

**CML 100: 2015-2016
Thermodynamics Tutorial 3**

(Submit answers to Q. 4,6 on 27th August 2014 during the lecture: Remember to write your group # along with the name and entry #)

1. What is the change in the boiling point of water at 100 °C per Pa change in atmospheric pressure? Molar enthalpy of vaporization is 40.69 kJ mol⁻¹?
2. Calculate the equilibrium pressure for the conversion of graphite to diamond at 25 °C. The densities of graphite and diamond may be taken to be 2.25 and 3.51 g cm⁻³, respectively, independent of pressure, in calculating the change of ΔG with pressure. $\Delta G^0 = 2900 \text{ J mol}^{-1}$.
3. Ar has normal melting and boiling points of 83.8 and 87.3 K; its triple point is at 83.8 K and 0.7 atm, and its critical temperature and pressure are 151 K and 48 atm. State whether Ar is a solid, liquid, or gas under each of the following conditions (a) 0.9 atm and 90 K (b) 0.7 atm and 80 K (c) 0.8 atm and 88 K (d) 0.8 atm and 84 K (e) 1.2 atm and 83.5 K.
4. The vapor pressure of zinc varies with temperature as

$$\log p \text{ (mmHg)} = -\frac{6850}{T} - 0.755 \log T + 11.24$$

and that of liquid Zn as

$$\log p \text{ (mmHg)} = -6620/T - 1.255 \log T + 12.34$$

Calculate

- (a) boiling pt of Zn.
 - (b) the triple point.
 - (c) the heat of evaporation at the boiling point.
 - (d) heat of fusion.
 - (e) the difference in Cps of solid and liquid Zn.
5. On the sea bottom at the Galapagos Rift, water heated to 350 °C gushes out of hydrothermal vents at a depth of 3000 m. Will this water boil or remain liquid at this depth? The vapor pressure of water is 163 atm at 350 °C.
 6. The measured density of an equilibrium mixture of N₂O₄ and NO₂ at 15 °C and 1.103 bar is 3.62 g L⁻¹, and the density at 75 °C and 1.013 bar is 1.84 g L⁻¹. What is the enthalpy change of the reaction N₂O₄ (g) \rightleftharpoons 2NO₂(g)? State any assumptions you needed to make.