

1. The vapor pressure of zinc have been written as
$$\ln p \text{ (atm)} = -15780/T - 0.755 \ln T + 19.25 \quad (1)$$
And
$$\ln p \text{ (atm)} = -15250/T - 1.255 \ln T + 21.79 \quad (2)$$
Which of the two equations is for solid zinc? (10 %)
2. A reversible heat engine, operating in a cycle, withdraw heat from a high-temperature reservoir (the temperature of which consequently decreases), performs work w , and rejects heat into a low-temperature reservoir (the temperature of which consequently increases). The two reservoirs are, initially, at the temperature T_1 and T_2 and have constant heat capacities C_1 and C_2 , respectively. Calculate the final temperature of the system and the maximum amount of work which can be obtained from the engine. (10 %)
3. Derive the relations of volume and pressure ($P_1 V_1^\gamma = P_2 V_2^\gamma$) in the reversible adiabatic processes. (15 %)
4. Lithium bromide vapor dissociates according to $\text{LiBr}_{(g)} \rightarrow \text{Li}_{(g)} + 1/2 \text{Br}_{2(g)}$. At what temperature does the partial pressure of Li reach the value of 10^{-5} atm when the gas is heated at a constant total pressure of 1 atm? ΔG° of this reaction is given $333900 - 42.09 T$. (15 %)
5. Calculate the standard reaction enthalpy, the change in Gibbs function, and the equilibrium constant of the reaction :
$$\text{N}_2\text{O}_4 (g) \rightarrow \text{NO}_2 (g) \text{ at } 298 \text{ K}$$
(The change of entropy is $175.8 \text{ JK}^{-1}\text{mol}^{-1}$ for the reaction. The standard enthalpies of formation of $\text{N}_2\text{O}_4 (g)$ forms $\text{NO}_2 (g)$ are 9.2 and 33.3 kJmol^{-1} , respectively.) (30 %)
6. For a binary mixture, what is the meaning of Gibbs-Duhem equation? Please derive the Gibbs-Duhem equation. (20 %)