Name: Joseph Specht

NPRE 201 Quiz #1

Please show any and all calculations necessary to complete the problem.

1. *Choose the two correct answers.*
Which of the following are projected to have the highest energy demand grow?

A. United States

B. Russia

C. India

D. China

E. EU – European Union

F. Japan

2. Explain the term "Peak Oil" and what has happened with the known oil supply in the past 20 years.

The term peak oil refers to the point in time where the global oil supply reaches its maximum and this has not occurred as the oil supply in the last 20 years has gradually increased.

3. *Answer the question correctly.*
How many U.S. gallons and liters does a barrel of oil contain?

158.987 L or 42 US gallons

4. *Choose the correct answer.*
The Three Gorges facility that was recently built in China is the world's largest _____-electric power plant.

A. Nuclear

B. Coal

C. Hydro

D. Oil

5. *Complete the following.*
Explain the term 'Levelized Cost of Electricity' (LCOE) and how it is determined (that is what goes into the calculation of LCOE).

The levelized cost of electricity is the price that everyone pays for electricity, and it is determined in an area through a bidding process. The prospective energy suppliers for a region will put in bids and promise they can produce a certain amount of energy at a given price. Once enough bids are put in place to power the region, the lowest price that encapsulates that much energy is chosen with the companies at or below that price being able to supply power to that region.

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6. *Choose the correct answer.*
When comparing equal energy content, the cost of transporting oil is _____ the cost of natural gas.

A. Less than
B. Equal to
C. Greater than
D. None of the above

7. *Fill in the correct answer.*
According to the 4:3:2:1 rule, if a country used 6 units of natural gas, how many units would be used of the following resources? (2 points)

Oil: 8

Coal: 4

Uranium/Other: 2

8. *Answer the question correctly.*
What is the definition of a "quad" of energy?

Quadrillion British thermal units

9. *Choose the correct answer.*
_____ is the most convenient fossil fuel to extract, transport, and use for many purposes when is found as a liquid in its natural state.

A. Natural Gas
B. Coal
C. Uranium
D. Oil

Explain what the issues of extraction, transportation, and use of these fuels are

Natural Gas: Is a gas, so hard to extract without leaking. Transportation requires the use of pressurized gas vessels. Use releases CO2 into the atmosphere.

Coal: Extraction destroys the local environment. Transportation is expensive as it is a solid, so it is not pumpable. Use generates toxic byproducts that need to be taken out of emissions and coal ash that is most often reburied.

Uranium: Extraction requires a large amount of rock to be mined as uranium concentration is fairly low close to earth's surface. Transportation needs to be secure as we don't want people stealing materials that could be used to make a nuclear weapon. Use generates long lived nuclear fuel that must be dealt with most often with a repository.

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Oil: Extraction under water could result in oil spills, which decimate marine ecosystems. Transportation is easy as it is a liquid, but there is an explosion risk. Use generates greenhouse gas emissions with very few ways to reduce them as oil is most often used in transportation.

10. *Complete the following.*
List in order and briefly describe the four steps that occur in a (four-stroke) internal combustion engine cycle. *Hint: start with "intake"*

1) Intake: air and fuel are taken in and mixed

2) Compression: air and fuel mixture is compressed to high pressure and temperature

3) Power: Mixture is ignited sending the piston down and generating power

4) Exhaust: Burnt fuel and hot air are sent out of the piston

11. *Complete the following.*
Give a real-world example of each type of engine:

- Otto cycle: My 2003 Toyota Highlander's
- Diesel cycle: My friend Tyler's diesel truck named Bertha
- Brayton cycle: The Baker-Hughes gas turbines they produce
- Rankine cycle: Abbot power plant on the UIUC campus

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12. *Complete the following problem*
A system uses an enclosed "working fluid" so the number of moles of the gas is constant. What is the thermal efficiency of the system if the hot temperature is 578 K and then cold temperature is 103 C.

Hint: $e_{th} = 1 - \frac{T_C}{T_H} = \frac{T_H - T_C}{T_H}$

$$\eta = 1 - \frac{103 + 273}{578} = .3495 = 35.95\%$$

13. *Complete the following.*
There are two identical power plants operating in Alaska and Champaign. Assume that the surrounding temperatures in Alaska and Champaign are 7 degrees Celsius and 29 degrees Celsius respectively. What are the desired steam temperatures of the two plants in order to achieve an ideal (Carnot) efficiency of 34%?

Hint: $e_{th} = 1 - \frac{T_C}{T_H} = \frac{T_H - T_C}{T_H}$

Alaska

$$.34 = 1 - \frac{7 + 273}{T_{Hot,Alaska}}$$

$$.66 = \frac{280}{T_{Hot,Alaska}}$$

$$T_{Hot,Alaska} = \frac{280}{.66} = 424.24\ K = 151\ C$$

Champaign

$$.34 = 1 - \frac{29 + 273}{T_{Hot,Champaign}}$$

$$.66 = \frac{302}{T_{Hot,Champaign}}$$

$$T_{Hot,Alaska} = \frac{302}{.66} = 457.58\ K = 184.58\ C$$