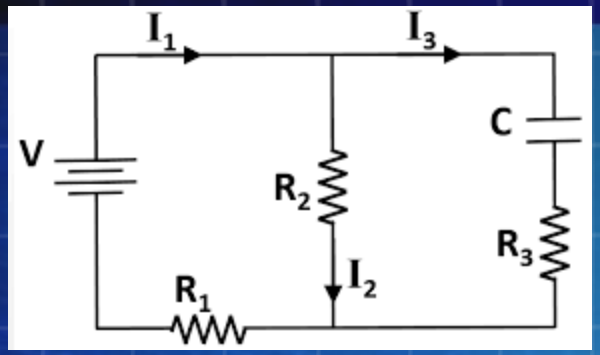
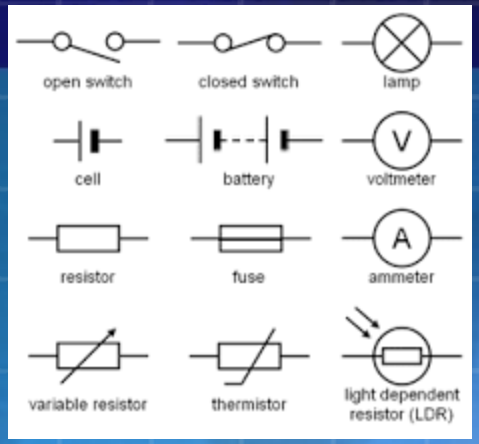
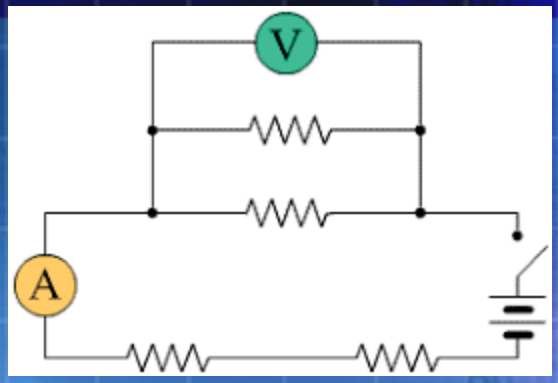






Circuit Lab

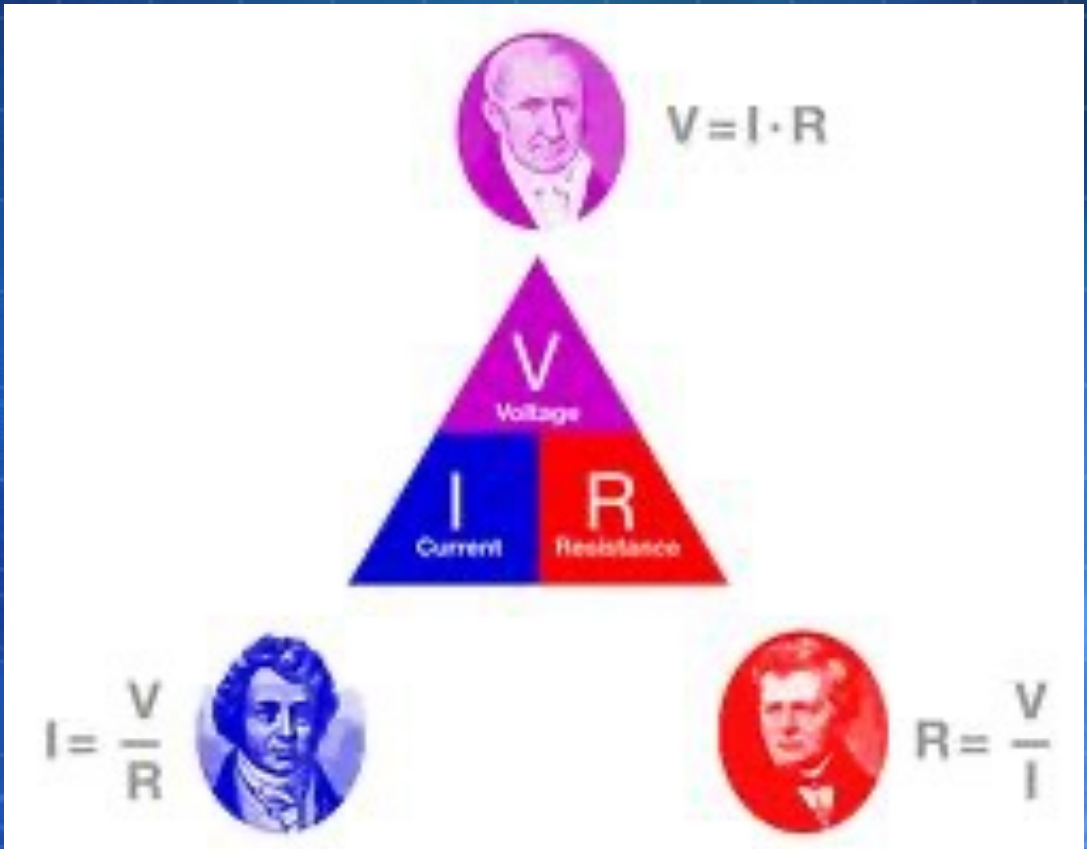
Practice #3—Kitchen Batteries, Series, and Parallel

Mr. Burleson
geaux15@hotmail.com

Agenda

- 15 minutes—Grading homework.
- 30 minutes—Learning Lesson of the Day
- 15 minutes—In Practice quick test on Lesson of the Day
- 25 minutes—Practical testing
- 5 minutes—Sending out homework

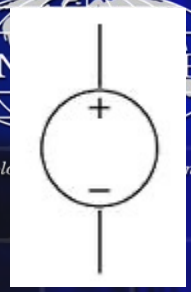
The Big Three—Volta, Ampere, and Ohm



How to identify batteries?

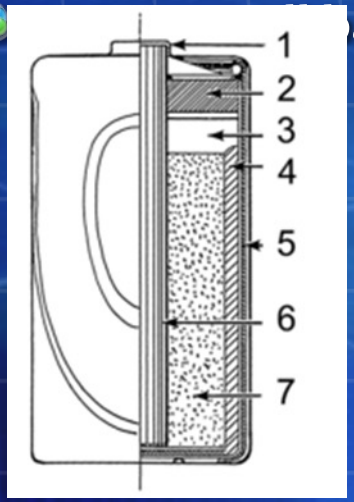
- All batteries are Direct Current (DC)
- They are usually denoted by their Voltage
  - Normally 1.5V, 3V, 6V, 9V, 12V, and 24V
  - This is because most cells produce 1.5V and then are put in series.
- POSITIVE (+) terminals are either marked or painted RED, sometimes with a cover to reduce chance of a SHORT CIRCUIT
- NEGATIVE (-) terminals are normally marked or painted BLACK or BLUE.

Batteries



Dry CELL

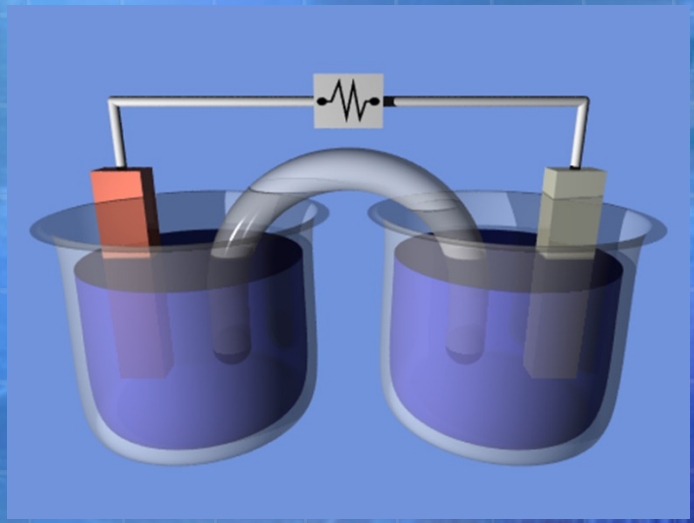
- Electrolyte is immobilized as a paste
- Zinc-carbon
- Alkaline batteries
- atteries



Line art drawing of a dry cell:
1. brass cap,
2. plastic seal,
3. expansion space,
4. porous cardboard,
5. zinc can,
6. carbon rod,
7. chemical mixture
(wikipedia.org)

WET CELL

- Has a liquid electrolyte
- Lead-acid (car batteries)
- Nickel-Cadmium



Kitchen Batteries

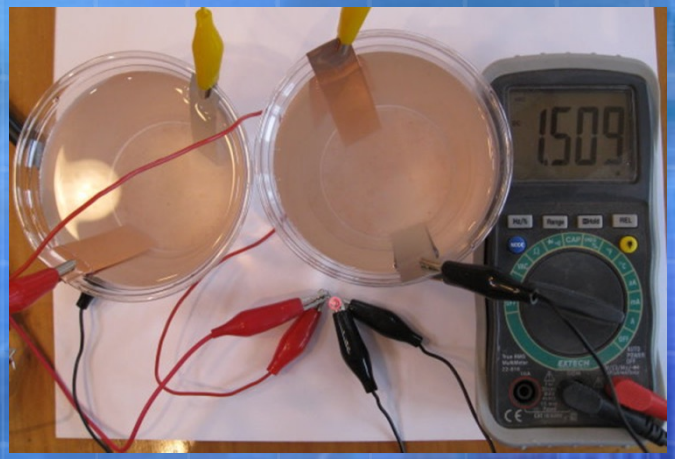
- You can create a simple battery with two different kinds of metal in a conducting solution
  - To the right is an Aluminum and Copper strip in a glass of soda

Copper-Aluminum Coke Battery

Kitchen Batteries

- You can create different types by changing the metals or changing the electrolyte solution
- You can add cells to increase the voltage

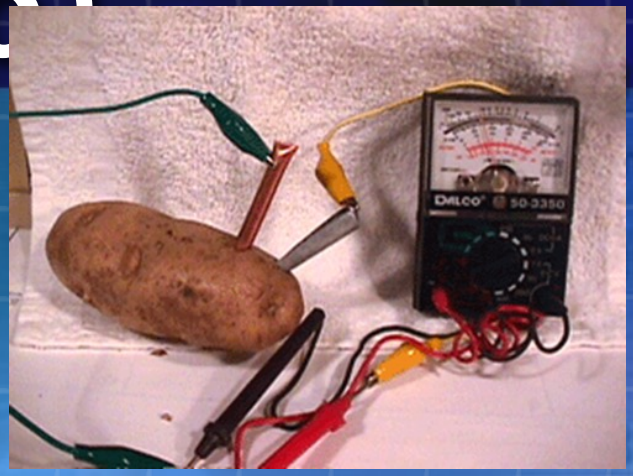
Zinc-Aluminum Coke Battery



Two Cell Zinc-Aluminum Sea Water Battery

Kitchen Batteries (Potato)

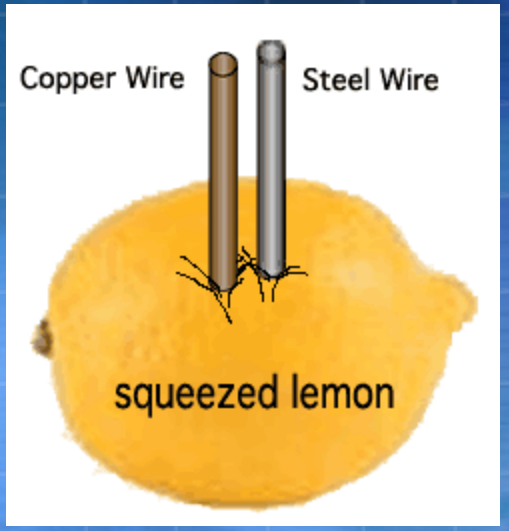
- Use the potato as the electrolyte
- Use a Copper electrode and an Zinc electrode
- Put them close together, but not touching
- Produces about 1.2 V
- (from miniscience.com)



Three Cell Copper- Zinc Potato Battery

Kitchen Batteries (Lemon)

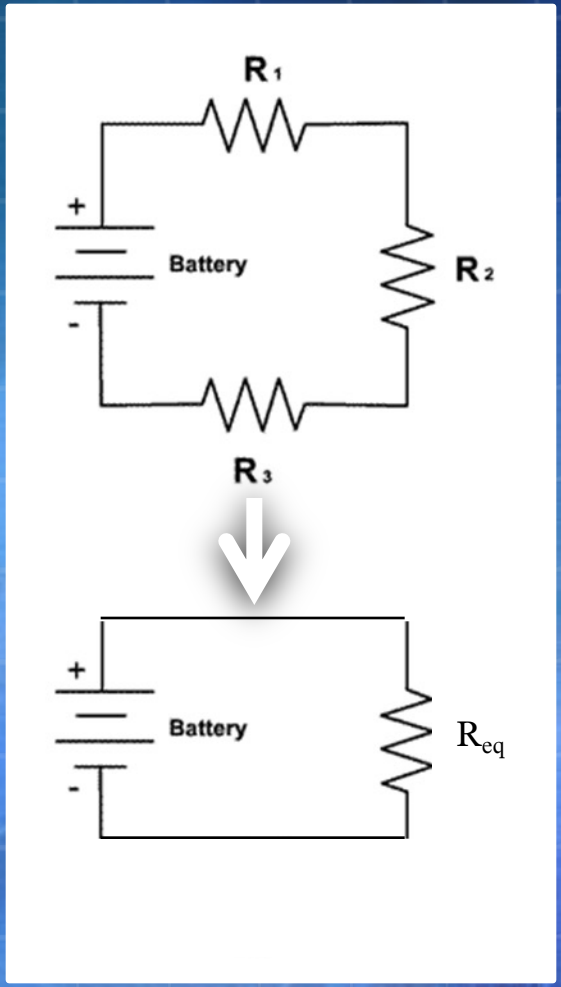
- Use the lemon as the electrolyte
- Use a Copper electrode and an Steel electrode
- Put them close together, but not touching
- Produces about 0.7 V
- (from energyquest.ca.gov)



One Cell Copper- Steel Lemon Battery, a Penny can be the Copper and a Paper Clip can be the Steel

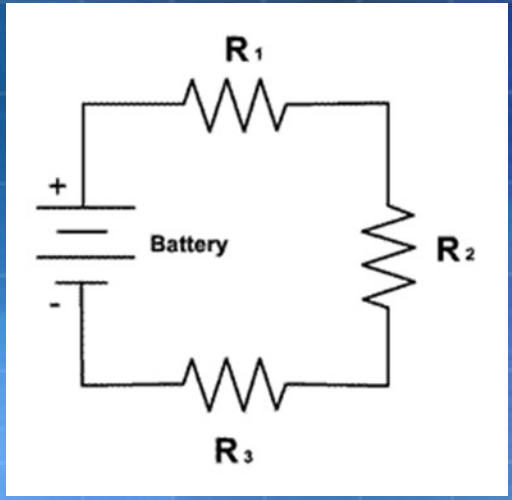
Equivalent Resistance or Load

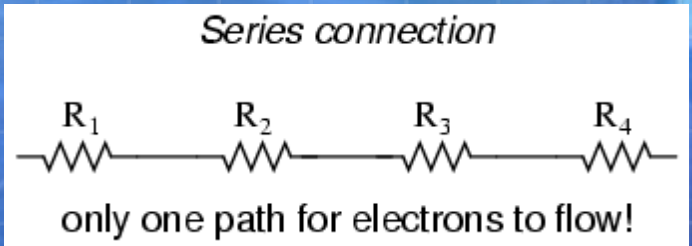
- Multiple resistors can be combined into a single resistance to represent all of them called an Equivalent Resistance or R_{eq}
- The current flowing through both of the circuits on the right is exactly the same



Series Circuit

- Two or more resistors in series
- Current is the same through all resistors (electrons have no other path)
- Voltage is split between resistors
- $R_{eq} = R_1 + R_2 + R_3$
- R_{eq} is always greater than the largest single resistance
- Current = Voltage / R_{eq}

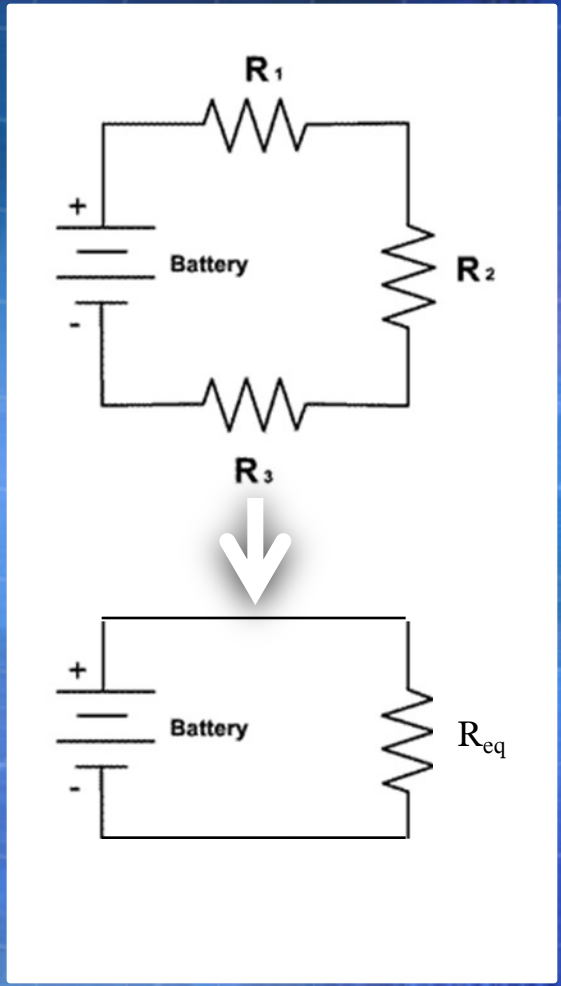




Series Circuit (example)

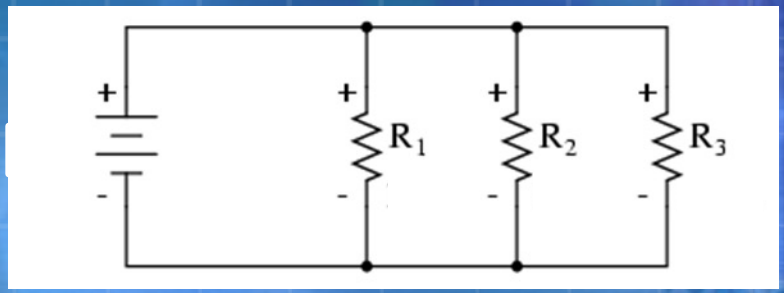
- $R_{eq} = R_1 + R_2 + R_3$
- $R_1 = 300\ \Omega$
- $R_2 = 300\ \Omega$
- $R_3 = 400\ \Omega$
- $R_{eq} = 300\ \Omega + 300\ \Omega + 400\ \Omega$
- $R_{eq} = 1{,}000\ \Omega$ or $1\ k\Omega$
- If V =1,000 V or 1 kV
- $I = V/R = 1kV/ 1\ k\Omega = 1\ A$

- ** R_{eq} = the sum of the resistors or if they are all the same value then multiply them by that number
  - Two 300Ω resistors in series = 2 x 300Ω = 600Ω
  - Three 300Ω resistors in series = 3 x 300Ω = 900Ω
  - Two 200Ω resistors in series = 2 x 200Ω = 400Ω



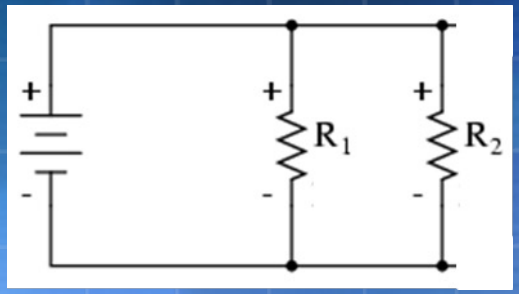
Parallel Circuit

- Two or more resistors in parallel
- Voltage is the same through all resistors
- Current is split between resistors (electrons are split between all branches)
- $1/R_{eq} = 1/R_1 + 1/R_2 + 1/R_3$
- R_{eq} is always less than the smallest single resistance
- Current (from battery) = Voltage / R_{eq} ,which is then split among the three branches



Parallel Circuit (Example

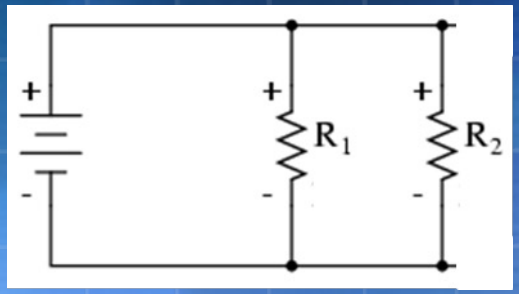
- $1/R_{eq} = 1/R_1 + 1/R_2$
- $R_1 = 2\ \Omega$
- $R_2 = 2\ \Omega$
- $1/R_{eq} = ½_\Omega + ½_\Omega = 1/_\Omega$
- $R_{eq} = 1\ \Omega$



- If V = 6 V
- I = V/R = 6 V/ 1 Ω = 6A, which is split among the two resistors

Parallel Circuit (Example

- $1/R_{eq} = 1/R_1 + 1/R_2$
- $R_1 = 4\ \Omega$
- $R_2 = 4\ \Omega$
- $1/R_{eq} = ¼\Omega + ¼\ \Omega = ½\ \Omega$
- $R_{eq} = 2\ \Omega$
- If V = 6 V
- I = V/R = 6 V/ 2 Ω = 3 A, which is then split among the two resistors
- **If the resistors have the same value, Req = the resistance is divided by the number in parallel
  - Two 4Ω resistors in parallel are 4Ω/2 = 2Ω
  - Two 6Ω resistors in parallel are 4Ω/2 = 3Ω
  - Three 6Ω resistors in parallel are 6Ω/3 = 2Ω



In Practice Quiz

- Please do the quiz using your binder!!!
- Ask Questions!!!!

Practical

- Create kitchen battery using the lemons and potatoes provided
  - Measure the voltage and determine the POSITIVE (+) and NEGATIVE (-) terminals
  - Identify the electrolyte, cathode, and anode.
- Create a series circuit and measure the voltage of all parts
  - What is the current through each one?
- Create a parallel circuit and measure the voltage of all parts
  - What is the current through each one?

Homework

- Describe the difference between wet and dry cell batteries? Give two examples.
- Give two examples of "kitchen batteries", including terminal notation
  - Which is the positive terminal and which is the negative terminal?
  - Which is the cathode and which is the anode?
  - What materials are used for the terminals?
  - What is the electrolyte?
- If I need to have the same VOLTAGE for all elements, would parallel or series circuit be better?
- If I need to have the same CURRENT for all elements, would parallel or series circuit be better?
- Homework Generator Level 1 VIR (for series circuits)
- Homework Generator Level 2 Parallel (for parallel circuits)