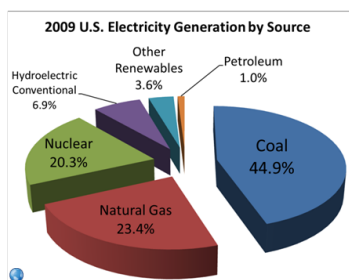


AP Phys 1 Unit 11.4 Notes - Electric Power

11.4 - Electric Power



Power

We calculated mechanical power, now we calculate electrical power!

Units are still Watts (J/s) (Resource P. 7):

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

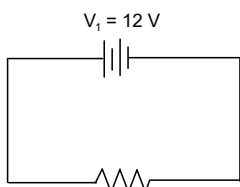
AP Equation

Unit analysis:

$$P = IV = \frac{C}{s} \cdot \frac{J}{C} = \frac{J}{s} = \text{Watts}$$

Power Examples

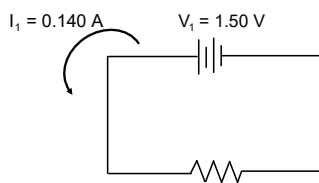
1. What is the power of the following circuit?



$$P = \frac{V^2}{R} = \frac{(12V)^2}{4.5\Omega} = 32W$$

Power Examples

2. What is the power of the following circuit?

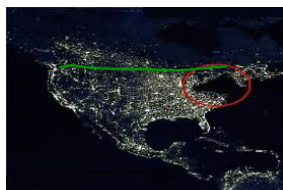


$$P = IV = 0.140 A \cdot 1.50 V = 0.21 W$$

Power Losses

Thermal power losses of resistors are referred to as joule heat, or I^2R losses ("I squared R"). Often this is undesirable, as in the heating of electronic circuitry during operation.

Other times it is part of the design, such as in electrical heaters.



Selling Power

Electrical energy is sold in terms of kilowatt-hours (kWh): a utility company might charge 0.13 \$/kWh.



kWh is actually a unit of energy (in joules):

$$1kWh = 1000W \cdot 1h \cdot \frac{3600s}{1h} = 1000 \frac{J}{s} \cdot 3600s = 3.6E6J$$

AP Phys 1 Unit 11.4 Notes - Electric Power

kWh Example

3. How much would it cost to run a dishwasher for 30 minutes, if your utility company charges \$0.14/kWh?

4. What's the resistance of a typical dishwasher?

Use Resources P. 7 for appliance information.



= \$

kWh Example

3. Cost:

- Average power = 1200W
- Time = 30 min. x 1 h/60 min. = 0.5 hr.
- Price = \$ 0.14/kWh

Total Energy:

$$Energy = P \cdot t = 1.200 kW \cdot 0.5 h = 0.6 kWh$$

Total Cost:

$$Cost = Energy \cdot Rate = 0.6 kWh \cdot \frac{0.14 \text{ Dollars}}{kWh} = 0.084 \text{ Dollars}$$

kWh Example

4. Resistance:

- Current = 10.0 A (from R. 7)
- Voltage = 120 V (Voltage = Power/Current)

$$V = IR$$

$$R = \frac{V}{I} = \frac{120V}{10A} = 12\Omega$$

Kill-a-Watt Meter

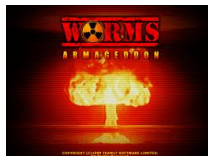
Power, current, and voltage can be measured in real time, and homeowners can find out the power consumption of appliances.



You'll use one of these in tomorrow's lab.

Homework

11.4 Problems.
Due: Next Class.



Too Much Power
Captain!!