Electricity

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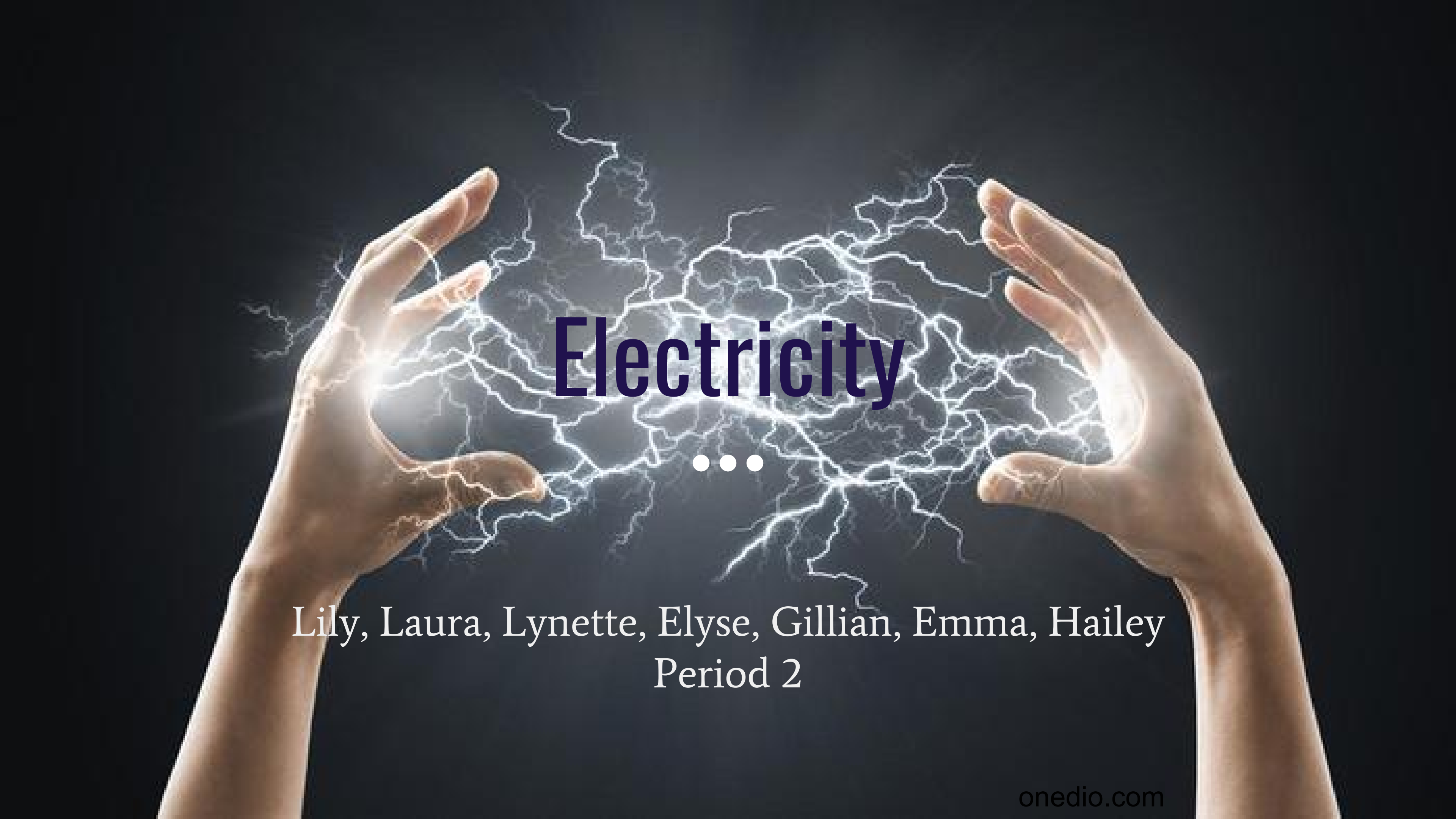
Period 2



Electrostatics vs. Electricity

- *Electrostatics* is the study of charges at rest
  - Electrostatics: to help remember the difference the word static means stationary or not moving
- *Electricity* puts those charges in motion

Electric Current

- Defined as the flow of electric charge over a period of time
  - $I = \triangle Q / \triangle t$
- Measured in Amperes, A
- Is a completely dependent variable - it relies on voltage and resistance

Batteries

- Supply electric current to a system
- **They only *push* charge**
- They do NOT create or supply electric charge
- Use a chemical reaction to create a potential difference (voltage).

Ohm's Law

- Current in a wire is proportional to potential difference (voltage) applied to its ends
- **V=IR**
    - Voltage: volts (V)
    - Current: amps (A)
    - Resistance: ohms (Ω)
- Resistance and voltage are independent
- Current is dependent

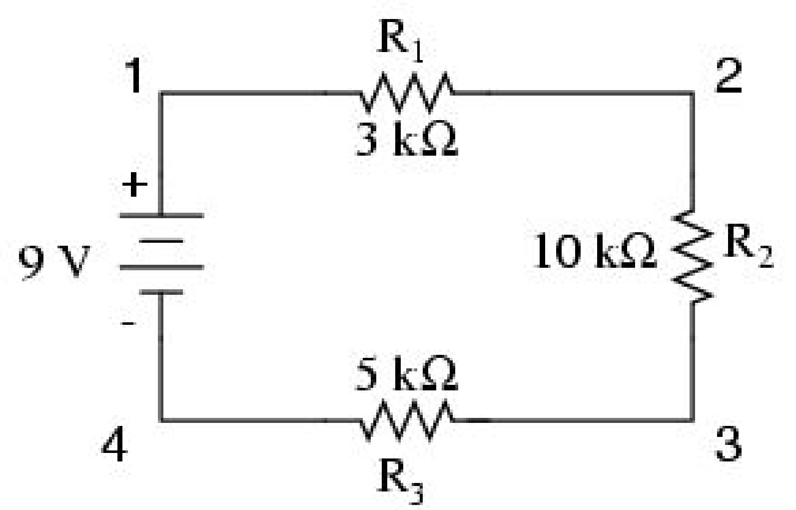
Resistivity

- All electronic devices offer resistance to the flow of current
- *Resistivity* is a measure of the resisting power of a specified material to the flow of an electric current
- $R = \rho L/A$
- ρ(greek letter rho)= the resistivity of a material
- Measured in Ωm= Ohm meters
- *Resistivity* depends on temperature
  - **Hot** temperature → increased resistivity
  - **Cold** temperature → decreased resistivity

Power

- Electric energy can be easily transformed into other forms of energy
  - Examples:
    - Lightbulbs turn it into light energy and thermal energy
    - Motors turn it into mechanical work
    - Electric heaters, stoves, and toasters turn it into thermal energy
- P = IV = I2R = V2/R

Series Circuits



- **Series:** two or more resistors are connected end to end
- **Voltage will drop across each resistor**
- Same current will pass through each resistor
- Battery doesn't know difference between one big resistor and several small resistors working together

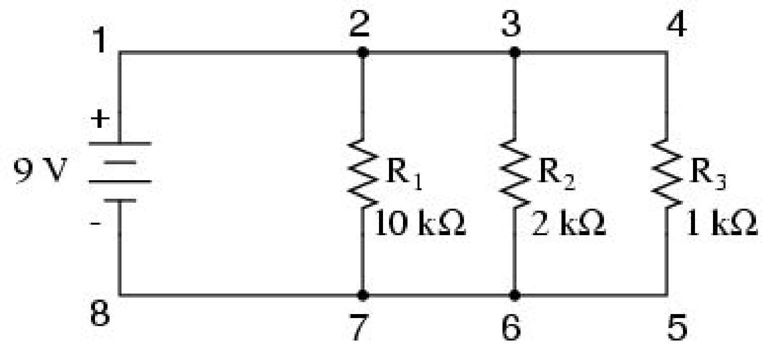
$$V = V_1 + V_2 + V_3 + \dots$$

$$I = \text{constant}$$

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

Parallel Circuits

- Resistors connected in parallel will split the current into branches that run parallel to each other
- Junctions are the joints where these branches connect
- Voltage remains constant across the circuit
- Current is split between each individual branch
- Resistance is simply the reciprocal of a series circuit



$V = \text{constant}$

$I = I_1 + I_2 + I_3 + \ldots$

$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \ldots$

Kirchhoff's Rules

1. **Junction Rule:** at any junction, the sum of currents in equals the sum of currents out (conservation of charge)
2. **Loop Rule:** the sum of the changes in potential around any closed path of a circuit must be zero (conservation of energy)

- These rules are used to find values in circuits that are not all parallel or all series, but mixed

Capacitors in Circuits

- Capacitors in ***parallel:***
  - $Q = Q_1 + Q_2 + Q_3$
  - $C_{eq} = C_1 + C_2 + C_3$
- Capacitors in ***series:***
  - $V = V_1 + V_2 + V_3$
  - $$\frac{1}{C_T} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}$$

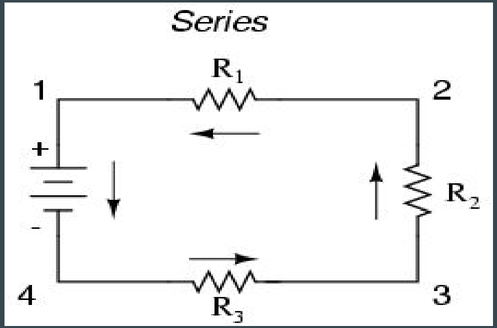
Common Mistake #1

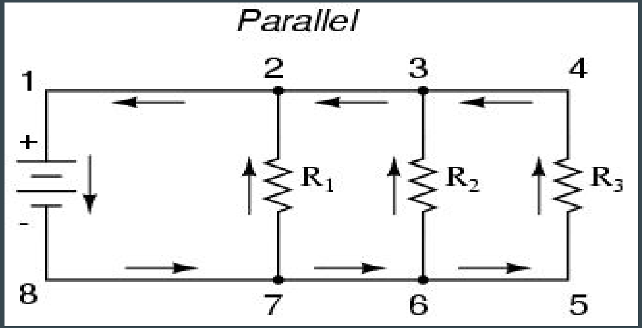
- V=IR
- Do not forget that CURRENT is the DEPENDENT variable and voltage is INDEPENDENT

- To avoid this common mistake rewrite the equation as
    - I=V/R
        - This way you remember current is the DEPENDENT variable

Common Mistake #2

- Know how to identify a SERIES and a PARALLEL circuit





- To avoid this common mistake know that a series circuit follows in a single loop with no junctions and a parallel circuit has various pathways for the current to travel on

Common Mistake #3

- Do not mix up the rules for Series and Parallel
    - Parallel

      $V = \text{constant}$

      $I = I_1 + I_2 + I_3 + \ldots$

      $\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \ldots$
    - Series

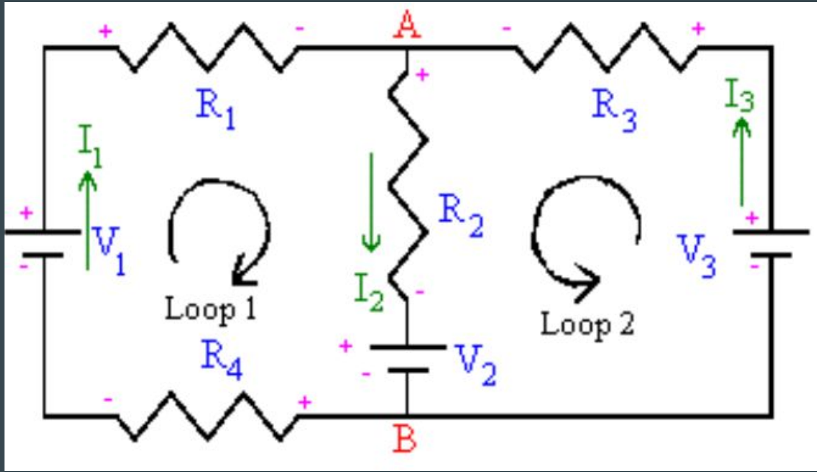
      $V = V_1 + V_2 + V_3 + \ldots$

      $I = \text{constant}$

      $R_{eq} = R_1 + R_2 + R_3 + \ldots$

Common Mistake #4

- Do not forget that when current is moving AGAINST the flow you ADD resistors and SUBTRACT for BATTERIES
- Normally when the current runs from the battery to a resistor you SUBTRACT when you reach the RESISTOR
    - However, SUBTRACTION switches to ADDITION when the current runs against the system.



Common Mistake #5

- Batteries only push charge
- It is commonly mistaken that batteries supply and store charge
- How to avoid: remember that capacitors are the ones that store charge and charges are supplied in wires

Common Mistake #6

- Do not mix up resistance and resistivity
- $R = \rho L/A$
  - R is resistance
  - ρ is resistivity
- Avoid this common mistake by remembering you have to use the resistivity(ρ) to find the resistance(R)

Kahoot

Ω