Which of the following is FALSE?

(a) The solubility product of an electrolyte has a fixed value at a given temperature.
(b) A solubility product is an equilibrium constant.
(c) The solubility product for an insoluble electrolyte is greater than zero.
(d) The units of any solubility product are $M^2$
The solubility product expression for Zn(OH)$_2$ is

(a) $[\text{Zn}^{2+}] [\text{OH}^-]$  
(b) $[\text{Zn}^{2+}] [\text{OH}^-]^2$  
(c) $[\text{Zn}^{2+}] 2 [\text{OH}^-]$  
(d) $[\text{Zn}^{2+}] 4 [\text{OH}^-]^2$
For an XY salt with $K_{sp} = 2 \times 10^{-6} \text{ M}^2$, which point on the following graph represents a saturated solution?

Which represents a supersaturated solution?
The solubility curve

is for a salt of stoichiometry

(a) $XY$  (b) $X_2Y$  (c) $XY_2$  (d) $X_2Y_2$

The value of the solubility product is

(a) $2 \times 10^{-3} \text{ M}^3$  (b) $2 \times 10^{-6} \text{ M}^3$
(c) $2 \times 10^{-9} \text{ M}^3$  (d) $4 \times 10^{-9} \text{ M}^3$
At the temperature at which the molar solubility of \((\text{Ag})_2\text{CO}_3\) in water is \(2 \times 10^{-4}\) M, the \(K_{sp}\) is

(a) \(6.0 \times 10^{-4}\) M
(b) \(4.0 \times 10^{-8}\) M²
(c) \(0.8 \times 10^{-11}\) M³
(d) \(3.2 \times 10^{-11}\) M³
In terms of its $K_{sp}$, the molar solubility of Fe(OH)$_3$ in water is

(a) $4K_{sp}$
(b) $(K_{sp} / 3)^{1/2}$
(c) $(K_{sp} / 4)^{1/3}$
(d) $(K_{sp} / 27)^{1/4}$
Which of the following has the largest molar solubility in water?

(a) SrSO$_4$  \[ K_{sp} = 2.8 \times 10^{-7} \text{ M}^2 \]
(b) Zn(OH)$_2$  \[ K_{sp} = 4.5 \times 10^{-17} \text{ M}^3 \]
(c) PbI$_2$  \[ K_{sp} = 8.7 \times 10^{-9} \text{ M}^3 \]
(d) MnS  \[ K_{sp} = 5 \times 10^{-15} \text{ M}^2 \]

Which has the smallest?
The solubility of AgCl in aqueous NaCl is

(a) greater than
(b) less than
(c) equal to

its solubility in pure water.
In a community with hard water (e.g., $[\text{Ca}^{2+}] = 0.01 \, \text{M}$), what is the maximum fluoride concentration that can be achieved by adding NaF?

(Note: $K_{\text{sp}}(\text{CaF}_2) = 3.9 \times 10^{-11} \, \text{M}^3$)

(a) $2.0 \times 10^{-3} \, \text{M}$  (b) $6.2 \times 10^{-5} \, \text{M}$
(c) $4.0 \times 10^{-3} \, \text{M}$  (d) $3.9 \times 10^{-9} \, \text{M}$
If Na$_2$C$_2$O$_4$ is added to a solution containing 0.1 M Ba$^{2+}$, 0.001 M Ca$^{2+}$, and 0.06 M Sr$^{2+}$, the first salt to precipitate out will be

(a) BaC$_2$O$_4$ \( (K_{sp}=1.1\times10^{-7} \text{ M}^2) \)
(b) CaC$_2$O$_4$ \( (K_{sp}=2.3\times10^{-9} \text{ M}^2) \)
(c) SrC$_2$O$_4$ \( (K_{sp}=5.6\times10^{-8} \text{ M}^2) \)
If NaOH is added to a solution containing 0.01 M Ag⁺, 0.03 M Mg²⁺, and 0.1 M Al³⁺, the first salt to precipitate out will be

(a) AgOH \ (K_{sp}=1.5\times10^{-8} \ M^{2})
(b) Mg(OH)_{2} \ (K_{sp}=1.2\times10^{-11} \ M^{3})
(c) Al(OH)_{3} \ (K_{sp}=3.7\times10^{-15} \ M^{4})
The solubility of an unknown salt is found to decrease when NaBr is present. The relationship between the solubility of the unknown \( z \) in g/L and the concentration of the NaBr \( C \) in g/L is found to be

\[
z \left( C + \alpha \cdot z \right)^2 = \beta
\]

where \( \alpha \) and \( \beta \) are two constants.

We can conclude that the unknown salt must be of the type

- (a) \( MBr \)
- (b) \( M_2Br \)
- (c) \( MBr_2 \)
- (d) \( M_2Br_2 \)
Which of the following insoluble salts is appreciably more soluble in acid than in water?

(a) PbBr\(_2\)  (b) CuCl
(c) Cd(CN)\(_2\)  (d) Ag(IO\(_3\))\(_2\)
The solubility of which salt is not significantly greater in acid than in pure water?

(a) $\text{BaSO}_4$  
(b) $\text{Ba(OH)}_2$  
(c) $\text{Ba}_3(\text{PO}_4)_2$  
(d) $\text{BaCO}_3$
In which of the following is CaCO$_3$ most soluble?

(a) water
(b) 0.1 M Na$_2$CO$_3$
(c) 0.1 M CaCl$_2$
(d) 0.1 M HCl
(e) 0.1 M NaCl
If $K_{sp}(\text{PbSO}_4) = 1.8 \times 10^{-8} \text{ M}^2$ and $K_a(\text{HSO}_4^-) = 1.0 \times 10^{-2} \text{ M}$, the equilibrium constant for the reaction

$$\text{PbSO}_4(\text{s}) + \text{H}^+(\text{aq}) \rightarrow \text{HSO}_4^-(\text{aq}) + \text{Pb}^{2+}(\text{aq})$$

is

(a) $2.8 \times 10^{-10} \text{ M}$  (b) $1.8 \times 10^{-10} \text{ M}$
(c) $1.8 \times 10^{-8} \text{ M}$  (d) $1.8 \times 10^{-6} \text{ M}$
If $K_{sp}(\text{Cd(CN)}_2) = 1 \times 10^{-8}$ M$^3$ and $K_a(\text{HCN}) = 4.9 \times 10^{-10}$ M, the equilibrium constant for the reaction

$$\text{Cd(CN)}_2 (s) + 2 \, \text{H}^+ (aq) \rightarrow \text{Cd}^{2+} (aq) + 2 \, \text{HCN} (aq)$$

is given by

(a) $2 \times 10^1$ M  
(b) $5 \times 10^{-2}$ M  
(c) $4 \times 10^{10}$ M  
(d) $2 \times 10^{-11}$ M
When 60 mL of 0.05 M BaCl₂ is mixed with 40 mL of 0.10 M K₂SO₄, 

(a) [K⁺] = 0.04 M in the resulting solution 
(b) [Ba²⁺] = 0.03 M in the resulting solution 
(c) No reaction will occur 
(d) BaSO₄ (K_{sp} = 1 \times 10^{-10} \text{ M}^2) 
will precipitate

Which of the following is untrue?

(a) [K⁺] = 0.08 M in the resulting solution 
(b) [Cl⁻] = 0.06 M in the resulting solution 
(c) [Ba²⁺] = 0 M in the resulting solution 
(d) [SO₄^{2−}] = 0.01 M in the resulting solution

In the resulting solution, [Ba²⁺] =

(a) 1 \times 10^{-5} \text{ M} 
(b) 1 \times 10^{-8} \text{ M} 
(c) 1 \times 10^{-10} \text{ M}