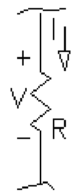
ECE 2210   Lectures 2 & 3 notes

A. Stolp
1/28/06,
9/5/08

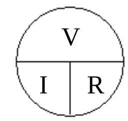
Ohm's law (resistors)

$V = I \cdot R$



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

$R = \frac{V}{I}$ definition of resistance and the unit "Ω"



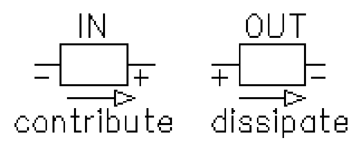
Power

flow $\frac{m^3}{sec}$ pressure $\frac{N}{m^3}$ flow x pressure: $\frac{m^3}{sec} \cdot \frac{N}{m^2} = \frac{m}{sec} \cdot \frac{N}{1} = \frac{N \cdot m}{sec} = \frac{Joule}{sec} = W$ = power

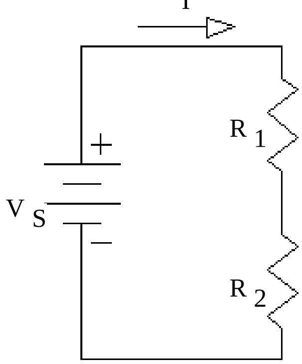
same for electricity   power $P = I \cdot V$

Power dissipated by resistors: $P = V \cdot I = \frac{V^2}{R} = I^2 \cdot R$

$P_{IN} = P_{OUT}$



Series Resistors

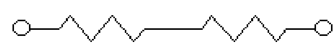


$V_1 = I \cdot R_1$

$V_2 = I \cdot R_2$

$V_T = V_1 + V_2$

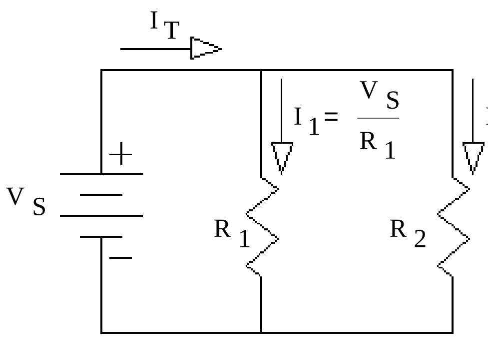
$R_{eq} = \frac{V_T}{I} = \frac{V_1 + V_2}{I} = \frac{V_1}{I} + \frac{V_2}{I} = R_1 + R_2$



$R_{eq} = R_1 + R_2$

Resistors are in series if and only if exactly the **same current** flows through each resistor.

Parallel Resistors

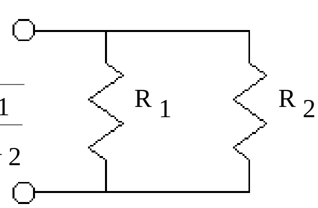


$I_1 = \frac{V_S}{R_1}$ $I_2 = \frac{V_S}{R_2}$

$I_T = \frac{V_S}{R_1} + \frac{V_S}{R_2}$

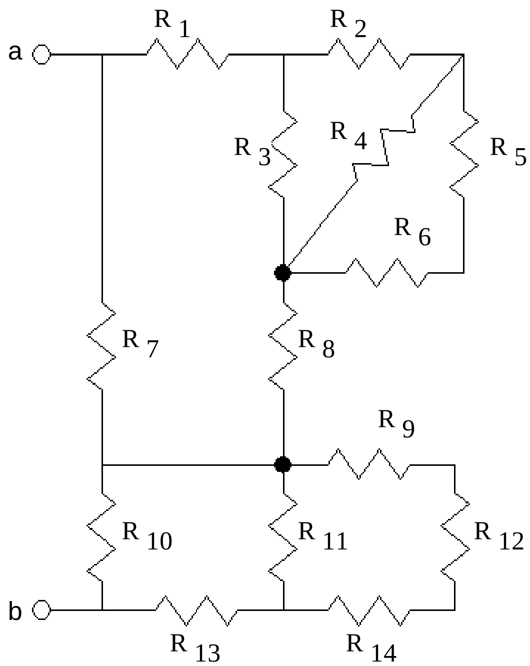
$R_{eq} = \frac{V_S}{I_T} = \frac{V_S}{\frac{V_S}{R_1} + \frac{V_S}{R_1}} = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2}}$

$R_{eq} = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2}}$



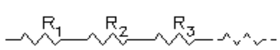
Resistors are in parallel if and only if the **same voltage** is across each resistor.

Series and Parallel



All resistor-only networks can be reduced to a single equivalent, but not always by means of series and parallel concepts.

Voltage Divider



series: $R_{eq} = R_1 + R_2 + R_3 + \dots$

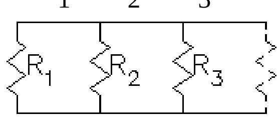
Exactly the **same current** through each resistor

Voltage divider:

$$V_{Rn} = V_{total} \cdot \frac{R_n}{R_1 + R_2 + R_3 + \dots}$$

Current Divider

parallel: $R_{eq} = \dfrac{1}{\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \dots}$

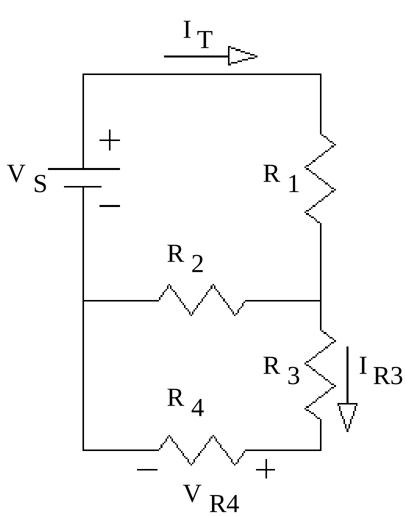


Exactly the **same voltage** across each resistor

current divider:

$$I_{Rn} = I_{total} \cdot \frac{\frac{1}{R_n}}{\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \dots}$$

May have to combine some resistors first to get series and parallel resistors to use with divider expressions.

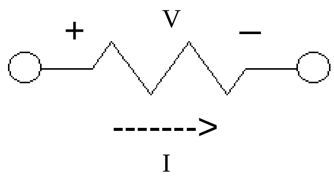


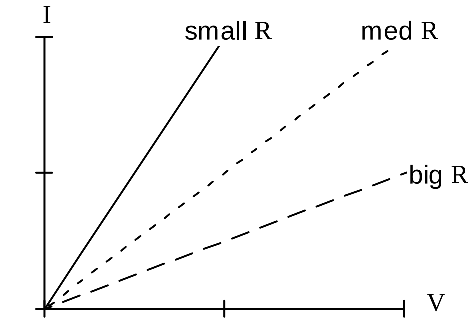
$V_{R4} =$

$I_T =$

$I_{R3} =$

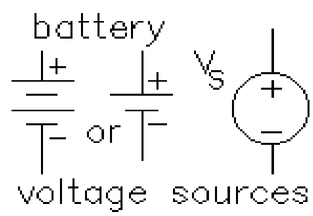
Resistors



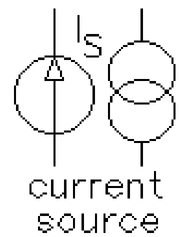


$$R = \frac{1}{\text{slope}} = \frac{\Delta V}{\Delta I}$$

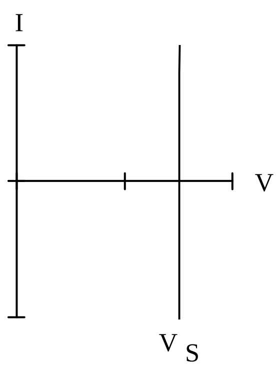
Sources

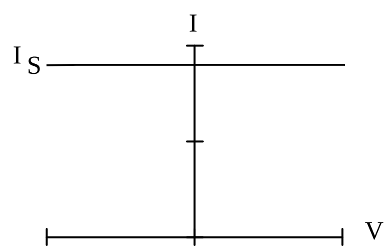


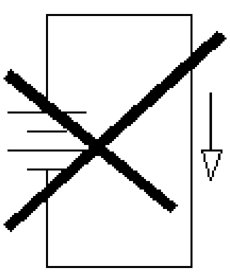
Battery Cell



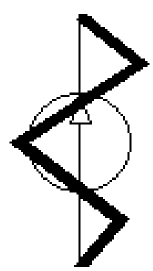
Less intuitive, less like sources we are used to seeing.



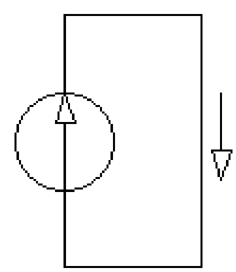




Doesn't make sense with for ideal voltage sources and ideal wires

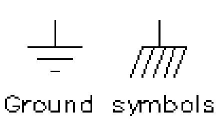


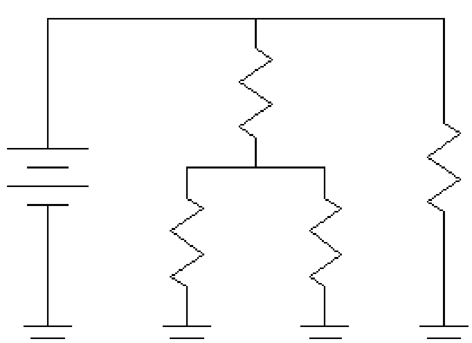
Doesn't make sense for ideal current sources

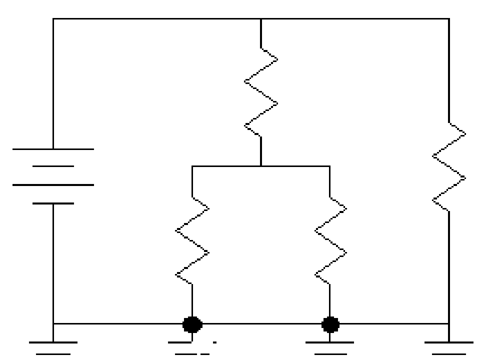


Must have a path for the current to flow

Ground



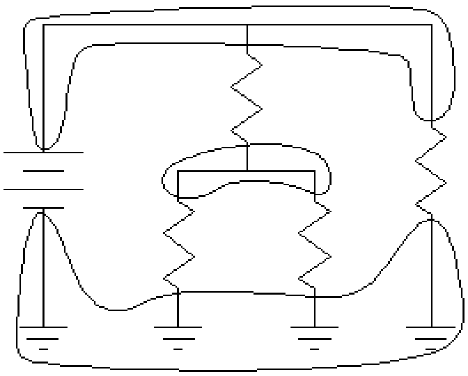




Ground is considered zero volts and is a reference for other voltages.

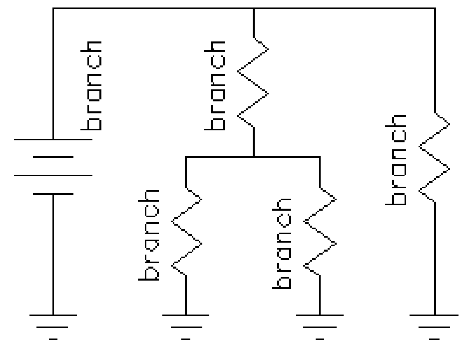
Nodes & Branches

Node = all points connected by wire, all at same voltage (potential)

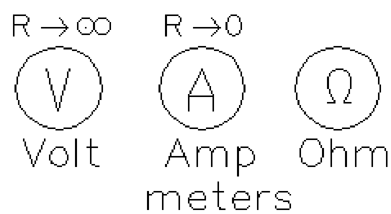


ground is a node

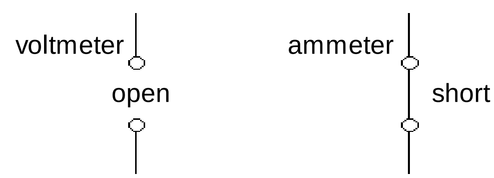
Branch = all parts with the same current



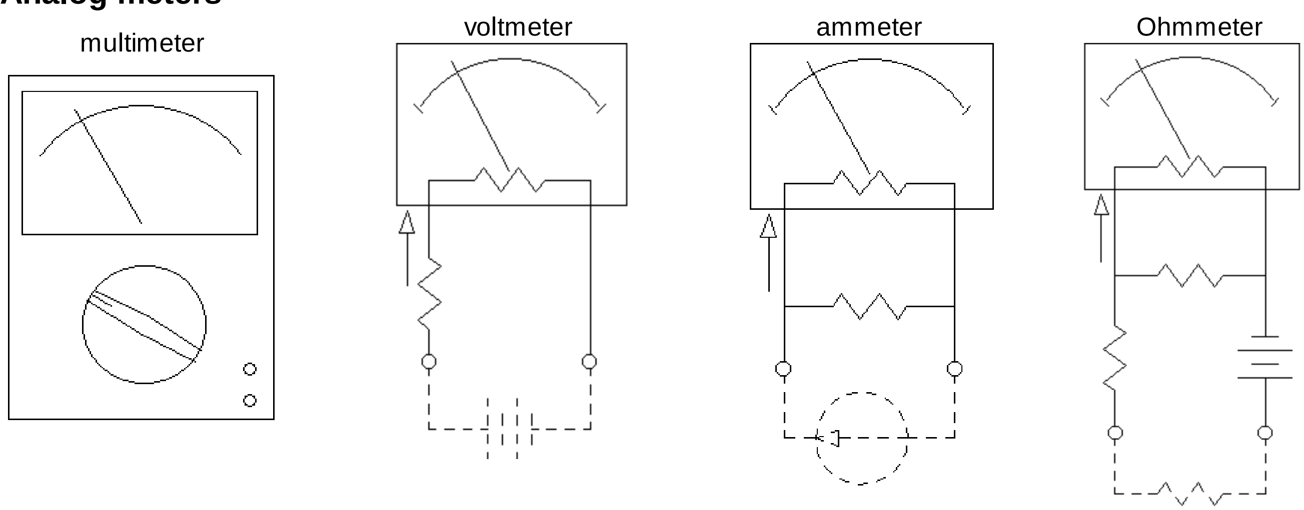
Meters



idealy:



Analog meters



Digital meter