**Efficiency Formula**

Efficiency generally refers to how far we are getting the particular outcome for the given input with as much less wastage as possible.

**Efficiency is defined as the ratio of useful work done to the heat or energy absorbed by the particular system. It is denoted by**η**.**

**Efficiency formula in terms of Work** is given by

**Efficiency formula in terms of Energy**is given by



Efficiency formula is used to calculate the efficiency for any given input. It is unit less and is expressed in percentage.

**Question 1:**Calculate the efficiency of a cyclist if he puts 600 J of work on his bicycle whereas the bicycle gives out 120 J of useful work.
**Solution:**

**Question 2:**A heat engine gives out 400 J of heat energy as the useful work. Calculate the energy given to it as input if its efficiency is 40%?
**Solution:**

**Energy Problems**

 *On the AP Environmental Science exam there is always a math problem involving energy conversions.  Therefore, the following should be good practice for these types of problems.  DO NOT USE CALCULATORS when solving these problems because you will not be allowed to use them on the AP exam.  To make calculations easier, convert all number to scientific format (for example 3500 = 3.5 x 103).*

 **Power Plant Problems**:  The following problems involve calculating the efficiency of a power plant.  To determine efficiency you calculate output/input x 100 (energy of kwh/Energy of Fuel x 100).  You first have to convert mwh or kwh to BTUs.  To do this, use the following conversion factor:  1kwh = 3413 BTU.  You will also have to convert tons to pounds and then pounds to BTUs.  To do this, use the following conversion factor:  1 ton = 2000 lbs.  Then use the BTU value of the fuel to calculate BTUs.  When calculating efficiency, your answers should range from 20-30%

1.  Ryegate Wood Chip Electrical Generating Plant (Average month)

           Electricity generated = 16128 mwh (megawatt hours)

            Wood chips consumed = 22579 tons

            BTU value of the wood chips = 4700 BTU/lb

*Calculate the efficiency of the power plant*

            Efficiency = Output   x  100         or        Energy of kwh    x    100

                                   Input                                  Energy of fuel

2.  Grayling Wood Chip Generating Station (Average year)

            Electricity generated = 155,000,000 kwh (kilowatt hours)

            Wood chips consumed = 250,000 tons

            BTU value of the wood chips = 4500 BTU/lb

*Calculate the efficiency of the power plant*

3.  Wheelabrator Frackville Culm Burning Plant (Average year)

            Electricity generated = 395,478 mwh

            Culm burned = 491,629 tons

            Coal burned = 250 tons

            Oil burned = 212,622 gallons

            BTU value of culm = 5000 BTU/lb

            BTU value of coal = 8000 BTU/lb

            BTU value of oil = 138,000 BTU/gallon

*Calculate the efficiency of the power plant*

4.  Waste Management (Average Month)

            Methane consumed = 26,000,000 cubic yards

            Electricity generated = 25,834,200 kwh

            BTU value of methane = 560 BTU/cubic foot

            BTU value of electricity = 3413 BTU/kwh

*Calculate the efficiency of the power plant*

5.  Which of the above power plants is most efficient and which type of fuel does it use?

**Home Energy Problems**:  to calculate the following home energy problems, the main calculations involve unit conversions.  Therefore, your goal is to cancel out the units, until you get what you're looking for.

1.  A family is building a new home in Buffalo, NY.  Buffalo experiences severe winters.  Assume the

following:

            - the house has 4000 square feet

            - 100,000 BTUs of heat per square foot are required to heat the house for the winter

            - Natural gas sells for $5.00 per thousand cubic feet

            - One cubic foot of natural gas supplies 1000 BTUs of heat energy.

            - 1 kwh of electricity supplies 10,000 BTUs of heat energy.

            - Electricity costs $50 per 500 kwh

            *Calculate the following, showing all the steps of your calculations, including units:*

            A.  The number of cubic feet of natural gas required to heat the house for the winter.

            B.  The cost of heating the house using natural gas.

            C.  The cost of heating the house using electricity.

            D.  Would you suggest the homeowners use natural gas or electricity to heat their house?

2. The environmental impact of washing a load of dishes in an electric dishwasher differs from that of