# Series Circuits



- A circuit is a closed loop in which electric current can flow.
  - For a continuous flow of electrons, there must be a complete circuit with <u>no gaps</u>
  - A gap is usually provided by an <u>electric switch</u> that can be opened or closed to either cut off or allow electron flow
- The simplest circuit requires a minimum of three things:
  - A source of electrical potential energy or voltage
    - Battery
  - A conductive path which would allow for the movement of charge
    - Wires
  - An electrical resistance (something that uses electricity to do work)
    - Light bulbs (brightness of the bulb depends on the amount of electrical power the bulb dissipates)

#### **Diagramming Electric Circuits**



#### Resistors In Series (Series Circuits)





• Equivalent resistance in the series circuit is the sum of the individual resistances along the circuit path.

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

**Ex:** Find the total resistance of the three resistors connected in series.

## In Series

• Current passing through each electric device is the same

$$I_1 = I_2 = I_3$$

• Ohm's Law applies across each individual device

$$V_1 = I_1 R_1$$
  $V_2 = I_2 R_2$   $V_3 = I_3 R_3$ 

• Sum of the voltage drops across the individual devices is equal to the total voltage supplied by the source

$$V_{total} = V_1 + V_2 + V_3$$

• For the entire circuit:

$$V_{total} = IR_{eq}$$

#### Example 1: Series

• What is the current through the battery?



#### Example 2: Series

• Find the resistance of the unknown resistor, R.



## Example 3: Series

- Two 4  $\Omega$  resistors and two 3  $\Omega$  resistors are connected in series to a 28 V battery.
  - What is the equivalent resistance?
  - What is the current in the circuit?
  - What is the voltage drop across each resistor?