Phys 114 **Week 12: Amy's reading advice** **2021**

My observations about reading this week ...

0. Department of redundancy department:
• All texts talk about the **van der Waals gas** and its phase transition.

• All texts talk about the **Maxwell construction**. This permits one to follow the equilibrium liquid gas coexistence curve, rather than follow a spurious route in (P,V,T) space where the Gibbs free energy is not a minimum. This produces what some people call the "**lever rule**" ... the specific volumes of liquid and gas when they coexist. This equation is G&T (7.65), B&B (26.30), and Schroeder (5.57).

• Both B&B and G&T talk about the **virial series**.
(So does Schroeder but I didn't assign that section.)

1. G&T probably has the best coverage this week:
Downside? As usual it is more lengthy than B&B and more mathematical than Schroeder.
Upsides:
• It has a careful discussion of how to implement the calculation of the lever rule, and find the densities of liquid and gas when you are close to the critical point.
• It has a careful discussion of the Gibbs free energy as a function of density, reminiscent of the discussion of mean field theory for magnets. This feeds into an optional part of homework problem 5 where we see why the system "chooses" either liquid (high density) or gas (low density) or a coexistence.
• It alone has a discussion of **critical exponents for the van der Waals model.**

2. B&B has a few **unique** and/or **good** things:
• **Section 28.6 on Colligative properties is necessary reading this week .** The altering of a phase transition temperature when solute is present is a key idea :-).

• **Box** on **p. 298** has Z(T,V,N) and F for the van der Waals gas.
• **Section 26.4** has a concise treatment of the Law of Corresponding States, with a graph.
• **Section 28.1** shows S vs. T with the jump in S indicating L, a latent heat.
• **P. 329** discusses **metastability**. (The ensuing discussion of nucleation and droplets is great but not required.)
• **Section 28.5** introduces the **Gibbs phase rule**.
• **Section 28.7** defines **types of phase transitions by their order**, as well as the type of **symmetry which is broken**.

3. There is **nothing unique in Schroeder 5.3** that can't be found in other books. Still, he's super readable as he explains:
- The boundary between two phases
- The Clausius-Clapeyron (CC) Eq.
- The van der Waals model
- How to navigate the Maxwell construction.

Schroeder has some awesome problems. Thus, **you will need to look at Schroeder to find some of the homework**, and perhaps look near the problem to read some useful numbers or view a figure. Yet all the learning you need to do these problems can be obtained from other readings.

Schroeder 8.1 is not assigned, even though it discusses the virial series, which is a topic this week. It dives into a discussion of a diagrammatic expansion for which we don't have time. I am

assigning **Schroeder Problem 8.10,** but it's totally doable from G&T's treatment of the Lennard-Jones model.