HW06 - Solubility

I put a couple of kinetics problems at the start of this HW for more practice on those.
Note... to speed up solution entry and aid in simpler files. Scientific notation numbers will often be given in the "E" format - which is really a computer science thing. But this IS a science course, for science majors. So know that a "E" or "e" in a number stands for "times 10 to the ____ power". You could see this format anywhere, but I try to only use it in the explanations or solutions.
Examples: 6.022×10^{23} is simply 6.022E23 or 6.022e23 or for little numbers, Ka = 1.8×10^{-5} is also 1.8E-5.

1 2 points

Consider the following simple generic decomposition reaction:

$$A(aq) \longrightarrow 2\ B(aq)$$

Initially, 0.0800 moles of A are dissolved into 400 mL of water. There is no B initially, like most reactions. The rate constant for this reaction is 0.0250 $M^{-1} \cdot s^{-1}$. How long will it take to make 0.144 moles of B ?

- 1 hr
- 45 min
- 10 min
- 1.5 min
- 25 min
- 30 min

2 2 points

Reactant "A" is added to a reaction chamber such that it's partial pressure is 0.25 atm. The rate constant for this second order reaction is 0.040 $atm^{-1} \cdot s^{-1}$ in reactant A. What is the half life of this reaction under these conditions? note: yes, you can, and you should work this in partial pressures (atm) and not concentration. Look at the rate constant... it is in atm.

- 17 s
- 100 s
- 36 s
- 75 s
- 124 s

3 2 points

What is the net ionic equation for the reaction between aqueous solutions of Na_3PO_4 and $CuSO_4$?
Note: assume all ionic species are (aq).

- $Cu^{2+}(aq) + PO_4^{3-}(aq) \longrightarrow CuPO_4(s)$
- No reaction occurs since no precipitate is formed.
- $3Cu^{2+}(aq) + 2PO_4^{3-}(aq) \longrightarrow Cu_3(PO_4)_2(s)$
- $2Na^{+}(aq) + SO_4^{2-}(aq) \longrightarrow Na_2SO_4(s)$

4 2 points

If you mix equal volumes and concentrations of aqueous solutions of $Cu(NO_3)_2$ and K_2S, which ions will remain in solution as spectators in the reaction?

- Cu^{2+}, S^{2-}
- K^{+}, NO_3^{-}
- No ions are present as both products form precipitates.
- Cu^{2+}, NO_3^{-}, K^{+}, S^{2-}

5 2 points

Molar solubility is...

- the total molarity of the solution.
- the number of grams of a compound that dissolve to give one liter of saturated solution.
- equal to the K_{sp}.
- the number of moles of a compound that dissolve to give one liter of saturated solution.

6 2 points

A sample of pure water is saturated with $PbCl_2$. In this saturated solution, which of the following is true?

- $[Pb^{2+}] = [Cl^{-}]$
- $K_{sp} = [Pb^{2+}][Cl^{-}]$
- $K_{sp} = [Pb^{2+}][Cl^{-}]$
- $[Pb^{2+}] = 0.5[Cl^{-}]$

7 2 points

A hypothetical ionic substance M_3X_2 dissociates in water to form M^{2+} and X^{3-} ions.
The molar solubility of M_3X_2 is 4.5×10^{-3} mol/L.
What is the value of the solubility product constant?

- 2.0×10^{-5}
- 2.0×10^{-10}
- 1.1×10^{-8}
- 1.8×10^{-12}
- 3.6×10^{-7}
- 8.3×10^{-15}

8 2 points

The value of K_{sp} for $SrSO_4$ is 2.8×10^{-7}. What is the molar solubility of $SrSO_4$?

- 1.4×10^{-7} mol/L
- 7.6×10^{-7} mol/L
- 5.3×10^{-4} mol/L
- 2.8×10^{-7} mol/L

9 2 points

Determine the molar solubility of a salt with the generic formula AB_2 if $K_{sp} = 3.7 \times 10^{-5}$.

- 0.063 M
- 0.0061 M
- 0.021 M
- 0.033 M
- 0.052 M

10 2 points

Rank the following salts from lowest to highest molar solubility:

AgI	$K_{sp} = 8.5 \times 10^{-17}$
$Cd_3(AsO_4)_2$	$K_{sp} = 2.2 \times 10^{-33}$
$AlPO_4$	$K_{sp} = 9.8 \times 10^{-21}$
$CaSO_4$	$K_{sp} = 4.9 \times 10^{-5}$

- $Cd_3(AsO_4)_2 < AgI < AlPO_4 < CaSO_4$
- $CaSO_4 < AgI < AlPO_4 < Cd_3(AsO_4)_2$
- $Cd_3(AsO_4)_2 < AlPO_4 < AgI < CaSO_4$
- $AlPO_4 < AgI < Cd_3(AsO_4)_2 < CaSO_4$

11 2 points

A hypothetical compound MX_3 with a molar mass of 125 g/mol has a solubility of 1.5 g/L . What is the value of K_{sp} for MX_3?

- 1.4×10^{-4}
- 6.9×10^{-6}
- 5.6×10^{-7}
- 1.2×10^{-2}
- 3.6×10^{-8}
- 1.2×10^{-9}

12 2 points

Determine if a precipitate will form when 0.96 g Na_2CO_3 is combined with 0.20 g $BaBr_2$ in a 10 L solution. (For $BaCO_3$, $K_{sp} = 2.8 \times 10^{-9}$).

- $BaBr_2$ will remain in solid form as it is insoluble in water.
- $BaCO_3$ does not precipitate
- It is impossible to know if any $BaCO_3$ will precipitate with the information given.
- $BaCO_3$ precipitates

13 2 points

$CaSO_4$ has a $K_{sp} = 3 \times 10^{-5}$. In which of the following would $CaSO_4$ be the most soluble?

- 1.0 M $CaCl_2(aq)$
- 0.5 M $K_2SO_4(aq)$
- $CaSO_4$ would have the same solubility in all three of these solutions
- pure water

14 2 points

A solution of AgI contains 0.019 M Ag^{+}. The K_{sp} of AgI is 8.3×10^{-17}. What is the maximum I^{-} concentration that can exist in this solution before a precipitate begins to form?

- 6.8×10^{-9} M
- 0.019 M
- 1.6×10^{-18} M
- 4.4×10^{-15} M
- 8.3×10^{-15} M

15 2 points

What is the molar solubility of $Zn(OH)_2$ ($K_{sp} = 3.0 \times 10^{-17}$) in pure water ?
(note: you might want to compare the answer on this to the one in the next question)

- 5.3×10^{-13} M
- 8.1×10^{-13} M
- 7.2×10^{-8} M
- 9.5×10^{-9} M
- 2.0×10^{-6} M

16 2 points

What is the molar solubility of $Zn(OH)_2$ ($K_{sp} = 3.0 \times 10^{-17}$) in a solution that is buffered to a pH of 9.75?
(note: you might want to compare the answer on this to the one in the previous question)

- 7.2×10^{-8} M
- 8.1×10^{-13} M
- 5.3×10^{-13} M
- 9.5×10^{-9} M
- 2.0×10^{-6} M

17 2 points

A relatively insoluble metal hydroxide, $M(OH)_2$, has a K_{sp} value of 4×10^{-15} at a particular temperature. What is the pH of a saturated solution of $M(OH)_2$?

- 6.80
- 8.25
- 10.40
- 9.56
- 9.30
- 9.00
- 8.72