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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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David Ball



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