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NPRE 201 - Quiz #3

Please show all work/or any calculations that you must do.

1) Fill in the Blank:
Oil trapped in shale or sand is more expensive than oil that has accumulated in reservoirs, which is when porous material naturally accumulates over organic material.

2) *Answer the following:*
Name one country that is known to have large deposits of tar sands (oil sands).

Canada

3) *Choose the correct answer*
What is NOT required for the natural formation of oil?

A. Heat

B. Acidic conditions

C. Extreme pressure

D. Long lengths of time

4) *Explain the following*
Explain how primary, secondary, and tertiary extraction recover oil.

Primary
- Uses pressure of the oil to extract oil and this nets ~30 of the total oil in the reserve

Secondary
- Uses pressure from injected liquids to extract oil and this nets 30%-50% of oil in the reserve

Tertiary
- Uses pressure from gas or chemical injections to extract up to 80% of the oil in the reserve

5) *Fill in the blank:*

Sulfur dioxide reacts with atmospheric oxygen to produce sulfur trioxide. This reacts with rainwater to produce, H_2SO_4 or acid rain.

6) *Choose the correct answer*

Which of the following is NOT an input into the coal liquefaction process?

A. CO_2 (carbon dioxide)

B. H_2O (water)

C. O_2 (oxygen)

D. Coal

7) *Choose the correct answer*

Since the late 1970's, in order to control nitrogen oxide emissions from motor vehicles, governments have been requiring what addition be made to automobiles?

A) Air filters

B) Catalytic converters

C) Twin cam turbos

D) Mufflers

8) *Calculate the following*

A 500 MWth (500*10^6 Joules/second) coal-fired powerplant bums bituminous coal, weight composition listed below. The heating value of bituminous coal is 28,400 Joules/gram.

Carbon:67%; Hydrogen=7%; Sulfur=l.5%; Nitrogen: 1.5%; Oxygen:13%; Ash: 10%

Part A) How much coal (in grams) is burned in a year?

Hint: how many seconds are there in a year?

$$\frac{500 * 10^6\ J}{s} * \frac{31{,}536{,}000\ sec}{year} * \frac{1\ gram}{28{,}400\ J} = 5.55 * 10^{11}\ \frac{grams\ coal}{year}$$

Part B) What is the amount of carbon entering the plant annually (in grams)?

$$5.55 * 10^{11}\ \frac{grams\ coal}{year} * \frac{.67\ gram\ carbon}{1\ gram\ coal} = 3.72 * 10^{11}\ \frac{grams\ carbon}{year}$$

Name:_____

9) *Answer the following*

Name three greenhouse gases that are suspected of contributing to climate change:

Methane
CO_2
N_2O

10) *Describe the following*

Explain what is done with waste heat in a combined cycle or cogeneration power plant. Whydoes a combined cycle or cogeneration power plant have a higher efficiency than a regular power plant?

The waste heat is used to either boil water to generate steam that will be run through a turbine or be used to heat a high temperature process. This combined cycles has a higher efficiency than a rebular plant because instead of discarding all the waste heat into the atmosphere, it is used to generate either more power or to create something that would not be there without another cycle generating heat.

11) *Match the following with its description (there is only one answer for each)*

i. Fluidized Bed of Fuel: B

ii. Gas Reburning: D

iii. Bubbling bed boiler: A

iv. Sorbent Injection: C

A. Spraying the heated exhaust with hydrated lime to reduce acidic particulates

B. Having air injected through a perforated bed of coal suspends the fuel for a more complete burn

C. Adding limestone to the bed helps remove more harmful byproducts burn

D. Reheating the exhaust to ensure complete burn of all particulates

Name:_____

12) Calculate the following, make sure to show your work

A conventional, simple cycle gas turbine plant operation at 300 MWe ($300*10^6$ Joules/second) for 4000 hours in a year has a net efficiency of 24%. A combined cycle gas plant having the same capacity operation for the same amount of time offers a higher efficiency of 42%. If natural gas costs $5.20 per GigaJoule (GJ), the annual fuel cost savings offered by the combined cycle plant would be.

Hint: "giga" 10^9, 1 GJ=10^9 J

A) $400,000 per year

B) $4 million per year

C) $40 million per year

D) Other

$$\frac{300 * 10^6\ J}{sec} * 4000\ hours * \frac{3600\ sec}{hour} * \frac{\$5.20}{10^9\ J} * \frac{1\ J\ burned}{.24\ J\ thermal} = \$93.6m$$

$$\frac{300 * 10^6\ J}{sec} * 4000\ hours * \frac{3600\ sec}{hour} * \frac{\$5.20}{10^9\ J} * \frac{1\ J\ burned}{.42\ J\ thermal} = \$53.5m$$

$$\$93.6b - \$53.5b = \$40.1$$

13) Calculate the following, make sure to show your work

Consider the cost distribution table given here for a coal fired plant with sulfur scrubber.

Cost Item	**Steam, $/million Btu**	**Electricity, mills/kWhr**
Labor	0.30	1.6
Coal	1.82	10
Limestone	0.35	1.85
Waste Disposal	0.11	0.6
Auxiliary Power	0.30	1.6
Total	2.88	15.5

Hint: 1 mill = $0.001 (or 1/1000th of a dollar)

In terms of their contribution to the electricity cost in mills/kWhr, everything besides fuel is what percentage of the total (rounded to the nearest %)?

a) 11% b) 14% c) 28% d) None of the above

$$15.5\frac{mills}{kWhr} - 10\frac{mills}{kWhr} = 5.5\frac{mills}{kWhr}$$

$$\frac{5.5}{15.5} = .355 = 35.5\%$$