

NPRE 201 - Quiz #2

If you cannot do the calculations, make sure to show how to set up the equation.

Please show all work for any calculations that you must do.

1. *Choose the correct answer*

Biofuels (ex. Corn-based ethanol, biodiesel) are typically utilized in which sector?

- A. Residential heating/cooling
- B. Transportation**
- C. Electricity production
- D. Water heating

2. *Choose the correct answer*

What is the main concern with solar PV panels?

- A. Capital cost (installation and materials)**
- B. Carbon emissions from producing cells
- C. Trace amounts of toxic cadmium
- D. Solar flares

Explain your answer:

I feel the main concern is it is not a baseline power, but the capital cost of pv panels is very high compared to other energies and is only competitive though government subsidies.

3. *Answer the following questions*

Explain the difference between solar thermal and solar photovoltaic.

Hint: What is each used for? What is the output from each? How does each work?

Solar thermal is used to heat a working fluid very hot to generate steam that could go through a turbine and generate electricity. Solar photovoltaics use the excitation of electrons through uv absorption to generate electricity directly. Solar thermal could be used for power generation, industrial applications, or for the heat it generates. Solar photovoltaics can almost exclusively be used for residential power and potentially hydrogen production.

4. Choose the correct answer.

Which region of the United States has by far the **worst** potential to generate wind power?

A. West of the Rockies

B. Midwest / The Great Plains

C. Northeast

D. **Southeast**

5. Choose the correct answer

Which of the following substances has the highest energy density? Why (short answer?)

A. Methanol

B. Ethanol

C. **Heptanol**

D. Glucose

Why: **Glucose isn't used for power and methanol, ethanol, and heptanol are all alcohols, but heptanol has the longest hydrocarbon chain of any of these.**

6. Complete the following

Suppose a wind turbine in 15 mph (6.7 m/s) winds generates 0.5 MW of power. If the same turbine is placed in 30 mph (13.4 m/s) winds, what power would be generated? *Show your calculations!*

Since power is proportional to windspeed cubed, we can obtain the relationship below to find the scaling factor for this turbine.

$$\begin{aligned} .05MW &= x * 15mph^3 \\ .05MW &= x * 3375mph^3 \\ x &= 1.4815e-5 \frac{MW}{mph^3} \\ power &= x * 30mph^3 \end{aligned}$$

$$power = .4MW$$

7. Choose the correct answer

If the area of a wind turbine (i.e. the diameter of the wind turbine blades) is increased, the power output would: —

A. decreases

B. **increases**

C. stays the same

D. none of the above

8. *Choose the correct answer*

When calculating the power output from a hydroelectric facility, which is NOT a factor?

- A. flow rate of the water
- B. density of the water <- effectively the same regardless of temperature or pressure
- C. surface area of the reservoir
- D. difference in height between intake and discharge

9. *Explain the following*

What is the source of the energy (heat) captured by a geothermal power plant? Why are these plants typically located near tectonic plate boundaries?

The source of heat is the magma plumes that are generated near geologically active points in the earth's crust. They are most often near tectonic plate boundaries as it is common to have a thinner mantle and thus more geological activity there.

10. *List the following*

List TWO advantages and TWO disadvantages of biomass energy.

Advantages:

1.) Carbon Neutral

2.) Limited sulphur and heavy metal emissions compared to traditional gasoline

Disadvantages:

1.) Corn based ethanol is hardly energy productive

2.) It takes land and water to generate biomass energy

11. *Complete the following.*

Suppose we have an Ocean Thermal Energy plant. The surface temperature is 25°C. The temperature of the water gets colder at a rate of 0.02 C per meter. We want our plant to be 3% efficient. How far down will we have to draw water in order to make this efficiency?

Show your work!

$$.03 = 1 - \frac{(.02 \frac{C}{m} * x m) + 273}{25 + 273}$$

$$.97 = \frac{(.02 \frac{C}{m} * x m) + 273}{298}$$

$$289.06 = (.02 \frac{C}{m} * x m) + 273$$

$$16.06 = .02 \frac{C}{m} * x m$$

$$x = 803 m$$

12. *Explain the following.*

Explain why both wind power and solar power are difficult to use as an electricity supply.

They are unpredictable and only generate power at certain times of the day. For solar to generate electricity, the sun must be shining and, for wind to generate electricity, there must be wind. Neither of these things are a given and only happen at certain times.

13. *Explain the following:*

Explain why wind power did not start to become an important energy source until about 2000

The turbines had to reach a critical size before becoming economically viable, which happened around 2000.

14. *Explain the following:*

Explain why photovoltaics did not become an important energy source until about 2010.

The government had not been subsidizing them until then.

15. *Explain the following:*

Explain why sugar cane is a better choice than corn for use to make bio-ethanol.

It has a higher glucose content, which allows for more alcoholic fermentation.