1045 Recitation, Week 2, Spring 2020

As I mentioned in class, hydrogen is often mentioned as the fuel of your future. We've been say that a hydrogen-based economy is about ten years away, and we've been saying it for the last 30 years or so. In case you're interested, I'll the article *How the Hydrogen Economy Could Make a Comeback* by Stuart Nathan to the course website.

I. We carried out the reaction in class. A candle was used to ignite a balloon filled with hydrogen. The flame burned through the rubber balloon, allowing the oxygen in the air to mix with the hydrogen, which was then ignited by the flame. The product of the reaction, H_2O, ultimately cools to form water.
and a balanced chemical equation for the reaction is given below.

$$2H_2(g) + O_2(g) \rightarrow 2H_2O(\ell)$$

The other product of the reaction, not shown in the above chemical equation, is the considerable energy released by the reaction. We observed this in class as a large orange ball of flame and the sound of a modest explosion. The "Hydrogen Economy" refers to the possibility of using hydrogen instead fossil fuels (coal, petroleum) to provide the power needed to drive our economy (industry, transportation, agriculture... everything that makes or takes money).

This recitation assignment applies some of the skills and concepts we covered over the past week towards understanding the chemistry we need to evaluate the feasibility of a hydrogen-based economy.

I. Which, if any, of the chemical species in the reaction $2H_2(g) + O_2(g) \rightarrow 2H_2O(\ell)$ are...
(Yes, I know. We did this in class. Do it again here without looking at your notes.)

A. atoms? none

B. molecules? $H_2(g)$, $O_2(g)$, and $H_2O(\ell)$

C. elements? $H_2(g)$ and $O_2(g)$

D. compounds? $H_2O(\ell)$

II. Identify the following as an extensive property or an.

A. the mass of oxygen — extensive property _____

B. the density of hydrogen — intensive property _____

C. the boiling point of water — intensive property _____

D. the volume of hydrogen — extensive property _____

E. the color of gold — intensive property _____
(unless you go to the quantum level)

F. the cost of gold — extensive property _____
(the cost depends on how much you buy)

G. the price (per gram) of gold — intensive property _____
(if we buy it from the same place at the same time)

III. A gallon of gasoline provides roughly the same amount of chemical energy as 1.0 kg of hydrogen gas. So if you wanted to power your car by burning hydrogen, what volume of hydrogen gas (in gallons) would you need to provide the same energy as a tank of gasoline?

A. First, state any assumptions you made to solve this problem.

volume of the gas tank (we also assume that the efficiency of the two fuels is the same)

B. Now, solve for the volume of hydrogen gas you would need to carry. The density of hydrogen gas is 0.090 g/L at "room temperature and pressure."

16 gal x (1000 g H_2/gal gasoline) x (1 L/0.090 g) x (1 gal/3.785 L) = 4.6 x 10^4 gal

C. Based on your answer to Part B, comment on the feasibility of using hydrogen gas as an automobile fuel?

That's an awfully big fuel tank! This is one of the problems that we have to solve if we are going to go to a hydrogen economy.

IV. So ten years from now you'll be filling up your tank with hydrogen gas. Or not, Obviously there are still some problem to work out before this happens. In the meantime, this weekend is followed by Martin Luther King, Jr. Day, and some of you are driving home for the three-day weekend. One of us is going to Nashville. Let's assume that person is driving.

How much does it cost to drive from Tallahassee to Nashville, and back?

A. What do you need to know? Write it down.

Find online: distance from Tallahassee to Nashville
average gasoline prices in the states between here and Nashville

Anything else: the person is driving a 2016 Honda Accord
only the cost of gasoline, they do not need to include other expenses
no, you do not know the addresses in Tallahassee or Nashville

Price of fuel and fuel efficiency can be found online, or you can estimate these values.

Some of the information you can find online, so you can use your phones for that. It's possible your recitation instructor may have some useful information, but you must ask specifically for that information. (S/he can't just say everything s/he know about everything she knows. You must ask specifically for what you want to know.) If there is anything else you need to know, then you'll have to estimate it. Yes, there is more than one way to work this problem.

B. So, much does it cost to drive from Tallahassee to Nashville, and back?

Using distance = 2 x 490 miles = 980 miles; 29 miles/gal (fueleconomy.gov for 2016 Honda Accord, 2.4 L, 4 cyl, automatic, regular gasoline); \$2.50/gal gives…

980 miles x (1 gal/29 miles) x \$2.50/gal = \$84