Dougherty Valley HS Chemistry - AP
Solutions – More Ksp Practice

Worksheet #9

Name: **Period:** **Seat#:**

Perform the following calculations, be sure to include units and show work to an AP level.

1) The molar solubility of $NiCO_3$ is 3.74×10^{-4} mol/L. Find the Ksp value. *1.4×10^{-7}*

2) The molar solubility of $Ca(OH)_2$ is 6.875×10^{-3} mol/L. Calculate the Ksp value. *1.3×10^{-6}*

3) The Ksp of Ag_3PO_4 is 1.8×10^{-18}.What is the $[Ag^+]$ in a saturated solution? *4.82×10^{-5} M*

4) $Mg_3(AsO_4)_2(s) \rightleftharpoons 3\ Mg^{2+}(aq) + 2\ AsO_4^{3-}(aq)$
The solubility of magnesium arsenate is very low. Based on this, which of the following is/are true?

a) There is a significant $[AsO_4^{3-}]$ in solution
b) Almost all of the salt remains in its solid form
c) At equilibrium, there is almost no $Mg_3(AsO_4)_2$ left

5) The Ksp for lead (II) phosphate is 1.0×10^{-54}. Calculate:

a) Molar solubility

b) The $[PO_4^{3-}]$ in a saturated solution

c) and the solubility in grams per liter.

6.21×10^{-12} mol/L, 1.24×10^{-11} M, 5.04×10^{-9} g/L

6) The Ksp for PbF_2 is 4.0×10^{-8}. Calculate:

a) Molar solubility in a solution of 0.5 M NaF

b) Molar solubility in water.

c) Explain the difference in solubility that you calculated.

1.6×10^{-7} mol/L, 2.15×10^{-3} mol/L

7) The Ksp of $Mg(OH)_2$ is 1.8×10^{-11}. What effect would each of the following changes will have on the solubility of $Mg(OH)_2$ in an aqueous solution? Explain.

a) Decrease the pH

b) Increasing the pH

c) Adding NH_3 to the solution

d) Adding $Mg(NO_3)_2$ to the solution

8) Based on Le Chatelier's principle, explain what will happen to the solubility of AgCN when

a) $HClO_4$ is added to the solution

b) NaCN is added to the solution

9) Based on Ksp values, which has a greater molar solubility between MgF_2 (Ksp = 5.16×10^{-11}) and PbI_2 (Ksp = 9.8×10^{-9})? Justify your answer.

10) Based on Ksp values, which has a greater molar solubility between MgF_2 (Ksp = 5.16×10^{-11}) and $MgCO_3$ (Ksp = 3.5×10^{-8}). Justify your answer.

11) Based on the Ksp values in the table below, a saturated solution of which of the following would have the highest concentration of chloride ions? Justify your answer.

Compound	K_{sp}
$PbCl_2$	1.2×10^{-5}
CuCl	1.6×10^{-7}
AgCl	1.8×10^{-10}
Hg_2Cl_2	1.4×10^{-18}

12) Identify the compound that has the smallest Ksp value from the following general ionic compounds and their molar solubilities in pure water.

a) M_2X, molar solubility = 3.52×10^{-4} M

b) MX_3, molar solubility = 2.54×10^{-4} M

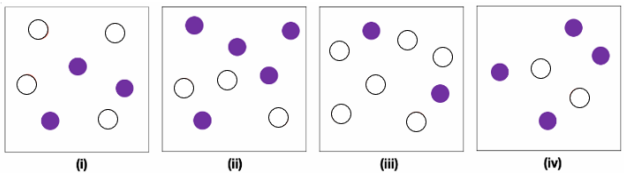
c) MX, molar solubility = 4.23×10^{-4} M

13) What is the required minimum pH to completely precipitate $Cd(OH)_2$ ($K_{sp} = 2.5 \times 10^{-14}$) so that the remaining concentration of $Cd^{2+}(aq)$ is less than 1.0 part per billion (1 ppb = 1 µg/L, 1 µg = 1×10^{-6} g)? *pH 11.22*

14) The $[Pb^{2+}]$ and $[AsO_4^{3-}]$ in a certain saturated $Pb_3(AsO_4)_2$ solution are both equal to 8.3×10^{-8}. In a saturated solution with $[Pb^{2+}] = 0.0200$ M, what is $[AsO_4^{3-}]$? *7.0×10^{-16} M*

15) Lead (II) chloride, $PbCl_2$, is a sparingly soluble salt with a solubility product (Ksp) of 1.60×10^{-5} at 25°C. Calculate the molarity of a saturated solution of $PbCl_2$ at 25°C. *0.0159 M*

16) The images below show solutions of Cu_2CO_3 where the grey spheres represent the Cu^+ ions, and white spheres represent the CO_3^{2-} ions. Note that other ions may be present in the solution but are not shown. Image (i) shows the solution in equilibrium with solid Cu_2CO_3.

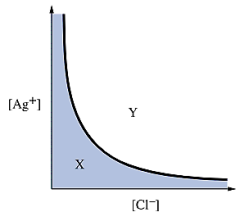


a) Using diagram (i) calculate the value of Ksp for Cu_2CO_3

b) Calculate the Q values for diagrams (ii) – (iv)

c) Which of the solutions shown in images (ii) – (iv) will form a solid Cu_2CO_3 precipitate? Explain.

17) The curve below represents the concentrations of $Ag^+(aq)$ and $Cl^-(aq)$ for which the product $[Ag^+][Cl^-]$ is equal to the value of Ksp for AgCl. Which of the following provides the correct comparison of Q and Ksp, and describes the overall process that occurs at any point in the unshaded region Y of the graph?



a) Q > Ksp and dissolution of AgCl(s) occurs

b) Q < Ksp and dissolution of AgCl(s) occurs

c) Q > Ksp and precipitation of AgCl(s) occurs

d) Q < Ksp and precipitation of AgCl(s) occurs

18) Three saturated solutions (X, Y, and Z) are prepared at 25°C. Based on the information in the table above, which of the following lists the solutions in order of increasing $[Ag^+]$?

a) X < Z < Y

b) Y < X < Z

c) Z < Y < X

d) Z < X < Y

Solution	Solute	K_{sp} at 25°C
X	AgBr	5.0×10^{-13}
Y	AgCl	1.8×10^{-10}
Z	AgI	8.3×10^{-17}

19) Which of the following ranks the compounds listed in the table above in order of increasing solubility?

a) $Cu(OH)_2 < Co(OH)_2 < FeOH$

b) $FeOH < Cu(OH)_2 < Co(OH)_2$

c) $Co(OH)_2 < FeOH < Cu(OH)_2$

d) $Cu(OH)_2 < FeOH < Co(OH)_2$

Compound	K_{sp}
$FeOH$	4.9×10^{-17}
$Cu(OH)_2$	1.6×10^{-19}
$Co(OH)_2$	1.1×10^{-15}