

## Chapter 23: 11<sup>th</sup> edition Solutions to 23a

### Review Questions; pg. 418-419

4. What is an ampere?

An ampere is 1 coulomb per second of charge moving in a conductor.

6. How much energy is supplied to each coulomb of charge that flows through a 12-Volt battery?

**Ans.** Since Voltage is the amount of energy in joules per coulomb of charge, 12 Volts will yield 12 joules of energy per coulomb of charge.

10. If the resistance in a circuit is doubled while the voltage is kept constant, what happens to the current?

**Ans.** We can see from Ohm's law ( $I = V/R$ ) that the current  $I$  is inversely proportional to the resistance  $R$ . Therefore, if the resistance is doubled while the voltage is kept constant, the current will be  $1/2$  of its original value.

11. If the resistance of a circuit remains constant while the voltage across the circuit is changed to  $1/2$  of its original value, what happens to the current?

**Ans.** From Ohm's law ( $I = V/R$ ) we see that current is directly proportional to voltage. Cutting the voltage in half will cut the current in half.

12. How does water moisture on your skin affect your skin's electrical resistance?

**Ans.** Your skin's resistance goes down as it becomes more moist.

14. Does a battery produce dc or ac? Does the generator at a power station produce dc or ac?

**Ans.** A battery produces direct current, dc. The power station produces alternating current, ac.

15. What does it mean to say that a certain current is 60 HZ?

**Ans.** It means that the current is changing direction at a rate of 60 complete cycles per second. This is an example of alternating current which is abbreviated AC.

23. When you pay your household electric bill, which of the following are you paying for: voltage, current, power or energy?

**Ans.** You are billed for a certain number of kilowatt hrs. Kilowatts are units of power. Power times time = Energy.

25. What is the relationship between electrical power, current and voltage?

**Ans,** The relationship is given by  $P = IV$ :

We can see that power is directly proportional to the current  $I$ , as well as the voltage  $V$ .

If the current is measured in amps and the voltage is in volts, then the power will be in watts.

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26. Which of these is a unit of power and which is a unit of energy: a watt; a kilowatt; a kilowatt-hour?

**Ans.** Watts and kilowatts are units of power.

Kilowatt-hour is a unit of energy. Looking at the equation for power:

Power = Energy/time

If you multiply power by time, you are left with energy.

$$\text{Power}(\text{time}) = \frac{\text{Energy}}{\text{time}} * \text{time} = \text{Energy}$$

28. In a circuit of two lamps in series, if the current through one lamp is 1 amp, what is the current through the other lamp?

**Ans.** Since resistors in series all have exactly the same current through them, the current in the second lamp must also be 1 amp.

29. If a voltage of 6 volts is impressed across the circuit in the preceding question and the voltage across the first lamp is 2 volts, what is the voltage across the second lamp? Defend your answer.

**Ans.** The second lamp will have a voltage of 4 volts. I know this because I believe in the conservation of energy.

30. In a circuit of two lamps in parallel, if there is a voltage of 6 volts across one lamp, what is the voltage across the other lamp?

**Ans.** 6 volts. All electrical devices in parallel will have the same voltage.

31. How does the sum of the currents through the branches of a simple parallel circuit compare with the current that flows through the voltage source?

**Ans.** They will be equal. Charge is conserved.

**Extra:** What role do resistors normally play in an electric circuit?

**Ans.** Resistors are used to regulate the amount of current and therefore the power in various parts of an electrical circuit. When you turn the volume up on your radio, you are actually decreasing the resistance and increasing the current in the portion of the circuit that produces the sound.

**Extra:** For a given voltage, what happens to the amount of current that flows in your skin when you perspire?

**Extra:** Distinguish between dc and ac.



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3. Rearrange the equation  $I = \frac{V}{R}$  to express resistance in terms of current and voltage. Then solve the following: A certain device in a 120-V circuit has a current rating of 20 amps. What is the resistance of the device?

**Ans.**  $R = \frac{V}{I} = \frac{120 \text{ v}}{20 \text{ amps}} = 6 \text{ ohms}$

**Extra:** Solve the formula  $Power = IV$  for I, and then find the current drawn by a 1200-watt hair dryer connected to 120-volt source. Then using Ohm's law, find the resistance of the hair dryer.

**Ans.** Since  $P=IV$  then  $I = \frac{P}{V}$ . Therefore the current  $I = \frac{P}{V} = \frac{1200 \text{ watt}}{120 \text{ V}} = 10 \text{ amps}$

The resistance of the hair dryer:  $R = \frac{V}{I} = \frac{120 \text{ V}}{10 \text{ amps}} = 12 \text{ ohms}$

5. The total charge that an automobile battery can supply without being recharged is given in terms of ampere-hours. A typical 12-V battery has a rating of 60 ampere-hours. That means that the total charge  $q$ , equals 60 amps multiplied by 1 hour. Suppose you forget to turn off the headlights in your parked car. If each of the two headlights draws 3 amps, how long will it be before your battery is "dead"?

**Ans.**

$$I \equiv \frac{q}{t} \text{ Solving for time, } t = \frac{q}{I} = \frac{60 \text{ amp-hrs}}{6 \text{ amps}} = 10 \text{ hours}$$

**Page 420 plug and chug**

**1. Calculate the current in a toaster that has a heating element of 15 ohms when connected to a 120-V outlet.**

$$I = \frac{V}{R} = \frac{120V}{15\Omega} = 8 \text{ amps}$$

**2. Calculate the current that moves through your fingers if your resistance is 1,000 ohms when you touch the terminals of a 6-V battery.**

$$I = \frac{V}{R} = \frac{6V}{1000\Omega} = 0.006 \text{ amps. } 6 \text{ milliamps}$$

**3. Calculate the current in the 240  $\Omega$  filament of a light bulb connected to a 120V house electrical outlet.**

$$I = \frac{V}{R} = \frac{120V}{240\Omega} = 0.5 \text{ amps}$$

**4. Calculate the power of a device that carries 0.5 amp current across a 120 volt electrical difference.**

$$Power = IV = 0.5 \text{ amps} * 120V = 60 \text{ watts.}$$