

# Physical Chemistry 2nd Edition Ball

## Solutions Manual

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## Chapter 7

### *Equilibria for Multiple Component Systems*

- 7.2. With only a single component and phase, if only  $\text{Fe}_2(\text{SO}_4)_3$  were present in our system, we would have  $C - P + 2 = 1 - 1 + 2 = 2$  degrees of freedom.
- 7.4. For a single-component system, there will never be negative degrees of freedom. The maximum number of phases that can exist in equilibrium is three, so the Gibbs phase rule would yield  $1 - 3 + 2 = 0$  degrees of freedom (like might occur at the triple point). For a two-component system, the maximum number of phases that can exist in equilibrium is four. There will never be negative degrees of freedom.
- 7.6. In this reaction, there are only three independent components (the amount of the fourth can be determined from the equilibrium constant) and 3 phases, two solids and a gas mixture. Therefore, there are  $3 - 3 + 2 = 2$  degrees of freedom.
- 7.8. For water:  $n = \frac{pV}{RT} = \frac{(23.76 \text{ torr})(5.00 \text{ L})}{(0.08205 \text{ L} \cdot \text{atm/mol} \cdot \text{K})(298.15 \text{ K})} \times \frac{1 \text{ atm}}{760 \text{ torr}} = 6.39 \times 10^{-3}$  mol of water is needed to ensure that there is a liquid and gas phase. This equals 0.115 grams.  
For methanol:
- $$n = \frac{pV}{RT} = \frac{(125.0 \text{ torr})(5.00 \text{ L})}{(0.08205 \text{ L} \cdot \text{atm/mol} \cdot \text{K})(298.15 \text{ K})} \times \frac{1 \text{ atm}}{760 \text{ torr}} = 3.36 \times 10^{-2}$$
- mol of methanol is needed to ensure that there is a liquid and gas phase. This equals 1.08 grams.
- 7.10. Since, according to equation 7.11,  $a_i = \frac{p_i}{p_i^*}$ , and since  $p_i^* = 760 \text{ torr}$ , we can calculate  $a_i$ :

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**Ian Pickup**



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