Phys 114 Week 1: Amy's reading advice 2021

Preamble: As requested by some of you, this is a short and totally not-objective view of how navigate the two texts this week. Who does what better? Not-objective ... b/c each of you, today, have your own comfort level with Thermo and Stat Mech. Each of you will be receptive to the different authors to different degrees.

Generic advice: Read the whole assignment for *either* B&B *or* G&T. Read closely ... which for me involves taking notes, looking at images and captions, and being sure I can get between equations and can follow examples. Write down anything that confuses you.

Then take a break. (Nap, eat, exercise, let the sun set and rise again, ...)

Then read from the other textbook, with your notes next to you. Linger on things that confused you, are new, or really interest you. Skim or skip other things.

My observations about reading this week:

1. Topics that are common to both books:

- At a minimum: definitions of N_A, molar mass, equilibrium, pressure, extensive vs. intensive variables, the ideal gas, the first law of thermo, isothermal and adiabatic processes, heat capacities at constant volume and pressure.
- For example: Either section 2.5 of G&T or 1.3 of B&B will teach you about using
  $PV = NkT$
- I can find nothing in B&B Chapters 1.1-1.3 and 2 that are not found scattered throughout G&T Chapter 1.
- Both books talk about functions of state (B&B 11.1 and G&T 2.8), reversible and quasistatic processes (see B&B Fig. 12.1 and G&T Fig 2.5)
- Both books do an argument about counting states, but interestingly they do the *same* kind of counting for *two different systems*. G&T does N particles, where n could be on the left side and N-n on the right side of a box. B&B does n atoms, each of which could have 1 or 0 quanta of energy, and the whole system has r quanta of energy. Once you get your mind around it, G&T's (N, n, W) is B&B's (n,r,Ω). Yikes! The counting is the same and B&B has the kindness to tell you the form of Ω , the binomial coefficient, ${}^nC_r$. (We'll get to Stirling's approximation later.)

2. Topics that might be unique to one book:

- B&B tends to have more history-of-science. It also has more about numbers and unit systems.
- G&T Ch. 1 expounds on the approach to equilibrium, with simulations dedicated to this. It has Molecular Dynamics simulations with Lennard-Jones interactions, and Monte Carlo simulations.
- G&T Ch. 1.9 has more content on different models of matter, and Ch. 2.5 has the van der Waals gas.
- G&T talks about the 0th law of thermo: "thermometers work". (But you could read roughly 1 page in B&B, Ch. 4.1 about it.)
- G&T talks about temperature more, and shows a Demon thermometer algorithm. (But you could read roughly 1 page in B&B, Ch. 4.2 about thermometers. There you'd see a more historical and practical discussion.)
- Each book has different, but nice schematic pictures that help anchor concepts. G&T Fig 2.1 is system + surroundings, Fig. 2.1 of B&B has two ways to heat a system: at constant volume and constant pressure.

3. Generic things Amy likes about B&B:

• If you feel strong on a topic, it's **short with just a few, well-chosen examples**. One nice example in Ch. 12.3 is about how temperature rises in the atmosphere: using adiabatic and isothermal models.

• It has **chapter summaries**. Even if you choose G&T as your main text, you can glance at these ridiculously short summaries in grey boxes on pp. 5, 17, 115 and 123.

• On p. 5 it has a **map of what the text covers** in what order. The big topics are classical thermo, kinetic theory of gasses, and stat mech (with or without quantum mechs).

• It says stuff like "It is therefore with a somewhat heavy heart that we turn to the topic of ... ". LOL

4. Specific things Amy likes about B&B this week:

• It uses a very popular notation in thermo, which G&T does not. For infinitesmal quantities which are not exact differentials, it uses a bar through the "d". So the first law for tiny changes is written:

$$dU = đW + đQ$$

which reminds us that energy, U, is a function of state, but work and heat are not.

• Eq. (11.12) is a more generic expression for the infinitesmal heat than is found in G&T, which applies for any substance, not just an ideal gas. (We will pick it up later, though.)

$$đQ = \left(\frac{\partial U}{\partial T}\right)_V dT + \left(\left(\frac{\partial U}{\partial V}\right)_T + P\right) dV \qquad 11.12$$