Electronic Supplementary Material (ESI) for Chemistry Education Research and Practice.

Reading Quiz – 5 pts or 1 pt

10.0 g of ammonia is reacted with 10.0 g of platinum chloride as shown below. How much cisplatin should be produced?

$$NH_3 + K_2PtCl_4 \rightarrow \underbrace{[Pt(NH_3)_2Cl_2]}_{\text{cisplatin}} + KCl$$

a) 0.588 g

b) 0.819 g

c) 7.23 g

d) 9.21 g

e) 12.4 g

Worksheet Clicker Question (5 pts or 1 pt)

1. What is coal?

a) A solid rock that is made up of hydrocarbons.

b) A solid rock that is made up of carbon.

c) A solid rock that is made up of mostly carbon, along with various amounts of other impurities that are found in the earth's crust (sulfur, metal-based minerals, etc.).

d) A solid rock that is made up of wood.

e) A mixture of solid and liquid carbon.

Worksheet Clicker Question (5 pts or 1 pt)

2. Which of the following explains why it is advantageous/desirable to convert coal to a liquid fuel?

A) Our current energy infrastructure is centered on transporting and using liquid fuels for our ground fleet of cars and tractor trailers, therefore being able to use this infrastructure is more economically viable.

B) Liquid hydrocarbon fuels have a high energy density (e.g., much higher than that of gaseous hydrogen used in fuel cells), therefore can provide the energy required to move ground fleet vehicles (especially tractor trailers).

C) This would provide the U.S. an opportunity to develop a liquid fuel supply without depending as much on foreign oil, which will continue to diminish in supply over the coming years.

D) It is easier to convert coal to liquid fuel than it is to convert petroleum to liquid fuel.

E) A and B and correct.

F) A, B, and C are correct.

G) A, B, C, an d D are correct.

Worksheet Clicker Question (5 pts or 1 pt)

3. Hildebrandt et al propose a reaction scheme (reaction scheme 2 pg. 1681, bottom reaction in Figure 1) in which coal is converted to hydrocarbon fuel ($-CH_2-$). What are the advantages of this proposed reaction scheme compared to the traditional reaction scheme (reaction scheme 1 pg. 1680, top reaction in Figure 1)?

A) The new proposed reaction should consume more CO_2 than the normal process (if the supplemental hydrogen is obtained from non-fossil fuel sources such as nuclear, wind, etc.), potentially lowering the amount of carbon dioxide that would be emitted to the atmosphere.

B) The new proposed reaction would require a smaller input of work (in the form of heat energy) than the normal process, making it more efficient.

C) Though some overall net consumption of water is required in both the new and traditional reaction process, the new proposed reaction can recycle water back into the gasification reaction whereas the traditional reaction cannot.

D) A and B are correct.

E) A, B, and C are correct.

Worksheet Clicker Question (5 pts or 1 pt)

4. If you write the reactions in a stepwise fashion, what is the overall net reaction?

a) $2C(s) + 6H_2O \rightarrow 2(-CH_2-)(l) + 4H_2O(l) + CO_2(g)$

b) $3C(s) + 4H_2O \rightarrow 2(-CH_2-)(l) + 4H_2O(l) + CO_2(g)$

c) $3C(s) + 6H_2O \rightarrow 2(-CH_2-)(l) + 4H_2O(l) + CO_2(g)$

d) $3C(s) + 6H_2O \rightarrow 2(-CH_2-)(l) + 6H_2O(l) + CO_2(g)$

Worksheet Clicker Question (5 pts or 1 pt)

5. What would be the balanced reaction sequence?

a)

$C(s) + 2H_2O(l) \rightarrow CO_2(g) + 2H_2(g)$

$9CO_2(g) + 25H_2(g) \rightarrow C_8H_{18}(l) + 16H_2O(l) + CO_2(g)$

b)

$C(s) + 2H_2O(l) \rightarrow CO_2(g) + 2H_2(g)$

$CO_2(g) + 12H_2(g) \rightarrow C_8H_{18}(l) + H_2O(l) + CO_2(g)$

c)

$C(s) + 2H_2O(l) \rightarrow CO_2(g) + H_2(g)$

$9CO_2(g) + 12H_2(g) \rightarrow C_8H_{18}(l) + 16H_2O(l) + CO_2(g)$

Worksheet Clicker Question (5 pts or 1 pt)

6. The authors state that the goal would be to use this process to make 80,000 barrels of liquid hydrocarbon fuel per day. How many tons of coal would be required to produce this much liquid fuel? Use the balanced equation from question 4:

a) 1.25×10^3 tons

b) 2.75×10^3 tons

c) 4.88×10^3 tons

d) 1.27×10^4 tons

e) 3.25×10^5 tons

Worksheet Clicker Question (1 pt)

7. What are the advantages and disadvantages of using coal to produce liquid fuels? If you had to decide whether or not to invest federal funds in developing the CLT (coal-to-liquids) technology, would you support these efforts?

a) Yes

b) No