Name: Date:

Practice Math Problems for APES
Answer all questions by showing all your work (including units!) as you would on the A.P. Exam.

1. A major coal fired electrical power plant produces 13,000 MW-hr of electrical energy per day.
    a) Assuming that 1.0 MW-hr corresponds to 3,400,000 BTU's, how many BTU's are produced by the plant each day?
    b) Assuming that one pound of coal can produce 5000 BTU's, how many pounds of coal are used by the plant each day?

2. A major coal fired electrical power plant uses 4500 tons of coal each day. Each pound of coal can produce 5000 BTU's of electrical energy. Given: 3400 BTU's are equivalent to 1.0 kW-hr of energy. How many kW-hr of electrical energy are produced by the plant each day?

3. A student measures out 225 grams of water, which they heat from 50 degrees Fahrenheit to 110 degrees Fahrenheit.
    a) How many Btu's of heat energy were needed to change the water's temperature to the new temperature?
    b) How many kilocalories of energy were needed?
    c) How many kilowatt-hours of energy were needed?

    | 1 gram of water = 1 milliliter of water |
    | 1 pound of water = 454 milliliters |
    | 1 Btu = .252 kilocalorie |
    | 1 kilowatt-hour = 3413 Btu |
    | Specific heat of water 1Btu / lb F (It takes one Btu to raise the temperature of one pound of water, 1 degree F) |

4. A family is building a new home in Alaska which experiences severe winters. Assume the following
• The house has 4000 square feet
• 100,000 BTU's 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 BTU's of heat energy
• 1 kilowatt-hour of electricity supplies 10,000 BTU's 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

5. An incinerator is located in Lake Grove. It generates 90 MW of electricity per hour.
The shredded trash must be fed into three different boilers at a rate of 12 tons per hour per boiler.
The trucks delivering the trash to the plant have an 80,000 pound capacity of trash when fully loaded.
There are 2,000 pounds in one ton. Assume all trucks that arrive are fully loaded
    a) What is the number of trucks arriving each day to keep the plant operating 24 hours a day, seven days a week?
    b) If the ash produced from the combustion is 10% of the original mass of the refuse, how many truck loads of ash must be disposed of in one day?

6. How long will it take 600 grams of Plutonium 239 (half life 24,400 years) to decay to 18.75 grams?

7. How many grams of iodine 131 (half life 8.07 days) would be left after 48.42 days if you start with 25 grams?

8. Approximately how many years must a sample of Americium 241 (half life 458 years) be stored before it decays to a safe level?

Use the following conversion factors to answer #s 1 – 9.

Conversion Chart for Energy Units
One Btu = .252 kilocalorie
One Btu = .000293 kilowatt-hour
One kilocalorie = 3.97 Btu
One kilocalorie = .0012 kilowatt-hour
One kilowattt-hour = 3,413 Btu
One kilowatt-hour = 860 kilocalories
One barrel of oil (42 US gallons) = 1,410,579 kilocalories
One barrel of oil = 1,640.8 kilowatt-hours

Energy Content of Fossil Fuels
(Btu/ton)
Coal (Anthracite & Bituminous) 25,000,000
Peat 3,500,000
Gasoline 38,000,000
Natural gas 47,000,000
Crude Oil 37,000,000

 1. Which fuel has the greatest energy content per ton?
2. Which fuel has the least energy per ton?
3. How many kilowatt-hours of electricity could you get from a ton of peat?
4. How many kilowatt hours of electricity could you get from a ton of coal?
5. How many barrels of oil would give you the same energy as a ton of coal?
6. How many kilocalories are there in one gallon of oil?
7. How many more Btu per ton does gasoline have than crude oil?
8. How many tons of coal would be needed to produce 10,000 kilowatt-hours of electricity?
9. How many tons of natural gas would be needed to produce 20,000 kilocalories of heat energy?