

## **Challenge Activity: Circuits**

### Overview

This activity will reinforce concepts about circuits and parallel and series

Time allotted: 1 class period

Grade level: 9-12

### PA State Standards

- 3.2.P.B4. Develop qualitative and quantitative understanding of current, voltage, resistance, and the connections among them.

### Objectives/Learning Goals:

- To analyze circuits having combinations of parallel and series

### Materials needed (per student group):

- One light bulb/circuit board
- Switches, batteries, and light bulbs needed to produce the circuits in the problem on the worksheet.

Name: \_\_\_\_\_

Date: \_\_\_\_\_

Partner(s): \_\_\_\_\_

## CHALLENGE PROBLEM: CIRCUITS

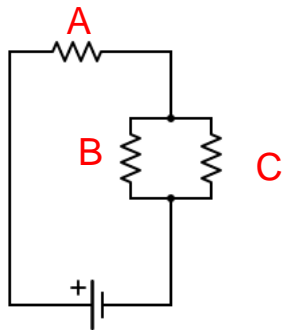
**Objective:** To analyze circuits having combinations of parallel and series

**Materials:** Light bulb boards

This circuit includes three 40 watt light bulbs (A,B,C) as well as 6 switches (numbered as seen on board). Switches can be set to either the open or closed position. The power supply has a voltage of 120V.

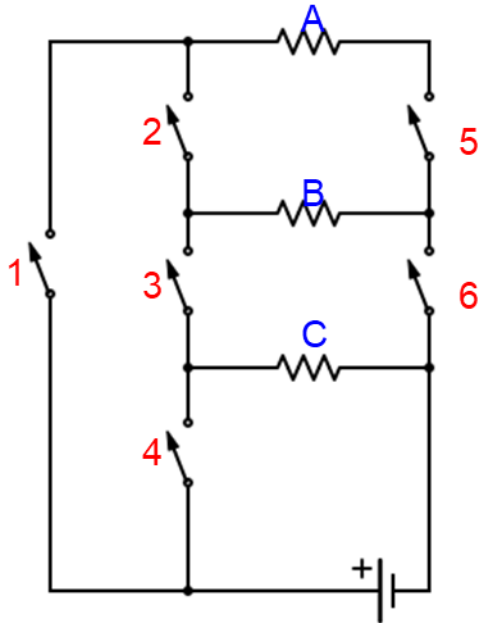
### Pre-Challenge Questions:

1. What does it mean when the lights are in series? In parallel?
  
  
  
  
  
  
  
  
  
  
2.
  - a. Given the circuit below, what is the equivalent resistance of  $R_B$  and  $R_C$ ?



- b. Redraw the diagram of the new circuit of  $R_A$  and  $R_{BC}$  and calculate the equivalent resistance of this circuit.

**Challenges:** You and your group will now be given a few minutes to play with the circuit board to see how it all works. For the following questions, you will only be allowed to open/close switches 5 times per question, so think before you switch! Diagram of the circuit is provided below. Be sure to note the brightness of the bulb for each equation



1. Which switches will light up *only* C?
2. Which switches will light up *only* B?
3. Which switches will light up B and C, but not A?
4. Which switches will light up A and B, but not C?
5. List combinations that would put A, B, and C in series.
6. List combinations that would put A, B, and C in series.

**Post-Challenge Questions:**

1.
  - a. When did the bulbs have *full brightness*? What combination of switches will *dim all three* lights?
  - b. Why does this happen? (Hint: Think about what brightness is related to and look at calculations made in Pre-Challenge questions.)
2. What can you conclude about the brightness of bulbs in series compared to the brightness of bulbs in parallel?