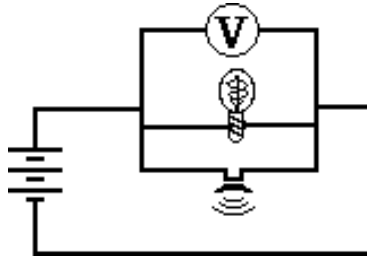
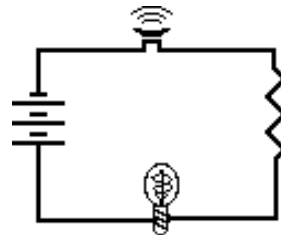


SERIES CIRCUITS

1. Electrical devices in circuits can be connected to each other in a number of different ways. The two most common connections are *series* connections and *parallel* connections. Observe the electrical wiring below. Indicate whether the connections are series or parallel.

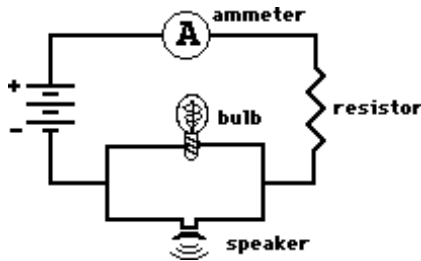


Parallel



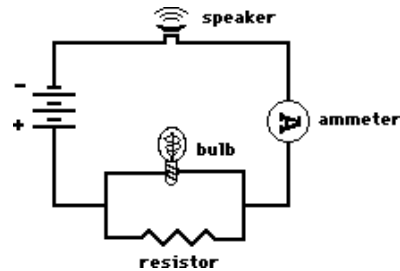
Series

2. Two electric circuits are diagrammed below. For each circuit, indicate which two devices are connected in series and which two devices are connected in parallel.



Series ammeter and resistor

Parallel bulb and speaker



Series ammeter and speaker

Parallel bulb and resistor

3. **Comparing Series vs. Parallel Circuits**

Fill in the table below to indicate the manner in which series and parallel circuits differ.

	Series Circuit	Parallel Circuit
a. Definition: The pathway by which charge loops around the circuit is characterized by _____ pathway(s).	a single	multiple
b. Observation: If one light bulb goes out, the other light bulbs _____.	go out	remain lit
c. Observation: As the number of resistors is increased, the overall current _____.	decreases	increases
d. Observation: As the number of resistors is increased, the overall resistance _____.	increases	decreases

4. The following diagrams represent circuits consisting of two electrical devices connected in series. For each diagram, fill in the blanks to show the voltage drop across the designated device.

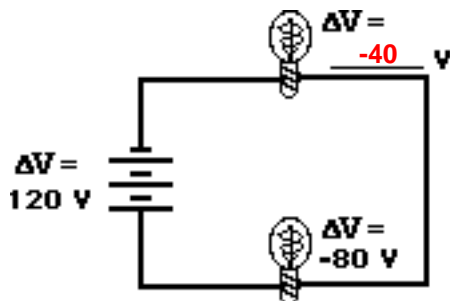


Diagram A

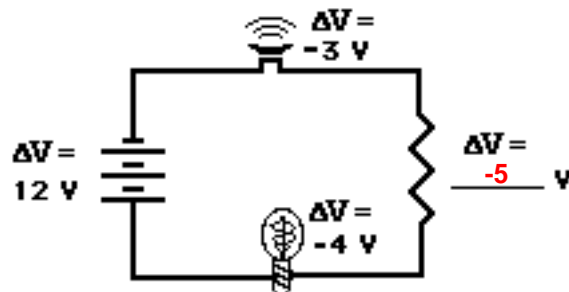


Diagram B

Electric Circuits

5. Consider the following two diagrams of series circuits. For each diagram, use arrows to indicate the direction of the conventional current. Then, make comparisons of the voltage and the current at the designated points for each diagram.

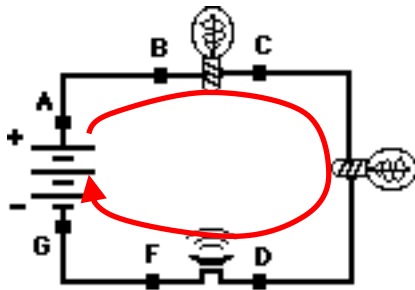


Diagram A

$$V_A > V_G$$

(>, <, or =)

$$V_B > V_C$$

(>, <, or =)

$$V_B > V_F$$

(>, <, or =)

$$I_A = I_G$$

(>, <, or =)

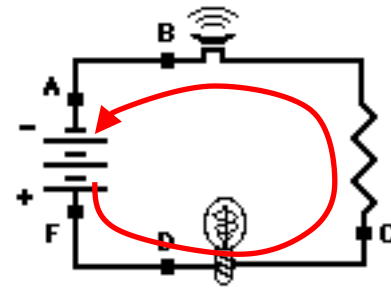


Diagram B

$$V_A < V_F$$

(>, <, or =)

$$V_B < V_C$$

(>, <, or =)

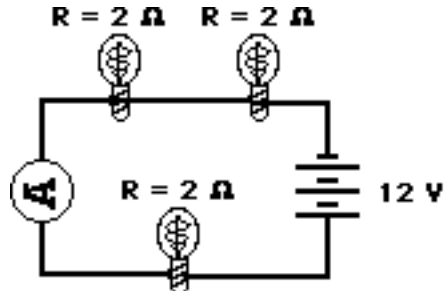
$$V_D \approx V_F$$

(>, <, or =)

$$I_A = I_F$$

(>, <, or =)

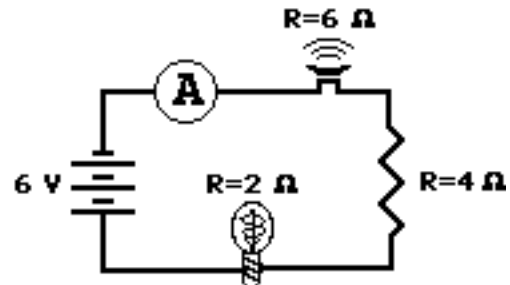
6. Analyze the following circuit and determine the equivalent or total resistance. Then determine the current at the ammeter location.



Circuit A

$$R_{\text{tot}} = \underline{6 \Omega}$$

$$I = \underline{2 \text{ A}}$$



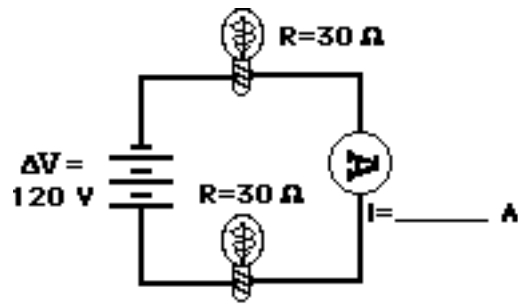
Circuit B

$$R_{\text{tot}} = \underline{12 \Omega}$$

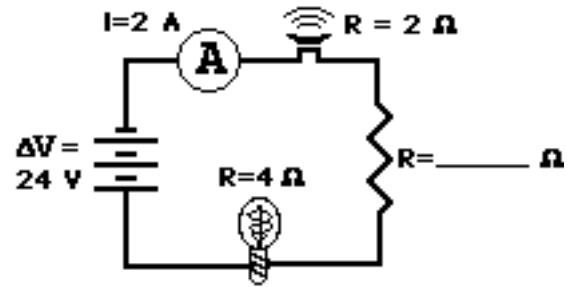
$$I = \underline{0.5 \text{ A}}$$

The total resistance (a.k.a., equivalent resistance) is determined by adding the individual resistance values. The current is then determined using $\Delta V = I \cdot R_{\text{tot}}$ where ΔV is the battery voltage.

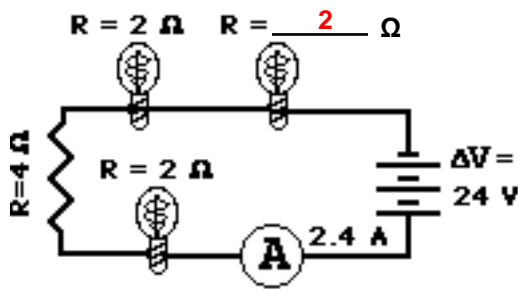
7. For the following diagrams, utilize the concept of equivalent resistance and Ohm's Law in order to fill in the blank.



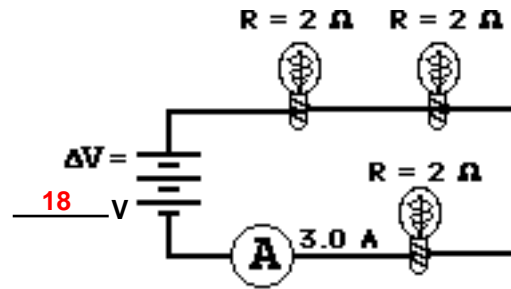
Circuit A



Circuit B



Circuit C



Circuit D

Circuit A: $R_{\text{tot}} = 30 \Omega + 30 \Omega = 60 \Omega$; $I = \Delta V / R_{\text{tot}} = (120 \text{ V}) / (60 \Omega) = 2 \text{ A}$

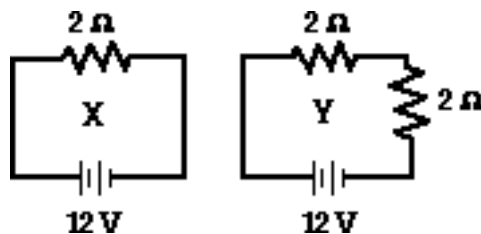
Circuit B: $R_{\text{tot}} = \Delta V / I = (24 \text{ V}) / (2 \text{ A}) = 12 \Omega$; $R_{\text{tot}} = 12 \Omega = 4 \Omega + R_2 + 2 \Omega$; $R_2 = 6 \Omega$

Circuit C: $R_{\text{tot}} = \Delta V / I = (24 \text{ V}) / (2.4 \text{ A}) = 10 \Omega$; $R_{\text{tot}} = 10 \Omega = 2 \Omega + 4 \Omega + 2 \Omega + R_4$; $R_4 = 2 \Omega$

Circuit D: $R_{\text{tot}} = 2 \Omega + 2 \Omega + 2 \Omega = 6 \Omega$; $\Delta V = I \cdot R_{\text{tot}} = (3.0 \text{ A}) \cdot (6 \Omega) = 18 \text{ V}$

Electric Circuits

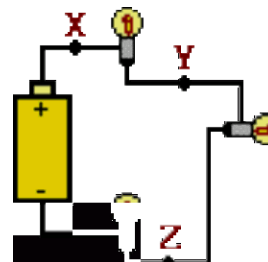
9. Compare circuits X and Y. Consider circuits X and Y below. Each circuit is powered by the same battery and contains identical resistors. Circuit X has one resistor and circuit Y has two resistors. The equivalent resistance of circuit X will be < (> or < or =) that of circuit Y. The current in the battery in X will be > (> or < or =) that in the battery in Y.



10. Three identical light bulbs are connected to a battery as shown below. Which adjustments could be made to the circuit that would increase the current being measured at X? Circle all that apply.

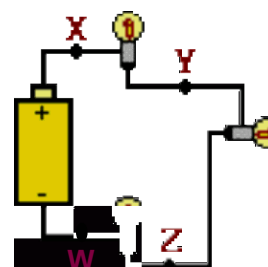
Answer: **BEF**

- Increase the resistance of one of the bulbs.
- Decrease the resistance of two of the bulbs.**
- Increase the resistance of two of the bulbs.
- Decrease the voltage of the battery.
- Increase the voltage of the battery.**
- Remove one of the bulbs (and re-connect the circuit).**



11. Three identical light bulbs are connected to a battery as shown below. W, X, Y and Z represent locations along the circuit. Which one of the following statements is true? Answer: **D**

- The potential difference between X and Y is greater than that between Y and Z.
- The potential difference between X and Y is greater than that between Y and W.
- The potential difference between Y and Z is greater than that between Y and W.
- The potential difference between X and Z is greater than that between Z and W.**
- The potential difference between X and W is greater than that across the battery.
- The potential difference between X and Y is greater than that between Z and W.

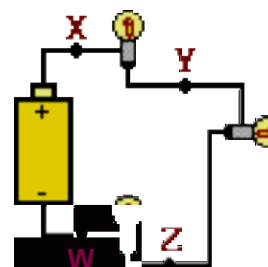


12. Three identical light bulbs are connected to a battery as shown below. Which one of the following statements is true? Answer: **A**

- All three bulbs will have the same brightness.**
- The bulb between X and Y will be the brightest.
- The bulb between Y and Z will be the brightest.
- The bulb between Z and the battery will be the brightest.

Justify your answer to this question using the language of physics.

The current in a series circuit is everywhere the same. So the current is the same in each bulb. The bulbs are identical so the resistance is the same. Power - the rate at which energy is transformed by a bulb - depends on I and R ($P=I^2 \cdot R$) and is the quantity that determines bulb brightness. With the same I and R, the bulbs have identical power and brightness.



13. Compare a circuit with three light bulbs to a circuit with two light bulbs. All light bulbs are identical. In which circuit will the overall power be the greatest? Intelligently defend your answer.

Power can be calculated as the product of $I \cdot \Delta V$. Assuming each circuit is powered by the same battery, the ΔV across the whole circuit will be the same for each circuit. Yet the current will be greatest in the 2-bulb circuit since adding more resistors (light bulbs) decreases the current. So the $I \cdot \Delta V$ product will be greatest for the 2-bulb circuit; it will have the greatest overall power.