Electric Power

$P = IV$

- Unit: _____ (W)
- Other _____ for electrical _____

$$P = I^2R$$

$$P = \frac{V^2}{R}$$

Let's say an electric heater has a resistance of 1430 Ω and operates at 120V. What is the power rating of the heater? How much electrical energy does it use in 24 hours?

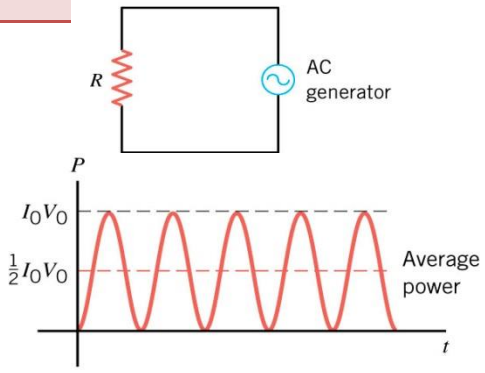
Kilowatt hours

- Electrical _____ _____ you for the amount of electrical _____ you use
- Measured in _____ _____ (kWh)

If electricity costs $0.15 per kWh how much does it cost to operate the previous heater (P = 10.1 W) for one month?

Alternating Current

- Charge flow _____ direction _____
- Due to way that _____ plants _____ power
- Simple circuit
- Periodicity
  - _____, _____, and _____ _____ with time
  - So we usually talk about the _____



Average Power

- DC

$$P = IV$$

- AC

$$P_{ave} = \frac{1}{2}I_0V_0$$

  - Often P is used to represent _____ power in _____ AC circuits.

Root Mean Square (rms)

$$P_{ave} = \frac{1}{2}I_0V_0 = \left(\frac{I_0}{\sqrt{2}}\right)\left(\frac{V_0}{\sqrt{2}}\right) = I_{rms}V_{rms}$$

- I_{rms} and V_{rms} are called _____ _____ _____ current and voltage
- Found by dividing the _____ by _____

$$I_{rms} = \frac{I_0}{\sqrt{2}} \qquad V_{rms} = \frac{V_0}{\sqrt{2}}$$

Convention in USA

- V_0 = 170 V, V_{rms} = _____V
- _____ electronics specify 120 V, so they really mean _____
- We will always (unless noted) use _____ _____, and root mean square _____ and _____
- Thus all _____ learned equations _____!

A 60 W light bulb operates on a peak voltage of 156 V. Find the V_{rms}, I_{rms}, and resistance of the light bulb.

Why are you not supposed to use extension cords for devices that use a lot of power like electric heaters?

Homework

1. Give an example of a use of AC power other than in the household. Similarly, give an example of a use of DC power other than that supplied by batteries.
2. Why do voltage, current, and power go through zero 120 times per second for 60-Hz AC electricity?
3. You are riding in a train, gazing into the distance through its window. As close objects streak by, you notice that the nearby LED christmas lights make dashed streaks. Explain.
4. What is the power of a 1.00×10^2 MV lightning bolt having a current of 2.00×10^4 A? (OpenStax 20.40) $\mathbf{2.00 \times 10^{12}\ W}$
5. What power is supplied to the starter motor of a large truck that draws 250 A of current from a 24.0-V battery hookup? (OpenStax 20.41) **6.00 kW**
6. A charge of 4.00 C of charge passes through a pocket calculator's solar cells in 4.00 h. What is the power output, given the calculator's voltage output is 3.00 V? (OpenStax 20.42) $\mathbf{8.33 \times 10^{-4}\ W}$
7. How many watts does a flashlight that has 6.00×10^2 C pass through it in 0.500 h use if its voltage is 3.00 V? (OpenStax 20.43) **1.00 W**
8. Find the power dissipated in each of these extension cords: (a) an extension cord having a 0.0600-Ω resistance and through which 5.00 A is flowing; (b) a cheaper cord utilizing thinner wire and with a resistance of 0.300 Ω. (OpenStax 20.44) **1.50 W, 7.50 W**
9. An electric water heater consumes 5.00 kW for 2.00 h per day. What is the cost of running it for one year if electricity costs 12.0 cents/kW·h? (OpenStax 20.50) **$438/y**
10. With a 1200-W toaster, how much electrical energy is needed to make a slice of toast (cooking time = 1 minute)? At 9.0 cents/kW·h, how much does this cost? (OpenStax 20.51) **0.18 cents**
11. (a) What is the hot resistance of a 25-W light bulb that runs on 120-V AC? (b) If the bulb's operating temperature is 2700°C, what is its resistance at 2600°C? (OpenStax 20.72) **580 Ω, 320 Ω**
12. Certain heavy industrial equipment uses AC power that has a peak voltage of 679 V. What is the rms voltage? (OpenStax 20.73) **480 V**
13. A certain circuit breaker trips when the rms current is 15.0 A. What is the corresponding peak current? (OpenStax 20.74) **21.2 A**
14. What is the peak power consumption of a 120-V AC microwave oven that draws 10.0 A? (OpenStax 20.79) **2.40 kW**
15. What is the peak current through a 500-W room heater that operates on 120-V AC power? (OpenStax 20.80) **5.89 A**