CH302 Random Musings February 1, 2007

1. Class is about to be in full swing though we are still gearing up with the e-book and the grading. I do apologize for the inconvenience. Such is the consequence of change. We should have everyone on the same page in time to prepare effectively for exam 1.

2. Which of course means that this spot is reserved for grading results for quiz 1. Perhaps I will fill them in, in which case I got them before I read these musings, or perhaps you are reading what I am writing now, which is that I don't have then yet, which means that you should refer to item 3 below.

3. Quest—As with any new piece of software you have to be patient. So you are not seeing quite the turnaround time with grades you might have expected—the problem was they didn't think I would be giving in class tests (or in my case quizzes) until the middle of February, so they weren't quite ready when I needed them to be. So there will be a bit of a delay. All I can offer is that patience is a virtue and that you will be able to access your grades from quiz 1 about five minutes after we can access them.

4. I met with the sales rep from the publisher of the Atkins Jones e-book this morning and this is what is happening on that front:

- The online ChemPortal price will be set to $40. This will be just for 1 week, starting today at 3PM and ending next Friday 2/8.
- Tech support will credit the 6 students that have already paid full price an amount of $40--this will be done as an actual credit.

It is my find hope that when I post a practice quiz 2 this weekend on the Chemportal that all of you will take it.

5. I was looking at my schedule and saw that I was scheduling a quiz for Tuesday, just one week after the first one and about two days before I could reasonable expect you to know the material on worksheet 2. So I am delaying quiz 2 until Thursday next week. My apologies for the inconvenience.

.

7. Here are the question types for quiz 2:

- Theory: creating equilibrium expressions from chemical reactions
- Calculation: determining K from equilibrium concentrations
- Calculation: determining equilibrium concentrations from K
- Problem: appreciating what the magnitudes of K values mean
- Problem: predicting reaction direction from Q and K
- Theory: LeChatelier's principle
- Problem: LeChatelier and reaction direction
- Calculation: Van't Hoff equation relating K to T

Note that there is a question type on the van't Hoff equation relating K to T. Somehow this topic was dropped from my lecture notes a few years ago. I am adding it back now. It can be found at the end of the musings and is also on the web site in the lecture materials as an addendum to lecture 7.

8. A very nice worksheet 2 is posted with answers to help you prepare for the quiz.

9. A bit of advice on how to know whether to go to my office or to the classroom for my office hours:
Method 1. I will tell you in the musings each week. For example:

- Next Monday and Tuesday I will hold office hours in my office
- On Wednesday and Thursday before the quiz I will hold them in the assigned classrooms

Method 2. Make up a little poem to assist with a common sense assessment. Here are two I have written:

- If there's a quiz or a test, it's not in Dave's nest
- Is there a quiz or test soon? Go to the classroom.

One of your classmates also provided some little jingles. Most make no sense to me or seem just wrong, but hey, I don't pretend to understand today's youth, so maybe you'll like his better. For example:

- If you don't want your grade to go 'ka-boom' see Dr Laude in a larger room
- On days when you use a calculator, Judy will say "see you later"
- If you'll be nerv-ous, there will be more-of-us
- If you will fill out a sheet, Dr Laude is across the street

10. Valentine's Day is close at hand and this is your chance to submit your favorite poetry for publication in a special poetry musings on the 15th. Only lovingly sweet poetry will be published at this time. This is your chance, like on radio stations, to dedicate a poem to someone. Then, in the new millennium equivalent of listening to songs dedication by Kasey Kasem in the 80s, you can go to my web site and point out to your beloved, a dedication on my random musings link.

11. Public Service Announcements—feel free to submit yours to the musings.

- Contagious Smiles is a new organization at the University of Texas at Austin that focuses on dedicating quality time with children who have prolonged visits to hospitals in the surrounding area. We plan to volunteer at the Brackenridge Children's Hospital in Austin. We aspire to bring smiles to children by creating numerous activities that are fun and have an educational aspect to them. This organization is unique in the sense that we want to commit to spending quality time regularly with the children. Meeting Times: Every other Tuesday @ 7 pm. Location: MEZ 1.208. Next meeting is February 12. Please come if you're interested in finding out more! FREE FOOD!!! For more information, check out the Facebook group "Contagious Smiles" http://utexas.facebook.com/group.php?gid=2255557482 Email: contagiousmiles07@yahoo.com

- Circle K International (CKI) Meetings are every Tuesday at 7:30 PM in Sanchez Building (SZB) 278. Circle K International is the largest collegiate service organization in the world and is looking for people interested in volunteering and serving the community. Past volunteer opportunities include volunteering at parks, working with Austin State School, tutoring at Matthews Elementary, and volunteering at the Austin Humane Society Animal Shelter. CKI is affiliated with Key Club and Kiwanis. Feel free to come to any meeting or e-mail sawhney.r@mail.utexas.edu for more information.

12. Poetry Corner. For poetry corner today I offer up a pretty funny story told by another professor who teaches freshman chemistry—it is the challenge that every parent, who knows more than is good for them, faces.

DIALOGUE WITH SARAH, AGED 3: IN WHICH IT IS SHOWN THAT IF YOUR DAD IS A CHEMISTRY PROFESSOR, ASKING "WHY" CAN BE DANGEROUS

By Stephen McNeil
- FROM THE ARCHIVES -

SARAH: Daddy, were you in the shower?

DAD: Yes, I was in the shower.

SARAH: Why?

DAD: I was dirty. The shower gets me clean.

SARAH: Why?

DAD: Why does the shower get me clean?

SARAH: Yes.

DAD: Because the water washes the dirt away when I use soap.

SARAH: Why?

DAD: Why do I use soap?

SARAH: Yes.

DAD: Because the soap grabs the dirt and lets the water wash it off.

SARAH: Why?

DAD: Why does the soap grab the dirt?

SARAH: Yes.

DAD: Because soap is a surfactant.

SARAH: Why?

DAD: Why is soap a surfactant?

SARAH: Yes.

DAD: That is an EXCELLENT question. Soap is a surfactant because it forms water-soluble micelles that trap the otherwise insoluble dirt and oil particles.

SARAH: Why?

DAD: Why does soap form micelles?

SARAH: Yes.

DAD: Soap molecules are long chains with a polar, hydrophilic head and a non-polar, hydrophobic tail. Can you say 'hydrophilic'?

SARAH: Aidrofawwic

DAD: And can you say 'hydrophobic'?

SARAH: Aidrofawwic

DAD: Excellent! The word 'hydrophobic' means that it avoids water.

SARAH: Why?

DAD: Why does it mean that?

SARAH: Yes.

DAD: It's Greek! 'Hydro' means water and 'phobic' means 'fear of'. 'Phobos' is fear. So 'hydrophobic' means 'afraid of water'.

SARAH: Like a monster?

DAD: You mean, like being afraid of a monster?

SARAH: Yes.

DAD: A scary monster, sure. If you were afraid of a monster, a Greek person would say you were gorgophobic.

(pause)

SARAH: (rolls her eyes) I thought we were talking about soap.

DAD: We are talking about soap.

(longish pause)

SARAH: Why?

DAD: Why do the molecules have a hydrophilic head and a hydrophobic tail?

SARAH: Yes.

DAD: Because the C-O bonds in the head are highly polar, and the C-H bonds in the tail are effectively non-polar.

SARAH: Why?

DAD: Because while carbon and hydrogen have almost the same electronegativity, oxygen is far more electronegative, thereby polarizing the C-O bonds.

SARAH: Why?

DAD: Why is oxygen more electronegative than carbon and hydrogen?

SARAH: Yes.

DAD: That's complicated. There are different answers to that question, depending on whether you're talking about the Pauling or Mulliken electronegativity scales. The Pauling scale is based on homo- versus heteronuclear bond strength differences, while the Mulliken scale is based on the atomic properties of electron affinity and ionization energy. But it really all comes down to effective nuclear charge. The valence electrons in an oxygen atom have a lower energy than those of a carbon atom, and electrons shared between them are held more tightly to the oxygen, because electrons in an oxygen atom experience a greater nuclear charge and therefore a stronger attraction to the atomic nucleus! Cool, huh?

(pause)

SARAH: I don't get it.

DAD: That's OK. Neither do most of my students.

Stephen McNeil is an Assistant Professor of Chemistry at University of British Columbia Okanagan in Kelowna, British Columbia. His lectures and conversation tend to incorporate a large degree of both gesticulation and pontification, occasionally of a frighteningly unbridled and reckless nature. He often reminds people of his namesake on "Blue's Clues", and he knows that already, so you really don't need to mention it again.

Quantifying the Relationship between K and T (add to notes at the end of page 75 or end of lecture 7).

LeChatelier's Principle gives us a way to argue the direction in which a reaction will shift with change in temperature. But is there a way to quantify this? Of course, and it is shown below without derivation (which awaits those of you who have to take physical chemistry in a couple of years.) Here it is, the van't Hoff equation:

$$\ln\frac{K_2}{K_1} = \frac{\Delta H_r^\circ}{R}\left\{\frac{1}{T_1} - \frac{1}{T_2}\right\}$$

Note a few things about to note about the equation:

- It is of a form identical to the Clausius Clapeyron, which makes sense in that the Clausius Clapeyron explains the temperature dependence of a physical equilibrium phenomenon (vapor pressure) and van't Hoff generalizes this to any equilibrium phenomenon.
- Also note that the qualitative picture of the direction in which a reaction shifts from LeChatelier's principle is consistent with the Van't Hoff equation.
- The change in enthalpy, which you can determine using anything from a bomb calorimeter calculation to a heat of formation calculation to a bond energy calculation, has a sign associated with it that will flip positive or negative depending on the direction in which you write the reaction and consequently whether the reaction as written is exothermic or endothermic.

Sample Problem:

The equilibrium constant *K* for the synthesis of ammonia is 6.8×10^5 at 298 K.

$$3H_{2(g)} + N_{2(g)} \rightarrow 2NH_{3(g)}$$

Predict its value at 400. K.

Solution. The standard reaction enthalpy for the forward reaction is

$$\begin{aligned}\Delta H_r^\circ &= 2\Delta H_f^\circ(NH_3, g) = 2(-46.11\ \text{kJ·mol}^{-1}) \\ &= -92.22\ \text{kJ·mol}^{-1} \text{ or } -92.22 \times 10^3\ \text{J·mol}^{-1}\end{aligned}$$

Therefore,

From $\ln(K_2/K_1) = (\Delta H_r^\circ/R)\{(1/T_1) - (1/T_2)\}$,

$$\ln\frac{K_2}{K_1} = \frac{\overbrace{-9.222 \times 10^4\ \text{J·mol}^{-1}}^{-92.22\ \text{kJ·mol}^{-1}}}{8.3145\ \text{J·K}^{-1}\text{·mol}^{-1}} \times \left\{\frac{1}{298\ \text{K}} - \frac{1}{400.\ \text{K}}\right\} = -9.49$$

Take antilogarithms (e^x).

$$K_2 = K_1 e^{-9.49} = (6.8 \times 10^5) \times e^{-9.49} = 51$$

The answer is close to the experimental value of 41 but is not exact because ΔH_r° is not actually constant over the temperature range. This same complication arose when performing a Clausius Clapeyron calculation and resulted in the boiling point of water being predicted as 105°C.