Envirothon Test Questions on Renewable Energy

1) (Two points) The following are all types of electric power plants operating in the U.S. List them in order of their total installed generating capacity is the United States, with the first being the highest. The first and last are given:

Coal	Nuclear	Hydropower
Biomass	Solar Energy	Natural Gas
Wind Power	Oil	Geothermal
Ocean (Tidal/Wave/Ocean Thermal)		

#1: Coal
#2: _____
#3: _____
#4: _____
#5: _____
#6: _____
#7: _____
#8: _____
#9: _____
#10: Ocean (Tidal/Wave/Ocean Thermal)

2) (One point) How is the electric power used at your home generated, and how much does your family pay for it?

3) (Two points) A 40MW wind farm and a 40MW geothermal plant are installed at the same time, both on a proven resource. After 6 months, the geothermal power plant has generated 172,800MWhours of electricity, while the wind farm has generated 57,000MWhrs. Why is this, when both power plants have the same installed capacity of 40MW?

4) (One point) How much energy does the average American use each day?

a) 25kWhrs b) 45kWhrs c) 65kWhrs d) 85kWhrs e) 105kWhrs

5) (One point) What percentage of total world energy use is the U.S. responsible for?

a) 5% b) 15% c) 25% d) 30% e) 35%

6) (One point) What are some environmental and social issues you might need to consider when deciding whether to install a wind farm?

7) (Three points) Circle the types of fuel sources that are originally derived from solar energy, and explain why or why not each one is solar-derived. If you need more room, write on the back.

Fossil Fuels (Oil, Coal, Natural Gas):

Nuclear:

Hydropower:

Biomass:

Wind Power:

Geothermal:

Ocean (Tidal/Wave/Ocean Thermal):

8) (Two points) Describe the difference between energy, work, and power using an example.

9) (12 points) Use the solar panel and equipment provided to answer the following questions.

a) What is the voltage produced by the panel (use the multimeter provided). What is the amperage? How does this compare to its rated output?

b) Is the power AC (Alternating Current) or DC (Direct Current)?

c) Cover up a single cell on the panel to block the sunlight, and measure the voltage and amperage again. How has it changed? What does this tell you about how the cells in the solar panel are wired (parallel or series)?

d) How many of these panels would you need to provide power to a typical house in Fairbanks (using 10kWhours at 120Volts AC), with the average equivalent of 1 hour of direct sun per day annually? How many panels would you need in Tuscon, Arizona, with the average daily equivalent of 8 hours per day direct sunlight? Power(Watts) = Voltage (Volts) x Current (Amps)

Problem 10-15
You are a Renewable Energy Design Engineer and have been hired to design a hydropower plant for this site (Spring Creek). In order to determine how much power you can generate, you need to know the flow rate of the water in the stream, and the amount of head, or drop, available along the stream. You have already sent a survey crew out to measure the elevation difference over a 1 mile stretch of the stream, and you have that data available to you (see sheet showing head for Spring Creek). Now you need to determine the flow. Because the stream is spring fed, you have been told the flow rate is relatively consistent year-round. Therefore, you will use this measurement you are making today to come up with a preliminary plan for a hydropower plant.

In order to measure the flow, you need to know how long it takes a known volume of water to pass a certain point. Therefore, you need to calculate the cross sectional area of the stream. You can use the yardstick, hip waders, and tape measure to estimate the cross sectional area. Assume this is constant over the 50ft stretch of stream which has been marked out.

10) (Two points) What is the cross sectional area you measured? Multiply the average depth times the width of the stream.

11) (One Point) What is the volume of water along this stretch of the creek? Multiply the cross sectional area times the distance (make sure you are using consistent units)

Now you need to measure the velocity of the water. Use the ping pong balls and the stopwatch to determine how fast the water is moving between the markers. Repeat the experiment three times and average your results.

12) (One point) How many seconds did it take each time?

13) (Two points) What is the flow rate of the water, in cubic feet per second? Flow=Volume/Time.

14) (Two points) Can you convert the flow rate you calculated to gallons per minute? (hint: 1gal = 7.48ft^3).

Now you are ready to calculate how much power you can generate from your hydropower site. For a water turbine, Power (Watts) = (Flow(ft^3/s) x Head(ft))/10.

15) (Two points) What is the maximum amount of power you can generate along the section of river you have surveyed?

16) (Two points) Now that you have calculated the maximum power you might be able to generate, there may be factors that may make you choose not to develop the site to its full capacity. Name some environmental and economic reasons you might have for not fully developing this site.

17) (Two points) How is most electric power generated in Alaska (using what sort of fuel)?

18) (Five points) Alaska has some world class renewable resources. Pick one renewable resource and discuss it in the context of power generation in Alaska. Where is this resource located, and where would it make the most economic sense to develop it? What are some barriers to development?