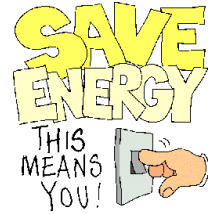


Electrical Energy Consumption



Some devices require a lot of electrical energy to function whereas some need little.

Can you name a device that uses a lot of electrical energy? ___ Dryer ___

One that uses little electrical energy? ___ Flashlight, remote control ___

Power is a measure of how much energy is used or produced per unit time.

as an equation it would look like →

$$P = E / T$$

Power (J/s) = Energy (Joules)/Time (seconds)

To simplify the units for power, Power is measured in ___ Watts ___, symbol ___ W ___

*note- the units of power (J/s) is expressed as a ___ Watt ___ since 1 ___ J/s ___ = 1 ___ W ___

Calculating Power

In order to calculate the power rating of a device we need to find out its current and voltage.

as an equation it would look like →

$$P = VI$$

Power (W) = Current (A)/Voltage (V)

We can also derive the first equation from this one using the formulas for voltage and current from our previous note:

$$P = J/C \times C/s = J/s$$

Power Questions

1) The Apple iPhone has a 3.7 V battery and when running draws a current of 0.54 A. What is its power consumption?

G: $V = 3.7V$
 $I = 0.5A$

A: $P = VI$

P: The iPhone uses 2W of power.

R: P

S: $P = 3.7V \times 0.5A$
 $= 2W$

2) Find the power rating of a toaster if it draws 5 A when plugged into a 110V socket.

$$P = 110V \times 5A$$

$$= 550W$$

Calculating the cost of electrical energy consumption

The price we pay for the amount of electricity we use every month depends on three factors

- 1) The ___power___ ___rating___ of the devices (eg
- 2) The ___time___ that the device is used for
- 3) The ___cost___ ___rate___ set by the power company



To calculate cost used the following formula

$$\text{Cost} = \text{power} \times \text{time used} \times \text{cost per kW}\cdot\text{h}$$

Cost Questions

- 1) Joey uses his video game console for 1.5 hours. If the power consumption of the device is 0.10 kW and the rate cost is 8.8 ¢ per kW·h, calculate how much the cost would be in cents.

$$\begin{aligned} \text{Cost} &= P \times t \times \text{rate cost} \\ &= (0.1\text{kW})(1.5\text{h})(8.8\text{cents/kWh}) \\ &= 1.32 \text{ cents} \end{aligned}$$

- 2) The power company in Quebec charges 5.5 ¢ per kW·h. If a ski lift operator runs her ski lift for 10 hours and the power rating of the lift is 3000 kW, calculate the cost in dollars.

$$\begin{aligned} \text{Cost} &= (3000\text{kW})(10\text{h})(5.5\text{cents/kWh}) \\ &= 165\,000 \text{ cents} \\ &= \$1650 \end{aligned}$$

Percent Efficiency

Most electrical devices convert electrical energy to some other form (light, heat, sound, movement of a motor...)

The energy conversion is never 100%, much energy is lost

The ability of a device to convert electrical energy (input) into useful energy (output) is called its "Percent Efficiency"

The formula for calculating percent efficiency is:

$$\% \text{ Efficiency} = \frac{\text{useful energy output (in J)}}{\text{total energy input (in J)}} \times 100$$

the bigger number

Percent Efficiency Problems

1) An electric kettle requires 210 000J of energy to heat up a pot of water until it boils. If it takes 184 000 J of energy to heat the water, what is the percent efficiency of the kettle?

$$\begin{aligned} \% \text{ efficiency} &= E \text{ output} / E \text{ input} \\ &= (184 \text{ 000J} / 210 \text{ 000J}) \times 100 \\ &= 87.6\% \end{aligned}$$

2) a) A light gives off 54 000 J of light energy but requires 80 000 J to accomplish this. Find the percent efficiency. b) Can you suggest where the lost energy goes to?

$$\begin{aligned} \% \text{ efficiency} &= (E_{\text{output}} / E_{\text{input}}) \times 100 \\ &= (54 \text{ 000J} / 80 \text{ 000J}) \times 100 \\ &= 67.5\% \end{aligned}$$