Tutorial 3 – Group A

Please make sure that you write your answers on a A4 sheet, portrait mode. The pdf also has to be in portrait mode. IF not, the tutorial sheet will not be evaluated.

Please write your roll number and name at the centre of every sheet.

Please use the file name rollnumber_tut3.pdf

1. 1 kmol of CO (assume ideal, C_P = 29.3 J/ mol K) at 2.758 MPa and 700K (state 1) is subjected to the following process:

   (i) Expand isothermally to 0.552 MPa (state 2)
   (ii) Cool at constant volume to 437.5K (state 3)
   (iii) Cool at constant pressure to 350K (state 4)
   (iv) Compress adiabatically to 2.758 MPa (state 5)
   (v) Heated at constant pressure to 2.758 MPa (state 1)

   Compute Q, W, ΔH, ΔU for the system for each step if all the processes are conducted reversibly. State also which of the values will change if reversibility is not ensured.

2. Molten Cu is supercooled to 5oC below its melting point of 1084^{o}C. If you leave this system in adiabatic container and promote nucleation will reach equilibrium with some fraction of Cu being solid and the rest in liquid form. Given Cp(liquid, Cu) = 31.4 J mol^{-1} K^{-1} and Cp of (solid, Cu) = 22.6+6.28x10^{-3} T j mol-1 K-1 and enthalpy of fusion = 13000 J mol-1. Calculate the mole fraction of solid copper in the system? (of course the whole process is isobaric and adiabatic process)

Please practice this problem below, but need not be submitted as the part of the tutorial, as there may not be time.

3. The pressure above the piston is lowered infinitesimally below 1 atm. And the water allowed to evaporate isothermally until no liquid is left. For this process, q = 40671 J.

   Calculate w, ΔE and ΔH for the process.

   Data : At 373 K and 1 atm , Specific volume of water - 1.043x10^{-3} m^3/kg

   And that of steam - 1.677 m^3/kg

   If in the above process, instead of the reversible expansion, the piston is allowed to move against vacuum on the outside, and still reach the same state finally, calculate q, w, ΔU and ΔH for the process.