# ECE 201, Section 4
# Lecture 3

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# Homework Changes

- HW solution #1 posted

# Ohm's Law

- Ohm's Law: $V=IR$ 
- Power $P(t)=I(t)V(t)$, thus:

  $P(t)=[I(t)]^2R$

  $P(t)=[V(t)]^2/R$

- Dissipated power given off as heat

# Resistance

- Physical property of material: resistivity $\rho$ ($\Omega \cdot m$)
- Resistance for cylinder: $R=\rho L/A$ ($\Omega$)

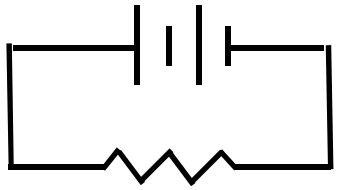
# Conductance

- Physical property of material: conductivity $\sigma$ (S/m)
- Conductance for cylinder $G=\sigma A/L$ (S or $\mho$)

# Example 1

- Find the resistance of a carbon rod with L=1 cm and A=0.1 $cm^2$

- Find the current flow and power dissipated through the carbon rod when connected to a 1.5 V battery:



# Example 1: Solution

- Find the resistance of a carbon rod with L=1 cm and r=0.02 cm:

  $\rho = 2400 * (17\ n\Omega \cdot m) = 40.8\ \mu\Omega \cdot m$

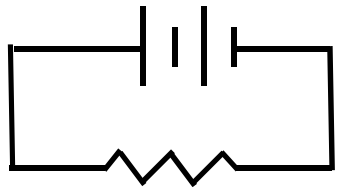
  $R = \rho L/A = (40.8\ \mu\Omega \cdot m)(1\ cm)/\pi(0.02\ cm)^2 = 3.25\ \Omega$

- Find the current flow through the carbon rod when connected to a 1.5 V battery:

  $I = V/R = (1.5\ V)/(3.25\ \Omega) = 0.46\ A$

- Find the power dissipated:

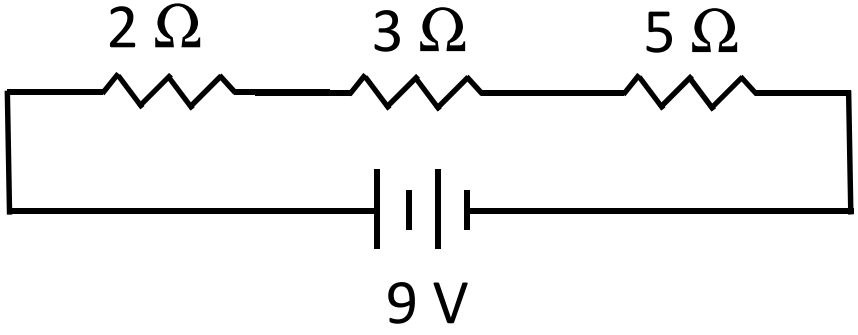
  $P = IV = (0.46\ A)(1.5\ V) = 0.69\ W$



# Example 2: Series Circuits

- Calculate the effective resistance of 3 resistors in series with resistances 2 Ω, 3 Ω, and 5 Ω:


- Calculate the current generated when powered by a 9 V battery:



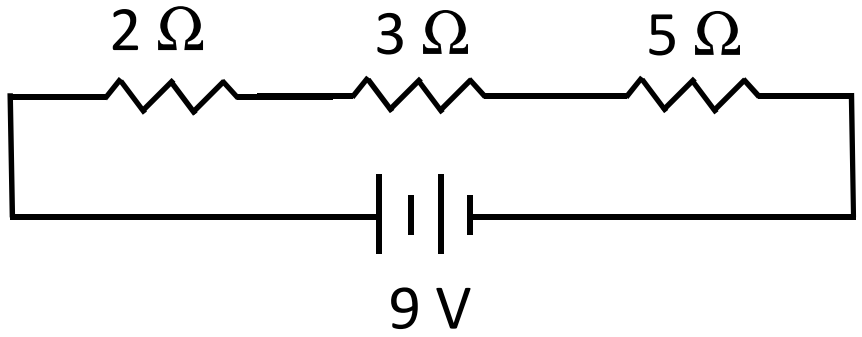
# Example 2: Solution

- Calculate the effective resistance of 3 resistors in series with resistances 2 Ω, 3 Ω, and 5 Ω:


$$R_{\text{eff}} = \sum_{i=1}^{3} R_i = 2\ \Omega + 3\ \Omega + 5\ \Omega = 10\ \Omega$$

# Example 2: Solution Cont'd

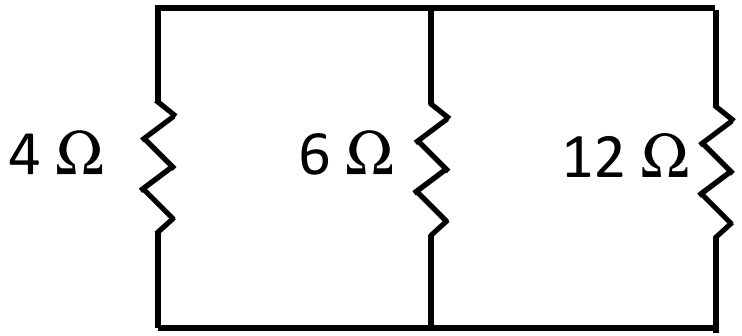
- Calculate the current generated when powered by a 9 V battery:




$I=V/R_{eff}=(9\ V)\ /\ (10\ \Omega) = 0.9\ A$

# Example 3: Parallel Circuits

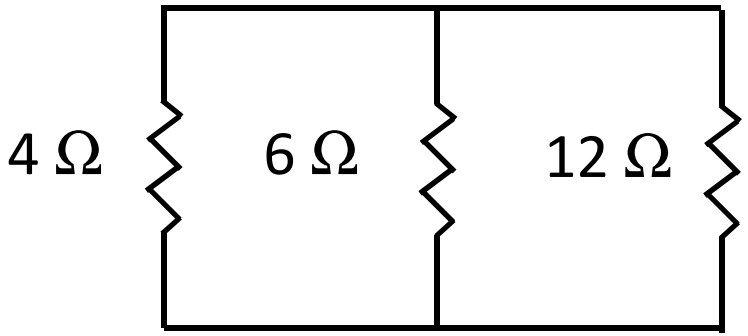
- Calculate effective resistance of 3 resistors of resistances 4, 6, and 12 Ω:




- Calculate current when connected to two 1.5 V batteries in series:

# Example 3: Solution

- Calculate effective resistance of 3 resistors of resistances 4, 6, and 12 Ω:



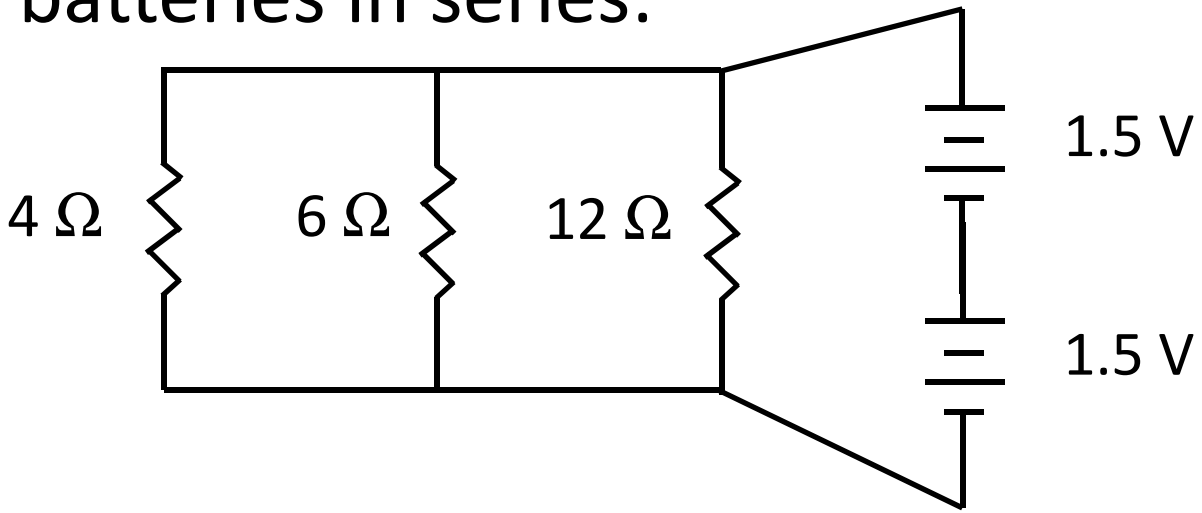

$$R_{\text{eff}}^{-1} = \sum_{i=1}^{3} R_i^{-1}$$

$$R_{\text{eff}}^{-1} = \frac{1}{4} + \frac{1}{6} + \frac{1}{12} = 0.5\ \text{S}$$

$$R_{\text{eff}} = 2\ \Omega$$

# Example 3: Parallel Circuits

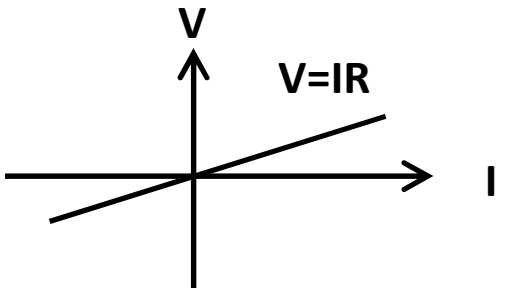
- Calculate current when connected to two 1.5 V batteries in series:



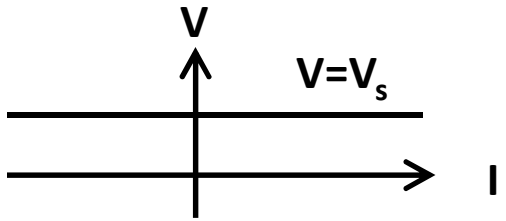

$I = V_{eff}/R_{eff}=(1.5 + 1.5\ V)/2\ \Omega = 1.5\ A$

# Current-Voltage Relations

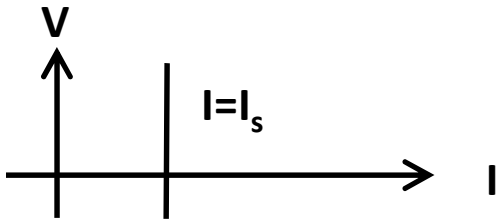
- Resistor




- Ideal voltage source




- Ideal current source



# Controlled Ideal Sources

- Can use current or voltage to control output current or voltage

Control type

| Output type | Voltage | Current |
|---|---|---|
| **Voltage** | VCVS $V=\mu v_x$  | CCVS $V=IR$  |
| **Current** | VCCS $I=gV$  | CCCS $I=\beta I_x$  |

# Homework #3 for Monday

- DeCarlo & Lin, 3rd Edition, Chapter 1
  - Problem 23
  - Problem 28
  - Problem 38
- All homework posted on Blackboard