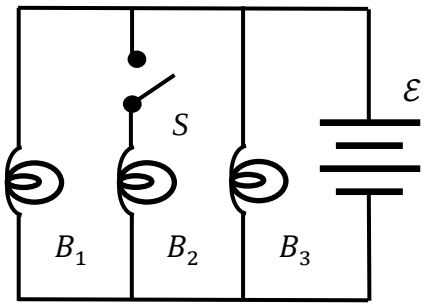
Section	Group	Name	Signature
Grade			

After this activity you should know: • *understand what happens to currents, voltage drops and power when circuits are changed by opening and closing switches and shorting portions of the circuit.*

1. Three identical light bulbs are attached in parallel to an EMF as shown. The switch *S* is initially in the open position as shown. Treat the light bulbs as ohmic and the EMFs as ideal. Note that bulb brightness is proportional to power dissipated in the bulb.



   a. What is true of bulbs B_1 and B_3 when the switch is in the open position?
   - Bulb B_3 is brighter than B_1 because it is closer to the EMF than B_1.
   - Bulb B_3 has the same brightness as B_1 because they are connected in series.
   - Bulb B_3 has the same brightness as B_1 because they are connected in parallel.

   b. What happens to the brightness of B_1 after the switch is closed?
   - B_1 becomes brighter because the equivalent resistance of the circuit decreases.
   - B_1 becomes dimmer because the current is now split between three bulbs instead of two.
   - The brightness of B_1 does not change because it is connected directly across the terminals of the EMF.

   c. Let the resistance of each light bulb be 6Ω and the EMF be $15V$. What is the current through the EMF and the power provided by the EMF when the switch is in the open position?

$$I = \frac{V}{R} = \frac{15}{3} = 5\ A$$

$$P = V \cdot I = 75W$$

   d. What is the current through the EMF and the power provided by the EMF when the switch is in the closed position?

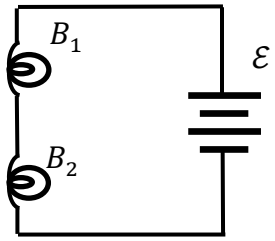
$$I = \frac{V}{R} = \frac{15}{2} = 7.5A$$

$$P = V \cdot I = 112.5\ W$$

   e. A common mistake is to think that the light bulb becomes dimmer because the current is now split into three instead of two. Why is this argument incorrect?

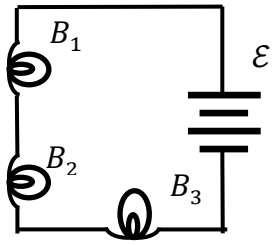
since they are in parallel all their voltages are equal.

2. Two identical light bulbs are connected in series. A third light bulb is then added in series with the first two. Let the resistance of the bulbs be 6Ω and the EMF be 24 V.



   a. What is the voltage drop across B_1 before the third bulb is placed in the circuit?

12 V



   b. What is the voltage drop across B_1 after the third bulb is placed in the circuit?

6.55 V

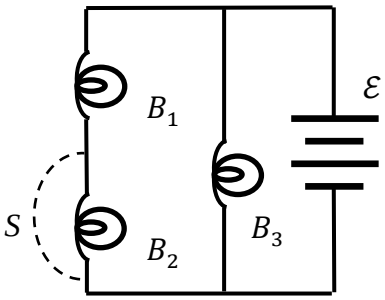
   c. What happens to the brightness of B_1 after the third bulb is in place?

   - quadruples
   - quarters
   - unchanged
   - goes out
   - 3/2 as large
   - 2/3 as large
   - 9/4 as large
   - 4/9 as large

   d. Based on your results for parallel and series circuits, is your house wired in parallel or in series? Explain.

parallel, my lights intensity are equal.

3. Three light bulbs are connected to an EMF as shown. A wire S is then placed to short circuit bulb B_2.



   a. What is true of the brightness of bulbs B_1 and B_2 before B_2 is shorted.

   - B_1 is four times as bright as B_2.
   - B_1 is twice as bright as B_2
   - B_2 is four times as bright as B_1.
   - B_2 is twice as bright as B_1
   - The two bulbs have the same brightness.

   b. What happens to the brightness of B_3 after B_2 shorted?

   - quadruples
   - doubles
   - unchanged
   - halves
   - quarters
   - goes out

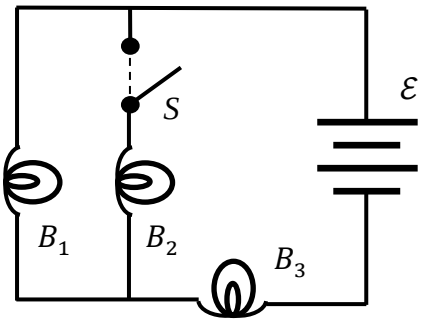
   c. What happens to the brightness of B_2 after it is shorted?

   - quadruples
   - doubles
   - unchanged
   - halves
   - quarters
   - goes out

   d. What happens to the brightness of B_1 after B_2 is shorted?

   - quadruples
   - doubles
   - unchanged
   - halves
   - quarters
   - goes out

4. Three identical bulbs are now connected as shown. Switch S is initially in the open (solid line) position.



   a. Assume all resistances are 6Ω and the EMF is 24 Volts. Determine the equivalent resistance when the switch is in the open position.

12 Ω

   b. Determine the current through B_3 when the switch is open.

2 A

   c. Determine the voltage across B_1 when the switch is open.

12 V

   d. Determine the equivalent resistance when switch *S* is closed (dashed line)

9 Ω

   e. Determine the current through B_3 when the switch is closed.

2.67 A

   f. Determine the voltage across B_1 when the switch is closed.

8 V

   g. Determine the P_{close}/P_{open} of the power dissipated by B_3 when the switch is closed and open.

$$\frac{P_c}{P_o} = \frac{16 \cdot 2.67}{12 \cdot 2} = 1.78$$

   h. What happens to the brightness of B_3 when the switch S is thrown to the closed position?
   - becomes brighter
   - becomes dimmer
   - goes out

   i. What happens to the brightness of B_1 when the switch S is thrown to the closed position?
   - becomes brighter
   - becomes dimmer
   - goes out

   j. If you have time use the PhET DC circuit simulation https://phet.colorado.edu/sims/html/circuit-construction-kit-dc/latest/circuit-construction-kit-dc_en.html to test your results.