

Chapter 17 (Solubility) and Chapter 18 (Entropy)

1. What mass of ZnS ($K_{sp} = 2.5 \times 10^{-22}$) will dissolve in 300.0 mL of 0.050 M $\text{Zn}(\text{NO}_3)_2$? Ignore the basic properties of S^{2-}
2. If you add sodium sulfate to a solution containing these metal cations, each with a concentration of 0.13 M, what will be the concentration of the first ion that precipitates (Ba^{2+} or Sr^{2+}) when the second, more soluble salt begins to precipitate? (K_{sp} for BaSO_4 is 1.1×10^{-10} , K_{sp} for SrSO_4 is 3.4×10^{-7})?
3. The Ca^{2+} ion in hard water can be precipitated as CaCO_3 by adding soda ash, Na_2CO_3 . If the calcium ion concentration in hard water originally is 0.017 M and if the Na_2CO_3 is added until the carbonate ion concentration is 0.048 M, what percentage of the calcium ions had been left in the water? (You may neglect carbonate ion hydrolysis.) $K_{sp} = 3.4 \times 10^{-9}$

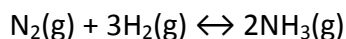
Note: Question #4 is beyond the scope of Summer Chemistry 104 for 2023.

4. In principle, the ions Ba^{2+} and Ca^{2+} can be separated by the difference in solubility of their fluorides, BaF_2 and CaF_2 . If you have a solution that is 0.17 M in both Ba^{2+} and Ca^{2+} , CaF_2 will begin to precipitate first as fluoride ion is added slowly to the solution. What concentration of fluoride ion will precipitate the Ca^{2+} ion without precipitating BaF_2 ? What concentration of Ca^{2+} remains in solution when BaF_2 just begins to precipitate? ($K_{\text{sp}}(\text{BaF}_2) = 1.7 \times 10^{-6}$ and $K_{\text{sp}}(\text{CaF}_2) = 3.9 \times 10^{-11}$)

5. For which of the following reactions is $\Delta S^\circ > 0$? (Do not use any math)

- a. $2\text{NO}(\text{g}) + 2\text{H}_2(\text{g}) \leftrightarrow \text{N}_2(\text{g}) + 2\text{H}_2\text{O}(\text{l})$
- b. $2\text{NH}_3(\text{g}) + 3\text{N}_2\text{O}(\text{g}) \leftrightarrow 4\text{N}_2(\text{g}) + 3\text{H}_2\text{O}(\text{g})$
- c. $\text{NH}_4\text{I}(\text{s}) \leftrightarrow \text{NH}_3(\text{g}) + \text{HI}(\text{g})$
- d. $2\text{H}_2\text{O}(\text{g}) + 2\text{Cl}_2(\text{g}) \leftrightarrow 4\text{HCl}(\text{g}) + \text{O}_2(\text{g})$
- e. $\text{C}_2\text{H}_4(\text{g}) + \text{H}_2\text{O}(\text{g}) \leftrightarrow \text{CH}_3\text{CH}_2\text{OH}(\text{g})$

6. Using standard absolute entropies at 298K, calculate the entropy change for the **system** when **1.94** moles of **$\text{N}_2(\text{g})$** react at standard conditions.



7. Repeat the above calculations for 2.28 moles of liquid H_2O :

