Energy Practice 1

Can You Solve These Energy Problem???

Here are Some Helpful Tools

1 MW (megawatt) = 1,000,000 watts
1 MW = 1,000 kW (kilowatt)
1 kW = 1,000 watts
1 GW (gigawatt) = 1,000,000,000 watts

Watt/Joule/BTU = unit of energy
kWh = unit of energy equal to that expended by one kilowatt in one hour (note: both are in numerator)

****REMEMBER, ON THE AP TEST, YOU WILL BE REQUIRED TO SHOW YOUR WORK...SO, SHOW YOUR WORK!!****

Easiest: 1) The capacity of a wind turbine is 3 MW per year. How many kilowatts can be generated by this power plant in a year? MW → KW

$$3\,MW \times \frac{1{,}000\,kW}{1\,MW} = 3{,}000\,kW$$

With your partner, write down each step taken to solve this problem below:

Step 1: Known MW

Step 2: Conversion factor: 1mW = 1,000kW

Step 3: Set up

Step 4: Solve

Medium: A capacity of a solar power plant is 30 megawatts (MW). Assuming that the power plant can operate at full capacity for 6,000 hrs/yr, how many kWh of electricity can be produced by the plant in one year? MW → KW → KWh → hrs/yr

$$30\,MW * \frac{1{,}000\,kW}{MW} \times \frac{1\,kW}{1\,hr} \times \frac{6{,}000\,hr}{yr} = 180{,}000{,}000\,\frac{kWh}{yr}$$

With your partner, write down each step taken to solve this problem below:

Step 1: 30MW Known

Step 2: Convert to KW

Step 3: Convert to KWhrs (1 KW = 1 KWh)

Step 4: multiply by 6,000 hrs/yr

Most Difficult: The city of Fremont consumes 100,000 MWh of electricity per year. There are approximately 10,000 homes in Fremont. Fremont's Electricity Company charges $0.10/kWh. Assuming that the houses of Fremont split the electrical consumption equally, how much would each home have to pay on its yearly bill?

100,000 MWh

With your partner, write down each step taken to solve this problem below:

Step 1:

Step 2:

Step 3:

Step 4:

Energy Practice 2

ENERGY, ENERGY AND MORE ENERGY PROBLEMS

Helpful Tools

a 1 GW = 1,000,000,000 watts
b 1 MW = 1,000,000 watts
c 1 MW = 1,000 kW
d 1 kW = 1,000 watts

watt = unit of energy

kWh = unit of energy equal to that expended by one kilowatt in one hour (note: both are in numerator)

****SHOW ALL OF YOUR WORK TO RECEIVE FULL CREDIT. THIS INCLUDES SET UP AND SIMPLE MATH SOLUTIONS!!****

1) 9 megawatts of energy equals how many watts of energy?

MW to Watts ⇒ equation b
OR
Mega = million

$9\,mW \times \frac{1{,}000{,}000\,W}{1\,mW} = 9{,}000{,}000\ watts$

2) 9 megawatts of energy equals how many kilowatts of energy?

MW to KW ⇒ equation c

Kilo = thousand

$9\,mW \times \frac{1{,}000\,kW}{1\,mW} = 9{,}000\ watts$

3) A capacity of a coal power plant is 12 megawatts (MW). Assuming that the power plant can operate at full capacity for 8,000 hrs/yr, how many kWh of electricity can be produced by the plant in one year?

MW to KWh in a year. KW = KWh

$12\,MW \times \frac{1{,}000\,kW}{1\,MW} = 12{,}000\,kW = 12{,}000\,kWh \times 8{,}000\,hr/yr$

$= 96{,}000{,}000\,kWh/yr$

4) A capacity of a nuclear power plant is 6 megawatts (MW). Assuming that the power plant can operate at full capacity for 6,000 hrs/yr, how many kWh of electricity can be produced by the plant in one year?

MW → KWh in a year

$6\,MW \times \frac{1{,}000\,kW}{1\,MW} = 6{,}000\,kW = 6{,}000\,kWh \times 6{,}000\,kWh/yr$

$= 12{,}000{,}000\,kWh/yr$

5) A capacity of a wind turbine farm is 3 megawatts (MW). Assuming that the power plant can operate at full capacity for 10,000 hrs/yr, how many kWh of electricity can be produced by the plant in one year?

$3\,MW \times \frac{1{,}000\,kW}{1\,MW} = 3{,}000\,kW = 3{,}000\,kWh \times 10{,}000\,kWh/yr$

$= 30{,}000{,}000\,kWh/yr$

GW → W → KW → KWh → KWh/year
(equation a) (equation b)

6) A capacity of a solar panel farm is 3 gigawatts (GW). Assuming that the power plant can operate at full capacity for 10,000 hrs/yr, how many kWh of electricity can be produced by the plant in one year? GW to KWh/yr.

$$3\,GW \times \frac{1{,}000{,}000{,}000\,W}{1\,GW} \times \frac{1\,KW}{1{,}000\,W} = 3{,}000{,}000\,KW = KWh$$

(equal)

$$3{,}000{,}000\,KWh \times 10{,}000\,hr/yr = 3 \times 10^{10}\,KWh/yr$$

7) In the town of Fremont, the average household uses 8,000 kilowatt hours (kWh) of electrical energy each year. There are 3,000 homes in this community. How many kWh of electrical energy does the community consume in one year?

$$\frac{8{,}000\,KWh}{house} \times 3{,}000\,homes = 24{,}000{,}000\,KWh\ Whole\ Town$$

8) In the town of Carson, the average household uses 12,000 kilowatt hours (kWh) of electrical energy each year. There are 10,000 homes in this community. How many kWh of electrical energy does the community consume in one year?

$$\frac{12{,}000\,KWh}{house} \times 10{,}000\,homes = 120{,}000{,}000\,KWh\ Whole\ Town$$

No Conversions needed

9) In the town of Claremont, the average household uses 4,000 kilowatt hours (kWh) of electrical energy each year. There are 1,000 homes in this community. How many kWh of electrical energy does the community consume in **two years**?

$$\frac{4{,}000\,KWh}{home} \times 1{,}000\,homes = 4{,}000{,}000\,\frac{KWh}{yr} \times 2\,yrs = 8{,}000{,}000\,KWh$$

10) Identify and explain TWO environmental benefits of switching from coal to wind power and TWO economic benefits of switching from coal to wind power?

Environmental

- No CO_2 output
- Sustainable, Renewable
- less Air, Wind, land Pollution
- Does not take up large land Parcles

Economical

- No cost to Mine
- Generates More Power
- Generates economy in rural Areas
- Low priced $0.06 cents Per KWh
- Domestic Source - does not need to be

Energy Practice 3 Key

Energy Practice Problems for APES

One way to conserve energy is to replace incandescent light bulbs with compact fluorescent bulbs. The fluorescent bulb typically uses 25% of the energy of an incandescent bulb of comparable brightness typically lasts about 12 times longer.

1. How much would you save by replacing a 100-watt incandescent bulb with a compact florescent bulb over the 12,000 hour lifetime of the bulb if the electricity cost 0.08$ per kwh (kilowatt hour)? W → KW → Kwh → Cost

Incandl.: $100W \times \frac{1kW}{1000W} \times \frac{1KWh}{1h} \times \frac{12{,}000h}{1} \times \frac{\$0.08}{1KWh} = \$96$

Flourescent: $100 \times .25 = 25W$ (25%) do the same as above $= \$24$

Save $72

2. If that bulb was turned on for 12 hours a day, how many months before it needs to be replaced?

$12{,}000hr\,life \times \frac{1day}{12h} = 1000days \times \frac{1mo.}{30days} = 33mo$

3. If an incandescescent bulb cost $1 and lasts 1,000 hours, and a compact fluorescent bulb costs $8 and lasts 12,000 hours, which bulb has the cost advantage and by how much? Cost Per hour = cost adv.

1,000 hrs ~~=$1~~

12,000 hrs = $8 or 1,500 hr for = $1

500 hrs more life

AP Free-Response Example:

Answer the questions below regarding the heating of a house in the Eastern United States. Assume the following:

- The house has 3,000 square feet of living space.
- 80,000 BTUs of heat per square foot are required to heat the house for the winter.
- Natural gas is available at a cost of $5.00 per thousand cubic feet.
- One cubic foot of natural gas supplies 1,000 BTUs of heat energy.
- The furnace in the house is 80% efficient.

Not needed info →

1) 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 one winter
   b. The cost of heating the house for one winter

2) Discuss two environmental impacts of natural gas use, one positive and one negative.

3) Identify and describe three actions the residents of the house could take to conserve heat energy and lower the cost of heating the house.

4) The residents decide to supplement the heating of the house by using a wood-burning stove. Discuss two environmental impacts, one positive and one negative, of using a wood-burning stove.

1a) $\frac{3{,}000\ ft^3\ Space}{1\ House} \times \frac{80{,}000\ BTU}{1\ ft^3\ Space} \times \frac{1\ ft^3\ Gas}{1{,}000\ BTU} = 240{,}000\ ft^3\ N.\ Gas$

1b) $240{,}000\ ft^3\ N.\ Gas \times \frac{\$5.00}{1{,}000\ ft^3} = \$1200$