ANSWER KEY | Solubility Equilibria - Ksp and Common-Ion

Worked key for instructor review and student self-check. Credit sound chemical reasoning as well as the final result.

PART A: Multiple choice and application

1. For CaF2(s) Ca+ + 2 F-, Ksp is

Correct: A. [Ca+][F-]

Explanation: Coefficients become powers; pure solids are omitted.

2. If CaF2 molar solubility is s in pure water, [F-] is

Correct: B. 2s

Explanation: Two moles of fluoride ions form per mole of dissolved CaF2.

3. Which concentration expression follows from idealized CaF2 dissolution?

Correct: A. Ksp = 4s

Explanation: Ksp = s(2s)^2 = 4s^3.

4. Adding a soluble source of chloride usually does what to AgCl solubility?

Correct: B. Decreases it

Explanation: Common-ion chloride shifts dissolution toward the solid.

5. Qsp > Ksp for a mixed ion solution predicts

Correct: A. Precipitation is thermodynamically favored

Explanation: A supersaturated state thermodynamically favors solid formation.

6. When two ionic solutions are mixed, Qsp uses

Correct: B. Concentrations after mixing, before precipitation

Explanation: Account for total solution volume before assessing the ion product.

PART B: Drawing and reasoning

7. Ksp(CaF2) = 4.0 x 10^-11. Find approximate molar solubility s in pure water. Ignore other ionic equilibria.

Worked answer: CaF2 -> Ca2+ + 2 F-. Let [Ca2+]=s, [F-]=2s. Ksp=4s^3, so s^3=1.0 x 10^-11 and s=2.15 x 10^-4 M (about 2.2 x 10^-4 M).

8. Immediately after mixing, [Ag+] = 0.0020 M and [Cl-] = 0.0030 M. Ksp(AgCl) = 1.8 x 10^-10. Predict the result.

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Worked answer: Qsp=(0.0020)(0.0030)=6.0 x 10^-6, which is greater than Ksp. AgCl precipitation is thermodynamically favored.

Equivalent chemically correct structures and mechanisms are acceptable.