Electrical Efficiency

Not all of the energy consumed by a device is converted into the desired form of energy.

Electrical efficiency – The amount of useful energy an electrical device produces, expressed as a percentage of the energy supplied to the device.

Example:
An incandescent light bulb has an electrical efficiency of 10%.

- _____% of the electricity supplied to the bulb is "useful" (converted to light).

- The remaining _____% is converted into heat.

Calculating electrical efficiency:

$$\% \text{ efficiency} = \frac{\text{useful energy output}}{\text{total energy input}} \times 100\%$$

$$\% \text{ efficiency} = \frac{E_{out}}{E_{in}} \times 100\%$$

> Energy can be expressed using many different units. The ones you should be familiar with are:
>
> - **Kilowatt-hours** (kW·h)
> - **Watt-seconds** (W·s), which are equal to **Joules** (J)

Practice Problem
A toaster oven uses 1200 J of energy, and produces 850 J of thermal energy. Calculate the percent efficiency of the toaster oven.

GIVEN: *ANALYSIS & SOLUTION:*   *STATEMENT:*

REQUIRED:

Practice Problems: Efficiency

1. A washing machine has a power rating of 512 W. If one cycle has 30 min, how much energy does the machine use per cycle? (express your answer **4 ways** - in watt-seconds, joules, kilojoules, and kilowatt-hours)
2. "A radio is not 100% efficient." What does this mean?
3. If a light bulb uses 30 000 J of electrical energy and emits 900 J of light energy, what is the percent efficiency of the light bulb?
4. The spin cycle of a clothes washer operates for 3 min at a power of 300 W (this represents the energy input). The useful output from the washer is 40 kJ. What is the percent efficiency of the washer?
5. A motor is 80% efficient. If it is supplied with 200 kW·h of energy, how much useful work can the motor do?
6. Calculate the cost of operating the following devices. The cost of electricity is 12¢/kW·h:
    a. A 100 W incandescent light bulb for 1000 hours
    b. A 13 W CFL bulb for 1000 hours
    c. A 400 W computer for 600 hours
    d. A refrigerator operating at its power of 750 W for one year

Answers:
(1) 921600 Ws; 921600 J; 921.6 kJ; 0.256 kWh; (3) 3%; (4) 74%; (5) 160 kWh (6a) $12.00 (b) $1.56 (c) $28.80 (d) $788.40