**Physical Chem Lab Writing Workshop: Chemistry 6854 Spring 2016**

***(Due 3 February in Lecture)***

Over the last three years of teaching this course, I’ve observed that students struggle most (and lose the most points from) the approach (or more precisely, lack of approach) they take to writing the lab report. Just read pages 1-11 of the Lab Manual, though, and you’ll realize I am dead dog serious about getting you to the next level in writing as a scientist.

 Unlike the many other courses you’ve had where a specific rubric was always available beforehand, none are available here. This is because I know you’ll end up just trying to do what the rubric says to get a good grade rather than wrestling with what your results really mean and how to write it up so the story sings. Here, premium is set on you digging deep and hard into both the measurements you made, and how the theory you are using are woven together into succinct and clear sentences that concretely express the provable central concepts and findings of the experiment. Moreover, like writing a poem, (though it is far from being one) this must be a solitary effort that reflects you and you alone.

In the past, I just threw students into the deep end of the pool without comment on writing up these labs and silently prayed for the miracle of buoyancy. That’s how I was `instructed’ back in the `good old days.’ After figuratively needing to apply unpleasant, mouth-to-mouth resuscitation on many, teary-eyed students , though, I’m experimenting this year with a painless swimming lesson.

First, examine carefully the lab notebook entry attached, which is a hypothetical set of measurements made by one J. van der Waals, who was testing whether the behavior of two noble gases (He and Xe) deviate from the Ideal Gas Law. The data has been `cooked’ so that the usual **b** term correcting for finite gas volume is negligible. (You’ll need to look up the van der Waals equation and see how it applies here. That’s part of the exercise.)

Your mission is to convert the measurements into a typed report that stringently follows the format laid out on pages 1-11 of the Lab Manual***. You will turn in two copies of this report***: ***one with your name*** on it to me that I will ~~savage~~ comment on and ***one without your name*** so that we can use it as an example (maybe) during the 3 Feb Workshop you’ll be participating in.

There are three main things I’ll be looking for and commenting on your anonymous workshop reports:

1. How completely, quantitatively and succinctly does your **Abstract** capture what’s in the experiment and what you think it implies. This will represent at least 10% of the grade.
2. Do you follow both the order of presentation, and, do you adhere to the style dictated for line spacing, figure and table labeling, brevity, and, is the correct information in place and in the right part of the report ? (~30% of the grade)
3. How you analyze and graph the data in **Results** and synthesize a `story’ from what you’ve present about what’s going on with the two inert gases in **Discussion.** This is the big enchilada (usually at least 50%-60% of the lab grade is here).

**Key questions to ponder: (FYI the data sets will be sent to you electronically so you can cut/paste into EXCEL)**

1. How do you concretely demonstrate that “….it looks like something’s not quite right with the Ideal Gas Law. Will need to apply some part of my little theory, methinks .” from the data in the 3 tables? More specifically, how do you manipulate the modified van der Waals equation to fit the data and test the equation’s validity given b=0 ?
2. How do you write up and describe your fit of the data so that it is short, but complete and consistent with the format laid out on pages 1-11 of the Lab Manual ?
3. Do both gases exhibit similar deviance, or are they different? How?
4. What more general physical trends are implied by the data? (be careful here…you need to firmly support any `speculated physical trend’.)

**Participants who carry this exercise in good faith and with more than a “day-before-it’s due” effort will receive 20/20. Those who try my patience will be traded in for a yellow dog, after which I will shoot the dog. Then the real punishment will begin. Do this on your own! If it looks like you’ve substantially copied each other you will earn a zero (0). I want original efforts, not the work of a committee.**

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An Examjnation of the P-V-T-n behavior of two Noble Gases, Helium (He) and Xenon (Xe) (continued)

 J vander Waals 2/16/15

Using the gas manifold apparatus and technique described earlier by Forey1 , **~~Ne~~** Xe (99.999%, Linde Gas Reagent grade lot #561A-3) and He (99.99%, Air Gas Technologies, Technical grade, lot AG3412) were examined under a variety of conditions to see what if any deviance from the ideal gas law : **Pideal (atm)V(L)= =n(moles)(0.08206)T(K)** is observed.

Specifically, three different sets of measurements are desired:

1. the relationship between gas pressure, P and n at constant V=20.000L and T =300.0 K
2. the relationship between gas pressure P and T, at constant V=20.000 L and constant n=1.000 moles
3. the relationship between gas pressure P and V at constant T=300.0 K and constant n=1.000 moles

I have collected all of these cases after several hours of very trying, time consuming work, and tabulated the observed variations in the three tables below. The uncertainty of the apparatus in measuring, P, V, T and n described in reference 1 is reflected in the precision of the listed values so that we can assume n ± 0.001 moles, P ± 0.0001 atm, V ±0.001 L and T ± 0.1 K

(2) V=20.000 L, n=1.000 moles; T varied

|  |  |  |
| --- | --- | --- |
| T( K) | P(He, obs), atm | P(Xe, obs), atm |
| 100.0 | 0.4102 | 0.3997 |
| 200.0 | 0.8205 | 0.8099 |
| 300.0 | 1.2308 | 1.2202 |
| 400.0 | 1.6411 | 1.6305 |
| 500.0 | 2.0514 | 2.0408 |
| 600.0 | 2.4617 | 2.4511 |
| 700.0 | 2.8720 | 2.8614 |
| 800.0 | 3.2823 | 3.2717 |

(1) V=20.000 L, T= 300.0 K; n varied

|  |  |  |
| --- | --- | --- |
| n (moles) | P(He,obs) atm | P(Xe,obs) atm |
| 0.100 | 0.1231 | 0.12300 |
| 0.200 | 0.2462 | 0.2458 |
| 0.500 | 0.6154 | 0.6128 |
| 1.000 | 1.2308 | 1.2202 |
| 2.000 | 2.4615 | 2.4193 |
| 5.000 | 6.1524 | 5.8889 |
| 8.000 | 9.8418 | 9.1672 |
| 20.000 | 24.5840 | 20.3680 |

(3) T=300.0 K, n=1.000 mol ; V(L) varied

|  |  |  |
| --- | --- | --- |
| V(L) | P(He, obs), atm | P(Xe, obs) , atm |
|  1.000 | 24.5840 |  20.3680 |
| 5.000 | 4.9222 | 4.7536 |
|  10.000 | 2.4614 | 2.4193 |
| 20.000 | 1.2308 | 1.2202 |
| 40.000 | 0.6154 | 0.6128 |
| 100.000 | 0.2461 | 0.2458 |
| 200.000 | 0.1230 | 0.1230 |
| 500.000 | 0.0492 | 0.0492 |

**Curious results !!** As I suspect, it looks like something’s not quite right with the Ideal Gas Law. Will need to apply some part of my little theory, methinks. Yawn. Time for a quart or two of some good Dutch dunkel beer !

**1: 15 AM 2/16/15 J.D. van der Waals**

**references**

1. J. Forey, **Vacuum Sci. B**, **112**, 300-304 (1999)