Midterm 1 Review Sheet

- First, second, & third law of thermodynamics
- Energy minimization, entropy maximization
- Intensive vs. extensive variables
- Definitions: closed system, subsystem, adiabatic, reversible
- Legendre transforms
- Gibbs-Duhem equation
- Euler’s equation
- Maxwell relations
- How to take partial derivatives to obtain quantities of interest
- Conditions for single and multiphase equilibrium (thermal/mechanical/chemical equilibrium)
- Definitions of $\kappa_T$, $\kappa_S$, $c_V$, $c_P$
- Stability criteria
- Maxwell construction
- Interpreting phase diagrams
- Gibbs phase rule
- Equilibrium and Gibbs surfaces (including first- and second-order phase transitions)
- Clausius-Clapeyron equation
- The van der Waals equation of state
- P vs. V diagram for VDW (coexistence, metastable, spinodal region)
- Interfaces, surface tension
- Gibbs adsorption isotherm

Practice Problems for the Review Session:

Exercise 1.4 from Chandler. (EOS, thermal equilibrium, adiabatic)

The heat capacity and pressure of an isothermal, fixed volume system containing $n$ moles are given by:

$$C_v = 2bnT$$
$$P = \frac{an^2T}{V^2}$$

where $a$ and $b$ are known constants. Identify the thermodynamic potential ($Z$) you would use to describe this system. Using the equations above and neglecting chemical potential determine $Z$ as a function of $a$, $b$, $T$, $V$, and $n$. (Choice of thermodynamic function, EOS)

Exercise 2.10 from Chandler (Multiphase equilibrium, Clausius-Clapeyron equation)