

Section 1 Simple Circuits: Practice Problems

8. Holiday lights often are connected in series and use special lamps that short out when the voltage across a lamp increases to the line voltage. Explain why. Also explain why these light sets might blow their fuses after many bulbs have failed.

SOLUTION:

If not for the shorting mechanism, the entire set would go out when one lamp burns out. After several lamps fail and then short, the total resistance of the remaining working lamps results in an increased current that is sufficient to blow the fuse.

ANSWER:

If not for the shorting mechanism, the entire set would go out when one lamp burns out. After several lamps fail and then short, the total resistance of the remaining working lamps results in an increased current that is sufficient to blow the fuse.

12. Three resistors of 3.3 k Ω , 4.7 k Ω , and 3.9 k Ω are connected in series across a 12-V battery.

- What is the equivalent resistance?
- What is the current through the resistors?
- Find the total potential difference across the three resistors.

SOLUTION:

a. $R = 3.3 \text{ k}\Omega + 4.7 \text{ k}\Omega + 3.9 \text{ k}\Omega = 11.9 \text{ k}\Omega$

b.

$$I = \frac{\Delta V}{R} = \frac{12 \text{ V}}{1.19 \times 10^4 \Omega} \\ = 1.0 \text{ mA} = 1.0 \times 10^{-3} \text{ A}$$

c. $\Delta V = 3.3 \text{ V} + 4.7 \text{ V} + 3.9 \text{ V} = 11.9 \text{ V}$

ANSWER:

a. $R = 11.9 \text{ k}\Omega$

b. $I = 1.0 \text{ mA} = 1.0 \times 10^{-3} \text{ A}$

c. $\Delta V = 11.9 \text{ V}$

Chapter 23 Practice Problems, Review, and Assessment

14. You connect three $15.0\text{-}\Omega$ resistors in parallel across a 30.0-V battery.

- a. What is the equivalent resistance of the parallel circuit?
- b. What is the current through the entire circuit?
- c. What is the current through each branch of the circuit?

SOLUTION:

a.

$$\begin{aligned}\frac{1}{R} &= \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} \\ &= \frac{1}{15.0\ \Omega} + \frac{1}{15.0\ \Omega} + \frac{1}{15.0\ \Omega} \\ &= \frac{3}{15.0\ \Omega} \\ R &= 5.00\ \Omega\end{aligned}$$

b.

$$I = \frac{\Delta V}{R} = \frac{30.0\ \text{V}}{5.00\ \Omega} = 6.00\ \text{A}$$

c.

$$I = \frac{\Delta V}{R_1} = \frac{30.0\ \text{V}}{15.0\ \Omega} = 2.00\ \text{A}$$

ANSWER:

- a. $R = 5.00\ \Omega$
- b. $I = 6.00\ \text{A}$
- c. $I = 2.00\ \text{A}$

Chapter 23 Practice Problems, Review, and Assessment

16. You connect a $120.0\text{-}\Omega$ resistor, a $60.0\text{-}\Omega$ resistor, and a $40.0\text{-}\Omega$ resistor in parallel across a 12.0-V battery.

- What is the equivalent resistance of the parallel circuit?
- What is the current through the entire circuit?
- What is the current through each branch of the circuit?

SOLUTION:

a.

$$\begin{aligned}\frac{1}{R} &= \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} \\ &= \frac{1}{120.0\ \Omega} + \frac{1}{60.0\ \Omega} + \frac{1}{40.0\ \Omega}\end{aligned}$$

$$R = 20.0\ \Omega$$

b.

$$I = \frac{\Delta V}{R} = \frac{12.0\ \text{V}}{20.0\ \Omega} = 0.600\ \text{A}$$

c.

$$I_1 = \frac{\Delta V}{R_1} = \frac{12.0\ \text{V}}{120.0\ \Omega} = 0.100\ \text{A}$$

$$I_2 = \frac{\Delta V}{R_2} = \frac{12.0\ \text{V}}{60.0\ \Omega} = 0.200\ \text{A}$$

$$I_3 = \frac{\Delta V}{R_3} = \frac{12.0\ \text{V}}{40.0\ \Omega} = 0.300\ \text{A}$$

ANSWER:

a. $R = 20.0\ \Omega$

b. $I = 0.600\ \text{A}$

c. $I_1 = 0.100\ \text{A}$, $I_2 = 0.200\ \text{A}$, $I_3 = 0.300\ \text{A}$

Chapter Assessment

Section 1 Simple Circuits: Mastering Concepts

36. Why is it frustrating when one bulb burns out on a string of holiday tree lights connected in series?

SOLUTION:

When one bulb burns out, the circuit is open and all the bulbs go out.

ANSWER:

When one bulb burns out, the circuit is open and all the bulbs go out.

37. Why does the equivalent resistance decrease as more resistors are added to a parallel circuit?

SOLUTION:

Each new resistor provides an additional path for the current.

ANSWER:

Each new resistor provides an additional path for the current.

Chapter 23 Practice Problems, Review, and Assessment

38. Several resistors with different values are connected in parallel. How do the values of the individual resistors compare with the equivalent resistance?

SOLUTION:

The equivalent resistance will be less than that of any of the resistors.

ANSWER:

The equivalent resistance will be less than that of any of the resistors.

39. **BIG IDEA** Why is household wiring constructed in parallel instead of in series?

SOLUTION:

Appliances in parallel can be run independently of one another.

ANSWER:

Appliances in parallel can be run independently of one another.

Chapter Assessment

Section 1 Simple Circuits: Mastering Problems

64. A $16.0\text{-}\Omega$ and a $20.0\text{-}\Omega$ resistor are connected in parallel. A difference in potential of 40.0 V is applied to the combination. (Level 2)

- a. Compute the equivalent resistance of the parallel circuit.
- b. What is the total current in the circuit?
- c. What is the current in the $16.0\text{-}\Omega$ resistor?

SOLUTION:

a.

$$\begin{aligned}\frac{1}{R} &= \frac{1}{R_1} + \frac{1}{R_2} \\ R &= \frac{1}{\left(\frac{1}{R_1} + \frac{1}{R_2}\right)} \\ &= \frac{1}{\left(\frac{1}{16.0\ \Omega} + \frac{1}{20.0\ \Omega}\right)} \\ &= 8.89\ \Omega\end{aligned}$$

b.

$$I = \frac{\Delta V}{R} = \frac{40.0\text{ V}}{8.89\ \Omega} = 4.50\text{ A}$$

c.

$$I_1 = \frac{\Delta V}{R_1} = \frac{40.0\text{ V}}{16.0\ \Omega} = 2.50\text{ A}$$

ANSWER:

- a. $R = 8.89\ \Omega$
- b. $I = 4.50\text{ A}$
- c. $I_1 = 2.50\text{ A}$