ENERGY AND POWER ACTIVITY

Basic units, equations, and conversion factors

A. **Joule (J) = basic unit of energy (E)**

1000 J = 1 kJ

1 calorie (cal) = 4.184 J

1 British Thermal Unit (BTU) = 1.05 kJ

1 therm = 100000 BTU

B. **Watt (W) = basic unit of power (P), or the rate at which energy is used**

1 Watt (W) = 1 joule per second or 1 J/s

Thus, a 100 watt light bulb uses 100 J/s of electrical energy. If it is 20% efficient, the light bulb converts 20% of the electrical energy into light while 80% of the energy is transformed into heat.

C. or

Knowing the relationship between energy and power allows us to find the energy used when an appliance of know power (in watts) operates for a known period of time (in seconds).

Example: How much energy, in kJ, does a 75 watt light bulb use when it is turned on for 25 minutes?

P = 75 watts = 75 J/s

t= 25 min x 60 s/min = 1500 s

110,000 J (2 sig figs) = 110 kJ

D.

If no wattage is given, some information about the current can usually be found. To find the power (in watts) of any electrical appliance in your home that does not give the wattage, use the above equation, P = IV.

V is the voltage in volts (V)

I is the current in amps (A)

E. **The kilowatt-hour (kwh) is a unit of energy, not power.** Notice that kilowatt is a unit of power and hour is a unit of time; multiplied together they are a unit of energy (E = P x t). A kilowatt-hour is equal to 1 kw (or 1000 watts) delivered continuously for 1 hour (3600 sec).

1 kwh = 1000 W = 1000 J/s x 3600 sec/hour = 3 600 000 J = 3600 kJ

or

1 kwh = 3600 kJ

**Example: Mr. Melega’s Nov-Dec Duke Power bill shows that his home used 1355 kwh over a 30 day period.**

a) Find the energy used, in kJ, for the 30 day period

E = 1355 kwh x = 4878000 kJ

b) Find the energy used in J/day.

x = 1.626 x 108 J/day

c) At the rate of $.0749/kwh, what is Mr. Melega’s Duke Power bill (without all the

taxes, fees, and surcharges)?

1355 kwh x $.0749/kwh = $101.49

NAME \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Give an equation, show work with units, and give the correct answer with units and the correct number of sig figs.

1. The current through a 110 V toaster is 8.0 A.

a) What is the power of the toaster (in Watts)?

answer\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_W

b) How much energy in Joules will the toaster use in 5.0 minutes of operation?

answer \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_J

2. A 120 watt light bulb is in a lamp.

a) How much energy in Joules does it use in 12 hours of operation?

answer \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_J

b) If the bulb is only 20.0 % efficient, how much energy is converted to light during the 12 hours? How much to heat?

answer (light)\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_J

answer (heat)\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_J

c) Convert the total energy use (from part a) to kwh.

answer \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_kwh

3. An electric clothes dryer has a power rating of 40Ō0 W (3 sig figs). Assume that a family does 5 loads of laundry each week for 4 weeks. Assume that each dryer load takes 1 hour.

a) Find the energy used in Joules and kwh.

answer \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ J

answer \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_kwh

b) If the cost of electricity is $.0758/kwh, find the cost of operating the dryer for 1 month.

answer \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

4. Mr. Melega’s natural gas bill states that his household used 110 therms of energy for a 30 day period.

a) Convert 110 therms to kwh.

answer \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_kwh

b) The charge for his energy was $88.78. Find the cost of this gas in $/kwh.

answer \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ $/kwh

c) Which form of energy is more expensive, electricity or natural gas? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

How many times more $$$? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_