Part 2: Engineering Calculations – 30 Points

1. You are going to heat 3.5 lb_m of Ammonia at constant pressure of 247 psia from a saturated liquid to a saturated vapor. Calculate how much heat (Btu) will be required to do this.
   Remember: This process will have both heat and moving boundary work.
   Tip: Be very careful with units on the $\int Pdv$ work calculation

2. Air enters the compressor at 14.7 psia and 60 °F, and leaves at 119.0 psia. If the process is reversible and adiabatic (which means isentropic), but the specific heat of air is *not* constant, calculate the temperature (in °F) of the air leaving the compressor. **Hint:** There is a table in your supplement that will be very useful.

3. You are going to fill an initially empty Acetylene tank (C_2H_2) tank until it reaches 250 psia. The tank is wrapped in adiabatic insulation. The tank is connected to a supply of Acetylene that stays at a constant 500 psia and 75 °F through the filling process. Additionally, the specific heats for Acetylene at 100 °F are: c_p = 0.35 Btu/(lbm °R), and c_v = 0.27 Btu/(lbm °R)

   a. Set up the equations that describe the process happening, completing separating and integrating terms to get the governing equation. Simplify as appropriate.

$$\dot{Q} - \dot{W} + \sum_i \dot{m}_i \left(h_i + \frac{V_i^2}{2g_c} + \frac{g}{g_c} z_i \right) - \sum_e \dot{m}_e \left(h_e + \frac{V_e^2}{2g_c} + \frac{g}{g_c} z_e \right) = \frac{d}{dt}(U + KE + PE)$$

$$\sum_i \dot{m}_i - \sum_e \dot{m}_e = \frac{dm}{dt}$$

   b. Assuming constant specific heats (given above), solve for the final temperature (°F) of the Acetylene gas in the cylinder after it is filled.