Solubility equilibrium

8.

Which salts will be more soluble in an acidic solution than in pure water?

CsClO ₄
Cul
CaCO ₃
Zn(OH) ₂
Ag ₂ SO ₄

10.

The K_{sp} of PbBr₂ is 6.60×10^{-6} .

What is the molar solubility of PbBr₂ in pure water?



What is the molar solubility of PbBr₂ in 0.500 M KBr solution?



What is the molar solubility of PbBr₂ in a 0.500 M Pb(NO₃)₂ solution?



12.

Given the equation



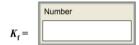
$$Ag^{+}(aq) + 2NH_{3}(aq) \longrightarrow [Ag(NH_{3})_{2}]^{+}(aq)$$
 $K_{f} = 2.00 \times 10^{7}$

determine the concentration of NH₃(aq) that is required to dissolve 597 mg of AgCl(s) in 100.0 mL of solution. The K_{sp} of AgCl is 1.77×10^{-10} .



The generic metal A forms an insoluble salt AB(s) and a complex AC₅(aq).

The equilibrium concentrations in a solution of AC₅ were found to be [A] = 0.100 M, [C] = 0.0190 M, and [AC₅] = 0.100 M. Determine the formation constant, K_1 , of AC₅.



The solubility of AB(s) in a 1.000-M solution of C(aq) is found to be 0.158 M. What is the $K_{\rm SD}$ of AB?

	Number
$K_{\rm sp} =$	

14.

A 0.170-mole quantity of NiCl₂ is added to a liter of 1.20 M NH₃ solution. What is the concentration of Ni² M ions at equilibrium? Assume the formation constant* of Ni(NH₃)₆²⁺ is 5.5×10^8 .

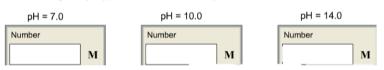
Number	
	M

15.

Consider an amphoteric hydroxide, M(OH)₂(s), where M is a generic metal.

$$M(OH)_2(s) \rightleftharpoons M^{2+}(aq) + 2OH^-(aq)$$
 $K_{sp} = 3 \times 10^{-16}$
 $M(OH)_2(s) + 2OH^-(aq) \rightleftharpoons [M(OH)_4]^{2-}(aq)$ $K_f = 0.05$

Estimate the solubility of $M(OH)_2$ in a solution buffered at pH = 7.0, 10.0, and 14.0.



19.

Sodium sulfate is slowly added to a solution containing 0.0500 M $Ca^{2+}(aq)$ and 0.0280 M $Ag^{+}(aq)$. What will be the concentration of $Ca^{2+}(aq)$ when $Ag_2SO_4(s)$ begins to precipitate? Solubility-product constants, K_{sp} , can be found here.



What percentage of the $Ca^{2+}(aq)$ can be precipitated from the $Ag^{+}(aq)$ by selective precipitation?



Suppose you have a solution that contains 0.0410 M Ca²⁺ and 0.0910 M Ag⁺. If solid Na₃PO₄ is added to this mixture, which of the following phosphate species would precipitate out of solution first?



When the second cation just starts to precipitate, what percentage of the first cation remains in solution?



21.

Consider the following Gibbs energies at 25 °C.

Substance	ΔG°_{f} (kJ· mol ⁻¹⁾
Ag ⁺ (aq)	77.1
Cl⁻(aq)	- 131.2
AgCl(s)	- 109.8
Br⁻(aq)	- 104.0
AgBr(s)	- 96.9

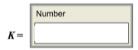
(a) Calculate ΔG°_{rxn} for the dissolution of AgCl(s).



(c) Calculate ΔG°_{rxn} for the dissolution of AgBr(s).

Number	
	kJ⋅mol ⁻¹

(b) Calculate the solubility-product constant of AgCl.



(d) Calculate the solubility-product constant of AgBr.

	Number
K=	

22.

- A solution containing a mixture of metal cations was treated as follows.

 1. Dilute HCl was added and a precipitate formed. The precipitate was filtered off.

 2. H₂S was bubbled through the acidic solution. Again, a precipitate formed and was filtered off.
 - 3. The pH was raised to about 9 and H_2S was again bubbled through the solution. No precipitate formed.
 - 4. Finally, sodium carbonate was added and no precipitate formed.

What can be said about the presence of each of these groups of cations in the original solution?

Cation Group	Description	Present in the original solution?
Ag ⁺ , Pb ²⁺ , Hg ₂ ²⁺	form insoluble chlorides	
Bi ³⁺ , Cd ²⁺ , Cu ²⁺ , Hg ²⁺ , Pb ²⁺ , Sb ³⁺ , Sn ²⁺ , Sn ⁴⁺	form acid-insoluble sulfides	
Al ³⁺ , Co ²⁺ , Cr ³⁺ , Fe ²⁺ , Fe ³⁺ , Ni ²⁺ , Mn ²⁺ , Zn ²⁺	form base-insoluble sulfides or hydroxides	
Ba ²⁺ , Ca ²⁺ , Mg ²⁺ , Sr ²⁺	form insoluble carbonates	
Li ⁺ , Na ⁺ , K ⁺ , NH ₄ ⁺	completely soluble	

At least one of these ions was present. unknown None of these ions were present. All of these ions were present.

A student was given a solid containing a mixture of nitrate salts. The sample completely dissolved in wal $^{\text{Map}}$ and upon addition of dilute HCI, no precipitate formed. The pH was lowered to about 1 and H₂S was bubbled through the solution. No precipitate formed. The pH was adjusted to 8 and H₂S was again bubbled in. This time, a precipitate formed.

Which compounds might have been present in the unknown?

Ca(NO₃)₂
Pb(NO₃)₂
Cu(NO₃)₂
Zn(NO₃)₂
Ni(NO₃)₂
KNO₃
AgNO₃
Cr(NO₃)₃