  - $i \; = C\frac{dv}{dt}$
  - Parallel Capacitors: $C_{series} = \sum_{n=1}^{m} C_n$
  - Series Capacitors: $1/C_{parallel} = \sum_{n=1}^{m} 1/C_n$

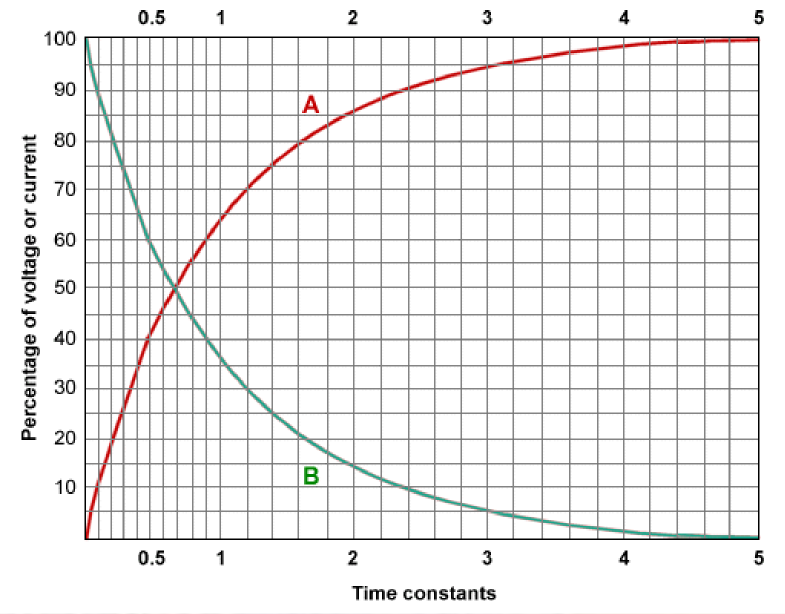
- Inductance
  - $\Phi_m \; = LI$
  - $v \; = L\frac{di}{dt}$
  - Series Inductors: $L_{series} = \sum_{n=1}^{m} L_n$
  - Parallel Inductors: $1/L_{parallel} = \sum_{n=1}^{m} 1/L_n$

Circuit Review

- RC transients
  - R
    - Output impedance of a circuit (gate)
    - Wire (trace) resistance
  - C
    - Input capacitance of a circuit (gate)
    - Wire (trace) capacitance
  - τ
    - RC time constant
    - Units is seconds

Circuit Review

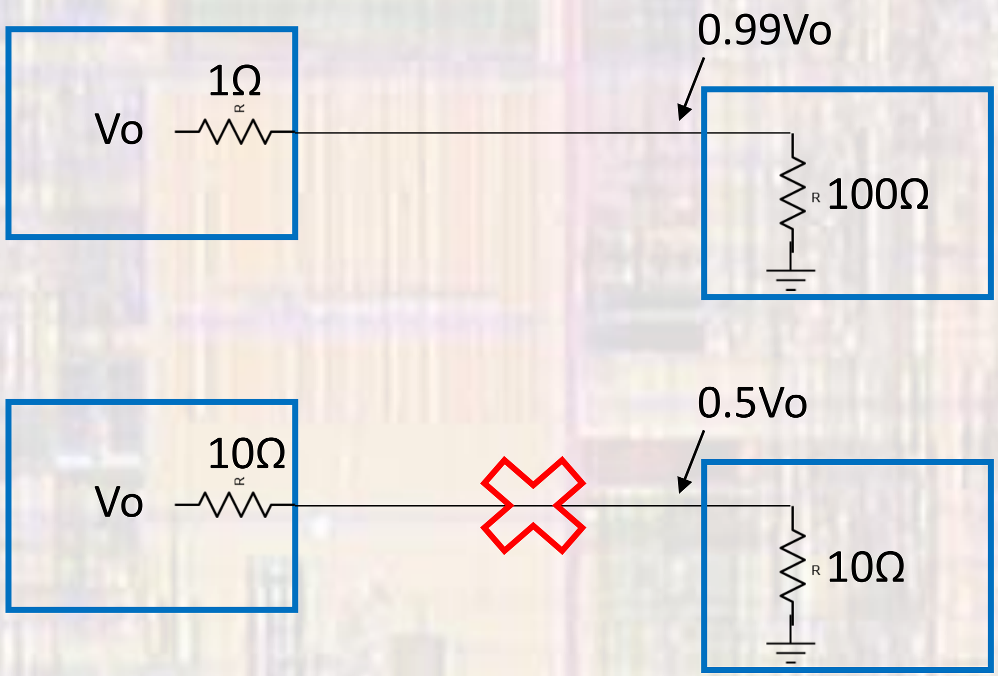
- RC transients
  - Rising (charging) transient*
    - $v(t) = v_{final}\left(1 - e^{-t/\tau}\right)$
    - * assuming $v_{initial} = 0v$
  - Falling (discharging) transient*
    - $v(t) = v_{initial}\, e^{-t/\tau}$
    - * assuming $v_{final} = 0v$
  - General transient
    - $v(t) = v_{final} + \left(v_{initial} - v_{final}\right) e^{-t/\tau}$



50% - 0.693τ
98% - 4τ

Circuit Review

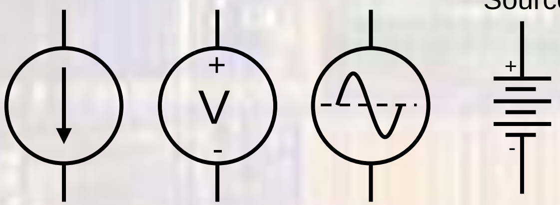
- Input / Output Impedance
  - Want low output impedance driving high input impedance



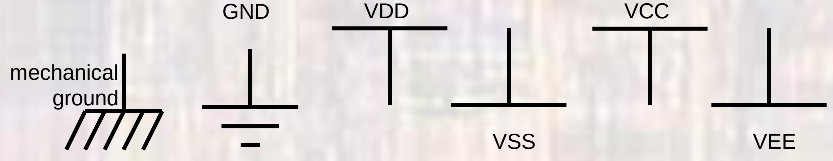
Circuit Review

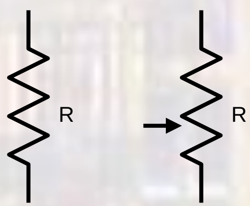
- Common Symbols

current source | voltage source | signal source | Battery Voltage Source

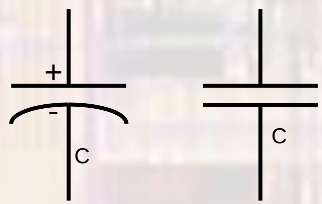


power & ground symbols





fixed resistor | potentiometer



polarized capacitor | unpolarized capacitor

inductor