Questions

1. What is the flow of current when a lamp containing a 60-watt bulb is plugged into a standard U.S. outlet?
    a. 6600 volts
    b. 5.5 volts
    c. 0.66 amps
    d. 0.55 amps
    e. 6600 amps

Solution: Use the equation $P = IV$ where *P* is given as 60 watts, *V* is given as 110 volts. Solving for *I*, which will be in amps:

$$P = IV$$

$$60\ \text{W} = I\,(110\ \text{V})$$

$$\frac{60}{110} = 0.54545454... \approx 0.55\ \text{A}$$

2. Theoretically, how many lamps like that in question *1* could be on the same circuit before tripping the 15-amp circuit breaker?
    a. 5 lamps
    b. 15 lamps
    c. 20 lamps
    d. 27 lamps
    e. 55 lamps

Solution: The 60 W bulb uses 0.55 A. The total number of lamps must use under 15 A.

$$\frac{15\ \text{A}}{0.55\ \text{A}} \approx 27; \quad \text{Check:}\ \ 27 \times 0.55 = 14.85$$

Using 28 lamps on the circuit will trip the breaker.

3. How much power is generated by the number of lamps calculated in question 2?
    a. 0.165 watts or less
    b. 1400 watts or more
    c. 1650 watts or less
    d. 0.14 watts or less
    e. 1650 watts or more

Solution: Use the equation $P = IV$ where *I* is given as the total current from question 2 in amperes, the potential difference is given as 110 volts. Solving for *P*, in watts gives:

$$P = IV$$

$$P = (14.85\ \text{A})(110\ \text{V})$$

$$P = 1633.5\ \text{W}$$

4. A hair dryer draws a current of 10 A on its "Hot" setting and a current of 4 A on its "Cool" setting. What percent decrease in power occurs when you switch the hair dryer from the "Hot" setting to the "Cool" setting?

a. 60% *
b. 150%
c. 0.6%
d. 15%
e. −150%

Solution: Use the equation $P = IV$ to find the power drawn by the hair dryer on "Hot."

$$P = IV$$

$$P = (10\text{ A})(110\text{ V}) = 1100\text{ W}$$

Next, use the equation again to find the power drawn by the hair dryer on "Cool."

$$P = IV$$

$$P = (4\text{ A})(110\text{ V}) = 440\text{ W}$$

Finally, compute the percent decrease in power using the formula provided:

$$\text{Percent decrease} = \frac{\text{original value} - \text{new value}}{\text{original value}} \times 100$$

$$= \frac{1100 - 440}{1100} \times 100$$

$$= 60\%$$

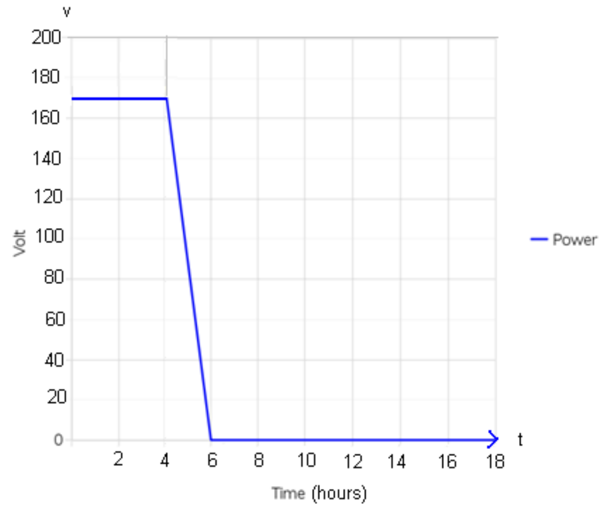
Therefore, there is a 60% decrease in power.

5. Referring to the graph of a transient fault, about how much power was the electrical line carrying before the fault occurred?

a. 200 V
b. 228 V
c. 0 V
d. 50 V
e. 250 V

Solution: Looking at the graph line, it starts above the halfway point between 200 volts and 250 volts. The closest answer choice is 228 volts for *time* = 0 until the transient fault occurred.

6. Which of the following piecewise functions best describes the graph of the blackout event shown below?



a. $f(t) = \begin{cases} 170 \text{ if } 0 \le t < 4 \\ -85t + 510 \text{ if } 4 \le t < 6 \\ 0 \text{ if } t \ge 6 \end{cases}$

b. $f(t) = \begin{cases} 170 \text{ if } t < 4 \\ 85t - 510 \text{ if } 4 \le t < 6 \\ 0 \text{ if } t \ge 6 \end{cases}$

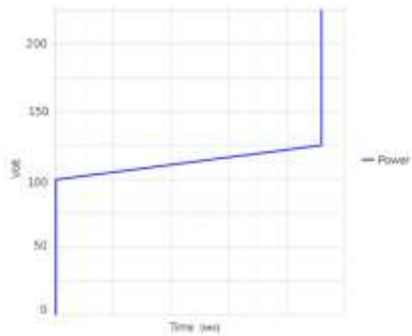
c. $f(t) = \begin{cases} 170 \text{ if } 0 \le t \le 4 \\ -85t + 510 \text{ if } 4 \le t \le 6 \\ 0 \text{ if } t \ge 6 \end{cases}$

d. $f(t) = \begin{cases} 170 \text{ if } t \le 4 \\ 85t - 510 \text{ if } 4 < t \le 6 \\ 0 \text{ if } t > 6 \end{cases}$

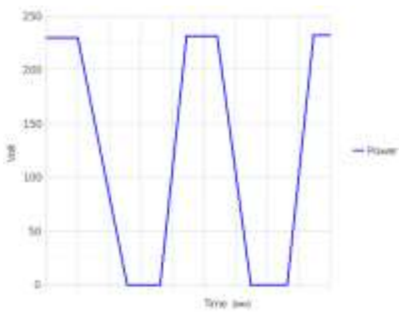
Solution: The leftmost piece of the graph is the horizontal line at $V = 170$, the middle segment of the graph is the line $V = -85t + 510$, which is found by using endpoints (4, 170) and (6, 0) and the rightmost segment of the graph is the horizontal line at $V = 0$.

7. Which of the following graphs shows what a typical brownout would look like in terms of power supply over time?

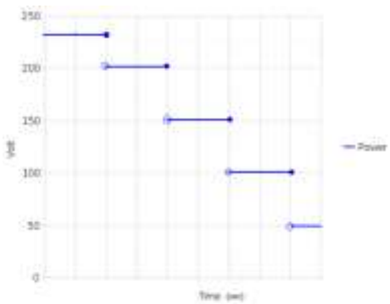
a.



b.



c.



d. Correct answer:

8. Based on the information provided, why would a silver ground wire be chosen over a copper one?
   a. Silver conducts an electric charge better than copper.
   b. Silver has a higher density than copper.
   c. Silver has a higher Resistivity-density product than copper.
   d. Silver is more resistive than copper.

Solution:

$$\rho_{COPPER} = \frac{\text{resistivity-density product}}{\text{density}} = \frac{150}{8.96} = 16.74 \text{ n}\Omega \text{ im}$$

$$\sigma_{COPPER} = \frac{1}{\rho} = \frac{1}{16.74} = 0.0597 \text{ S/m}$$

$$\rho_{SILVER} = \frac{166}{10.49} = 15.82 \text{ n}\Omega \text{ im}$$

$$\sigma_{SILVER} = \frac{1}{15.82} = 0.0632 \text{ S/m}$$

$$\sigma_{SILVER} > \sigma_{COPPER}$$

9. What resistance would be required in the circuit, or network, shown?

   a. 960 ohms
   b. 12 ohms
   c. 15 ohms
   d. 0.07 ohms
   e. 8 ohms

Solution: To find resistance, first solve the Ohm's Law equation, $I = \frac{V}{R}$, for resistance (R).

$$I = \frac{V}{R}$$

$$I \times R = \frac{V}{R} \times R$$

$$\frac{I \times R}{I} = \frac{V}{I}$$

$$R = \frac{V}{I}$$

Next, substitute the known values for voltage and current into the new rearranged equation.

$$R = \frac{120 \text{ V}}{8 \text{ A}}$$

$$R = 15 \text{ ohms, or } 15\ \Omega$$

Therefore, the resistance in the circuit is 15 ohms.

10. Using the information in the Table, which logic gate should be used when designing a properly functioning relay circuit?
    a. AND
    b. NAND
    c. OR
    d. NOR
    e. EX-NOR