## Practice Problems

While not required, it will be very helpful to sketch the thermodynamic state or process (i.e. starting and ending point) on an appropriate thermodynamic diagram.

1. Flash steam is an interesting phenomenon. In a constant enthalpy (isenthalpic) process, water flowing through a valve for instance, it occurs so quickly that part of the exiting flow will be steam. In this situation you have water flowing through a valve, and the inlet has saturated liquid at 2.00 MPa, and the exit of the valve is at 1.00 MPa. Calculate the following:
   1. What percent of the exit is in the vapor state (i.e., what is the quality)?
   2. What is the temperature of the exit state?
2. You should search YouTube for some videos of material passing through the critical point. This problem is about creating an apparatus that allows CO2 to pass through the critical point. Assume you’ve created a sealed, rigid, transparent enclosure that has a volume of 2.00 \* 10-6 m3 (note the -6 exponent). Calculate the following:
   1. Calculate the mass [kg] of dry ice (solid CO2) do you need to place in your evacuated chamber so that it can pass through the critical point?
   2. To what temperature [°C] must your device reach in order for the CO­2 to pass through the critical point?
   3. When the CO2 in your apparatus passes through the critical point, what will the pressure [MPa] be in your enclosure?
3. Find/calculate the missing information from Table 3.20 in your textbook (pg. 96)

## Preparatory Reading Questions

1) What is the first law of thermodynamics on an energy balance basis?  
 Write this in terms of specific energy, identifying all variables in this equation.  
 What does this equation reduce to for closed systems?

2) Explain what is represented by each of the terms in equation 4.10.

3) What is the sign convention for work transfer (both into and out of a system)?

4) What is the sign convention for heat transfer (both into and out of a system)?

## Answers to Practice Problems

1. At State 2 quality is ~0.072, or 7.2%, and Temperature is ~179.9 °C
2. Initial mass of CO2 should be 9.334 \* 10-4 kg. Critical temperature is 31.05 °C, and critical pressure is 7.39 MPa
3. Fill in property table
   1. va = 90.24, and xa is undefined
   2. Tb = 900 °F, and xb is undefined
   3. xc = 0.185, or 18.5%
   4. P­d\_sat = 21.203 psia, and v­d = 0.01185 ft3/lbm
   5. Te\_sat = 457.72 °F, and v­e = 48.42 ft3/lbm