Solutions to the Extra Practice Problems for Chapter 15

1. The effective resistance is 6.94 Ω. The resistors are in parallel:

$$\frac{1}{R_{eff}} = \frac{1}{R_1} + \frac{1}{R_2} = \frac{1}{19\ \Omega} + \frac{1}{11\ \Omega} = 0.053\ \frac{1}{\Omega} + 0.091\ \frac{1}{\Omega} = 0.144\ \frac{1}{\Omega}$$

$$R_{eff} = \frac{1}{0.144\ \frac{1}{\Omega}} = 6.94\ \Omega$$

2. The current is 1.3 A. Since we have V and R, we can use Ohm's Law:

$$V = I \cdot R$$

$$9.0\text{ volts} = (I) \cdot (6.94\ \Omega)$$

$$I = \frac{9.0\text{ volts}}{6.94\ \Omega} = 1.3\text{ A}$$

3. The power is 12 W. With V, I and R, we could use either Equation (15.2) or Equation (15.3). The latter is a bit easier:

$$P = I \cdot V = (1.3\text{ A}) \cdot (9.0\text{ V}) = 12\text{ W}$$

4. Yes, it will. There will no longer be a conductive path through the 19-Ω resistor to the other side of the battery, but there is still a conductive path through the other resistor, so it will still work.

5. The effective resistance is 3.0×10^1 Ω. The resistors are in series:

$$R_{eff} = R_1 + R_2 = 19\ \Omega + 11\ \Omega = 3.0 \times 10^1\ \Omega$$

The answer must be in scientific notation, because the rules of addition indicate that the ones place must have a significant figure.

6. No, it will not. Once the 19-Ω resistor becomes an open switch, there is no way for the current to go from the positive side of the battery to the negative side, so no current will flow.

7. Use the 0.60 A fuse. Since we have V and R, we can use Ohm's Law to get the proper current:

$$V = I \cdot R$$

$$12.0\text{ volts} = (I) \cdot (3.0 \times 10^1\ \Omega)$$

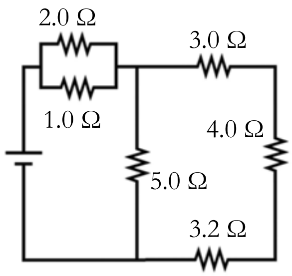
$$I = \frac{12.0\text{ volts}}{3.0 \times 10^1\ \Omega} = 0.40\text{ A}$$

We need a fuse that will allow 0.40 A to flow but will blow at higher currents.

8. The effective resistance is 4.0 Ω. As current leaves the positive side of the battery, it faces a choice between a 1.0-Ω resistor and a 2.0-Ω resistor. After that, it faces a choice between going down or straight. If it goes down, it passes only through the 5.0-Ω resistor. However, if it goes straight, it goes through a 3.0-Ω resistor, then a 4.0-Ω resistor, and then it faces a choice between a 6.0-Ω resistor and a 7.0-Ω resistor. That's the last choice, so we start there, replacing it with its effective resistance.

$$\frac{1}{R_{eff}} = \frac{1}{R_1} + \frac{1}{R_2} = \frac{1}{6.0\ \Omega} + \frac{1}{7.0\ \Omega} = 0.17\ \frac{1}{\Omega} + 0.14\ \frac{1}{\Omega} = 0.31\ \frac{1}{\Omega}$$

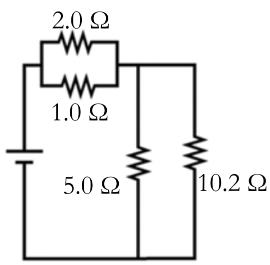
$$R_{eff} = \frac{1}{0.31\ \frac{1}{\Omega}} = 3.2\ \Omega$$



That leads to the circuit on the left. We can now see that the 3.0-Ω resistor, the 4.0-Ω resistor, and the 3.2-Ω resistor are all in series. That means their effective resistance is:

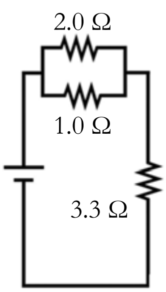
$$R_{eff} = R_1 + R_2 + R_3 = 3.0\ \Omega + 4.0\ \Omega + 3.2\ \Omega = 10.2\ \Omega$$

Notice that we pick up a significant figure since all the resistance have their last significant figure in the tenths place, which means the answer must as well. That leads to the circuit on the left. We now see that the second choice is really between a 10.2-Ω resistor and a 5.0-Ω resistor.



$$\frac{1}{R_{eff}} = \frac{1}{R_1} + \frac{1}{R_2} = \frac{1}{5.0\ \Omega} + \frac{1}{10.2\ \Omega} = 0.20\ \frac{1}{\Omega} + 0.0980\ \frac{1}{\Omega} = 0.30\ \frac{1}{\Omega}$$

$$R_{eff} = \frac{1}{0.30\ \frac{1}{\Omega}} = 3.3\ \Omega$$

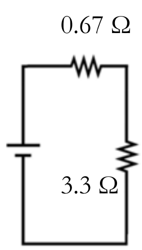


Notice that since 0.20 has its last significant figure in the hundredths place, the answer must as well, which gives us only two significant figures for the division. Now we have the circuit on the left.

The first choice was between the 1.0-Ω resistor and the 2.0-Ω resistor:

$$\frac{1}{R_{eff}} = \frac{1}{R_1} + \frac{1}{R_2} = \frac{1}{1.0\ \Omega} + \frac{1}{2.0\ \Omega} = 1.0\ \frac{1}{\Omega} + 0.50\ \frac{1}{\Omega} = 1.5\ \frac{1}{\Omega}$$

$$R_{eff} = \frac{1}{1.5\ \frac{1}{\Omega}} = 0.67\ \Omega$$



We can now see that this is a circuit with a 0.67-Ω resistor in series with a 3.2-Ω resistor.

$$R_{eff} = R_1 + R_2 = 0.67\ \Omega + 3.3\ \Omega = 4.0\ \Omega$$

We are limited to the tenths place because of the 3.2.

9. <u>The current must be 1.9 A</u>. Since we know the power and the resistance:

$$P = I^2 \cdot R$$

$$15.0\ W = I^2 \cdot (4.0\ \Omega)$$

$$I = \sqrt{\frac{15.0\ W}{4.0\ \Omega}} = 1.9\ A$$

10. <u>The voltage must be 7.4 V</u>. There are lots of ways to get this one, but I will use Ohm's Law:

$$V = I \cdot R = (1.9\ A) \cdot (3.9\ \Omega) = 7.4\ V$$